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Analysis of the Impact of Green Economy on Economic Growth in ASEAN Countries

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Abstract

The Green Economy is a mechanism that enhances and develops human well-being while reducing environmental risks. In terms of environmental benefits, the Green Economy aims to improve climate by reducing pollution and also plays a crucial role in providing job opportunities and investments, supplying materials and human resources, and supporting poverty alleviation efforts. This study aims to analyze the impact of Renewable Energy, Greenhouse Gas (GHG) Emissions, Emission Intensity, Agricultural Productivity, Unemployment Rate, and Life Expectancy on Gross Domestic Product (GDP) in five ASEAN countries: Indonesia, Malaysia, the Philippines, Thailand, and Vietnam over the period of 2013 – 2022. The research employs a quantitative analysis using secondary data. The study applies panel data regression using the Common Effect Model (CEM) approach, assisted by Eviews 12.0 software. The research findings indicate that Agricultural Productivity, Unemployment Rate, and Life Expectancy have a significant negative impact on Gross Domestic Product (GDP). In contrast, other variables such as Renewable Energy and Greenhouse Gas Emissions do not show any significant influence and have insignificant negative values concerning GDP. Additionally, Emission Intensity exhibits a positive but insignificant value in relation to GDP.

Keywords: Green Economy; Gross Domestic Product (GDP); Agricultural Productivity; Life Expectancy; Renewable Energy; GHG Emissions; Emission Intensity; Unemployment Rate

1. Introduction

The concept of a Green Economy was introduced by the United Nations Environment Programme (UNEP) to enhance social equity and human well-being, as well as to reduce ecological scarcity and environmental risks. It is regarded as a new approach that can promote environmentally friendly and sustainable economic development [1]. The Green Economy is presented as a model that asserts sustainable economic growth requires a balance between the impacts of economic growth on the environment and the environment's capacity for assimilation. It is also considered a suitable strategy as part of recovery programs designed to address the global economic crisis. In other words, the Green Economy posits that steering economic recovery in alignment with more environmentally friendly guidelines will not only facilitate the success of the recovery itself but also help achieve long-term goals in promoting a sustainable economic development model. Therefore, it represents a growth model that is not only aligned with conservation but also with the enhancement of environmental quality [2].

In line with the goals of SDG No. 13, which aims to take urgent action to combat climate change and its impacts, no country in the world is immune to the effects of climate change. Greenhouse gas emissions continue to rise, and global warming is causing prolonged climate changes. Increasing levels of greenhouse gases, both natural and anthropogenic, will lead to a rise in Earth's temperatures. The residual heat gases will be absorbed by the Earth's atmosphere and re-emitted as infrared radiation. As the longwave radiation released increases or as the concentration of trapped gases at the Earth's surface grows, global temperatures will continue to change. The term "Greenhouse Gases" refers to gases present in the atmosphere, whether of natural origin or produced by human activities (anthropogenic).

The report by the COP26 Universities Network and the British High Commission to Singapore indicates that increased rainfall due to climate change will have significant impacts on agricultural productivity in ASEAN countries. It is estimated that

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agricultural production, particularly rice production, could decrease by as much as 50% due to flooding, prolonged droughts, and significant weather changes. Climate change will also affect the economic income derived from the fisheries sector [3]. Consequently, ASEAN could potentially lose around 35% of the region's Gross Domestic Product (GDP) by 2050 as a result of climate change [4]. The relationship between emission intensity and the green economy is crucial in the context of sustainable development. Emission intensity refers to the amount of greenhouse gas emissions produced per unit of economic activity, such as per unit of GDP. Carbon dioxide emissions and other human-generated greenhouse gases are major drivers of global temperature rise. The relationship between global temperature and greenhouse gas concentrations—particularly CO2—has been evident throughout Earth's history. The green economy aims to reduce this emission intensity through the use of renewable energy, energy efficiency, and environmentally friendly technologies. CO2 and other greenhouse gases, such as methane and nitrous oxide, are released when we burn fossil fuels, produce materials like steel, cement, and plastic, and grow the food we consume. If we want to reduce these emissions, we need to transform our energy systems, industrial practices, and food systems.

[5] found that changes in energy consumption levels and population growth are key factors influencing carbon emission intensity. At the same time, we need to address energy poverty, low living standards, and malnutrition, all of which remain significant issues for billions of people. Technological advancements enable us to tackle both challenges. The prices of solar and wind energy, as well as batteries, have plummeted over the past few decades, further reducing the costs of alternatives to fossil fuels. Continued advancements will allow us to provide affordable and clean energy for everyone. The green economy has great potential to reduce unemployment by creating new jobs in sustainable sectors. However, the success of this transition depends on the ability of governments and the private sector to manage structural changes, provide adequate training, and support social inclusion within the green economy. With the right strategies, the transition to a green economy can not only reduce unemployment but also enhance long-term economic resilience. A report by the United Nations Environment Programme (UNEP) indicates that the green economy can strengthen economic resilience by reducing reliance on limited resources and mitigating environmental risks that could affect economic stability. By enhancing economic resilience, the risk of unemployment due to economic crises can be diminished.

In 2021, the global average life expectancy was just over 70 years. This is a staggering fact—two hundred years ago, the average life expectancy was less than half of that. This trend is consistent across all regions of the world: in 1800, no region had a life expectancy of over 40 years. Average life expectancy has steadily and significantly increased across all areas. This remarkable improvement is the result of various advancements in health—such as nutrition, clean water, sanitation, neonatal healthcare, antibiotics, vaccines, and other public health efforts—as well as improved living standards, economic growth, and poverty reduction. The relationship between life expectancy and the green economy is an interesting topic, as both influence each other through various mechanisms. The green economy focuses on the management of natural resources and the reduction of environmental impacts from economic activities, such as decreasing carbon emissions, air pollution, and other forms of environmental contamination. When the environment is cleaner and healthier, the quality of air and water improves. This can reduce the incidence of pollution-related diseases, such as respiratory illnesses and cancer, which in turn can enhance the life expectancy of the population.

Air pollution is one of the leading causes of respiratory and cardiovascular diseases. According to the World Health Organization (WHO), air pollution is responsible for millions of premature deaths each year. Reducing pollution levels through green economic policies, such as transitioning to renewable energy and promoting eco-friendly transportation, can decrease the occurrence of these diseases and subsequently improve community life expectancy. Effective water management and ecosystem conservation can prevent diseases caused by contaminated water and environmental degradation. According to a report from the United Nations Environment Programme (UNEP), sustainable and environmentally friendly agricultural practices can reduce incidents of hunger and malnutrition, which are critical factors in improving life expectancy in developing countries. The governments of ASEAN countries recognize this. During the ASEAN Summit in Hanoi, Vietnam, in November 2020, member states formulated a recovery framework focused on five key areas, including efforts to create a sustainable and resilient future, referred to as the Green Recovery.

2. Literature Review

According to Amsyari, the environment is divided into three groups. The first group is the physical environment, which includes everything that exists around humans. The physical environment consists of inanimate objects such as air, water, light, rocks, houses, and more. The second group is the biological environment, which encompasses all elements surrounding human life. This includes living organisms, excluding those within the human body itself, such as plants and animals. The third group is the social environment, which refers to the life of groups of people within a community. In this social environment, humans interact with society. All environmental activities conducted thus far aim to improve the welfare of the community, which is reflected in economic growth. In reality, increased economic growth not only brings positive effects to an economy but also has negative impacts on the environment. In economics, environmental damage caused by human activities is specifically referred to as externalities.

Externalities arise when certain activities by producers and consumers have unintended (indirect) effects. Externalities can be either positive or negative. Positive externalities occur when actions taken by an individual or group benefit others. For example,

scientific discoveries not only benefit the discoverers but also contribute to knowledge and the environment as a whole. On the other hand, negative externalities occur when activities by individuals or groups produce harmful effects for others. High greenhouse gas emissions are an example of a negative externality. Another example of positive externalities is the utilization of renewable energy development. Investments in renewable energy, such as wind, solar, and hydro power, can reduce dependence on fossil fuels, thereby lowering greenhouse gas emissions and air pollution. This helps mitigate the effects of global warming and climate change, providing long-term benefits for environmental health and the Earth as a whole. By harnessing renewable energy, we can minimize negative impacts on the environment and support the sustainability of ecosystems, benefiting not only the current generation but also future generations. The advantages of such investments will be widely felt by the community, not just by the companies that build these facilities.

The United Nations Environment Program (UNEP) defines the green economy as a mechanism that significantly increases human well-being while reducing environmental risks and ecological resource scarcity. The green economy is a form of economic activity that not only focuses on meeting societal needs but also considers its impact on the environment [6]. According to [7] the green economy is a concept that differs from traditional economics because it prioritizes the future of natural resources, environmental well-being, and the reduction of risks associated with resource consumption. Green economy practices emphasize long-term planning, as they can help reduce poverty, carbon dioxide emissions, and ecosystem degradation [8].

Energy is what makes everything around us happen—we use energy for everything we do. Energy exists in all things: humans, plants, animals, machines, and natural elements (such as the sun, wind, and water). There are many primary sources of energy, which can be classified into two main categories:

1. Conventional energy is derived from sources that are available in limited quantities on Earth and cannot be regenerated. These energy sources will eventually run out and can be harmful to the environment.
2. Renewable energy is generated from natural sources like the sun, wind, and water, and can be produced over and over again. These sources will always be available and do not harm the environment.

By 2010, many countries had recognized the importance of utilizing renewable energy sources as a replacement for non-renewable energy sources like petroleum, coal, and gas, which have had devastating impacts on the Earth. As reserves of non-renewable energy become depleted, the costs of extraction will rise, leading to increased prices for consumers. At the same time, non-renewable energy releases carbon emissions into the atmosphere, significantly contributing to global warming. This indicator is important for the Green Economy Index (GEI) as it highlights the need for decarbonization in the energy sector, which is the second-largest contributor to greenhouse gas (GHG) emissions in Indonesia. A higher share of renewable energy in a country signifies a stronger commitment by the government to transition to cleaner and more environmentally friendly energy sources.

The term "greenhouse gases" is used by experts to describe the function of Earth’s atmosphere. The atmosphere is likened to the glass of a greenhouse, commonly seen in plant cultivation practices. It allows sunlight to pass through, warming the Earth's surface and enabling life to thrive. Without the atmosphere, the Earth would be cold. Greenhouse gases are defined as gases contained in the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation. Some of the solar radiation received by the Earth's surface in the form of short waves is re-emitted back into the atmosphere as long-wave radiation (infrared radiation). This long-wave radiation emitted by greenhouse gases in the lower atmosphere, close to the Earth's surface, is absorbed and creates a warming effect known as the greenhouse effect.

Greenhouse gases are a collection of gases that contribute to the greenhouse effect found in the Earth’s atmosphere. These gases function like glass, allowing sunlight to pass through while trapping heat energy. According to the United Nations Framework Convention on Climate Change (UNFCCC), there are six types of gases classified as greenhouse gases: CO2 (carbon dioxide), CH4 (methane), N2O (nitrous oxide), HFCs (hydrofluorocarbons), PFCs (perfluorocarbons), and SF6 (sulfur hexafluoride) (Samiaji, 2009). As noted by the Intergovernmental Panel on Climate Change (IPCC) in 2014, human economic activities drive greenhouse gas emissions. This indicator is chosen to represent the proactive measures taken by governments to implement "green" policies aimed at reducing greenhouse gas emissions. The government’s target to reduce GHG emissions aligns with the global targets agreed upon in the Paris Agreement back in 2015.

Indonesia is an archipelagic country with the second-longest coastline in the world, making it vulnerable to climate change. Additionally, as a tropical nation with significant areas of forest and peatland, Indonesia has a high potential for both emissions and carbon sinks, which refer to systems or processes that absorb and store carbon dioxide (CO2) or other greenhouse gases from the atmosphere. Sinks play a crucial role in reducing greenhouse gas concentrations in the atmosphere and aiding in climate change mitigation. As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, Indonesia plays an important role in the Paris Agreement. Emission inventory indicators are used because they reflect efforts to reduce emissions and support national economic growth. A lower emissions intensity indicates economic growth without compromising greenhouse gas emissions, suggesting a shift towards greener economic development.

Agriculture, in a broad sense, encompasses all activities involving the utilization of living organisms (including plants, animals, and microbes) for human benefit. In a narrower sense, agriculture refers specifically to the use of a piece of land to cultivate certain types of crops, particularly annual ones. The agricultural sector is a highly strategic and essential component of the national economy, as it generates a significant portion of the country's gross domestic product, provides a major share of export income, and employs millions of people. The agricultural sector can be considered the backbone of the economy [9]. Agriculture produces much more than just crops. Agricultural practices have extensive impacts on various ecosystem services, including water

quality, nutrient cycling, soil retention, and carbon sequestration. In turn, these ecosystem services influence agricultural productivity, which affects the broader economic sector. This indicator demonstrates that the growth of the agricultural sector is aligned with the benefits derived from ecosystem services. Higher agricultural productivity coupled with healthy ecosystem services indicates that society is moving towards a greener economy.

Life Expectancy is one of the indicators used to assess the health status of a population. According to Statistics Indonesia, life expectancy at birth is the average number of years a newborn is expected to live in a given year. Life expectancy varies between regions, depending on the quality of life that residents can achieve. Many factors influence life expectancy, and this indicator is related to the level of welfare and the national healthcare system.

According to [10], unemployment refers to individuals who are currently not working at all or are working less than two days a week but are actively seeking employment. The dimension or indicator of unemployment is derived from the percentage that divides the number of unemployed individuals by the total labor force, expressed as a percentage. A high unemployment rate can be a barrier to achieving sustainable economic growth. Unemployment leads to decreased individual incomes and reduces the overall purchasing power of the community. When people have low incomes, they tend to cut back on consumption, which ultimately affects company revenues. Additionally, high unemployment hinders overall economic productivity due to underutilized human resources. Adopted from the Partnership for Action on Green Economy (UNPAGE), this indicator links the implementation of a green economy to community welfare. The paradigm of low-carbon industrial development is expected to promote the growth of green sectors and create new job opportunities, thereby reducing unemployment rates.

Economic growth indicates the extent to which economic activities generate additional income for the community over a specific period. In macroeconomic terms, economic growth refers to the increase in Gross Domestic Product (GDP), which means an increase in National Income. GDP is used as an indicator to assess the economic condition of a country over a specific period, whether based on current prices or constant prices. GDP at current prices explains the value added of goods and services calculated based on the prices prevailing each year, while GDP at constant prices indicates the value added of those goods and services calculated using the prices from a specific year. GDP at current prices can be used to examine the economic structure and its shifts, while GDP at constant prices is used to assess year-over-year economic growth. The GDP growth rate serves as an indicator to determine economic growth. An economy is considered to be growing when the real income of the community in a particular year is greater than the real income in the previous year. Therefore, economic growth can also be described as the development of a country's economic activities measured using GDP.

3. Methods

The type of research used is quantitative, aimed at analyzing the impact of the Green Economy on the economic growth of ASEAN countries. This type of research is utilized to measure issues by generating numerical data or data that can be translated into statistics for use. The scope of the research examines the influence of the Environmental Pillar, Economic Pillar, and Social Pillar on the economic growth of ASEAN countries, including Indonesia, Malaysia, the Philippines, Thailand, and Vietnam, using a dataset covering a 10-year period corresponding to the historical data of the Green Economy Index (GEI). The objective of this research is to analyze the relationship and impact of Renewable Energy, Greenhouse Gas Emissions, Emission Intensity, Agricultural Productivity, Unemployment Rate, and Life Expectancy on Gross Domestic Product (GDP) in five ASEAN countries, specifically Indonesia, Malaysia, the Philippines, Thailand, and Vietnam, during the period from 2013 to 2022.

This study, purposive sampling was employed, which, according to [11] involves selecting samples based on specific considerations that meet the desired criteria to determine the number of samples to be studied. The sampling in this research was conducted by establishing certain criteria, namely:

1. Countries that are part of the Association of Southeast Asian Nations (ASEAN).
2. ASEAN countries that have reports containing the necessary data for the research.

This study utilizes secondary data and employs panel data regression techniques. According to Basuki (2016), panel data regression is a method that combines time series data with cross-sectional data. Panel data analysis integrates cross-sectional and time series data, providing informative and efficient insights. Panel data can offer detailed information, reduce multicollinearity among variables, increase the degrees of freedom, and enhance efficiency. The panel data regression model is conducted to determine the effect of two or more independent variables on the dependent variable.

The Chow test is a test that aims to determine the choice between Common Effect Models (CEM) and Fixed Effect Model (FEM) in the context of panel data modeling. Hypothesis used in the process the determination of the panel data regression model is that if the cross-section chi-square value is <0.05, then it is a Fixed Effects Model (Fixed Effect Model) would be the right choice. Conversely, if the cross-section chi-square value is > 0.05, then the Common Effect Model will be selected, and in this case, the Hausman test is not required. The Lagrange Multiplier test is a testing method used to determine a better modelfit between the Common Effect Model (CEM) and the Random Effect Model (REM) in panel data analysis. Testing The Lagrange Multiplier was developed by Breusch-Pagan and focuses on the residual value resulting from Common Effects Model. The Lagrange Multiplier test is based on the Chi-Square distribution with degrees of freedomwhich is equal to the number of independent variables. If the LM value is greater than the Chi-Square value, then the model the appropriate one is the Random Effect Model.

Conversely, if the LM value is smaller than the Chi-Square value, then the appropriate model is Common Effect Model. [12] said that the Hausman test should not be used if the Chow test shows that the most appropriate model is the Common Effect Model. The Hausman test is used if the Chow test shows that the model used is the Fixed Effect Model, and the Lagrange Multiplier (LM) shows that the most appropriate model is the Common Effect Model (CEM).

The heteroskedasticity test is used to determine whether there is a variance inequality across all regression observations. A good regression model is free from heteroskedasticity. If the significance test result is greater than 0.05, it indicates that heteroskedasticity is not present. The purpose of the multicollinearity test is to examine whether there is a correlation among the independent variables in a regression model. A good regression model should not exhibit correlation among the independent variables. If the correlation coefficient is below 0.85, it indicates that there is no evidence of multicollinearity. Panel data regression models are carried out to determine the influence of two or more independent variables on the dependent variable. The regression model to test the hypothesis with modifications. The following is the research model:

$$PDBit = \alpha 0 + \alpha 1ETit + \alpha 2EGKit + \alpha 3IEmit + \alpha 4PPit + \alpha 5HHit + \alpha 6Pit + \varepsilon it$$

Where:
ET : Renewable Energy
EGRK : Percentage Reduction of Greenhouse Gas Emissions
Iem : Emission Intensity
PP : Agricultural Productivity
HH : Life Expectancy
P : Unemployment Rate
α : Slope Coefficient or Directional Coefficient
t : Time Period
i : Cross-Section.

The T-test is used to determine the extent of the individual influence of independent variables on the dependent variable. If the calculated t-value is smaller than the table t-value, the null hypothesis is rejected, indicating that the independent variable has a significant partial effect on the dependent variable. Conversely, if the calculated t-value is greater than the table t-value, the null hypothesis is accepted, meaning that the independent variable does not have a significant partial effect on the dependent variable. The F-test aims to assess the validity of a regression model by examining whether one or more independent variables in the model have a significant overall effect on the dependent variable. The criteria for the F-test are as follows: if the calculated F-value is greater than the table F-value or if the probability value is less than 0.05, it can be concluded that the null hypothesis (H0) is rejected and the alternative hypothesis (Ha) is accepted, indicating that one or more independent variables significantly affect the dependent variable, which means the regression model is considered significant. Conversely, if the calculated F-value is less than the table F-value or if the probability value is greater than 0.05, it can be concluded that the null hypothesis (H0) is accepted and the alternative hypothesis (Ha) is rejected, indicating that none of the independent variables significantly affect the dependent variable, meaning the regression model is not significant. The coefficient of determination measures how well the model can explain the dependent variable. The value of R2 ranges from 0 to 1 ($0 < R2 < 1$). A smaller R2 value indicates that the independent variables have very limited ability to explain the variation in the dependent variable and may not explain it at all. Conversely, a larger R2 value suggests that the independent variables can effectively explain and represent the variation in the dependent variable.

4. Results

The Chow Test or Likelihood Ratio Test is a test to choose between the Common Effect Model and the correct Fixed Effect Model. Chow test is a test by looking at the F statistics results to choose a better model, between the Common Effect Model or the best Fixed Effect Model.

Tabel 1. Chow Test

F-hitung	d.f.	p-value
0.3796268	43	0.8218

Source: Researcher Processed Data

Based on the test results in Table 1, it is found that the probability value for Cross section F > 0.05 is 0.379628 and having a probability value > 0.05 means that H0 is accepted and H1 is rejected, which means that the Common Effect Model (CEM) model is more appropriate to use than with the Fixed Effect Model (FEM). If the profitability value F is < 0.05 significant level, then the

hypothesis H0 is rejected and H1 is accepted. This means that the model used for panel data regression is the Fixed Effect model. So it can be concluded that the appropriate data test for this research model is the Common Effect Model (CEM). Thus the test continues to the Lagrange Multiplier test. This test determines which method is more appropriate to use, the common effect or random effect method in estimating panel data regression. If the LM value is smaller than the 0.05 significance level, then H0 is accepted and H1 is rejected. This means that the more appropriate model to use is the General Effects model.

Tabel 2. Lagrange Multiplier Test

Chisq	d.f.	p-value
0.1393	1	0.0000

Source: Researcher Processed Data

Based on the test results in Table 2, it is found that the p-value is > 0.05, namely 0.1393. A probability value > 0.05 means that H0 is accepted and H1 is rejected, which means that the Common Effect Model is more appropriate to use compared to the Random Effect Model. So for the Lagrange Multiplier (LM) test it can be concluded that the Common Effect Model is more appropriate to use in this research. The multicollinearity test aims to test whether the regression model finds a correlation between independent variables. A good regression model should have no correlation between independent variables. If the correlation coefficient is below 0.85, it means that there are no symptoms of multicollinearity. Based on the research test results in Table 4, it shows that there is a probability value for the variable IE_X3 < 0.05 so it does not pass the heteroscedasticity test. To show that the data is free from symptoms of Heteroscedasticity, all variables must have a prob value > 0.05, therefore to overcome this we must transform the data. From the residual graph it can be seen that it does not exceed the limits (500 and -500). This means that the residual variance is the same. Therefore, there are no symptoms of heteroscedacity or passing the heteroscedacity test.

Panel data regression analysis is a regression analysis tool where data is collected across individuals (cross section) and followed over a specific time period (time series). The purpose of developing a panel data regression model is to process and analyze the obtained sample, as well as to evaluate the established hypotheses. Based on this table, the regression equation in this study is:

$$PDB\_Y = 1.01 - 0.04*ET\_X1 - 0.005*EGRK\_X2 + 0.01*IE\_X3 - 0.01*PP\_X4 - 1.49*TP\_X5 - 0.01*HH\_X6$$

The explanations are as follows: The constant value of 1.01 means that in the absence of the variables Renewable Energy (X1), Greenhouse Gas Emissions (X2), Emission Intensity (X3), Agricultural Productivity (X4), Unemployment Rate (X5), and Life Expectancy (X6), the Gross Domestic Product (GDP) variable (Y) will increase by 1.01%. The beta coefficient for the Renewable Energy variable (X1) is -0.04. If the other variables remain constant and X1 increases by 4%, then the GDP variable (Y) will decrease by 4%. Conversely, if the other variables decrease by 4%, then Y will increase by 4%. The beta coefficient for the Greenhouse Gas Emissions variable (X2) is -0.005. If the other variables remain constant and X2 increases by 0.5%, then the GDP variable (Y) will decrease by 0.5%. Conversely, if the other variables decrease by 0.5%, then Y will increase by 0.5%. The beta coefficient for the Emission Intensity variable (X3) is 0.01. If the other variables remain constant and X3 increases by 1%, then the GDP variable (Y) will increase by 1%. Similarly, if the other variables remain constant and X3 decreases by 1%, then Y will decrease by 1%. The beta coefficient for the Agricultural Productivity variable (X4) is -0.01. If the other variables remain constant and X4 increases by 1%, then the GDP variable (Y) will decrease by 1%. Conversely, if the other variables decrease by 1%, then Y will increase by 1%. The beta coefficient for the Unemployment Rate variable (X5) is -1.49. If the other variables remain constant and X5 increases by 149%, then the GDP variable (Y) will decrease by 149%. Conversely, if the other variables decrease by 149%, then Y will increase by 149%. The beta coefficient for the Life Expectancy variable (X6) is -0.01. If the other variables remain constant and X6 increases by 1%, then the GDP variable (Y) will decrease by 1%. Conversely, if the other variables decrease by 1%, then Y will increase by 1%.

The results of the partial test for each independent variable are: The results of the t test on the Renewable Energy variable (X1) obtained a tcount value of 0.46 < ttable, namely 1.67722 and a sig value. 0.64 > 0.05, then Ha is rejected and H0 is accepted, meaning that the relationship between Renewable Energy and Gross Domestic Product has an insignificant negative relationship with GDP in ASEAN countries. The results of the t test on the GHG Emission variable (X2) obtained a t value of 0.69 < t table, namely 1.67722 and a sig value. 0.48 > 0.05, then Ha is rejected and H0 is accepted, meaning that the GHG emissions variable has an insignificant negative relationship with GDP in ASEAN countries. The results of the t test on Emission Intensity (X3) obtained a t value of 0.86 < t table, namely 1.67722 and a sig value. 0.39 > 0.05, then Ha is rejected and H0 is accepted, the Emission Intensity variable has a positive and insignificant relationship to GDP in ASEAN countries. Results of the t test on Agricultural Productivity (X4), obtained a tcount value of 1.75 > ttable, namely 1.67722 and a sig value. 0.08 < 0.10 then Ha is accepted and H0 is rejected, meaning that the Agricultural Productivity variable has a significant negative effect on GDP in ASEAN countries. The results of the t test on the Unemployment Rate (X5), obtained a tcount value of 1.92 > ttable, namely 1.67722 and a sig value. 0.06 < 0.10 then Ha is accepted and H0 is rejected, meaning that the Unemployment Rate variable has a

significant negative effect on GDP in ASEAN countries. Results of the t test on Life Expectancy (X6), obtained a tcount value of 2.9 > ttable, namely 1.67722 and a sig value. 0.005 < 0.05 then Ha is accepted and H0 is rejected, meaning that the Life Expectancy variable has a significant negative effect on GDP in ASEAN countries. The estimated panel data regression using the Common Effect Model (CEM) approach used in this research has a calculated F value of 1.880 > F table, namely 1.635 and a sig value of 0.1 > 0.05. Based on the calculated F value and probability value, H0 is rejected and Ha is accepted, so it can be interpreted that one or more independent variables have an effect on the dependent variable. The coefficient of determination (R^2) or the adjusted R Square value is 0.097286 or 9.7286%. This coefficient indicates that the independent variables, which include Renewable Energy (X1), Greenhouse Gas Emissions (X2), Emission Intensity (X3), Agricultural Productivity (X4), Unemployment Rate (X5), and Life Expectancy (X6), can explain 9.7286% of the variation in GDP in ASEAN countries, while the remaining 99.02714% (100 - the adjusted R Square value) is explained by other variables not included in this study.

Based on the results of the estimation data using the Panel Data approach with the Common Effect Model (CEM) based on the results of the Hypothesis Test, namely the t test, on the Renewable Energy variable (X1) the coefficient value is -0.04 and has a calculated t value of 0.46 < t table, namely 1.67722 and sig value. 0.64 > 0.05, then Ha is rejected and H0 is accepted, meaning that the relationship between renewable energy and gross domestic product has an insignificant negative relationship with GDP in ASEAN countries. Based on the research conducted by Firmansyah (2022), it is shown that renewable energy consumption in Southeast Asia has an insignificant negative impact on GDP. This indicates that economic growth in the region is primarily driven by the consumption of non-renewable energy, even though the impact of renewable energy is not significant. This suggests that, despite some contribution from renewable energy, its effect on GDP remains weak. In the GHG Emission variable (X2), the coefficient value is 0.005 and has a calculated t value of 0.69 < t table, namely 1.67722 and a sig value. 0.48 > 0.05, then Ha is rejected and H0 is accepted, meaning that the GHG emissions variable has an insignificant negative relationship with GDP in ASEAN countries. If greenhouse gas emissions increase, GDP will decrease. The World Bank (2010) also explains that rising temperatures and an increased frequency of natural disasters due to climate change can damage infrastructure. For example, floods and storms can destroy land, roads, bridges, and other industrial facilities. This damage requires significant investment for repairs, diverting funds that could have been used for productive investments to disaster recovery efforts, which can ultimately reduce GDP. Emission Intensity (X3) obtained a coefficient value of 0.015 and had a calculated t value of 0.86 < t table, namely 1.67722 and a sig value. 0.39 > 0.05, then Ha is rejected and H0 is accepted, meaning that the Emission Intensity variable has an insignificant positive relationship with GDP in ASEAN countries. So if Emission Intensity increases, GDP will increase. This is because developing countries still rely heavily on CO2-intensive processes for their economic activities. These countries have yet to achieve a balance in CO2 emissions related to their economic activities. According to a study by the International Energy Agency (IEA), the increase in energy consumption, particularly from fossil sources, contributes to economic growth in many developing countries (IEA, 2021). This reflects a relationship between economic growth and rising emissions intensity. Agricultural Productivity (X4), obtained a coefficient value of - 0.01 and has a calculated t value of 1.75 > t table, namely 1.67722 and a sig value. 0.08 < 0.10 then Ha is accepted and H0 is rejected, meaning that the Agricultural Productivity variable has a significant negative relationship with GDP in ASEAN countries. If agricultural productivity in terms of rice production increases, GDP will decrease. This is because when agricultural productivity increases but is not balanced with economic diversification, dependence on agriculture can weaken overall economic growth. Unemployment Rate (X5), obtained a coefficient value of - 1.49 and has a calculated t value of 1.92 > t table, namely 1.67722 and a sig value. 0.06 < 0.10 then Ha is accepted and H0 is rejected, meaning that the Unemployment Rate variable has a significant negative relationship with GDP in ASEAN countries. If the unemployment rate rises, it can affect the decline in the GDP value obtained. When the unemployment rate rises, more individuals lose their jobs, leading to a decrease in household income. This reduction in income diminishes people's purchasing power, which in turn lowers domestic consumption one of the key components of GDP. In Life Expectancy (X6), the coefficient value obtained is -0.01 and has a calculated t value of 2.9 > t table, namely 1.67722 and a sig value. 0.005 < 0.05 then Ha is accepted and H0 is rejected, meaning that the Life Expectancy variable has a significant positive relationship with GDP in ASEAN countries. If life expectancy increases, GDP will decrease. According to a report by the United Nations Educational, Scientific and Cultural Organization (UNESCO), despite high life expectancy, if education and workforce skills do not align, productivity may remain low. Low skill levels among the workforce can limit a country's economic capacity to harness growth potential, even as life expectancy rises. Additionally, uneven health outcomes also contribute to a decline in GDP, alongside inadequate education and skills.

5. Conclusions

Based on the research results, hypothesis testing, and discussion description, the conclusions of this study are: Renewable energy has an insignificant negative impact on Gross Domestic Product (GDP) in ASEAN countries. Greenhouse gas emissions have an insignificant negative impact on Gross Domestic Product (GDP) in ASEAN countries. Emission intensity has an insignificant positive impact on Gross Domestic Product (GDP) in ASEAN countries. Agricultural productivity has a significant negative impact on Gross Domestic Product (GDP) in ASEAN countries. The unemployment rate has a significant negative impact on Gross Domestic Product (GDP) in ASEAN countries. Life expectancy has a significant negative impact on Gross Domestic Product (GDP) in ASEAN countries.

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