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SUSTAINABLE TOURISM IN SOUTHEAST ASIA: BALANCING ECONOMIC GROWTH, EMPLOYMENT, AND CARBON EMISSIONS THROUGH EVIDENCE-BASED STRATEGIES

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Abstract

Tourism, one of the world's fastest-growing industries, can boost GDP and create jobs. Southeast Asia ranks third among the thirteen tourism markets. 125.78 million visitors are expected annually. This industry contributes 12% of GDP and 4% of employment. However, tourism and related services have increased global carbon emissions from transportation, electricity, and housing. Since the UN's SDGs encourage tourism as a green growth industry to reduce carbon emissions, the ASEAN Socio-cultural Community (ASCC) Blueprint 2025 promotes environmentally sustainable cities. Consequently, this study uses panel data regression to examine tourism's effects on economic growth, employment, and carbon emissions. The findings can then provide a numeric assessment of the SDGs and the ASCC Blueprint 2025. This study uses 2002–2019 World Bank data from 11 Southeast Asian nations. The results reveal that GDP, employment, and carbon emissions are best modelled by the random effect and fixed effect models, respectively. We also find that tourism positively impacts GDP ($p<0.001$), employment ($p<0.008$), and carbon emissions ($p<0.001$). These models estimate that 22,000 international tourists will increase employment by 6.14% and generate $894 million in revenue. However, it will increase annual carbon emissions by 27 million. These findings suggest Southeast Asian governments, policymakers, and others should promote sustainable eco-tourism to boost economic development and green job creation by reducing carbon emissions. The government should incentivize the local community, as the tourism industry's primary actors, to promote awareness about these programs by implementing low-carbon technology and eco-friendly energy sources.

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INTRODUCTION

Tourism is a rapidly growing sector worldwide, offering substantial potential to boost GDP and create employment opportunities (Yong, 2022). The United Nations World Tourism Organization (UNWTO) has projected that in 2030, there will be 2 billion international tourists, generating an annual revenue of USD 2 billion worldwide (UNWTO, 2011). The UNWTO Publication 2012 also stated that the ASEAN region was again recognized as the fastest-growing international tourist arrivals worldwide. Additionally, Southeast Asia ranks third among thirteen regions worldwide in its tourism industry (UNWTO, 2012). Southeast Asia is also recommended as the most tourism-friendly regions by the World Economic Forum (2022). The estimated annual visitor count is expected to reach 125.78 million, reflecting a growth of 65.9%, equivalent to approximately 82.99 million foreign tourists (WTTC, 2019).

Zaman et al. (2016) argue that tourism promotes economic development. According to the most recent data from the World Travel and Tourism Council (WTTC), the travel and tourism industry significantly impacts Gross Domestic Product (GDP), amounting to $8,272.3 billion (WTTC, 2019). Moreover, there is projected to be a growth rate ranging from 10.4% to 11.7% by 2028. In Southeast Asia, the tourism industry contributes 12% to the region's GDP and expected to increase to 13% over the next decade (Ahmad et al., 2019). Tourism has also substantially generated 20% of the global workforce in the last ten years (WTTC, 2021). This business will create over 100 million job opportunities within the next decade. In Southeast Asia, the tourism industry accounts for 4% of the overall labour force and is projected to experience a 3% annual growth rate in the next ten years (WTTC, 2022).

However, the growing demand for tourism and its associated services has resulted in heightened energy use, contributing significantly to the global rise in carbon emissions from sectors such as transportation, electricity consumption, and residential areas (Bento & Moutinho, 2016). As of 2020, tourism accounts for approximately 8% of the world's greenhouse gas emissions (Jiaqi et al., 2022). The transportation sector is responsible for 75% of these emissions in the tourism business, while the accommodation sector contributes 20% (IPCC, 2014). Cetin et al. (2018) discovered a persistent correlation between tourism-generated income and carbon emissions, particularly during structural disruptions. Additionally, Bojanic and Warnick (2020) observed that countries with a more significant proportion of tourism in their GDP exhibit higher levels of greenhouse gas emissions compared to nations with minimal or no contribution from tourism to their GDP.

Several studies have examined the influence of tourism on economic development in Southeast Asia, including its impact on GDP and the employment rate (Benanav, 2019; Benjamin et al., 2014; Manzoor et al., 2019). Yong (2022) contends that tourism has a lasting impact on the currency rate. Manzoor et al. (2019) provide additional evidence to support this claim, illustrating tourism's positive and significant impact on sustained economic expansion and job creation. The increase in tourism activities, on the other hand, carries the possibility of causing ecological damage (Fernández et al., 2019). Croes et al. (2021) found a negative and indirect relationship between tourism specialization and human development. Furthermore, Ahmad et al. (2019) provided evidence in their study that tourism harms the environment, particularly concerning carbon emissions, in Indonesia, the Philippines, and Vietnam. Additionally, Lee and Brahmasrene (2013)

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conducted a study to analyze the dynamic effects of tourism on the ecological and economic development in Southeast Asia between 1988 and 2011. Their research has established that tourism has a persistent impact on economic growth and, if not adequately controlled, can lead to environmental consequences. Hence, Southeast Asian governments must adopt proactive strategies to mitigate the adverse impacts of the surge of tourists.

The ASEAN Socio-cultural Community (ASCC) Blueprint 2025 aligns with the sustainable development goals (SDGs) of the United Nations by placing particular emphasis on advancing tourism as an environmentally sustainable industry that drives economic growth (The ASEAN Secretariat, 2016). The primary objective of this policy is to reduce carbon emissions and promote the development of environmentally sustainable cities. The program utilizes several tactics, including promoting cooperation across relevant sectors, to guarantee the accessibility of clean land, air, water, sanitation, and environmentally friendly public spaces. Furthermore, it aims to enhance the interrelationships among beneficial economic, social, and environmental factors across all domains.

To minimize the negative impacts of tourism growth while maintaining natural, economic, social, and environmental balances, it is imperative to foster stakeholder cooperation involving the government, communities, local residents, and tourists (Haribudiman et al., 2023). While previous studies have examined the impact of the tourism sector on various elements such as economic growth, ecological harm, and employment generation, only some have explored the simultaneous influence of tourism development on these aspects. However, it is crucial to delve deeper into these impacts to amplify the positive effects and mitigate the negative ones effectively. Therefore, this study aims to analyze the influence of tourism on economic growth, employment rates, and carbon emissions across all Southeast Asian countries using panel data regression. Subsequently, we will project how tourism growth will affect GDP growth, employment rates, and carbon emissions, while also comparing conditions in Indonesia with other Southeast Asia countries. Finally, we will provide recommendations for achieving sustainable tourism development in Indonesia in the future. The data obtained can then be used to evaluate the Sustainable Development Goals and the ASEAN Socio-Cultural Community Blueprint 2025, quantitavely.

METHODOLOGY

This section will examine the data and methodology utilized in the empirical inquiry. This study employs a quantitative analysis of secondary data sources from the World Bank. We utilize time series data encompassing 2002 to 2019, obtained from eleven Southeast Asia nations (World Bank, 2020). The independent variable is the logarithm of inbound tourism, representing the number of foreign visitor arrivals. The models incorporate GDP, employment rate, and carbon emission as dependent variables. GDP encompasses economic activity directly associated with tourism, including accommodations, air transport, dining establishments, and recreational industries (Loayza, 2016). We calculated GDP in US dollars and adjusted it for inflation in 2015. We also determined the employment rate, which represents the ratio of employed individuals to the total population aged 15 and above, using estimates from the International Labour Organization (ILO, 2011). The employment rate in the tourist sector, directly and

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indirectly, reflects labor absorption (ILO & WTO, 2009). Carbon emissions, measured in millions, refer to the quantity of carbon released due to various tourism activities (World Bank, 2019). Table 1 provides additional information regarding the variables and their sources.

Table 1. Research Data and Variables

Variable	Source	Panel Data
Gross Domestic Product (Constant 2015 USD)	World Bank Data	Time series of 2002-2019 from eleven nations of the Southeast Asia (Brunei, Cambodia, Timor Leste, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Vietnam
Employment Rate (Rate to population ratio, 15+, ILO estimates)	World Bank Data	
Inbound tourism (Number of international tourist arrival)	World Bank Data	
Carbon Emission	World Bank Data	

Source: World Bank, 2019, 2020, 2022

This study employs both descriptive and statistical approaches for analysis. Descriptive analysis tables examine the spread of tourism in Southeast Asia and present the findings succinctly (Cleff, 2019). Additionally, panel data regression is employed to determine the impact of tourism on economic growth, employment rate, and carbon emissions in each model (Torres-Reyna, 2007).

Panel data regression is an econometric model integrating cross-sectional data from 11 Southeast Asian nations and time series data from 2002 to 2019. The predictor variable in this model is log tourism, while the response variables are log GDP, log CO_2, and employment rate. The purpose of applying a logarithmic transformation to the variables representing the number of tourists, GDP, and CO_2 is to standardize their ranges within each country, as significant variations exist among countries Conversely, the employment rate does not undergo a logarithmic transformation since its values uniformly span from 0 to 100 across countries. The following equation defines this regression model.

$$y_{it} = \alpha + \alpha_i + x_{it}\beta + \varepsilon_{it} \quad ...(1)$$

Where:
α = constant
β = parameters from the estimation result
x_{it}= the it-th observation from the explanatory variable
α_i = different individual effects for each i-th individual
ε_{it} = error of regression

During the step of selecting the estimating model, the Common Effect (CE), Fixed Effect (FE), and Random Effect (RE) models are suggested. The common effect model does not consider the variations in time and country, whereas the fixed effect model claims intercept differences may explain disparities among nations. The random effect will estimate the disturbance variable from the temporal and cross-country relationship. Three tests must be conducted to determine the most appropriate model: the Chow test to select

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between CE and FE models, the Hausman test to choose between FE and RE models, and the Lagrange multiplier test to decide between RE and CE models (Kneip et al., 2012).

FINDINGS AND DISCUSSION

The Trend of Tourism, GDP, Employment Rate, and Carbon Emissions in the Southeast Asia

The investigation began by graphing each nation according to a range of variables. Indonesia, Vietnam, Thailand, Malaysia, and the Philippines, among other Southeast Asian nations, experienced a rise in carbon emissions, as depicted in Figure 1(a). In contrast, carbon emissions in six other nations, including Myanmar, Singapore, Laos, Cambodia, Brunei, and Timor, had slight increases or even decreases. Indonesia stands out with the highest surge in carbon emissions among Southeast Asian countries from 2002 to 2019, witnessing an approximate per capita rise of 350 million metric tons. This significant increase in carbon emissions is attributed to exponential population growth, leading to an escalating consumption of fossil energy (Rostiana & Rodesbi, 2020). Furthermore, Indonesia ranks sixth as the highest emitter of greenhouse gases, as reported by the World Resource Institute (IMF, 2021).

Both, Thailand and Malaysia rank second, experiencing a substantial rise of approximately 150 million metric tons per capita in carbon emissions. In Thailand, international tourism is the most significant contributor to carbon emissions (Raihan et al., 2023). Meanwhile, Vietnam witnessed a significant increase in carbon emissions, reaching 272 million metric tons. Singapore is the sole country that has achieved a reduction in carbon emissions, decreased from 47 to 29 million metric tons. A study by Zang and Su (2019) indicated that Singapore declined in its CO_2 coefficients (carbon emissions to total energy consumption) from 5.78 kt/ktoe to 2.61 kt/ktoe between 1990 and 2014. Singapore stands out as the only country in ASEAN experiencing a significantly higher GDP growth rate than carbon emissions (Zhang et al., 2020). Singapore serves as a commendable model for emulation, as it has successfully reduced its CO_2 emissions by decreasing carbon and energy intensity (Akram et al., 2020). It reflects Singapore's commitment to adopting low-carbon energy sources and promoting less energy-intensive economic growth (Wójcik-Jurkiewicz et al., 2021).

Throughout the previous 18 years, there has been a general upward trend in the number of visitors in each country. Figure 1(b) illustrates the varying pace of growth in the number of visitors, which varies from less than 5 million to over 30 million tourists. Thailand has experienced the most significant surge in tourist arrivals in the last 18 years, with a staggering increase of about 30 million visitors. Malaysia follows closely behind with a jump of over 10 million tourists. Singapore, Vietnam, and Indonesia also experienced a surge in tourist arrivals, with an additional influx of 10 to 15 million visitors. Thailand's growth in visitor numbers surpassed that of other Southeast Asian countries, with increases of less than 5 million visitors observed in those nations.

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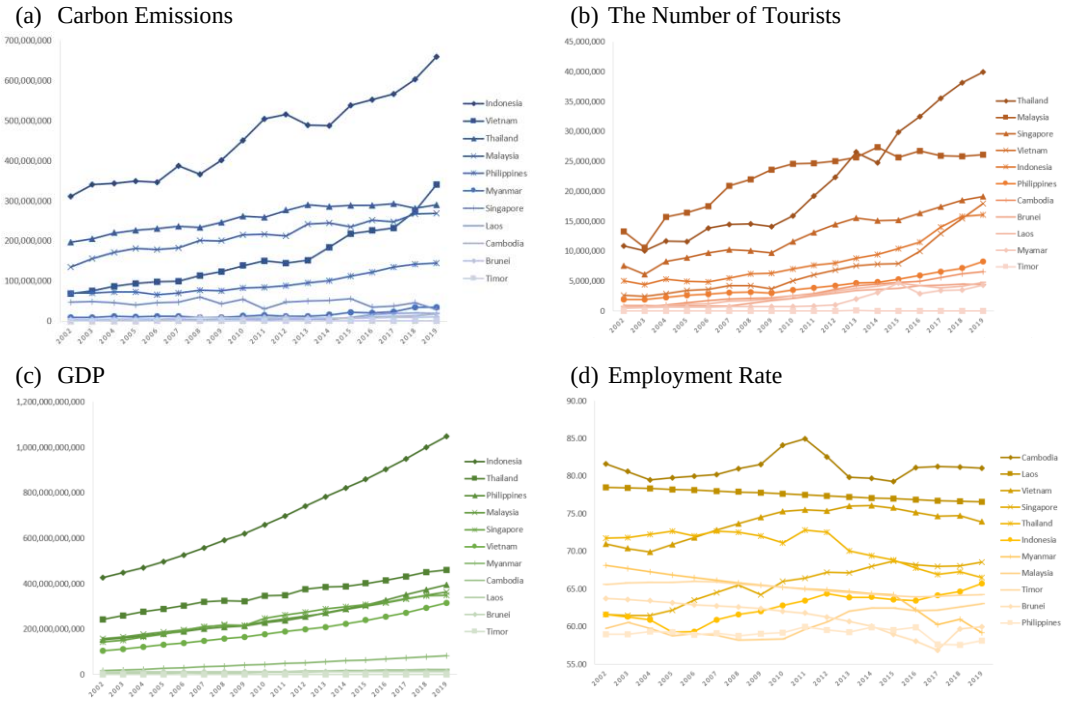

Figure 1. Carbon Emission, The Number of Tourists, GDP, and Employment Rate for Each Southeast Asia Nation 2002-2019
Source: primary data analysis, 2024

Figure 1(c) depicts the ascending trajectory of GDP in every Southeast Asian country. Indonesia has regained its position as the leading country in GDP growth, with a remarkable 150% increase from 2002 to 2019, rising from 427 billion to 1.05 trillion. Indonesia stands out as the sole Southeast Asian country exhibiting the most substantial increase in GDP, according to these statistics. Thailand, the Philippines, Malaysia, Singapore, and Vietnam have experienced significant GDP growth, ranging from 1.5 to 3 times higher than the period from 2002 to 2019. These countries have a closely aligned trend of economic expansion. Myanmar, Cambodia, Laos, Brunei, and the East are among the nations that often have lower GDP growth rates and a GDP below $100 billion. Moreover, the employment rates in Southeast Asian countries exhibit fluctuate annually. Countries such as Cambodia, Vietnam, Singapore, Indonesia, and Malaysia are experiencing increased in their employment rates. Figure 1(d) shows that employment rates in other Southeast Asian nations declined consistently.

Panel Data Regression of tourism to the GDP, Employment, and CO_2 Emission

To examine the influence of tourism on the GDP, employment, and carbon emission, we utilize panel data regression with three different models: the common effect model (specifically, partial least squares), the fixed effect model, and the random effect model. The outcome of each model is documented in Table 2 below.

Table 2. Panel Data Regression for GDP, Employment, and Carbon Emission Models

	GDP Model		Employment Model		CO_2 Emission Model	
Common Effect (CE)						
Parameter	**Coef.**	**P>t**	**Coef.**	**P>t**	**Coef.**	**P>t**
Log(Tourist)	0.899	<0.001*	0.119	0.678	1.014	<0.001*

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	GDP Model		Employment Model		CO_2 Emission Model	
Constant	11.377	<0.001*	59.228	<0.001*	4.970	0.004*
GoF Model	**Coef.**	**P-value**	**Coef.**	**P-value**	**Coef.**	**P-value**
F-test	509.170	<0.001*	0.17	0.678	526.02	<0.001*
R-squared	0.722		0.001		0.729	
Fixed Effect (FE)						
Parameter	**Coef.**	**P>t**	**Coef.**	**P>t**	**Coef.**	**P>t**
Log(Tourist)	0.444	<0.001*	0.589	0.008*	0.614	<0.001*
Constant	16.203	<0.001*	66.279	<0.001*	10.966	<0.001*
Rho	0.986		0.943		0.957	
GoF Model	**Coef.**	**P-value**	**Coef.**	**P-value**	**Coef.**	**P-value**
F-test	529.170	<0.001*	7.190	0.008*	308.50	<0.001*
R-squared	0.740		0.037		0.624	
Random Effect (RE)						
Parameter	**Coef.**	**P>z**	**Coef.**	**P>t**	**Coef.**	**P>z**
Log(Tourist)	0.449	<0.001*	0.576	0.008*	0.627	<0.001*
Constant	16.122	<0.001*	66.080	<0.001*	10.777	<0.001*
Rho	0.978		0.948		0.942	
GoF Model	**Stat**	**P-value**	**Coef.**	**P-value**	**Stat**	**P-value**
F-test	539.660	<0.001*	7.08	0.008*	324.60	<0.001*
R-squared	0.740		0.037		0.624	

Note: *Significant at the 5% level
Source: primary data analysis, 2024

Within the framework of the GDP model, the three-panel data regression model produces statistically significant coefficients for both the constant term and the logarithm of tourist numbers ($p<0.001$). The F-test conducted on the fixed effects (FE), random effects (RE), and common effects (CE) models confirms that all the coefficients in the model are significantly different from zero, indicating that all three models are valid. Both fixed effects (FE) and random effects (RE) models have greater values for the coefficient of determination (r-squared) in comparison to the constant effects (CE) model. The interclass correlation coefficient (rho) for fixed effects (FE) and random effects (RE) models is 98.6% and 97.8%, respectively. It indicates that 98.6% and 97.8% of the variability in the output may be ascribed to the variations among countries.

The employment model produced a precise result. The t-test conducted for the CE model showed statistical significance solely for the constant term. However, the FE and RE models demonstrated statistical significance for all parameters. The criterion results in a statistically insignificant f-test for the CE model ($p=0.678$) and the lowest r-squared value. The t-test, f-test, and r-squared values for both the fixed effects (FE) and random effects (RE) models exhibit high similarity. The interclass correlation indicates that the differences between countries explain 94.3% (for the FE model) and 94.8% (for the RE model) of the variability in the output.

The carbon emission model encompasses all CE, RE, and FE models essential characteristics. All three models demonstrate significant f-test findings, suggesting that each model is adequately competent for selection. CE has the highest r-squared value, showing that the CE model performs better than both the FE and RE models. The interclass correlation indicates that 95.7% (for the FE model) and 94.2% (for the RE model) of the variability in the output can be ascribed to the differences between countries.

After analyzing each model outlined above, we choose the best model for each response variable using the Chow, Hausman, and Lagrange Multiplier tests, as shown in

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Table 3. The data suggest that the random effect model is optimal for assessing GDP and employment. The Lagrange Multiplier test yields statistically significant results with p-values less than 0.001. On the other hand, the Hausman test results are not statistically significant, with p-values of 0.601 and 0.725, respectively. The fixed effect model is often regarded as the most appropriate model for assessing carbon emissions, as demonstrated by the highly significant results of the Chow and Hausman tests, with p-values below 0.001 and 0.004, respectively.

Table 3. Testing for Choosing the Best Panel Data Regression Model

Model		Chow Test	Hausman Test	Lagrange Multiplier	Best Model
GDP Model	Statistics	772.800	3.62	1365.140	RE
	P-value	<0.001*	0.057	<0.001*	
	Conclusion	FE > PLS	RE > FE	RE > PLS	
Employment Model	Statistics	295.060	0.12	1473.41	RE
	P-value	<0.001*	0.725	<0.001*	
	Conclusion	FE > PLS	RE > FE	RE > PLS	
CO_2 Emission Model	Statistics	277.96	12.53	1323.99	FE
	P-value	<0.001*	0.0004*	<0.001*	
	Conclusion	FE > PLS	FE>RE	RE > PLS	

Note: *Significant at the 5% level
Source: primary data analysis, 2024

After conducting tests to choose the most suitable panel data regression model for each explanatory variable listed in Table 3, we formulate an equation for each model.

$$\text{Log(GDP)} = 16.122 + 0.449*\text{Log(Tourism)} \quad ...(2)$$

$$\text{The Number of Employment} = 66.08 + 0.576*\text{Log(Tourism)} \quad ...(3)$$

$$\text{Log(Carbon)} = 10.966 + 0.614*\text{Log(Tourism)} \quad ...(4)$$

Utilizing this model allows us to forecast that for every increment of 1,000 international tourists, there will be a 3.98% increase in the employment rate and an additional $223 million in revenue. However, this will lead to an annual rise of 4.14 million metric tons of carbon emissions. This study reveals a negative correlation between tourism and carbon emissions, suggesting that increased tourism activities contribute to air pollution and environmental degradation. However, it is essential to note that tourism also has the potential to stimulate economic growth and increase employment rates (Bekun, 2022; Raihan & Voumik, 2022).

This assertion is substantiated by research conducted by Akadiri et al. (2020), which illustrates that a mere 1% rise in the number of international visitors coming to a country will result in a significant 4.1% expansion of the economy and a corresponding 1.29% increase in carbon dioxide emissions per person. A study conducted by Raihan et al. 2023) in Thailand found that a 1% increase in tourism leads to a corresponding 0.05% rise in CO_2 emissions. (Hieu & Yen, 2019; Shahzad et al., 2017) also support this paradigm, as their studies state that tourism is a prominent and influential sector that substantially impacts on employment in Southeast Asia.

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Subsequently, we will assess the influence of tourism on the GDP, rate of employment, and carbon emissions across various nations. While acknowledging the existence of country-specific factors, varying rates of development, and constraints that influence changes in tourism numbers, we will overlook these distinctions to provide a broad understanding of the tourism model. Assuming a consistent yearly growth rate of 2.5% for tourism numbers in all nations, we may anticipate the rise of GDP, carbon emissions, and employment rate, as depicted in Figure 2-4.

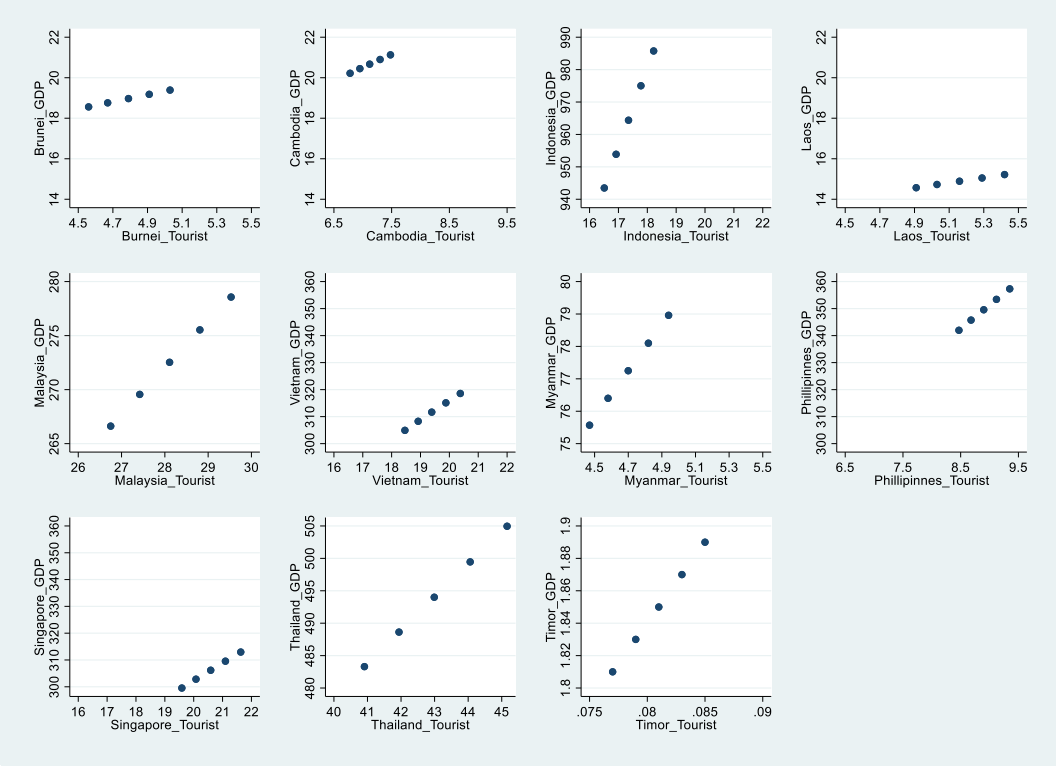

Figure 2. Forecast of the Number of Tourists (in millions) and GDP (in billions) for 2023-2027 for Each Country in Southeast Asia
Source: primary data analysis, 2024

According to Figure 2, assuming a yearly growth rate of 2.5% in tourist arrivals, the Southeast Asian nations that would have the most remarkable rise in visitor numbers over the next five years are Thailand (4.25 million), Malaysia (2.7 million), Singapore (2.03 million), Vietnam (1.9 million), and Indonesia (1.7 million). Timor, Brunei, Cambodia, Laos, Myanmar, and the Philippines all observe a surge in tourist numbers, with increases ranging from 8,000 to 900,000 visitors. This projection is supported by data from the World Bank, which states that Thailand attracts approximately 40 million international tourists annually, making it the most visited country in Southeast Asia and the 13th most visited globally (Raihan & Voumik, 2022; World Bank, 2022).

Surprisingly, despite experiencing a rise in tourist arrivals by more than 2 million, Indonesia has achieved a more significant increase in GDP compared to Vietnam and Singapore. Indonesia's GDP growth is 42.28 billion, while Vietnam's is 13.66 billion and Singapore's is 13.42 billion, all over the next five years. Additionally, Indonesia's GDP growth surpasses that of Thailand despite Thailand's tourism growth rate being twice as

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high as Indonesia's. According to the 2018 WTTC data, Indonesia is ranked 23rd globally in absolute growth, with the tourist sector contributing 5.8% of the total GDP (WTTC, 2019).

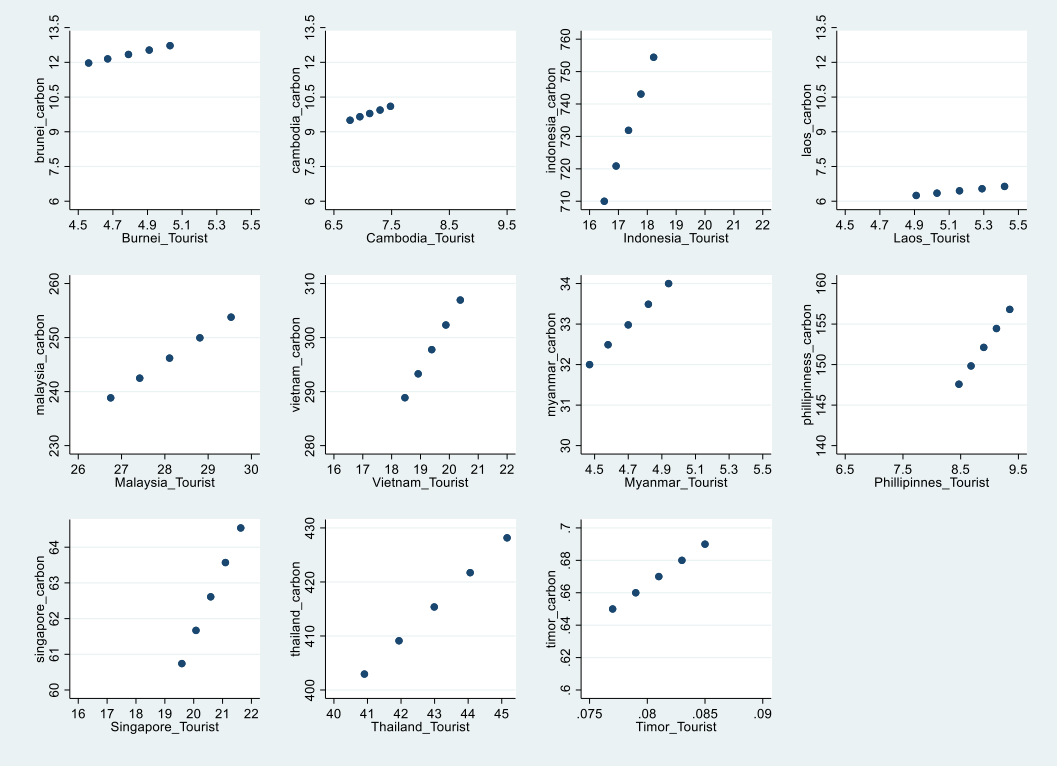

Figure 3. Forecast of the Number of Tourists (in millions) and Carbon Emissions (in millions) for 2023-2027 for Each Country in Southeast Asia
Source: primary data analysis, 2024

Figure 3 illustrates the projected increase in carbon emissions in Southeast Asian nations. Indonesia, Vietnam, Thailand, and Malaysia are expected to experience a substantial increase in carbon emissions over the next five years, with respective estimates of 44.4 million, 25.21 million, 18.07 million, and 14.94 million. The rise in tourist numbers in these countries, originating from various sectors, contributes to the surge in carbon emissions. In their study in Southeast Asia, (Sherafatian-Jahromi et al., 2017) highlighted that tourists' arrivals play a vital role in the emission of pollutants in Malaysia. An intriguing discovery is the anticipated surge in carbon emissions in the Philippines, forecast to reach 9.2 million measures. In contrast, the number of tourists is predicted to increase by only 880 thousand in the upcoming years.

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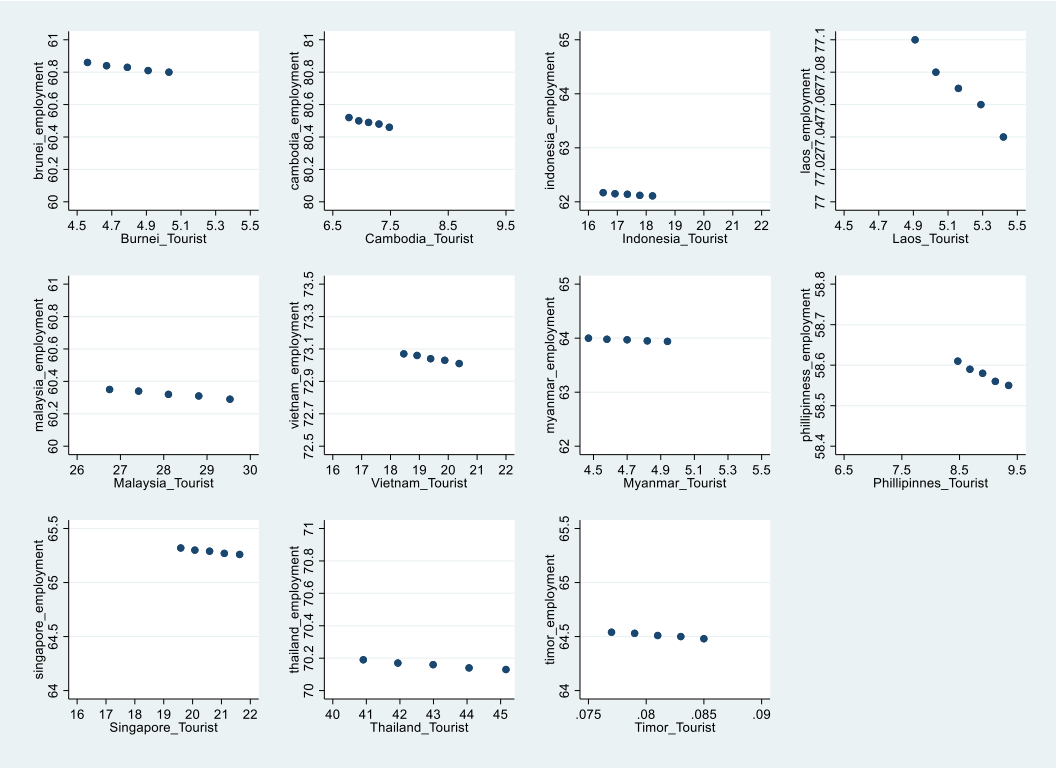

Figure 4. Forecast of the Number of Tourists (in millions) and Employment Rate (%) for 2023-2027 for Each Country in Southeast Asia
Source: primary data analysis, 2024

Figure 4 predicts that the projected increase in tourism numbers is expected to lead to a decrease in the employment rate across all Southeast Asian countries from 2023 to 2027. However, compared to 2002 to 2019, Cambodia, Laos, Vietnam, and Thailand are anticipated to experience an uptick in employment rates over the next five years, reaching 80.5%, 77%,73%, and 70%, respectively. According to the data provided by the WTTC, this industry is projected to see a rise in its total employment contribution from 7.6% to 8% over the next ten years (Manzoor et al., 2019). However, despite the projected rise in tourist arrivals between 700 and 500 thousand, Cambodia and Laos have achieved more excellent employment absorption. Conversely, nations like Indonesia, Malaysia, and Singapore, which see significant increases in tourism, exhibit somewhat lower rates of labour absorption, often ranging from 60% to 65%.

One reason for the differences in projections across various countries is the variation in tourism assets and country-specific environmental conditions. Additionally, geographical context contributes to these differences. Indonesia and the Philippines are archipelagic countries, while Thailand, Vietnam, Cambodia, Laos, and Malaysia are primarily located on the Asian continent. Singapore, Brunei, and Timor are either small island nations or part of larger islands.

Furthermore, the focus of tourism development programs varies among countries, with only a few, such as Indonesia and Thailand, placing significant emphasis on such initiatives. This strategic approach is predicted to lead to substantial growth in tourism, with significant impacts on employment, economic growth, and an increase in carbon emissions (Jermsittiparsert & Chankoson, 2019; Mardhani et al., 2021). The WEF has also

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indicated a promising future, with over 100 million international arrivals in Southeast Asia, leading to an average growth rate of 8%, job creation, and the facilitation of regional development (Hieu & Yen, 2019).

How to optimize the tourism effect for the country? Some policy implications

This section discusses various implications for optimizing the impact of tourism in Indonesia through evidence-based strategies drawn from several studies conducted in Turkey, South Asia, and the Asia Pacific region. These strategies, activities, and programs have been demonstrated to be effective based on evaluation research and empirical evidence.

Our projection results indicate a positive outlook for tourism activity and development in Southeast Asia, underscoring the need to effectively promote and expand the tourism sector in the future. It is imperative for governments, legislators, and other stakeholders in Southeast Asia to prioritize efforts aimed at promoting sustainable eco-tourism to mitigate the environmental and climate impacts of tourism. This promotion should not just be a policy but a mission, engaging both public and private sectors in a dynamic partnership that not only provides infrastructure, but also pioneers growth in the tourism sector (Iyer, 2022). A well-coordinated and supervised partnership between the public and commercial sectors is crucial for achieving sustainable growth in the tourism industry (Rasool et al., 2021). The focus of Southeast Asian countries on long-term tourism growth is crucial, given the interplay between tourism development and environmental protection, with the aim of preventing tourism from further deteriorating ecosystems and the environment.

Implementing this sustainable eco-tourism strategy can promote economic growth and create environmentally conscious job by reducing carbon emissions. (Akadiri et al., 2019; Bhattacharya et al., 2017) provide additional evidence to support this claim, as their research in South Asia and Asia Pacific, as well as Turkey, shows that the adoption of effective tourism management and sustainable tourism policies heavily influences the impact of tourism on carbon emissions. One successful implementation of sustainable tourism in Indonesia is the Low Emission Zone (LEZ) policy implemented in the Kota Tua Area (KTA) of Jakarta, which restricts the entry of motorized vehicles in that area (Istanto et al., 2023). This policy has increased tourist satisfaction by 23% and reduce carbon emissions.

Moreover, in several nations projected to witness heightened carbon emissions attributed to the tourism sector, such as Indonesia, the government should establish a comprehensive framework holding residents and tourists accountable for preserving the natural ecology of tourist destinations (Mathew & Sreejesh, 2017). All tourism businesses must implement sustainable practices and prioritize environmental conservation. It will help educate both residents and international tourists about the importance of energy conservation, environmental protection, and adopting eco-friendly practices, even during vacation.

Based on research conducted by (Li et al., 2021) in China, it is evident that the government's encouragement for enterprises to adopt environmentally friendly and low-carbon technologies, along with alternative energy sources, has led to positive outcomes in various tourism-related activities such as transport systems, logistics, and housing. This policy has resulted in a reduction of CO_2 emissions and a decrease in the overuse of

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resources. Drawing from this example, Southeast Asian nations, particularly Indonesia, could consider implementing similar policies to mitigate carbon emissions from tourism-related activities.

Another strategy is for the government to offer incentives to local individuals, the primary stakeholders in the tourism industry, to promote awareness of these initiatives through using low-carbon technology and ecologically sustainable energy sources. Turkey exemplifies a nation that possesses a well-defined environmental plan. Their Development Plan effectively manages and reduces the use of non-renewable energy in residential, transportation, industrial production, and tourism domains (Akadiri et al., 2020). This policy has a substantial and enduring impact on environmental quality. By promoting and adopting environmentally sustainable practices and investing in alternative energy sources, these countries can contribute to environmental conservation efforts while fostering sustainable tourism development.

To enhance the development of sustainable industrial tourism, it is recommended that financial resources and technical assistance be provided to the local community for the management of tourist attractions. In Indonesia, many tourist destinations have implemented community-based tourism that preserves local wisdom (Bagasta et al., 2021)**.** However, challenges often arise from resource constraints and the need for more technical assistance from the government and related agencies to empower and develop tourism (Andri & Dunan, 2023). Thorough guidance and counselling are essential for creating a secure and conducive atmosphere (Anser et al., 2021). This measure will also positively impact the restoration of natural scenic tourist spots and the reduction of expensive carbon abatement expenses (Umbu et al., 2023)**.**

The objectives above can be achieved with robust political determination, administrative capabilities, explicit mandates, financial resources, and public consciousness of low-carbon living. Establishing a customized policy framework for each country in the region is imperative. Southeast Asia has the potential to implement comprehensive tourist frameworks that will generate strong connections between institutions, organizations, decision-making processes, and established practices. In addition, other factors influences this relationship in Southeast Asian nations, which will aid in developing a plan that promotes social, economic, and environmental sustainability.

CONCLUSION

By utilizing the panel data regression model, this study found a positive and significant impact of tourism growth on the GDP, employment rate, and carbon emission. Overall, for every increment of 1,000 international tourists, there will be a 3.98% increase in the employment rate and an additional $223 million in revenue. However, this will lead to an annual rise of 4.14 million metric tons of carbon emissions. Based on that model, we project that some Southeast Asian countries will experience the most significant growth in tourist arrivals over the next five years, including Thailand (4.25 million), Malaysia (2.7 million), Singapore (2.03 million), Vietnam (1.9 million), and Indonesia (1.7 million). Indonesia has achieved a higher GDP growth than Vietnam and Singapore despite experiencing a rise in tourist numbers of over 2 million. Indonesia's GDP growth stands at 42.28 billion, while Vietnam and Singapore have recorded GDP growth of 13.66 billion and 13.42 billion, respectively. It is projected that nations like Cambodia, Laos, Vietnam,

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and Thailand will witness a rise in their employment rates by around 6% in the next five years, reaching rates of 80.5%, 77%, 73%, and 70% respectively, because of the growing tourism activities. Additionally, Indonesia, Vietnam, Thailand, and Malaysia are expected to have a substantial rise in carbon emissions due to the growth of tourism, with respective values of 44.4 million, 25.21 million, 18.07 million, and 14.94 million. Examining the anticipated growth of Indonesia's tourism industry and its associated rise in GDP, it becomes evident that the sector significantly contributes to increased carbon emissions. Therefore, the Indonesian government must adopt measures promoting sustainable eco-tourism and prioritize environmental conservation. This entails adopting of eco-friendly and low-carbon technologies alongside educational efforts targeting both local communities and international tourists, emphasizing the significance of energy conservation and environmental preservation. These initiatives will facilitate the emergence of environmentally friendly job opportunities and aid in curbing carbon emissions. Lastly, this study has some limitations, including the use of time series data limited to the years 2002-2019, which prevents capturing long-term patterns of the influence of tourism on economic growth, employment rate, and carbon emissions. In addition, the study used a simple panel data regression model, which only examines the causal relationship between tourism (as the predictor variable) and several response variables individually. A future study that constructs a more intricate model of the relationships between variables would be preferable. Another limitation of this research is that the GDP, employment rate, and carbon emission data utilized are aggregated from all sectors and not specifically tailored to the tourism sector. This is primarily due to data constraints, particularly in certain countries where comprehensive data for the tourism sector may be lacking or limited.

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