The Nexus Between Income Inequality and Environmental Degradation in ASEAN-6 Countries During 1992 – 2015 from Islamic Perspective

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Abstract. The purpose of the study is to examine the relationship between income inequality and environmental degradation in ASEAN-6 countries namely Indonesia, Malaysia, the Philippines, Thailand, Singapore, and Vietnam. It also provide analysis from the Islamic perspective based on result of the econometric regression. The study utilizes annual panel data from1992 until 2015 where the region suffered from high income distribution and environmental degradation. The analytical tool used in the study is Bias-Corrected Least Squared Dummy Variable (LSDVC), which is sufficient for small panel data. The methodological approach leads to two main findings. First, income inequality, measured by Gini coefficient, is contributing to environmental degradation (proxied by CO_2 emission and Natural Resources Depletion) in the short- and long-run term. Other explanatory variables namely GDP per capita and energy consumption, also impact significantly on environmental degradation level in the short- and long-term. From the findings, it is recommended that greater investment is required in addressing high level of income inequality and environmental issues. Instruments in Islam such as zakat and waqf provide solution to overcome issue of high income gap and environmental degradation in ASEAN-6 countries, moreover majority of Muslim population located in ASEAN countries. Hence, collaboration should be enhanced among the ASEAN-6 countries where wealth distribution, technology and knowledge sharing from high income countries to low and middle-income in ASEAN countries to mitigate the negative impact of high income inequality and environmental issue in the region.

Key words: ASEAN, environmental degradation, income inequality.

Abstrak. *Tujuan penelitian ini adalah untuk menguji hubungan ketimpangan pendapatan dengan degradasi lingkungan di enam negara-negara ASEAN seperti Indonesia, Malaysia, Filipina, Thailand, Singapura, dan Vietnam. Penelitian ini juga memberikan analisis dari perspektif Islam berdasarkan hasil regresi ekonometrik. Studi ini menggunakan data panel tahunan dari tahun 1992 hingga 2015 di mana keenam negara-negara ASEAN tersebut mengalami kesenjangan pendapatan dan degradasi lingkungan yang tinggi. Alat analisis yang digunakan dalam penelitian ini adalah* Bias-Corrected Least Squared Dummy Variable (LSDVC) *yang sesuai untuk data panel berukuran kecil. Penemuannya mengarah kepada dua hal. Pertama, ketimpangan pendapatan, yang diukur dengan Gini koefisien, berkontribusi terhadap degradasi lingkungan (diproksikan dengan emisi CO_2 dan penipisan sumber daya alam) dalam jangka pendek dan jangka panjang. Variabel bebas lainnya yaitu PDB per kapita dan konsumsi energi, juga berpengaruh secara signifikan terhadap tingkat degradasi lingkungan dalam jangka pendek dan jangka panjang. Dari temuan-temuan tersebut, disarankan dilakukannya investasi untuk mengatasi tingginya tingkat ketimpangan pendapatan dan permasalahan lingkungan hidup antar enam negara-negara ASEAN tersebut. Instrumen dalam Islam seperti zakat dan wakaf memberikan solusi untuk mengatasi permasalahan kesenjangan pendapatan yang tinggi dan degradasi lingkungan dienam negara-negara ASEAN, apalagi mayoritas penduduk Muslim dunia terletak di negara ASEAN. Oleh karena itu, kolaborasi harus ditingkatkan di antara enam negara-negara ASEAN sehingga bisa terjadi distribusi kekayaan, teknologi dan pertukaran pengetahuan dari negara-negara ASEAN yang*

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berpendapatan tinggi ke negara-negara ASEAN berpendapatan rendah dan menengah sehingga dapat memitigasi dampak negatif dari ketimpangan pendapatan yang tinggi dan masalah lingkungan hidup di kawasan tersebut.

***Kata kunci**: Degradasi lingkungan, ketimpangan pendapatan, negara-negara ASEAN.*

INTRODUCTION

Income distribution is an important issue after the 1990s which a situation that needs to be considered for countries' economic growth as well as development. According to Standard World Income Inequality (SWIID) within the period of 1992 – 2015 ASEAN-6 countries have issue of high income inequality, whereas Gini coefficient in Indonesia (0.431 in 2015), Thailand (0.447 in 2009), Malaysia (0.45 in 2007), Singapore (0.44 in 2013), the Philippines (0.46 in 2010), and Vietnam (0.41 in 2008) remained high. Based on the United Nations Children's Fund (UNICEF) generally, a Gini coefficient below 0.2 indicates equitable income distribution, 0.2-0.3 relative equitable, 0.3-0.4 adequate equality, 0.4-0.5 big income gap, and above 0.5 represents severe income gap.

High-income inequality is generally associated with more resource consumption and more waste generation. When income inequality is high, the poor are getting poorer, and they produce more pollution because they rely on their daily needs from natural resources and forcing them to use low-cost fuels that produce more carbon emissions. On the other hand, the rich are getting richer, and they already produce more pollution but bear less responsibility for the corresponding pollution cost. The rich invest their wealth in leading industries to get a higher return and ignore environmental quality. Therefore, greater income inequality worsened environmental quality.

During 1992 until 2015, the impact of high-income distribution in ASEAN-6 countries cause different issue on environment namely high usage of water and demand more electricity using for air – condition when temperatures rise in Singapore, and forest fire that damaging the important plant nutrients and disturbs the environmental quality in Thailand and Indonesia through 'slash and burn' technique to clearing forestland for agriculture in a short period (National University of Singapore, 2018; Fisher and Hirsch, 2007). At the same time according to Siwar and Murad (2001), the World Bank (2017), and Harianti and Nandi (2019), high income inequality in Indonesia, the Philippine and Malaysia also causing rapid urbanization, inadequate infrastructure, and basic service that provide gaps between the rich and the poor. On the other hand, according to Cai et al. (2015) high income gap in the Vietnam threaten the environmental quality through more pollution from fossil fuel and thousands of hectares of forests are destroyed which were converted into a wetland plot into a shrimp pond through the clear brush.

At the same time, widening income distribution is not the only issue that may impact environmental degradation, factors such as economic growth, population density and energy consumption would have influence on environmental degradation. Within the period of 1992 – 2015 ASEAN-6 countries experienced around 5% increased its annual growth rate. In line with economic growth, energy used increased approximately.

Previous studies by Zhang and Zhang (2020), Khan et al. (2018) and Ridzuan et al (2017) showed a positive relationship between energy consumption and CO_2 emission, which indicates that the more energy used within a nation, or a region leads to a more significant amount of CO_2 emission being produced. As a result, the level of environmental degradation increased and threatens environmental quality. Thus, greater percentages of energy consumption drive a high level of environmental degradation.

Furthermore, from 1992 until 2015, population density increased 2-4 % annually in ASEAN-6 countries. Higher population density areas could be a threat for environmental quality. Masud et al., (2018) discovered that more population density could leads to more CO_2 emission and Natural

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Resources Depletion (NRD). The member of ASEAN-6 comprises high-income and middle-income nations such as Singapore, Malaysia, Indonesia, Thailand, the Philippines, and Vietnam. In high-income and middle-income countries, higher per person GDP per capita could lead to higher energy consumption and more CO_2 emissions because of their economic structure, product structure, and consumption behaviour. Increasing revenues necessitate increasing the preservation of the environment.

Analysing the Environmental Kuznet Curve (EKC) theory in the context of income inequality is essential for ASEAN-6 countries to understand the relationship between income inequality and environmental degradation. The impact of income inequality on the environment degradation with the presence of EKC theory is mostly discussed in Europe, the United States, and Asian countries (Batmaz et al., 2023; Padhan et al., 2019; Khan et al., 2018; and Liu et al., 2019) and less attention was given to the ASEAN-6 countries despite their high income inequality level in the last two decades. Thus, analysing the EKC theory within the context of income inequality is essential for ASEAN-6 countries to understand the relationship between income inequality and environmental degradation. A study by Masud et al. (2018) observed the link between income inequality and environmental degradation in ASEAN but did not include the EKC theory.

With high income inequality and environmental degradation in ASEAN-6 countries, the community is challenged to implement environmental sustainability and save ASEAN from environmental degradation as part of ASCC (ASEAN Socio-Cultural Community) Blueprint 2025. A focus in income inequality is also essential because SDGs (Sustainable Development Goals) have proposed income inequality in the Open Working Group of the United Nations General Assembly to "reduce inequality within and among countries" as Goal 10. As part of Sustainable Development, environmental sustainability could be influenced by income inequality. Baloch et al. (2020) mentioned poverty as a key factor that contributes to environmental pollution. High income inequality made the poor damage the environment to meet their living standards, and the rich increases their consumption, which threatens environmental sustainability.

Furthermore, reducing income inequity and maintaining environmental quality are Sustainable Development Goals (17) initiated by United Nation in 2015 to be achieved by 2030. While the agenda shall end in another six years, the environmental quality aggravates. In that regard, it is important to mention that around 64% of the Muslim population is located in Southeast Asia. Such potential indicates to the need to implement the Islamic instrument such as zakat and waqf to reduce high income inequality and improve environmental quality. In other words, Muslims in ASEAN-6 should pursue the attainment of Islamic teaching and support the SDGs agenda.

Therefore, the objective of our paper is to examine the nexus between income inequality and environmental degradation within the period of 1992 – 2015 where there is issue of high income inequality and environmental degradation in ASEAN-6 countries. It also examine the relationship between environmental degradation, economic growth (GDP), population density and energy consumption for countries in ASEAN-6 countries in the short and long run. It also provide analysis from Islamic perspective based on result of the econometric regression. The following sections present the review of past studies follows by the methodology section. Next, result and discussion are presented in the subsequent section and last but not least, the conclusion section will also offer the policy implications of this study.

LITERATURE REVIEW

The Nexus of Income Inequality and Environmental Degradation

Environmental degradation embraces all aspects of socio-economics in the modern world. There have been various attempts in the past studies to relate environmental degradation with income distribution. Previous studies showed that income inequality could harm environment. A country that is trying to

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achieve economic growth has issues in environmental degradation such as deforestation, climate change, and air pollution. Past works by Wang et al. (2023), Knight et al. (2017), Khan et al. (2022) and Ali et al. (2016) reported that there is a strong association between income inequality and environmental degradation. Most of them such as Wang et al. (2023) and Baek and Gweisah (2013) explained how reducing income inequality could improve environmental quality.

Boyce (1994) is the first author to examine how income inequality affects environmental degradation. The study documented that higher power and income inequalities could increase environmental degradation. Boyce's hypothesis argued that most rich people have political power and have significant influence in deciding on environmentally damaging projects. Competition exists among the rich and the poor over project investment. Generally, the rich are the winners of the investment that has an environmental impact. There are arguments given to Boyce's (1994) hypothesis: Wang et al. (2023), Khan, et al. (2022) and Knight et al. (2017). For example, Wang et al. (2023) examined 56 developed countries from 2003 to 2018, and the empirical result show that with the increase of income inequality, the impact of economic growth on carbon emission changes from inhibiting to promoting.

In the scope of the ASEAN region, there are two studies examining the link between income distribution and environment, namely Ridzuan et al. (2017) and Masud et al. (2018). Both studies applied different tools in the analyses. The results indicated there is a positive relationship between income inequality and environmental degradation, where high income inequality leads to greater environmental degradation.

Ridzuan et al. (2017) did a comparative study for ASEAN-4 (Malaysia, Indonesia, the Philippines, and Thailand) to investigate the short-run and long-run effect between income inequality and energy consumption on CO_2 emission using Autoregressive Distributed Lag (ARDL) from 1971 until 2013. The finding reported that higher income gap leads to greater environmental degradation for Indonesia, Thailand, and Malaysia. However, for the Philippines, there is no significant relationship detected between income distribution and environmental quality.

Meanwhile, Masud et al. (2018) also focused on the impact of income inequality on environmental sustainability. The study applied Granger causality and panel regression tests to examine the relationship in ASEAN-5 (Indonesia, Malaysia, the Philippines, Thailand, and Vietnam) from 1985 until 2015. The result depicted bi-directional causality between inequality and environmental sustainability among the bottom 40% of income inequality levels. Furthermore, it found that high-income inequality is threatening environmental sustainability. It suggested that ASEAN-5 should reduce income inequality levels to strengthen environmental quality.

On the other hand, studies by Ghazouani and Beldi (2022), Magnani (2000), Ali et al. (2016) and Guo (2013) reported that there is a negative correlation between income inequality and environmental pollution, where widening income inequality leads to the reduction of carbon emission. For example, Guo (2013) mentioned that the negative relationship between income inequality and CO_2 emission caused the rapid economic growth in middle-income countries contributed to narrowed income disparity. To catch up with high-income countries, a low level of income inequality in middle-income countries increases the level of CO_2 emission. This situation appears because of their carbon emission industrial structure and low capability to reduce carbon emissions. This study is conducted in 88 countries over a period of 1980 to 2006.

Meanwhile, Ghazouani and Beldi (2022) found that income inequality increased mainly due to globalization which cause high demand for unskilled labour and promoted financial gains for the rich, consumption taxed and technological changed that negatively affected employment. Higher income inequality leads to weaker the earning low and middle income households, which drives to less consumption. Eventually it caused improvement in energy efficiency of goods bought by the upper-income household through technology advances and contributing to decline in CO_2. The study was

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conducted in seven Asian countries consisting of India, Japan, Korea, Malaysia, Pakistan, Philippines, and Sri Lanka, over the 1971-2014 period using a non-parametric procedure.

In brief, existing studies emphasized that the poor and powerless individuals have less information on environmental impacts and they are less likely to demand environmental protection because they rely on their daily needs from natural resources. Hence, environmental information plays important role in raising public awareness.

Previous studies tested the link between income inequality and environmental degradation based on EKC theory (Batmaz et al., 2023; Liu et al., 2019; Ridzuan, 2019; Padhan et al., 2019; Khan et al., 2018; Ridzuan, et al., 2017; Ullah and Awan, 2019 and Baloch et al., 2017). Their findings are divided into two categories based on their conclusions. First, studies that verify the influence of income inequality on environmental pollution by examining the existence of EKC theory, and second studies that refute the existence of the EKC theory based on the relationship between income inequality and environmental degradation. If EKC theory exist in the relationship between income inequality and environmental degradation, the result emphasized that widening income inequality would lead to damaging environmental quality and increase CO emission levels. This condition supports the importance of equal income distribution in reducing CO_2 emissions.

To validate the existence of EKC theory, Gross Domestic Product (GDP) is applied in the previous studies by Baloch et al. (2017), Ridzuan (2019), Kusumawardani and Dewi (2020), and Prasetyanto and Sari (2021) as an indicator for income. These studies measured the existence of EKC theory in short- and long-run relationships between CO_2 emission and income level using GDP per capita and GDP square per capita as income level indicators as conducted by Grossman and Kruger (1995).

At the same time, studies by Ray and Ray (2011), Baloch et al. (2017), Masud et al. (2018), and Saleem et al. (2018) showed that population density determines the availability of environmental resources in a particular area. The measurement of population density is normally in people per square kilometre of land area. Their finding indicated there is significant relationship between population density and environmental degradation.

Lastly, in the growing economy, energy demand is high, to accommodate the demand its energy supply leads to a high level of energy pollutants, and it threatens environmental quality. Energy consumption is fossil fuel consumption in the sum of energy from coal, oil, and gas. It is a significant contributor to energy pollution, which disturbs environmental quality. Previous studies by Xu et al. (2020), Khan et al. (2018), Ridzuan et al (2017) showed a positive relationship between energy consumption and CO_2 emission, which indicates that the more energy used within a nation, or a region leads to a more significant amount of CO_2 emission being produced. As a result, the level of environmental degradation increased and threatens environmental quality. Thus, greater percentages of energy consumption drive a high level of environmental degradation.

Environmental, Income Inequality and Islam

Islam, the religion of humanity, has demonstrated a clear importance in the matter of protecting the natural world and the environment. Islamic law, or shariah, states that it is a true Muslim's holy duty to prevent environmental degradation anywhere that endangers humankind. In fact, some people even contend that humans are the best aspect of nature and that they regulate it. We can observe such concepts from the Islamic perspective, in which the natural world is seen as a gift from God.

Based on QS. Al Maidah [5:32], is stated that that Allah has imposed the law upon the children of Israel that whoever save the life of a human, as if he has saved the whole human beings. On the contrary, if somebody kills a human, not because of the damage made on the earth, as if the person kills the whole human beings. Consequently, provide safety to the human being or human life is aimed as giving guardiance and maintaining dignity of human being as well as protecting the human rights.

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The worldly life is not merely for living and eating. Though there may be some idea of "live to eat and enjoy", but according to Islamic philosophy, we are here, in the earth, not for the same. We have to fulfill some criteria and reached to the final destination of Jannah in hereafter. And that‟s why every man is created. For us, the Worldly life is just like a field of examination and we have to pass it by performing the rituals of Islamic shariah and the duties given by Allah.

Nature is thus assist mankind to live on this earth and sometimes nature itself takes part to examine them whether men treat and utilize it in the proper way or not. In this regard, environment with all its elements is in a great use and surely does not exist without any thankful motive. Though, to some extent, we cannot recognize the creating purpose of being some creations, small or large, Islamic supreme idea makes us bound to say in this context: "Allah is the Creator of all things, He is the guardian of our all the affairs. To Him belong the keys of the heavens and the earth; and those who disbelieve in the revelation of Allah, they are the real losers.

Life on earth is more than just surviving and consuming food. While there may be a notion of "living to eat and enjoy," Islamic philosophy holds that our purpose for being on earth is different. To get to Jannah, our ultimate goal in the hereafter, we must meet a certain requirements. And for that reason each and every man was made. For us, our worldly existence is like an exam, which we must pass by adhering to Islamic shariah rituals and fulfilling our obligations to Allah.

Thus, nature helps humans to survive on this planet, and occasionally nature even intervenes to assess whether or not humans are treating and using it appropriately. In this sense, the environment, in all of its components, is highly useful and undoubtedly exists for a purpose. Even though we are unable to fully understand the purpose behind some creations, no matter how big or tiny, the Islamic precept "Allah is the Creator of all things, He is the guardian of our all affairs" obliges us to state this in this particular context. The keys to the earth and the heavens belong to Him, and the people who reject Allah's revelation are the ones who stand to lose the most.

In terms of solution to overcome high income inequality, protecting the wealth shows attention to social justice, sustainable development, and narrowing the gap between the rich and the poor. In QS. Surah Al-A'raf [7:128]; Al-Ĥadīd [57:5]; and Al-Baqarah [2:29] stated that the earth and the universe belong to Allah SWT. The Qur'an also motivate people to work and make money for the purpose of seeking rewards in the hereafter (Al-`Ankabūt [29:64]), and asks people to set aside a portion of their wealth for zakat and give donation to reduce the the gap between the poor and the rich [An-Nūr[24:37]; Ar-Rūm [30:39]; Adh-Dhāriyāt [51:19; Al-Ma`ārij [70:24-5]). Furthermore, usury (*riba*) is not allowed and trade is permitted (Al-Baqarah [2:275-9]).

Income inequality is the differences in wealth and income distribution amongst individuals in the economy. The reason for income inequality within a country is because economic growth is not equally shared, and it also caused by industrialization where there are differences in wages (Checchi, 2000 and World Bank, 2014). Equity according to Chapra (2009, 2016) means equal opportunity to succeed, earn an income and fairer distribution of resources. In his view, Islamic economics (IE) is the solution to income inequality and assurance to environmental sustainability. However, he admits that the practical aspect of IE, namely Islamic banking and finance (IBF), compromised such principal and foundational teachings. Siddiqi (2014) even admitted that IE is not possible if IBF continues with the replication of conventional economic, banking and finance practices.

However, the idea that IE has the potential to impart change with its maqāṣidic vision remains intact. The pursuit of genuine IE development with a purposive maqasid orientation would render extant practices irrelevant, reduce inequality, improve environmental quality and so contribute to the SDGs agenda. Hassan et al. (2021) appraised such an approach to sustainable IBF growth and development.

Increasing income inequality threatens developing countries depending on its permanent or temporary effect. If the impact is permanent, high-income inequality could cause social tension and disruptions

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to peace and order for long-term. Hence, it will harm growth and disrupt strategy for poverty alleviation. If the impact of income inequality is temporary, then its detrimental effects will have happened in the short-term.

Furthermore, rising income inequality is related with more resource consumption and more waste generation. When income inequality is increasing, the poor are getting poor because they produce more pollution and they depend on natural resources for cash and food. Moreover, they have no choice to use low-cost fuels that produce more carbon emission. Meanwhile, the rich are getting richer and they produce more pollution but bear less responsibility for the corresponding pollution cost. The rich invest their wealth in leading industries to achieve higher return and ignoring the environmental quality. Thus, a greater income gap contributes to more significant environmental degradation, which means a positive relationship exists between income inequality and environmental degradation.

Environmental degradation becomes the centre of attention because it embraces all aspects of socio-economic in the modern world. There are many factors caused environmental degradation namely high consumption, income inequality, natural disaster and climate change. Many works report that there is a strong association between income inequality and environmental degradation. Most of them explain how reducing income inequality can improve environmental quality and strengthen environmental sustainability.

As mentioned in previous section, Chapra (2009, 2016) viewed that Islamic economic is the solution to overcome income inequality and maintain the environmental quality. Through the practice of maqasid shariah issues of high income inequality and environmental degradation could be solved. The core of maqasid shariah is to recommend good deeds and avoiding bad things or getting manfa'at and rejecting the mudharat or gain the maslahat (benefit). Islam teaches equitable distribution of wealth in the society, groups of people who have excess of wealth are obligatory to distribute part of their property to other groups who are lack of possession to avoid accumulation of wealth that is only circulated in particular groups of people. One of instrument for wealth distribution is zakat. As a form of guidance arranged in Islam, there is a wisdom contained behind the obligation of zakat.

On the other hand, waqf as a charitable institution in Islam has potential to be utilized as an important instrument for environmental conservation. Nevertheless, waqf for environmental protection has been practiced for quite some time. For instance, in 1885 Ismail Zuhdu Pasa from Istanbul donated cropland, meadow, woods, forestry, and pasture, with a total area of 5,550,000 square meters (UNDP and BWI, 2022). Waqf has a significant role as one of Islamic financial instruments based to support socio-economic welfare. Enhancing green waqf for carbonization technology should be a prioritized program to support green economy. Hence, instruments in Islam such as zakat and waqf provide solution to overcome issue of high income gap among the ASEAN-6 countries and environmental degradation.

METHOD

The current study employs pooled data by combining cross-sectional units of six countries of ASEAN (Indonesia, Malaysia, the Philippines, Thailand, Singapore, and Vietnam) and 24 years from 1992 to 2015. The data were collected from World Development Indicator by the World Bank, United Development Program (UNDP), Our World in data by Oxford University and Standard World Income Inequality Data (SWIID).

We applies bias – corrected Least Squared Dummy Variable (LSDVC) estimation because this method is designed to analyse small time series and small cross-sectional panel data sets (or vice versa). The Monte Carlo simulation conducted by Kiviet (1995) and Judson and Owen (1999) recommended that the bias-corrected LSDV estimation (LSDVC) is more efficient compared to LSDV and GMM in terms of bias and root mean square error for small or moderately large samples.

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Bruno's (2005) study led to the development of biased-corrected Least Squared Dynamic Variable (LSDVC). The study was conducted for unbalanced panel data. The approximation terms were evaluated at the unobserved actual parameter values implying no direct use for estimation. The estimation in Bruno (2005) was obtained from a dynamic LSDV was not meaningful unless they were corrected for bias in small samples. The character of the dependent variable could rely on the past values itself along with a set of independent and control variables. Hence, a dynamic specification of the panel model could be expressed as follow:

$$Y_{it} = \beta_0 + \omega Y_{it-1} + X_{it}\beta + \alpha_i + \varepsilon_{it} \quad (1)$$

Where ω is the coefficient of the lagged value of the dependent variable, while $X_{it}\beta$ is the matrix of explanatory variables and coefficients.

The concept of LSDVC is to derive an accurate approximation of the LSDV bias and then remove it from the LSDV estimator. Hence, the following estimator is plugged into the bias approximation formula while producing bias approximation estimates $\widehat{\beta_i}$ is deducted to derive the corrected LSDV estimator.

$$LSDVC_i = LSDV - \widehat{\beta_i}, \; I=1, 2, \text{and } 3 \quad (2)$$

=There are three natural options for the initial consistent estimator in LSDVC regression, which are Arellano-Bond (AB); Anderson-Hsiao (AH); and the Blundell-Bond system estimator (BB). Firstly, the AB estimator is a GMM estimator for the first difference model that rely on many internal instruments. The second is the AH estimator, which transforms the data into first differences, precludes the fixed effects, and employs the second lags of the dependent variable, either difference or in levels, as an instrument one-time difference lagged dependent variable. Lastly, the BB estimator that predicts the first difference of the instrumental variables is not correlated with fixed effects, and adding the AB estimator by allowing for more instruments and improving the estimates' efficiency.

Modelling the Nexus Between Income Inequality and Environmental Degradation

Environmental degradation (ED) is presented by CO_2 emission or natural resources depletion (NRD). At the same time, income inequality (II) is proxied by Gini coefficient. GDP per capita and GDP per capita squared, PD is population density, and EC is energy consumption.

$$ED_{it} = \beta_1 II_{it} + \beta_2 GDP_{it} + \beta_3 GDP_{it}^2 + \beta_4 PD_{it} + \beta_5 EC_{it} + \beta_6 (GINI_{it}\, x\, GDP_{it}) + \varepsilon_i \quad (3)$$

$$ED_{it} = \omega ED_{it-1} + \beta_1 II_{it} + \beta_2 GDP_{it} + \beta_3 GDP_{it}^2 + \beta_4 PD_{it} + \beta_5 EC_{it} + \beta_6 (GINI_{it}\, x\, GDP_{it}) + \varepsilon_i \quad (4)$$

To observe the short- and long-run relationship between income inequality and environmental degradation, we divide the independent variable's coefficient by one minus coefficient of the lagged dependent variable as stated in equation (4) based on past theory by Bruno (2005). β_1 until β_6 are considered short-run coefficients within the dynamic framework measuring the immediate (within the year) environmental sustainability response.

Long-run coefficients are identified as $\frac{\beta_1}{1-\omega}$ until $\frac{\beta_6}{1-\omega}$, which measure the total adjustment of environmental sustainability. ω – coefficient capture the persistence of the process of environmental sustainability; since $|\omega|$ is the portion of the short-run adjustment that translated to the following year, $|\omega|$ is ranged from 0 to 1, 1 is the maximum of persistence in the dependent variable. Persistence indicates that the dependent variable continues from one year to the next. If the short-run coefficient of lagged dependent is greater than one, the result reflects that the model is unstable, thus, we could not use it to regress the long-run relationship.

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RESULTS AND DICUSSION

Overview of ASEAN-6 Countries

ASEAN is established in 1967 and the finding members consist of Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, and Thailand. In the late 1990s Vietnam, Laos, Cambodia, and Myanmar joined ASEAN. Each member has different economic condition and natural resources. International trade, exports, industrialization, and massive production have been the central to economic development in ASEAN countries. This condition has led to production and consumption trends that tend to cause polluting and carbon-intensive lifestyle and practice. As a result, high level of CO_2 emission exists in ASEAN-6 countries.

Fifth ASEAN State of Environment Report (SOER5) reported CO_2 emission in ASEAN-6 countries is predicted to increase 61% from 2014 to 2025. The increment of CO_2 emission every decade affected by the population health in ASEAN-6. Other than that, natural resources depletion (NRD) such as deforestation, land clearing, and agricultural expansion could lead to many impacts on soil, water, environment as well as human health, and livelihoods. With high-income inequality and environmental degradation in ASEAN countries within the period of 1992 – 2015 is challenging for the ASEAN-6 members to implement environmental sustainability and save ASEAN from environmental degradation as part of ASCC (ASEAN Socio-Cultural Community) Blueprint 2025.

Indonesia is country with populated Muslim country followed by Malaysia. Although the remaining countries in ASEAN-6 members are Muslim minority countries, it is possible to implement Islamic instruments in their countries to overcome high income inequality and environmental degradation. One of example for development of Islamic instrument in ASEAN-6 country is the implementation of halal industry in Thailand. Nurrachmi (2019) stated that Thailand is a country with Muslim minority population, however the country has developed their halal sector through boosting its export through halal food products and the country has exported halal food to 57 OIC countries.

The Nexus Between Income Inequality and Environmental Degradation

Prior analysing the result, diagnostic tests such as descriptive statistic, unit roots and correlation coefficient were conducted to check the data reliability and biasness. The result shows that the data suitable to the next analysis for regression. The statistics of diagnostic tests are available in the appendix.

LSDVC test utilized Arellano−Bond (AB) system estimators and the standard errors are bootstrapped with 500 repetitions. The method uses lagged dependent variable as an explanatory variable to measure the relationship between the present and past of the dependent variable in the model. Result of Table 1 suggests that the dynamic specification of lagged CO_2 emission ($CO_{2\,it-1}$) and lagged NRD (NRD_{it-1}) significantly captured the relationship between present and past CO_2 emission and NRD levels as being high in magnitude compared to other variables with a coefficient range from 0.7 to 0.998. The coefficients of lagged dependent variables are significant in all regressions at a 1% significant level. The lagged dependent variables are positive, persistent and in equilibrium condition in ASEAN-6 countries. The persistence of lagged dependent variable implies that the existence of CO_2 emission and NRD persistently give impact on environmental degradation from one year to the next.

The finding of Table 1 indicate that there is a positive and significant impact of GINI on CO_2 at a 10% significance level, meaning that the rising income gap leads to more CO_2 in the short and long run. The result support past studies conducted by Wang et al. (2023), Khan et al. (2022), and Knight et al. (2017). The outcome concludes that income inequality significantly affects the environmental degradation in the short and long run in ASEAN-6 countries.

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Meanwhile, economic growth is positively and significantly impact CO_2 which indicate the more ASEAN-6 countries growth leads to more pollution which supports past studies by Baloch et al. (2017), Ridzuan (2019), Kusumawardani and Dewi (2020), and Prasetyanto and Sari (2021). However, the EKC theory is not existed in the relationship between income inequality and environmental degradation.

All estimations of a dynamic model in Table 1 discover that PD does not have a significant impact on CO_2 and NRD which is against finding from past studies from Baloch et al. (2017). Masud et al. (2018) and Saleem et al. (2018) where there is positive relationship between population density and environmental degradation. In contrast, the finding of all estimators depict that the short-run impact of EC is positive and significant on CO_2 and NRD. The finding emphasized that more energy use increases short-term and long-term environmental degradation. The results support the finding of the previous studies carried out by Xu et al. (2020), Khan et al. (2018) and Ridzuan et al (2017). Green energy resources such as hydropower and low carbon energy are applied by ASEAN-6 countries, however, because household energy demands are high in ASEAN-6 countries, the energy supply leads to high levels of energy pollutants that threaten the sustainability of the environment.

Meanwhile, the impact of interaction term (GINI*GDP) is significantly negatively impact CO_2 with the presence of GINI. The negative effect shows that widening the income gap reduces environmental degradation for countries with high GDP per capita in the short- and long-term. For example, Singapore has the highest GDP per capita among the ASEAN member and there was a big income gap based on the Gini coefficient from 1992 until 2015 above 0.43. With its Green Mark Scheme through Green building to promote resource efficiency and reduce any potential environmental impact in the building environment, Singapore could reduce its CO_2 emission from 1992 to 2015. Thus, the poor could mitigate the use of water and the rich could reduce the use of air conditioners when the weather is hot in Singapore.

Table 1 Result of LSDVC – AB of short-run estimation on environmental degradation

Variable	Short-run				Long-run	
	CO_2 as the dependent variable		NRD as dependent variable		CO_2 as the dependent variable	NRD as dependent variable
	Coeff	P-Value	Coeff	P-Value		
$CO_{2\,it-1}$	0.756***	0.000	-	-		
NRD_{it-1}	-	-	0.7***	0.000		
GINI	26.497*	0.056	-42.26	0.684	108.594	Not significant
GDP	1.972**	0.028	-0.675	0.853	8.082	Not significant
GDP^2	-0.027	0.351	-0.122	0.551	Not significant	Not significant
PD	0.173	0.414	3.021	0.127	Not significant	Not significant
EC	0.006***	0.001	0.024*	0.072	0.025	0.08
GINI*GDP	-3.355*	0.051	3.477	0.781	-13.75	Not significant

Source: Author's regression, 2024.

Note. The bias-corrected LSDV is initialized with AB consistent estimators and the standard errors are bootstrapped with 100 repetitions. *,**,*** indicate significance at 1%, 5% and 10% levels respectively

4.3. The Role of Islam to Overcome High Income Inequality and Environmental Degradation

Issues of rising income inequality and environmental degradation have been challenging for ASEAN. Through blueprint of ASEAN that ended 2025, strong commitment from ASEAN should be done promptly. According to Fifth ASEAN State of Environment Report (SOER5), CO_2 emission in ASEAN-6 countries is predicted to increase 61% from 2014 to 2025. Environmental sustainability is a concept based on maintaining the ecosystem, both renewable and non-renewable resources that benefit human beings and improve their welfare. A human being must be aware that to enjoy and use natural capital throughout the ages and humanity, they must learn to live within the limitations of the

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biophysical environment. Moreover, environmental sustainability must meet current and future generations' needs without compromising the health of ecosystem that provides them.

In Islam, facilitating circulation of wealth is part of important objective of shariah. As a way of transfer the wealth in the community among as many hands as possible without threatening to those who acquired it lawfully. To obtain the objectives of maqasid shariah, Islam has framed the dimension of preserving of faith (*al-din*), preserving of life (*al-'nafs*), preserving of intellect (*al-'aql*), preserving of dignity (*al-'ird*) and preserving of property/wealth (*al-mal*) through charity, generosity, and philanthropy.

ASEAN must collaborate with each country to overcome income gaps between the rich and the poor. The poor in rural area is self-sufficiency rely on their daily need and cash from natural resources. Jointly, low income household have to live in the slum areas or informal settlement in the urban because they cannot afford to pay rental fee. Inefficiency facilities and poor sanitation cause them to throw household trash in the river or sea which damages the environment.

The appropriate policies to improve low income household in the rural areas or people who live in the slum areas are 1) increase the number of affordable housing units as cheap flats particularly in urban areas, 2) campaign or improve socialization government about caring for the environment to make it more attractive especially in people in rural areas where they depend their daily need and cash from forest, 3) promote green tourism for urban people to visit villages and forest as a way for distribution of income from urban area to rural areas.

Funding should not be the drawback to implement these policies. There are many ways to reduce high income inequality and attain environmental quality through distribution of zakat, crowd funding based on Islamic values, implementation of green waqf or forest waqf and green investment as stated in Figure 1. Further explanation are provided as follow:

Distribution of zakat

Distribution of zakat aims to reduce income gap between the poor in the rural area and the rich in the urban area. Distribution of wealth provides incentive for the poor to reduce their dependency on natural resources. As a result, the environmental quality can be sustained.

Crowd funding based on Islamic value

Issue of lack of infrastructure in the rural area caused the poor have difficulty to find source of income. Road building is one way to reduce the income inequality between the rich and the poor because the poor have better access for them to find source of income for their daily need. Through crowd funding for building road in the rural from the rich in the urban area will assist the poor, and funding can be allocated promptly.

Implementation of green waqf or forest waqf

Green Planning strategy has been implemented by government in ASEAN countries through replanting trees and campaign for renewable energy. However the planning required annual budgeting and the program will end soon. If ASEAN-6 countries apply green waqf or forest waqf as a way to achieve environmental sustainability, the government does not have to worry for budget allocation. Waqf forest is a forest developed on waqf land and has been implemented in Indonesia to maintain the environment. Based on a study by Jannah et al. (2021), waqf forest could provide biodiversity increment, forest health, forest production and contribute to social and economic development benefits. Hence, the poor could mitigate their dependence on natural resources for daily needs and the rich could use their income for forest production that contributes to society.

Green investment

Investors should consider investing for programs that related to renewable energy, energy efficiency, solid waste management, liquid waste management, alternative energy, fire burnt brick, non-fire block

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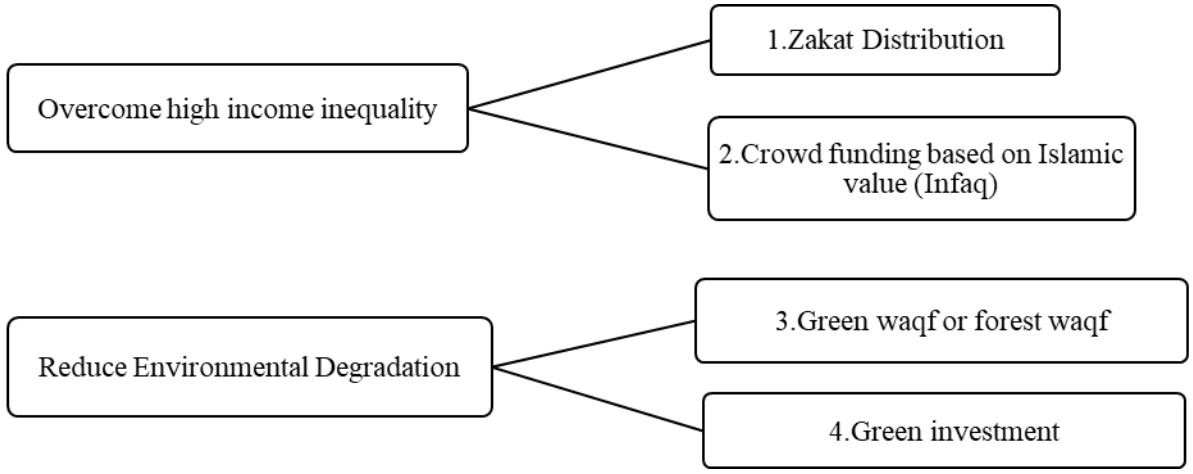
brick, recycling and recyclable product, green industry, safety and security of factories and miscellaneous. Collaboration between the shariah scholar, environment analysis, investor management, government, community, and academician on green investment can enhance the development of shariah green investment.

Indonesia and Malaysia launched its first green Islamic bond to finance sustainable climate resilient growth in the countries. Green sukuk issued in 2017 and the popularity has increased ever since. Investment in renewable energy as sources of clean energy meet the energy needs in a sustainable way, and the project is funded by green sukuk. The issues of high cost of initial installation, underdeveloped technological infrastructure and insufficient financial have been solved through green sukuk investment. Hence, through these activities the objective of shariah and environmental sustainability can be achieved.

These activities could reduce dependable of rural people on environment and increase awareness for urban people or high income household to care more on environment. Furthermore, the biggest contribution to maintain the environment is the effect of human beings. Human beings want to exist in this earth and there is a priority to protect the natural resources and environment. Hence, the protection for environment should not be the government's responsibility alone but also local people and leaders should be encouraged to provide a dedicated effort to eliminate the environmental problems.



Source: Author's analysis, 2024.

Figure 1 Islamic instrument to overcome high income inequality and environmental degradation

In Islam, all activities undertaken are not only to full fill material needs and want but also more importantly it should be undertaken to full fill religious obligations and to achieve non-material objectives such as reduce the income gap between the rich and the poor, and maintain the environmental quality. For ASEAN community, every activity should achieve shariah objectives that can benefit and provide food protection for the communities' property, wealth, environment and human beings.

CONCLUSION

ASEAN-6 countries are multi ethnic and rich in natural resources. 64% of Muslim populations are located in ASEAN nations. The study aims to investigate the nexus between income inequality, environmental degradation, economic growth (GDP), population density and energy consumption for countries in ASEAN-6 in the short and long run applying data within the period of 1992 – 2015. It also provide analysis from Islamic perspective based on result of the econometric regression.

For data analysis, the selection of models is made. The study chooses models which are suitable for small sample panel data with N=6 and T=24. The study selects a panel data technique suitable for

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small samples where GMM is not applicable efficiently. The model could capture the effects of economic reform on the estimation that are not instantaneous but rather lagged. The study adopts the biased–corrected LSDV (LSDVC) for robustness check. To support Gini coefficient as a measurement of income inequality.

The outcomes indicate that the lagged dependent variables for both models are positive, persistent and in equilibrium condition in ASEAN-6 countries. The persistence of lagged dependent variable implies that the existence of CO_2 emission and NRD persistently give impact on environmental degradation from one year to the next. Furthermore, the result shows that the relationship between income inequality and environmental degradation is significant in the short and long run in ASEAN-6 countries. At the same time, in the short and long run there is positive relationship between economic growth and CO_2 emission, which depicts that the more ASEAN-6 countries developed leads to more pollution produces.

The finding also indicates that the short-term and long-term EKC theory is not existed. Meanwhile, all estimations of a dynamic model depict that population density did not contribute to the changes of environmental degradation. In contrast, the finding indicates that more energy use increases short-term and long-term environmental degradation in ASEAN-6 countries. The interaction term (GINI*GDP) shows that widening the income gap reduces environmental degradation for countries with high GDP per capita in the short- and long-term.

SDG's agenda that end in 2030 and ASCC (ASEAN Socio-Cultural Community) Blueprint 2025 can be achieve promptly if the ASEAN community willing to apply Islamic instrument such as zakat and waqf in its policies. Moreover, through distribution of zakat, crowd funding from Islamic values, green waqf and green investment, the government does not have to worry about budget allocation that should be set annually.

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APPENDIX

Table 1 Descriptive statistics of variables on environmental degradation model

Variables in raw data	Obs	Mean	Max	Min	Std. Dev.
CO_2 (in metric tonnes)	144	3.996	18.121	0.297	3.93
NRD (in %)	144	2.793	7.83	0.00000098	2.25
GINI (in coefficient)	144	0.435	0.479	0.388	0.026
GDP (in US$)	144	9243.155	52785.31	476.776	13588.32
PD (in people in square km)	144	1199.522	7806.77	57.869	2332.087
EC (in %)	144	6.058	28.93	-12.405	6.167

Note. obs. = total observations; mean = mean of the overall sample; std. dev = standard deviation from the overall sample.

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Table 2 Results of panel unit root tests of variables in the environmental degradation model

Variable	Level							
	Levin, Lin & Chu (LLC)		Im, Pesaran and Shin (IPS)		ADF - Fisher Chi-square		PP - Fisher Chi-square	
	stat	P-Value	stat	P-Value	stat	P-Value	stat	P-Value
CO_2	-1.806**	0.035	0.084	0.533	8.537	0.742	17.555	0.130
NRD	-1.655**	0.049	-1.781	0.037	25.237	0.014	87.038***	0.000
GINI	-0.774	0.220	2.251	0.988	24.015**	0.020	51.907***	0.000
GDP	-1.309*	0.095	-1.312*	0.095	22.616**	0.031	17.008	0.149
PD	-1.017	0.155	2.112	0.983	19.715*	0.073	3.176	0.994
EC	-5.359***	0.000	-4.45***	0.000	42.793***	0.000	198.1***	0.000

Variable	First Difference							
	Levin, Lin & Chu t*		Im, Pesaran and Shin W-stat		ADF - Fisher Chi-square		PP - Fisher Chi-square	
	stat	P-Value	stat	P-Value	stat	P-Value	stat	P-Value
CO_2	-4.55***	0.000	-5.11***	0.000	48.377***	0.000	95.475***	0.000
NRD	-2.122**	0.017	-5.74***	0.000	54.694***	0.000	126.599***	0.000
GINI	-3.01***	0.001	-4.21***	0.000	28.572***	0.005	53.897***	0.000
GDP	-4.52***	0.000	-3.9***	0.000	35.856***	0.000	109.361***	0.000
PD	-10.7***	0.000	-10.9***	0.000	108.685***	0.000	18.768*	0.094
EC	-9.5***	0.000	-10.1***	0.000	89.878***	0.000	804.822***	0.000

Note. P values indicate that ***p<0.01, **p < 0.05, and *p<0.1

Table 3 Correlation coefficient in environmental degradation (CO_2 as dependent variable)

Variable	CO_2	GINI	GDP	PD	EC
CO_2	1				

GINI	0.268***	1			
	(0.0012)	-----			
GDP	0.922***	0.273***	1		
	(0.000)	(0.0009)	-----		
PD	0.407***	-0.099	0.629***	1	
	(0.000)	(0.236)	(0.000)	-----	
EC	-0.155	-0.172**	-0.199**	-0.031	1
	(0.0637)*	(0.0391)	(0.0169)	(0.7127)	-----

Note. P values indicate that ***p<0.01, **p < 0.05, and *p<0.1

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Table 4 Correlation coefficient in environmental degradation (NRD as dependent variable)

Variable	NRD	GINI	GDP	PD	EC
NRD	1				

GINI	-0.534***	1			
	(0.000)	-----			
GDP	-0.444***	0.273***	1		
	(0.000)	(0.0009)	-----		
PD	-0.594***	-0.099	0.629***	1	
	(0.000)	(0.236)	(0.000)	-----	
EC	0.107	-0.172**	-0.199**	-0.031	1
	(0.2006)	(0.0391)	(0.0169)	(0.7127)	-----

Note. P values indicate that ***p<0.01, **p < 0.05, and *p<0.1

Table 5 Variance Inflation Factor (VIF) in the environmental degradation

	CO2 as the dependent variable		**NRD as the dependent variable**	
Variable	**Coefficient Variance**	**Centered VIF**	**Coefficient Variance**	**Centered VIF**
Constant	0.217	NA	3.001	NA
GINI	1.211	1.254	16.779	1.254
GDP	0.001	2.105	0.013	2.105
PD	0.001	1.922	0.008	1.922
EC	0	1.065	0.0003	1.065

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