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**ASEAN zöld gazdaság és fenntarthatósági gyakorlat index 2022-ben: A
Quintuple Helix megközelítés
ASEAN Green Economy and Sustainable Practices Index in 2022:
Quintuple Helix Approach**

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Table of Contents

INTRODUCTION	1
1. LITERATURE REVIEW	4
1.1 THE CONCEPT OF GREEN ECONOMY	4
1.2 THE DEFINITION OF SUSTAINABLE PRACTICES	6
1.3 QUINTUPLE HELIX MODEL	9
2. METHODOLOGY	11
2.1 INDICATORS	11
2.1.1 Education: Student-Teacher Ratio	12
2.1.2 Economy: GDP Per Capita.....	12
2.1.3 Political: Government Effectiveness	12
2.1.4 Social: Income Inequality.....	12
2.1.5 Environmental: Carbon Emission Per Capita.....	13
2.2 COMPOSITE INDEX CALCULATION	13
2.3 ANALYSIS METHODS.....	14
3. RESULTS	15
3.1 EDUCATION: STUDENT-TEACHER RATIO	15
3.2 ECONOMY: GDP PER CAPITA.....	15
3.3 POLITICAL: GOVERNMENT EFFECTIVENESS	16
3.4 SOCIAL: INCOME INEQUALITY	17
3.5 ENVIRONMENTAL: CARBON EMISSION PER CAPITA	17
3.6 COMPOSITE INDEX	18
4. DISCUSSIONS.....	19
4.1 RANKING	19
4.2 NORMALITY TEST	20
4.3 CORRELATIONS.....	21
4.3.1 Correlation between the Overall Index with Environmental Outcome	21
4.3.2 Correlation between Government Effectiveness and Composite Index for Green Economy and Sustainability Practices	23

4.3.3 Correlation between Income Inequality and Composite Index for Green Economy and Sustainability Practices.....	24
4.3.4 Correlation between GDP per Capita and Carbon Emission per Capita in ASEAN Countries	25
4.3.5 Correlation between Student-Teacher Ratio and Composite Index for Green Economy and Sustainability Practices.....	26
4.4 COMPARISON	27
5. CONCLUSIONS.....	28
BIBLIOGRAPHY	29

List of Figures

FIGURE 1: THE REPRESENTATION OF SUSTAINABILITY IN THREE INTERSECTS	7
FIGURE 2: THE QUINTUPLE HELIX MODEL AND ITS FUNCTIONS	11
FIGURE 3: ILUSTRATION OF GREEN ECONOMY AND SUSTAINABLE PRACTICES INDEX	13
FIGURE 4: THE VISUALIZATION OF THE RANKING	19
FIGURE 5: CORRELATION BETWEEN OVERALL INDEX AND ENVIRONMENTAL OUTCOME ..	22
FIGURE 6: CORRELATION BETWEEN GOVERNMENT EFFECTIVESNESS AND SUSTAINABLE PRACTICES IN ASEAN COUNTRIES	23
FIGURE 7: CORRELATION BETWEEN INCOME INEQUALITY AND SUSTAINABLE PRACTICES IN ASEAN COUNTRIES	24
FIGURE 8: CORRELATION BETWEEN GDP PER CAPITA AND CARBON EMISSION PER CAPITA IN ASEAN COUNTRIES	25
FIGURE 9: CORRELATION BETWEEN STUDENT-TEACHER RATIO AND SUSTAINABLE PRACTICES IN ASEAN COUNTRIES	26
FIGURE 10: COMPARISON OF ASEAN COUNTRIES GREEN ECONOMY AND SUSTAINABLE PRACTICES.....	28

List of Tables

TABLE 1: STUDENT-TEACHER RATIO NORMALIZED VALUE.....	15
TABLE 2: GDP PER CAPITA NORMALIZED VALUE	16
TABLE 3: GOVERNMENT EFFECTIVENESS INDEX NORMALIZED VALUE	16
TABLE 4: GINI RATIO NORMALIZED VALUE.....	17
TABLE 5: CARBON EMISSION PER CAPITA NORMALIZED VALUE	18
TABLE 6: COMPOSITE INDEX VALUES.....	18
TABLE 7: RESULTS OF NORMALITY TEST	20

Introduction

The Association of Southeast Asian Nations (ASEAN) is a vibrant, diverse region made up of ten countries: Thailand, Brunei, Myanmar, Laos, Indonesia, the Philippines, Singapore, Vietnam, Cambodia, and Malaysia (ASEAN, 2024). ASEAN, which was founded in 1967 and is well-known for its wide cultural, linguistic, and religious diversity, has grown to be a significant force in the world economy (HV et al., 2014). The area has had exceptional economic growth in recent decades due to their innovation areas, industrial parks, and expanding populations (Rusiadi et al., 2024). Nonetheless, there are substantial environmental consequences associated with this quick development, especially their economic growth is tied closely with the use of natural resources both for their own use and export commodity (ibid).

In contrast to the 2% average in OECD nations, natural capital (resources including forests, water, biodiversity, and ecosystems) plays a significant role in the economy of ASEAN member states (Steele et al., 2021). However, the very resources that underpin the economic prosperity of ASEAN are running out quickly (ibid). In the absence of a transition towards more sustainable development, the area faces the danger of irreversibly harming its ecology (ibid). The ASEAN countries must embrace more environmentally friendly and sustainable practices in order to continue economic development, lower poverty rates, and raise living standards.

The purpose of this study is to create an ASEAN Green Economy and Sustainability Practices Index. In order to do this, the research will make use of the Quintuple Helix Model, a comprehensive framework that unites the following important sectors: economy (economic capital), politics (political and legal frameworks), media and civil society (social and informational capital), education (human capital), and environment (natural capital). This approach emphasizes the value of innovation, knowledge, and cross-sector collaboration in tackling environmental concerns, making it particularly pertinent for studying green transitions.

Elias G. Carayannis and David F.J. Campbell co-developed the Quintuple Helix Model in 2010, which is a ground-breaking paradigm for comprehending how innovation systems can tackle difficult social issues. The Quintuple Helix developed from the Triple Helix Model, which was originally centered on the relationships between government, business, and academia (Carayannis & Campbell, 2010). It added civil society (as did the Quadruple Helix) and, most importantly, the environment (ibid). This development acknowledged the environment's and sustainability's rising influence on innovation and knowledge creation (ibid). Because of this, the model has become a very useful tool for examining sustainable practices and the green economy, especially in varied and quickly emerging areas like ASEAN.

Since it encompasses every important aspect of sustainable development, the Quintuple Helix Model is the most effective instrument for creating the "Green Economy and Sustainable Practices Index" in ASEAN. With the environment, academics, business, government, and civil society all included in its framework, the model provides a holistic approach to dealing with the social and ecological aspects of transitions to a green economy. The Quintuple Helix offers a flexible and adaptive framework in a region as diverse as ASEAN, where political systems, economic priorities, and environmental challenges differ substantially. The model's focus on socio-ecological transitions is crucial for the ASEAN area, where the need for more sustainable governance structures has become urgent and natural capital is a major driver of economic growth (Rusiadi et al., 2024).

The European Union (EU) through its European Commission is one organization that has effectively used the Quintuple Helix Model, utilizing it to unify sustainable development policies among its member states (Franc & Karadžija, 2019). United Nations (UN) through United Nations Educational, Scientific and Cultural Organization (UNESCO) also directs its education for sustainable development initiatives utilized by this model (König et al., 2020). Although ASEAN has not yet completely incorporated this approach into its frameworks for policy, so far, there is only a research about ASEAN (not fully member states) utilizing triple and quadruple helix model by Afzal et al. in 2018. In contrast to the more tightly bound EU, ASEAN functions as a loose alliance of countries with various forms of government, making it harder to bind the regulation. ASEAN rarely has strong binding regulations toward its member states, they believe that each member states has a full sovereignty. Unlike EU that in some occasions represent the countries, ASEAN does not have that leverage power. This is why making a separate index for each ASEAN member state utilizing Quintuple Helix Model is important to highlight the differences of green economy initiatives and sustainable practices of each member state.

The creation of this index will give decision-makers, corporations, and other interested parties a comprehensive picture of each ASEAN nation's position with regard to sustainable development. In the end, the index will be a useful instrument to direct the area's transition to a greener, more sustainable future, guaranteeing that economic expansion is robust and in line with environmental requirements.

Based on the background explained above, this is the research hypothesis **“ASEAN countries with higher scores in Green Economy and Sustainable Practices index are likely to show better environmental outcomes, proven by the less carbon emission per capita”**. This leads to key questions about the role of governance, social equality, education, and economic growth in driving sustainability. First, the study asks: **Is there a positive link between government effectiveness and sustainable practices** in ASEAN countries? Strong governance is often seen as a cornerstone for successful environmental policies, and this research aims to explore how effective governments are in leading green initiatives. Another question the study explores is whether **countries with lower income inequality perform better in sustainability**. The idea here is that societies with more equal distribution of wealth may be more inclined to support and implement sustainable practices, ensuring that everyone benefits from green initiatives. In addition, the relationship between economic wealth and environmental responsibility is examined by asking: **How does GDP per capita relate to environmental practices, specifically carbon emissions per capita?** This is crucial for understanding whether wealthier countries in ASEAN are balancing economic growth with efforts to reduce their environmental impact. Finally, the study looks at the role of education, asking whether there is a connection between the **student-teacher ratio and a country's performance in sustainable practices**. Education is key to raising awareness about sustainability, and this question seeks to uncover how a strong education system might influence a country's commitment to green initiatives. By exploring these questions, the research aims to provide a clearer picture of what drives sustainable development in ASEAN countries and what factors might need greater attention for a greener future.

1. Literature Review

1.1. The Concept of Green Economy

The concept of Green Economy (GE) has emerged as a crucial framework aimed at balancing economic growth with environmental sustainability (Houssam et al., 2023). It addresses the urgent need for countries to balance their ambitions for economic growth with the preservation of natural resources and environment (Latif et al., 2023). This review critically evaluates the development and implications of the GE concept, as well as the challenges it faces.

The roots of the Green Economy can be traced back to Pearce et al.'s *Blueprint for a Green Economy* in 1989, which laid the groundwork for understanding how economic systems might take environmental concerns into account (Merino-Saum et al., 2020). Despite its foundational status, this document does not provide a clear definition of GE, leading to subsequent interpretations and developments by scholars like Jacobs in 1991, who differentiated GE from political ideologies and traditional environmental economics (ibid).

The GE gained renewed attention during the global financial crisis of 2008, highlighting the inadequacies of existing economic policies that failed to address systemic vulnerabilities (ibid). This crisis underscored the necessity of integrating a green perspective into economic strategies, prompting organizations like the United Nations Environment Programme (UNEP) and the OECD to explore sustainable economic frameworks (Houssam et al., 2023). Their work gave rise to the notion of green growth, which aims to foster economic innovation while safeguarding natural assets and services (ibid).

The GE is defined by its three pillars: environmental sustainability, social equity, and economic development (Mangukiya & Sklarew, 2023). This triad reflects the principles of sustainable development, with an emphasis on enhancing human well-being and reducing ecological risks (ibid). However, the GE concept often struggles with practical implementation (ibid). While it is intended to improve quality of life through social equity and economic growth, the mechanisms to achieve these goals remain ambiguous and are subject to different interpretations among stakeholders.

Significant institutional momentum for the GE was made by UNEP's Green Economy Initiative and its advocacy for a Global Green New Deal. GE was emphasized as a major focal topic at the 2012 Rio+20 summit (Houssam et al., 2023),

which raised its visibility even higher in the field of international policy. However, despite these initiatives, the operationalization of GE principles has been inconsistent across countries, often limited by political, economic, and social factors.

One of the primary critiques of the GE is its potential to become a catch-all term that lacks specificity, leading to confusion and misalignment in policy implementation (Sun et al., 2024). Critics argue that without a clear framework, GE can be co-opted by industries seeking to greenwash their activities rather than genuinely pursue sustainable practices (ibid). Furthermore, there is concern that the focus on economic growth may overshadow the urgent need for deeper systemic changes that address the root causes of environmental degradation especially in developing countries.

Additionally, there has been doubts about the idea of GE from a number of sources, especially from those who contend that real sustainability cannot be attained within the existing framework of unending economic growth (Fernandes et al., 2021). This perspective advocates for a rethinking of growth itself, suggesting that alternative models, such as the steady-state economy or degrowth, may be more aligned with long-term ecological and social well-being (Charonis, 2021). However, these alternatives are not suitable for developing countries, remembering the need for massive economic growth for them.

While the Green Economy presents a promising framework for reconciling economic and environmental objectives, its implementation remains fraught with challenges. The varying interpretations of GE and green growth, coupled with a lack of clarity in policy execution, risk undermining its effectiveness. Moving forward, it is essential to establish a more coherent and actionable understanding of the Green Economy that prioritizes genuine sustainability over mere economic expansion. Only through such an approach can the GE truly fulfill its potential as a transformative tool for fostering an equitable and sustainable future.

1.2. The Definition of Sustainable Practices

The concept of sustainability, rooted in the Latin word *sustinere*, meaning "to hold up," has evolved into a multifaceted framework that addresses the present needs of society without compromising the future welfare, the welfare of all who become impacted by our actions (Thiele, 2024). This welfare also impacted people who are distant in time or space, as well as other species (ibid). In another scenario, it means that the practices of a country can cause the welfare of another country even if they are a continent apart. Since their practices influence climate change and global warming which affect globally whether you do bad practices or not. Sustainability practices are best practiced when it is a collective action.

Despite its wider ramifications, sustainability is frequently misunderstood to be limited to environmental challenges. Many discussions focus on conserving natural resources or protecting biodiversity, but this narrow focus overlooks the other crucial pillars of sustainability: economic viability and social equity (Purvis et al., 2018). For true sustainability, there must be a balance between environmental stewardship, economic prosperity, and social welfare (ibid). Even when a practice is environmentally sustainable, it cannot be regarded as sustainable in the larger sense if it causes poverty in communities or impedes economic growth.

Purvis et al. (2018) draw attention to a core conflict in the discourse on sustainability. On the one hand, there is an emphasis on maintaining nature in its "pristine" state, while on the other hand, there is a need to address important human challenges such as poverty and economic inequality (ibid). While environmental preservation is vital, it also needs to be combined with social and economic strategy in order to build long-term, mutually beneficial systems. This interdependence is reflected in the popular metaphor of sustainability standing on three pillars: the environment, economy, and society, or the "triple bottom line": profit, people, and planet (ibid).

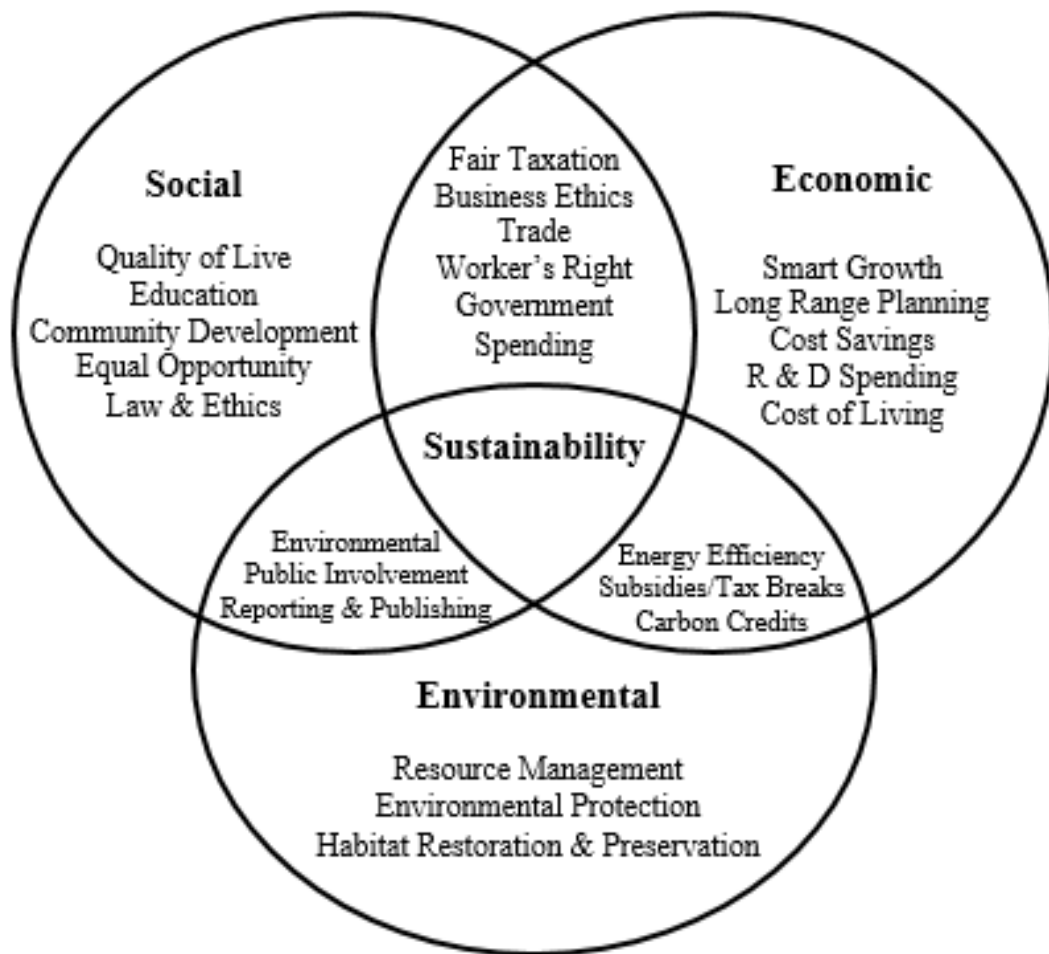


Figure 1: The representation of Sustainability in Three Intersects
Source: Hafizyar et al., 2019

Regarding sustainability practices, there is a debate between weak and strong sustainability that offers insight into the competing priorities of sustainability practice. Advocates of strong sustainability argue for the intrinsic value of nature, insisting that some elements of the natural world are irreplaceable (Ruggerio, 2021). This perspective holds that decision-making should be based on the precautionary principle and that economic growth should not come at the price of degrading ecosystems (ibid). This perspective is frequently in line with environmental movements that place a higher priority on biodiversity preservation and its inherent value over human-centered concerns (ibid).

On the other hand, Ruggerio (2021) explained weak sustainability proponents emphasize the role of economic systems and human progress. Weak sustainability approach believes that nature serves primarily as a supplier of resources and ecosystem services to fuel economic growth (ibid). This approach allows for the substitution of natural capital with artificial or human-made capital, suggesting that technological innovations and market mechanisms can mitigate environmental harm (ibid). In its extreme form, this perspective envisions a highly industrialized planet, where human creativity can offset the degradation of natural systems.

The tension between these two approaches highlights the complexity of sustainability as a concept. Ruggerio (2021) also explained that strong sustainability presents an idealistic view that, while appealing, may be impractical in a world where economic growth is essential for reducing poverty and improving living standards. Conversely, weak sustainability risks commodifying nature, reducing its value to that of a resource base for economic activity (ibid). By prioritizing economic growth over ecological health, weak sustainability may perpetuate environmental degradation and social inequality, particularly in vulnerable regions (ibid).

A critical flaw in both strong and weak sustainability models is their tendency to isolate one pillar of sustainability—either the environment or the economy—at the expense of the others. Strong sustainability, for instance, may neglect the needs of human societies, particularly in developing nations where economic development is crucial for improving living standards (Escobar Cisternas et al., 2024). This approach could lead to policies that are overly restrictive, limiting the ability of nations to leverage their natural resources for economic gain.

Weak sustainability, by contrast, places too much emphasis on economic growth, often at the expense of ecological integrity (Agheli & Taghvaei, 2022). While it acknowledges the importance of sustainability, it tends to view environmental protection as secondary to economic goals (ibid). This model risks perpetuating the very issues sustainability seeks to address, such as climate change and resource depletion. Moreover, it overlooks the fact that environmental degradation disproportionately affects the most vulnerable populations, particularly in developing countries (ibid).

A more balanced approach is needed, one that recognizes the interdependence of economic, social, and environmental systems. Sustainability must be seen as a dynamic process, rather than a fixed goal (Ly & Cope, 2023). It requires flexibility and adaptability, particularly in the face of global challenges such as climate change, biodiversity loss, and growing inequality (ibid). Policies that promote sustainable practices must be designed to ensure that all three pillars—society, economy, and environment—are strengthened simultaneously, rather than in isolation.

However, global cooperation on sustainability issues is often hindered by unequal power dynamics and competing interests. Developed nations, which have historically contributed the most to environmental degradation, often impose sustainability standards on developing nations without considering the economic and social implications for those countries (Zhang et al., 2024). This raises important questions about equity and justice in sustainability practices. For sustainability to be truly global, it must take into account the needs and priorities of all nations.

1.3. Quintuple Helix model

Green Economy and Sustainable Practice mentioned earlier are categorized as a broad framework. For the purpose of evaluating green economy initiatives and sustainable practices in ASEAN countries, the Quintuple Helix Model offers limitations as an analytical framework. The Quintuple Helix Model represents an evolved framework for understanding innovation systems, extending beyond earlier models such as the Triple Helix (university-industry-government relations) and Quadruple Helix (adding media and civil society), by incorporating the dimension of the environment (Carayannis & Campbell, 2010). The Triple Helix approach (Etzkowitz & Leydesdorff, 1998) centers on the creation and application of knowledge within the framework of "university-industry-government relations." A "media-based and culture-based public" is added to the Triple Helix to create the Quadruple Helix (Carayannis & Campbell, 2010).

Scholars such as Barth (2011) and Carayannis and Campbell (2010) have emphasized how this model facilitates the social exchange and transfer of knowledge within a national or regional system. According to Barth (2011), the model effectively addresses the complexity of knowledge application by integrating various subsystems within a state, enabling the resolution of sustainability challenges through interdisciplinary collaboration. Carayannis and Campbell (2010) further highlight the model's emphasis on the interaction between knowledge, innovations, and the environment, underscoring its potential for addressing socio-ecological problems.

One of the key strengths of the Quintuple Helix Model is its interdisciplinary and transdisciplinary nature. Carayannis and Campbell (2010) argue that the model requires engagement across the entire disciplinary spectrum, including natural sciences, social sciences, and the humanities. This broad involvement is essential for fostering collaboration between knowledge producers and users to create innovative solutions for sustainable development (Lavrinenko et al., 2019). The model's five-helix framework suggests that innovation cannot be understood solely within the confines of individual disciplines but requires the integration of multiple fields of knowledge (ibid). Barth (2011) supports this by explaining how the Quintuple Helix promotes interdisciplinary problem-solving, particularly in addressing complex sustainability challenges.

The Quintuple Helix is structured around five key subsystems that reflect the diverse forms of "capital" necessary for sustainable development. Barth (2011) outlines these subsystems: the education system, which generates "human capital"; the economic system, which focuses on "economic capital"; the political system, responsible for "political and legal capital"; and the social and media systems, which combine "social capital" and "information capital." The inclusion of the environment as the fifth subsystem provides the model with a critical ecological dimension (ibid). This subsystem, which embodies "natural capital," is vital for sustainable development because it includes the resources, biodiversity, and ecosystems upon which human survival and prosperity depend (Lavrinenko et al., 2019).

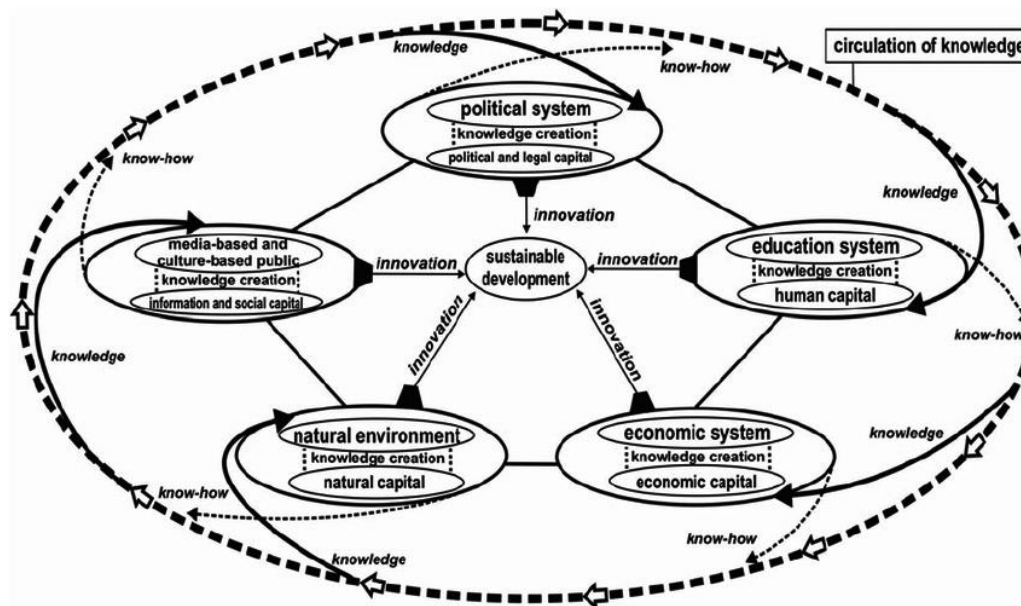


Figure 2: The Quintuple Helix model and its functions
Source: Carayannis et al., 2012

2. Methodology

The research in this study uses a quantitative methodology. The primary goal is to create a composite index of sustainable practices and green economy initiatives for ASEAN countries (Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Viet Nam) by 2022. The year 2022 was chosen because it is the most recent year for which complete data from all ASEAN countries is available. To do this, numerical data from a variety of indicators must be gathered and analyzed. The performance of these countries' green economies will be measured, compared, and ranked using the method mentioned below.

2.1. Indicators

The following indicators have been chosen to evaluate ASEAN countries' efforts in the green economy and sustainable practices that are aligned with the Quintuple Helix Model:

2.1.1. Education: Student-Teacher Ratio

This indicator indicates the quality and accessibility of education by assessing the number of students per teacher in the school system. Better educational outcomes are linked to lower student-teacher ratios because they show more individualized attention for each student, which promotes sustainability and long-term human capital development (Solheim & Opheim, 2019). The ASEAN Secretariat Publication "ASEAN Key Figures 2023" (ASEAN, 2023) is the source of this data on student-teacher ratios for ASEAN countries;

2.1.2. Economy: GDP per Capita

A country's total wealth and economic prosperity are gauged by its GDP per capita (also known as economic capital). It displays both the country's economic potential and the average income of its people. Greater GDP per capita in the context of a green economy might encourage investment in environmentally friendly projects and technology. World Bank Open Data is the source of the GDP per capita for ASEAN countries in 2022 (World Bank, 2023);

2.1.3. Political: Government Effectiveness

The efficacy of government is a crucial determinant of the caliber of public services, policymaking, and initiative execution. This indicator shows how well the government is able to control environmental regulations, establish and implement sustainable policies, and successfully manage resources. TheGlobalEconomy.com is the source of government effectiveness for ASEAN countries in 2022 (Globalen, 2022);

2.1.4. Social: Income Inequality

Income disparity or inequality is a measure of how wealth is distributed in a community. While efforts to promote social cohesion and sustainability might be hampered by high levels of inequality, more equitable income distribution points to a more inclusive and sustainable economy. Data is also taken from the "ASEAN Key Figures 2023" publication published by the ASEAN Secretariat (ASEAN, 2023) using the Gini ratio;

2.1.5. Environmental: Carbon Emission per Capita

This indicator calculates the average annual carbon dioxide emissions that each person in a country produces. One important environmental measure that shows a country's contribution to climate change is its per capita carbon emissions. Reduced emissions are a sign of more environmentally friendly policies and activities that lessen their impact on the environment. The information on the carbon emission per capita in 2022 was obtained from Worldometer (2024).

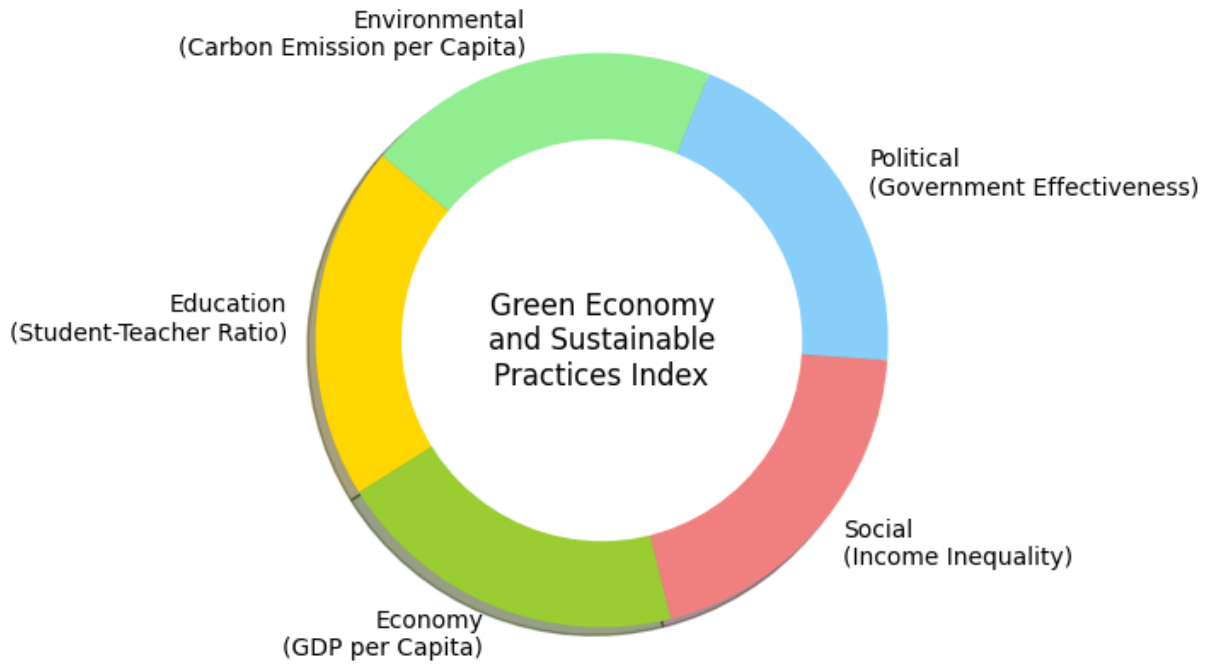


Figure 3: The Illustration of Green Economy and Sustainable Practices Index
Source: Own Compilation

2.2. Composite Index Calculation

The composite index calculation will be calculated by averaging the normalized values of all five indicators (Cherchye et al., 2006). The normalization of the value will be using Min-Max. This approach is essential for combining indicators with varying units and ranges, allowing for an accurate and meaningful composite score (ibid).

The **Min-Max normalization** formula is (ibid):

$$x' = \frac{x - \min}{\max - \min}$$

Where:

x' is the normalized value for each country;

x is the actual value of the indicator for the country;

min is the minimum value in the dataset for the indicator;

max is the maximum value in the dataset for the indicator.

By ensuring that the indicator values are evenly scaled between 0 (which represents the smallest value) and 1 (which represents the greatest value), this procedure makes it possible to compare indicators and countries (ibid). The adjusted values of all five indicators will be averaged to create the composite index for each country after normalization. By employing this Min-Max method, the index reflects the relative performance of each ASEAN country on sustainable practices and green economy initiatives, accounting for differences in the magnitude and units of the data.

2.3. Analysis Methods

In this research, the analysis is done by several methods which are ranking, correlation analysis, comparative analysis. After the composite index is generated by averaging the normalized values of the selected indicators, the ASEAN countries will be ranked based on their composite index scores. This ranking will allow for a clear comparison of country performance across various dimensions of green economy initiatives and sustainable practices.

In addition to the ranking, a deeper analysis is performed on each indicator using correlation analysis. Before the correlation analysis is performed, the normality test is run to determine whether the correlation analysis is based on Pearson Correlation or Spearman Rank Correlation. This will quantify the degree and direction of the linear relationship that exists between the composite index and each indicator. It can be determined how much each component contributes to the overall composite score using Pearson's and Spearman Rank's correlation, which gives us important information about which factors have the biggest effects on sustainability and green economy activities in ASEAN countries.

3. Results

The first step in this research involved calculating the normalization value for each indicators using the Min-Max method. Below are the results of the normalization calculations for each indicator:

3.1. Education: Student-Teacher Ratio

Here are the results of the Min-Max normalization for the student-teacher ratio in the ASEAN countries based on the ASEAN Secretariat Publication "ASEAN Key Figures 2023" (ASEAN, 2023), where the lowest ratio receives a value of 1 (indicating better education quality) and the highest ratio receives 0:

Country	Student-Teacher Ratio	Normalized Value
Brunei Darussalam	10.1	1.00
Cambodia	45.1	0.00
Indonesia	15.1	0.86
Laos	22.0	0.66
Malaysia	12.3	0.94
Myanmar	21.1	0.69
Philippines	27.1	0.52
Singapore	13.8	0.89
Thailand	14.6	0.87
Vietnam	25.1	0.60

Table 1: Student-Teacher Ratio Normalized Value

Source: Own Compilation

This normalization ensures that countries with better student-teacher ratios (lower values) are rewarded with higher normalized values in the final index.

3.2. Economy: GDP per Capita

The second indicator examined in this study is economy. For this purpose, GDP per capita was selected as a key metric, using the most recent data from the World Bank Open Data (2023). Below are the results of the Min-Max normalization for the GDP per capita in ASEAN countries:

Country	GDP per Capita (USD)	Normalized Value
Brunei Darussalam	37,152.5	0.41
Cambodia	1,759.6	0.01
Indonesia	4,787.9	0.04
Laos	2,054.4	0.01
Malaysia	11,993.2	0.12
Myanmar	1,149.0	0.00
Philippines	3,499.1	0.03
Singapore	88,428.7	1.00
Thailand	6,913.1	0.07
Vietnam	4,179.0	0.03

Table 2: GDP per Capita Normalized Value

Source: Own Compilation

The values are normalized between 0 and 1, where Myanmar has the lowest GDP per capita (0.00), and Singapore has the highest (1.00).

3.3. Political: Government Effectiveness

The third indicator focuses on the political dimension, using the Government Effectiveness Index from TheGlobalEconomy.com (2022). Here are the min-max normalized values for the Government Effectiveness Index in the ASEAN countries:

Country	Government Effectiveness Index	Normalized Value
Brunei Darussalam	1.42	0.81
Cambodia	-0.35	0.35
Indonesia	0.44	0.55
Laos	-0.6	0.28
Malaysia	0.99	0.70
Myanmar	-1.68	0.00
Philippines	0.06	0.46
Singapore	2.14	1.00
Thailand	0.13	0.47
Vietnam	0.18	0.49

Table 3: Government Effectiveness Index Normalized Value

Source: Own Compilation

This normalization scales the values between 0 and 1, with higher values indicating better government effectiveness.

3.4. Social: Income Inequality

The fourth indicator focuses on the social dimension, specifically addressing income inequality as measured by the Gini ratio. Data for this indicator was sourced from the ASEAN Secretariat's publication "ASEAN Key Figures 2023" (ASEAN, 2023). Here are the min-max normalization of Gini ratio for ASEAN Countries:

Country	Gini Ratio	Normalized Value
Brunei Darussalam		
Cambodia	0.29	0.00
Indonesia	0.38	0.60
Laos	0.36	0.47
Malaysia	0.40	0.73
Myanmar	0.30	0.07
Philippines	0.44	1.00
Singapore	0.44	1.00
Thailand	0.43	0.93
Vietnam	0.38	0.60

Table 4: Gini Ratio Normalized Value

Source: Own Compilation

The values are normalized between 0 and 1, where Cambodia has the worst income inequality (0.00), and Singapore and the Philippines have the best income distribution within their countries (1.00). Unfortunately, Brunei Darussalam's data is missing.

3.5. Environmental: Carbon Emission per Capita

The final indicator addresses the environmental dimension, focusing on carbon emissions per capita. Data for this indicator, reflecting carbon emissions in 2022, was sourced from Worldometer (2024). Here are the normalized values for this indicator where country with the highest carbon emission per capita receives 0 and country the least carbon emission receives 1:

Country	Carbon Emission per Capita (Ton)	Normalized Value
Brunei Darussalam	20.59	0.00
Cambodia	1.02	0.98
Indonesia	2.48	0.91
Laos	2.66	0.90
Malaysia	8.00	0.63
Myanmar	0.70	1.00
Philippines	1.36	0.97
Singapore	9.46	0.55
Thailand	3.94	0.83
Vietnam	3.29	0.87

Table 5: Carbon Emission per Capita Normalized Value

Source: Own Compilation

This normalization ensures that countries with less carbon emission will be rewarded with more value at the final index because they show positive output.

3.6. Composite Index

Here are the composite index values for Green Economy and Sustainable Practices in the ASEAN countries:

Country	Education	Economy	Politics	Social	Environmental	Index
Brunei Darussalam	1.00	0.41	0.81		0.00	0.55
Cambodia	0.00	0.01	0.35	0.00	0.98	0.27
Indonesia	0.86	0.04	0.55	0.60	0.91	0.59
Laos	0.66	0.01	0.28	0.47	0.90	0.46
Malaysia	0.94	0.12	0.70	0.73	0.63	0.62
Myanmar	0.69	0.00	0.00	0.07	1.00	0.35
Philippines	0.52	0.03	0.46	1.00	0.97	0.60
Singapore	0.89	1.00	1.00	1.00	0.55	0.89
Thailand	0.87	0.07	0.47	0.93	0.83	0.63
Vietnam	0.60	0.03	0.49	0.60	0.87	0.52

Table 6: Composite Index Values

Source: Own Compilation

These values represent the average of the normalized indicators across education, economy, politics, social, and environmental dimensions for each country.

4. Discussions

4.1. Ranking

Here is the ranked list of ASEAN countries based on their composite index for Green Economy and Sustainable Practices:

1. Singapore: 0.89
2. Thailand: 0.63
3. Malaysia: 0.62
4. Philippines: 0.60
5. Indonesia: 0.59
6. Brunei Darussalam: 0.55
7. Vietnam: 0.52
8. Laos: 0.46
9. Myanmar: 0.35
10. Cambodia: 0.27

This ranking reflects the countries' overall performance across the various sustainability indicators.

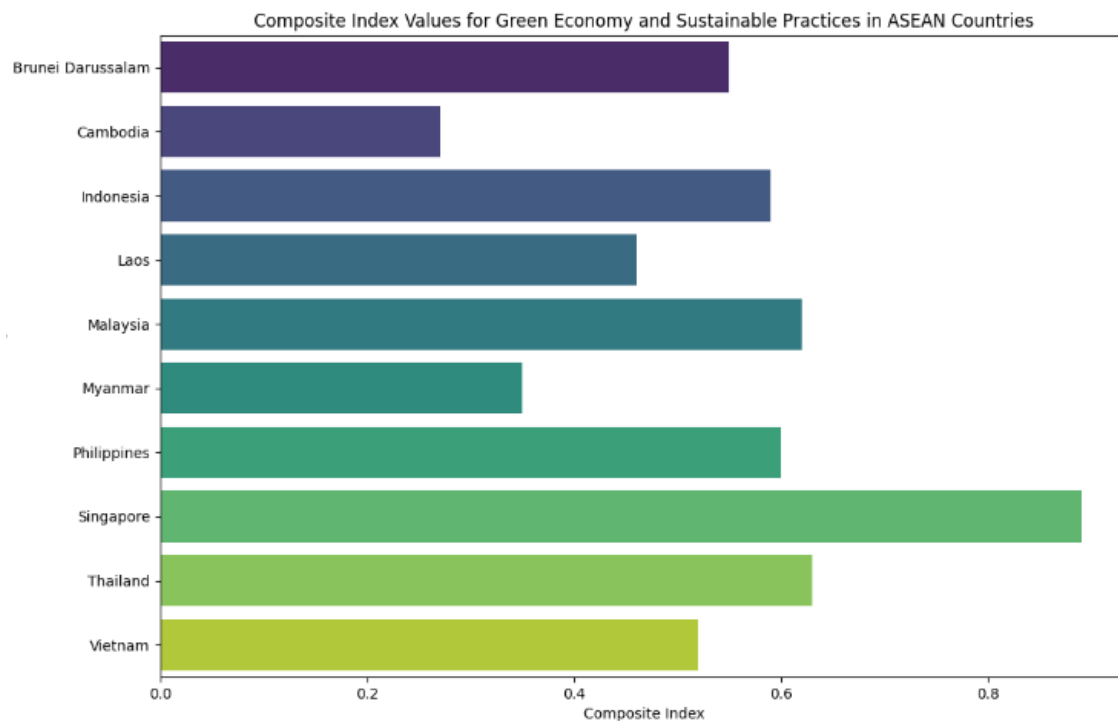


Figure 4: The Visualization of the Ranking
Source: Own Compilation

4.2. Normality Test

The results of normality test for all indicators and the index are as follows:

Indicator	Shapiro-Wilk Test Statistic	Shapiro-Wilk Test p-value	Kolmogorov-Smirnov Test Statistic	Kolmogorov-Smirnov Test p-value
Education	0.843	0.047	0.204	0.728
Economy	0.602	0.000059	0.365	0.105
Political	0.981	0.969	0.145	0.965
Social	0.895	0.224	0.167	0.930
Environmental	0.753	0.004	0.285	0.326
Index	0.943	0.584	0.214	0.674

Table 7: Results of Normality Test

Source: Own Compilation

Based on the results of the normality test, it can be interpreted as follows:

- 4.2.1. Student-Teacher Ratio (Education): Slight deviation from normality as indicated by the Shapiro-Wilk test ($p\text{-value} < 0.05$), while the Kolmogorov-Smirnov test shows no significant deviation. This yields mixed results for normality;
- 4.2.2. GDP per Capita (Economy): Both tests show significant deviation from normality ($p\text{-values} < 0.05$), confirming that GDP per Capita is not normally distributed;
- 4.2.3. Government Effectiveness (Political): No significant deviation from normality observed in either test ($p\text{-values} > 0.05$), suggesting normality for Government Effectiveness;
- 4.2.4. Income Inequality (Social): Neither test indicated a significant deviation from normality ($p\text{-values} > 0.05$), indicating that Income Inequality is normally distributed;
- 4.2.5. Environmental Outcome (Environmental): Mixed results significant deviation in Shapiro-Wilk ($p\text{-value} < 0.05$) but no significant deviation in Kolmogorov-Smirnov—indicating ambiguous normality;

4.2.6. Composite Index for Green Economy and Sustainable Practices (Index): No significant deviation from normality ($p\text{-value} > 0.05$), suggesting normality for the Composite Index.

From the interpretation, it can be concluded that Government Effectiveness, Income Inequality, and Composite Index for Green Economy and Sustainable Practices are categorized as normally distributed and GDP per Capita, Student-Teacher Ratio, and Environmental Outcome are categorized as not normally distributed.

In examining the key relationships within this study, different correlation methods are being used based on the normality of each variable. For the correlation between the Overall Green Index and Environmental Outcome, the Composite Index for Green Economy is normally distributed, while Environmental Outcome is not. Therefore, Spearman Rank Correlation is being used.

For the relationship between Government Effectiveness and the Composite Index for Green Economy and Sustainable Practices, both variables meet the normality assumption, making Pearson Correlation the most suitable method. Similarly, the correlation between Income Inequality and the Composite Index also involves two normally distributed variables, so Pearson Correlation is again appropriate.

In the case of GDP per Capita and Carbon Emission per Capita, both GDP per Capita and Carbon Emission per Capita are non-normally distributed. That being said, Spearman Rank is the best correlation method. Finally, for the relationship between Student-Teacher Ratio and the Composite Index for Green Economy and Sustainable Practices, the Student-Teacher Ratio does not fully meet normality assumptions, whereas the Composite Index is normally distributed. Thus, Spearman Rank Correlation for this pairing best addresses the differences in distribution.

4.3. Correlations

4.3.1. Correlation between the Overall Green Index with Environmental Outcome

Based on the provided data, the correlation between the composite index for Green Economy and Sustainable Practices with carbon emission per capita in ASEAN countries was analyzed to prove whether overall index and environmental outcome has a correlation.

The correlation coefficient between the composite index and carbon emission per capita is approximately 0.636. This indicates a moderate positive correlation, suggesting that higher scores in the Green Economy and Sustainable Practices Index are not strongly associated with lower carbon emissions per capita. The p-value of 0.048 indicates that this correlation is statistically significant at the 0.05 level.

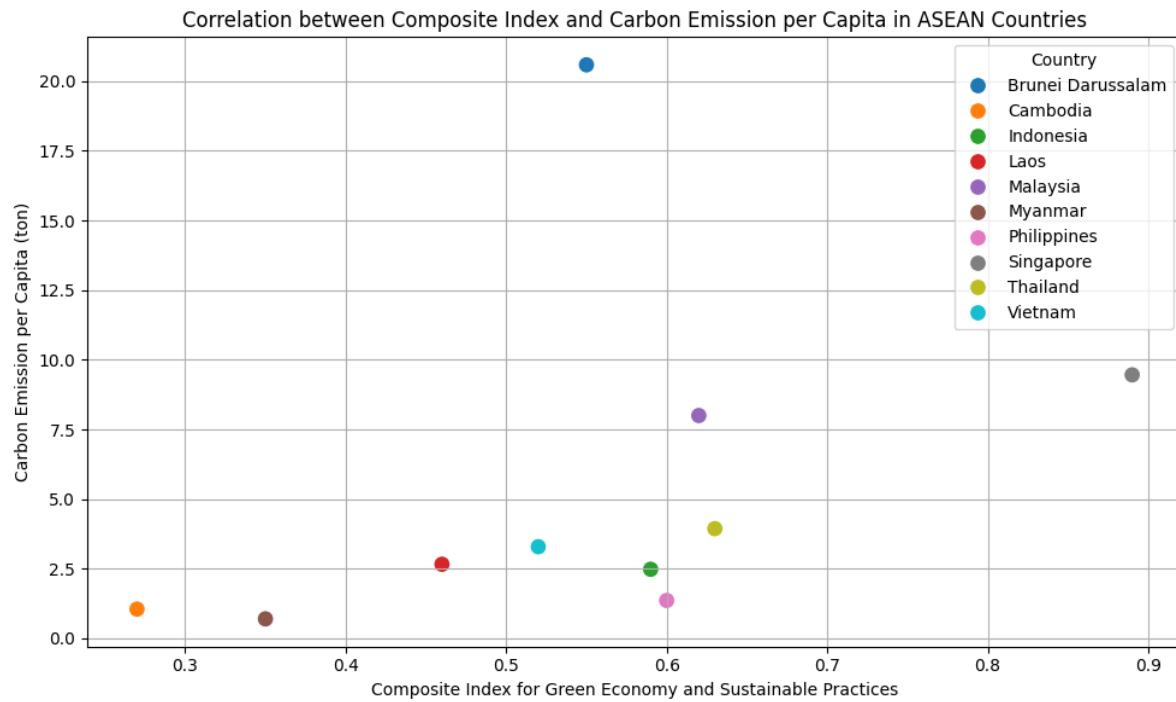


Figure 5: Correlation between Overall Index and Environmental Outcome

Source: Own Compilation

The scatter plot shows a moderate positive correlation between the composite index and carbon emission per capita. Countries like Singapore, with high composite index values, also have relatively high carbon emissions per capita. Countries with lower composite index values, such as Cambodia and Myanmar, tend to have lower carbon emissions per capita.

4.3.2. Correlation between Government Effectiveness and Composite Index for Green Economy and Sustainable Practices

Based on the provided data, there is a positive link between government effectiveness and sustainable practices in ASEAN countries. The correlation coefficient between government effectiveness and the composite index for green economy and sustainable practices is 0.802. This indicates a strong positive correlation. The p-value of 0.005 indicates that this correlation is statistically significant at the 0.05 level.

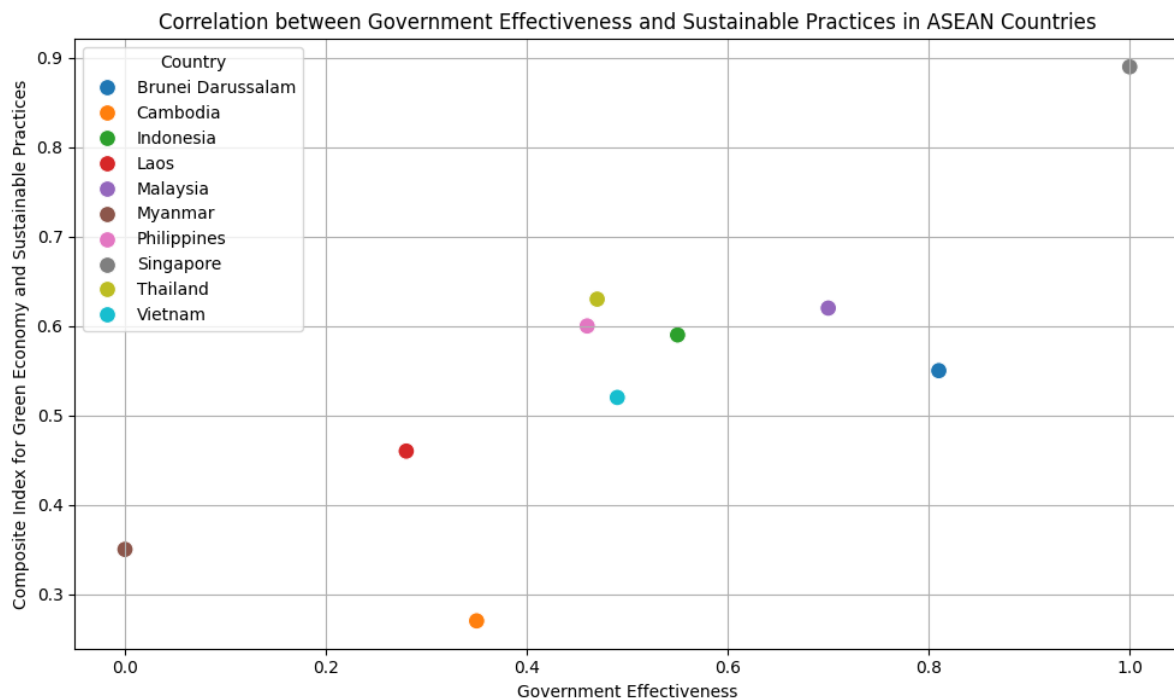


Figure 6: Correlation between Government Effectiveness and Sustainable Practices in ASEAN countries

Source: Own Compilation

Countries like Singapore and Brunei Darussalam, which have higher government effectiveness scores, also tend to have higher composite index values for sustainable practices. Countries with lower government effectiveness, such as Myanmar and Cambodia, generally have lower composite index values. This positive correlation suggests that effective governance plays a crucial role in promoting and implementing sustainable practices within these countries.

4.3.3. Correlation between Income Inequality and Composite Index for Green Economy and Sustainable Practices

Based on the provided data, the correlation coefficient between income inequality and the composite index for green economy and sustainable practices is 0.894. This indicates a strong positive correlation between income inequality (higher values indicating lower inequality) and the composite index. The p-value of 0.001 indicates that this correlation is statistically significant at the 0.05 level.

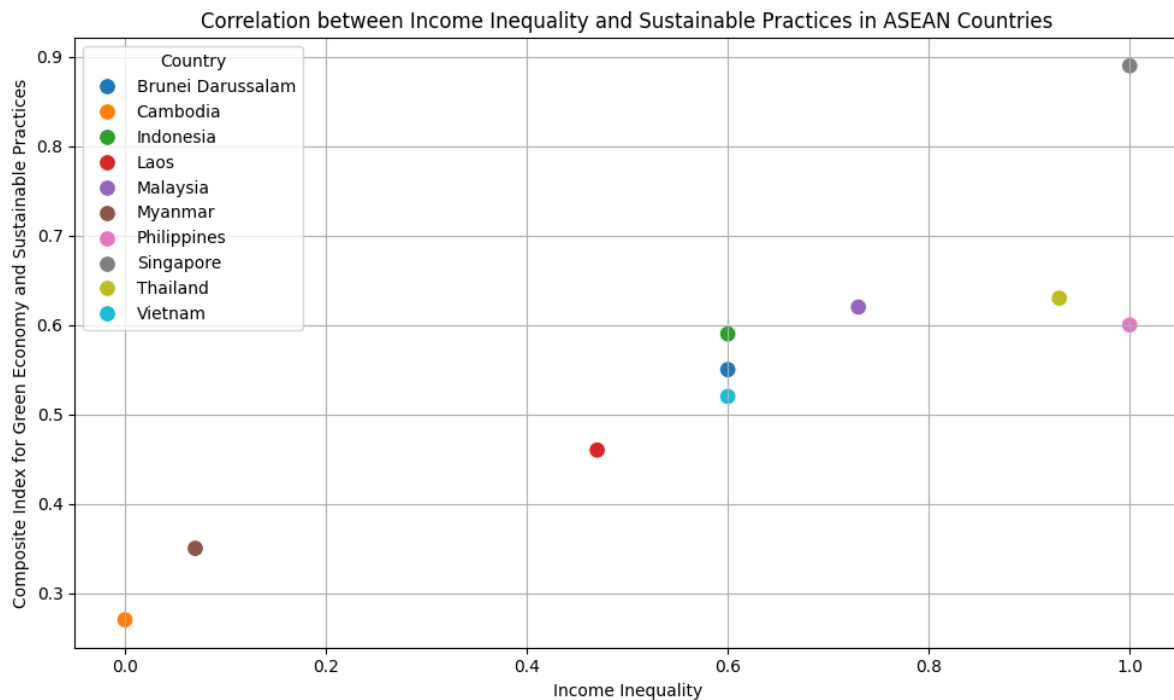


Figure 7: Correlation between Income Inequality and Sustainable Practices in ASEAN Countries

Source: Own Compilation

The scatter plot shows a strong positive correlation between income inequality and the composite index for green economy and sustainable practices. Countries like Singapore and Malaysia, which have lower income inequality, tend to have higher composite index values. Countries with higher income inequality, such as the Philippines and Cambodia, generally have lower composite index values. This analysis suggests that reducing income inequality could positively impact a country's sustainability performance.

4.3.4. Correlation between GDP per Capita and Carbon Emission per Capita in ASEAN Countries

The correlation coefficient between GDP per capita and carbon emission per capita is 0.896. This indicates a strong positive correlation, suggesting that as GDP per capita increases, carbon emissions per capita tend to increase as well. The p-value of 0.0004 indicates that this correlation is statistically significant at the 0.05 level.

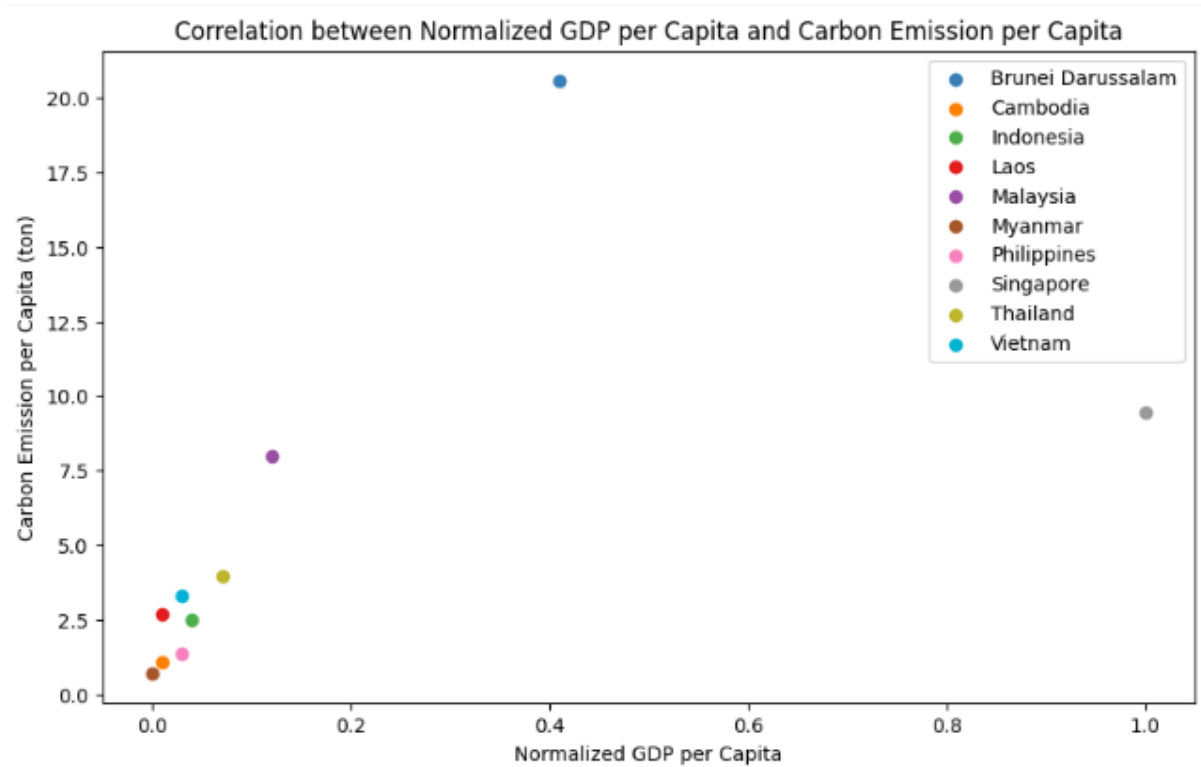


Figure 8: Correlation between GDP per Capita and Carbon Emission per Capita in ASEAN Countries

Source: Own Compilation

The scatter plot shows a weak positive correlation between GDP per capita and carbon emission per capita. Countries like Singapore, with high GDP per capita, also have relatively high carbon emissions per capita. Countries with lower GDP per capita, such as Cambodia and Myanmar, tend to have lower carbon emissions per capita. This analysis suggests that economic growth in ASEAN countries is associated with an increase in carbon emissions, although the correlation is not very strong.

4.3.5. Correlation between Student-Teacher Ratio and Composite Index for Green Economy and Sustainable Practices

The correlation coefficient between the student-teacher ratio and the composite index for green economy and sustainable practices is approximately 0.576. This indicates a moderate positive correlation, suggesting that countries with a better student-teacher ratio tend to perform better in sustainability. The p-value of 0.082 indicates that this correlation is not statistically significant at the 0.05 level.

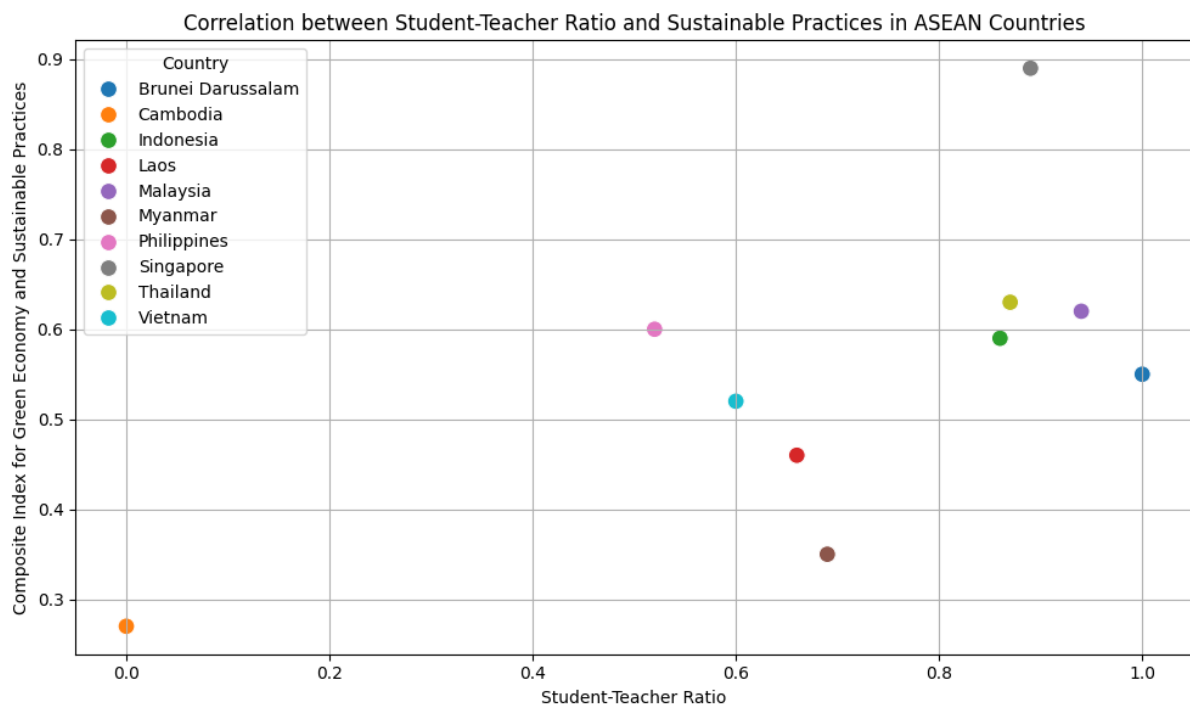


Figure 9: Correlation between Student-Teacher Ratio and Sustainable Practices in ASEAN Countries

Source: Own Compilation

The scatter plot shows a moderate positive correlation between the student-teacher ratio and the composite index for green economy and sustainable practices. Countries like Brunei Darussalam and Singapore, with better student-teacher ratios, also have higher composite index values. Countries with worse student-teacher ratios, such as Cambodia, tend to have lower composite index values. This analysis suggests that improving the student-teacher ratio could positively impact a country's sustainability performance. was analyzed to prove whether overall index and environmental outcome has a correlation.

4.4. Comparison

Here's a comparative analysis of the ASEAN countries based on the provided normalized values for various indicators:

4.4.1. Education (Student-Teacher Ratio):

Highest: Brunei Darussalam (1.0), Malaysia (0.94)

Lowest: Cambodia (0.0)

4.4.2. Economy (GDP per Capita):

Highest: Singapore (1.0)

Lowest: Myanmar (0.0), Cambodia and Laos (0.01)

4.4.3. Political (Government Effectiveness):

Highest: Singapore (1.0)

Lowest: Myanmar (0.0)

4.4.4. Social (Income Inequality):

Highest: Philippines and Singapore (1.0)

Lowest: Cambodia (0.0)

4.4.5. Environmental (Carbon Emission per Capita):

Highest: Myanmar (1.0)

Lowest: Brunei Darussalam (0.0)

4.4.6. Composite Index for Green Economy and Sustainable Practices:

Highest: Singapore (0.89)

Lowest: Cambodia (0.27)

Singapore consistently ranks high across most indicators, reflecting its strong performance in education, economy, political stability, and social equality. Cambodia and Myanmar show lower values in several indicators, indicating areas for potential improvements. Brunei Darussalam excels in education but has low environmental scores, suggesting a need for better environmental practices, especially due to their natural resources (oil) activities to boost the economy.

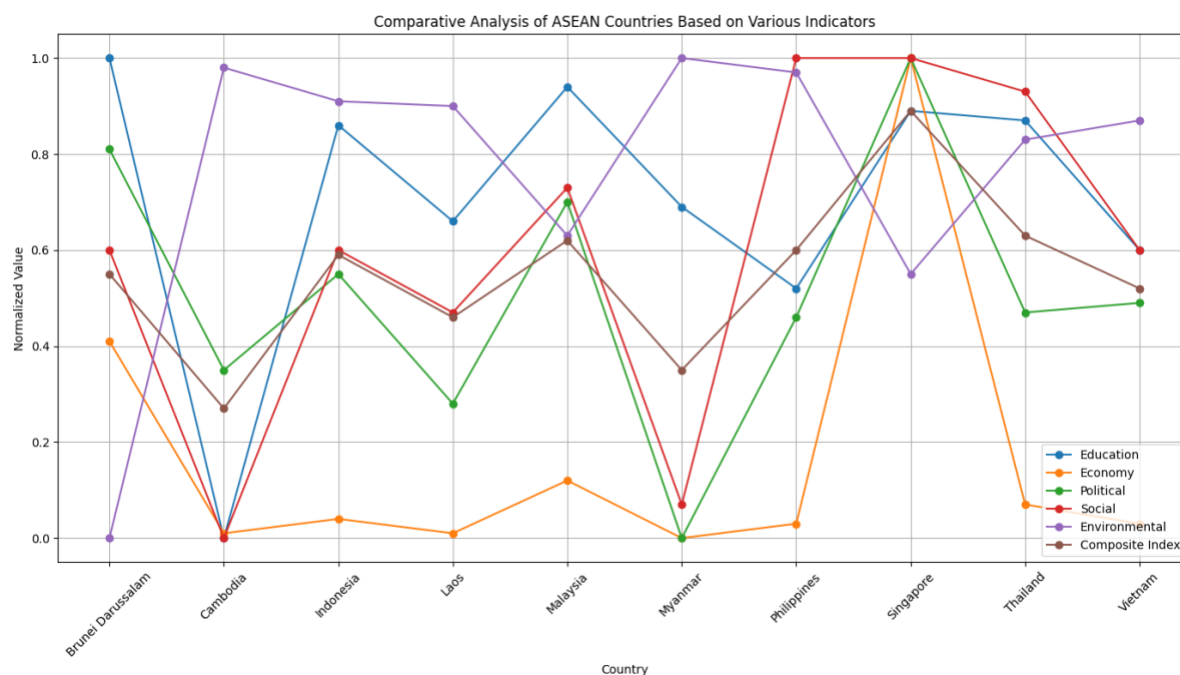


Figure 10: Comparison of ASEAN Countries Green Economy and Sustainable Practices

Source: Own Compilation

5. Conclusion

In conclusion, the findings suggest that countries with higher government effectiveness, such as Singapore and Brunei Darussalam, tend to perform better in sustainability measures. Notably, wealthier countries, particularly Singapore, demonstrate stronger environmental practices, indicating a potential link between economic growth and improved sustainability outcomes. Additionally, education systems with better student-teacher ratios are associated with higher sustainability performance, emphasizing the role of education in sustainable development. Furthermore, reducing income inequality emerges as a factor that can positively influence a country's sustainability efforts.

While effective governance, economic growth, education, and social equality are shown to be key drivers of sustainability in ASEAN countries, the hypothesis that higher scores in the Green Economy and Sustainable Practices Index would lead to lower carbon emissions per capita is not strongly supported. The weak positive correlation suggests that carbon emissions per capita are influenced by a complex set of factors, and further research may be needed to explore these influences in greater depth. These results highlight the multifaceted nature of sustainability and the need for a holistic approach to sustainable development in the ASEAN region.

BIBLIOGRAPHY

- Afzal, M.N. *et al.* (2018) 'A panel investigation of The triple helix (th), quadruple helix (QH) relationship in ASEAN-5 economies', *Journal of Innovation Economics & Management*, n° 27(3), pp. 97–122. doi:10.3917/jie.027.0097.
- Agheli, L. and Taghvaei, V.M. (2022) 'Political stability effect on environment and weak sustainability in Asian countries', *Sustainability Analytics and Modeling*, 2, p. 100007. doi:10.1016/j.samod.2022.100007.
- ASEAN (2024) *About ASEAN, Association of South East Asian Nations*. Available at: <https://asean.org/about-asean/> (Accessed: 05 October 2024).
- ASEAN Secretariat and ASEAN (2023) *Vol 6, ASEAN Key Figures 2023*. South Jakarta, Jakarta: ASEAN. Available at: <https://www.aseanstats.org/wp-content/uploads/2023/12/ASEAN-Key-Figures-2023.pdf> (Accessed: October 2024).
- Barth, T.D. (2011) 'The idea of a Green New Deal in a quintuple helix model of knowledge, know-how and innovation', *International Journal of Social Ecology and Sustainable Development*, 2(1), pp. 1–14. doi:10.4018/jsesd.2011010101.
- Carayannis, E.G., Barth, T.D. and Campbell, D.F. (2012) 'The quintuple helix innovation model: Global warming as a challenge and driver for Innovation', *Journal of Innovation and Entrepreneurship*, 1(1), p. 2. doi:10.1186/2192-5372-1-2.
- Carayannis, E.G. and Campbell, D.F.J. (2010) 'Triple helix, quadruple helix and quintuple helix and how do knowledge, innovation and the environment relate to each other?', *International Journal of Social Ecology and Sustainable Development*, 1(1), pp. 41–69. doi:10.4018/jsesd.2010010105.
- Cherchye, L. *et al.* (2006) 'An introduction to “benefit of the doubt” composite indicators', *Social Indicators Research*, 82(1), pp. 111–145. doi:10.1007/s11205-006-9029-7.
- Etzkowitz, H., & Leydesdorff, L. (1998). THE ENDLESS TRANSITION: A “TRIPLE HELIX” OF UNIVERSITY-INDUSTRY-GOVERNMENT RELATIONS: Introduction. *Minerva*, 36(3), 203–208. doi:10.1023/A:1017159001649
- Fernandes, C.I. *et al.* (2021) 'Green Growth Versus Economic Growth: Do Sustainable Technology Transfer and innovations lead to an imperfect choice?', *Business Strategy and the Environment*, 30(4), pp. 2021–2037. doi:10.1002/bse.2730.
- Franc, S. and Karadžija, D. (2019) 'Quintuple helix approach: The case of the European Union', *Notitia*, 5(1), pp. 91–100. doi:10.32676/n.5.1.8.
- Globalen (2022) *Government effectiveness in*, *TheGlobalEconomy.com*. Available at: https://www.theglobaleconomy.com/rankings/wb_government_effectiveness/Asi/ (Accessed: October 2024).

- Hafizyar, Rustam & Dheyaaldin, Mahmood. (2019). Concrete Technology and Sustainably Development from Past to Future. doi:10.26392/SSM.2019.02.01.001.
- Houssam, N. *et al.* (2023) ‘Assessing the role of green economy on sustainable development in developing countries’, *Heliyon*, 9(6). doi:10.1016/j.heliyon.2023.e17306.
- HV, V., Thompson, F. and Tonby, O. (2014) *Understanding ASEAN: Seven things you need to know*, McKinsey & Company. Available at: <https://www.mckinsey.com/industries/public-sector/our-insights/understanding-asean-seven-things-you-need-to-know> (Accessed: 05 October 2024).
- König, J., Suwala, L. and Delargy, C. (2020) ‘Helix models of innovation and Sustainable Development Goals’, *Encyclopedia of the UN Sustainable Development Goals*, pp. 1–15. doi:10.1007/978-3-319-71059-4_91-1.
- Latif, N. *et al.* (2023) ‘Unraveling the nexus: The impact of economic globalization on the environment in Asian economies’, *Research in Globalization*, 7, p. 100169. doi:10.1016/j.resglo.2023.100169.
- Lavrinenko, O. *et al.* (2019) ‘The role of Green Economy in Sustainable Development (Case Study: The EU states)’, *Entrepreneurship and Sustainability Issues*, 6(3), pp. 1113–1126. doi:10.9770/jesi.2019.6.3(4).
- Ly, A.M. and Cope, M.R. (2023) ‘New Conceptual Model of Social Sustainability: Review from past concepts and ideas’, *International Journal of Environmental Research and Public Health*, 20(7), p. 5350. doi:10.3390/ijerph20075350.
- Mangukiya, R.D. and Sklarew, D.M. (2023) ‘Analyzing three pillars of sustainable development goals at sub-national scales within the USA’, *World Development Sustainability*, 2, p. 100058. doi:10.1016/j.wds.2023.100058.
- Merino-Saum, A. *et al.* (2020) ‘Unpacking the green economy concept: A quantitative analysis of 140 definitions’, *Journal of Cleaner Production*, 242, p. 118339. doi:10.1016/j.jclepro.2019.118339.
- Purvis, B., Mao, Y. and Robinson, D. (2018) ‘Three pillars of sustainability: In Search of Conceptual Origins’, *Sustainability Science*, 14(3), pp. 681–695. doi:10.1007/s11625-018-0627-5.
- Ruggerio, C.A. (2021) ‘Sustainability and Sustainable Development: A review of Principles and definitions’, *Science of The Total Environment*, 786, p. 147481. doi:10.1016/j.scitotenv.2021.147481.
- Rusiadi, R. *et al.* (2024) ‘The influence of natural resources, energy consumption, and renewable energy on economic growth in ASEAN region countries’, *International Journal of Energy Economics and Policy*, 14(3), pp. 332–338. doi:10.32479/ijeep.15917.
- Solheim, O.J. and Opheim, V. (2019) ‘Beyond class size reduction: Towards more flexible ways of implementing a reduced pupil–teacher ratio’, *International Journal of Educational Research*, 96, pp. 146–153. doi:10.1016/j.ijer.2018.10.008.

- Steele, P., Halimanjaya, A. and Pasaribu, K. (2021) *Investing in Sustainable Natural Capital in ASEAN*. rep. South Jakarta, Jakarta: ASEAN, pp. 1–86. Available at: <https://asean.org/wp-content/uploads/2021/09/Investing-in-Sustainable-Natural-Capital-in-ASEAN-FINAL.pdf> (Accessed: September 2021).
- Sun, H., Bai, T. and Liu, Z. (2024) ‘Perceived policy uncertainty and enterprise greenwashing risk’, *Finance Research Letters*, 69, p. 106148. doi:10.1016/j.frl.2024.106148.
- Thiele, L.P. (2024) *Sustainability*. 3rd Edition. Cambridge, UK: Polity.
- World Bank (2023) *GDP per capita (current US\$)*, *World Bank Open Data*. Available at: <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?end=2023&start=1960> (Accessed: October 2024).
- Worldometer (2024) *CO2 emissions per capita*, *Worldometer*. Available at: <https://www.worldometers.info/co2-emissions/co2-emissions-per-capita/> (Accessed: October 2024).
- Zhang, S. *et al.* (2024) ‘Comparing developed and emerging nations’ economic development with environmental footprint for low-carbon competitiveness’, *Heliyon*, 10(14). doi:10.1016/j.heliyon.2024.e34039.