Geojournal of Tourism and Geosites
ISSN 2065-0817, E-ISSN 2065-1198

Year XIX, vol. 67, no. 3, 2026, p.2008-2019
DOI 10.30892/gtg.67316-1828

A CAUSAL RELATIONSHIP MODEL OF SOCIAL AND CULTURAL CHANGE INFLUENCING THE FUTURE SUCCESS OF INTEGRATED AND SUSTAINABLE TOURISM MANAGEMENT IN THAILAND

Nathaporn PHONG-A-RAN [1], Jindamas SUTTHICHAIMETHEE [2], Chaiyan JUNSIRI [3], Duangrat TANDAMRONG [4], Pongsatorn TANTRABUNDIT [4*]

[1] Rajamangala University of Technology Isan, Faculty of Business Administration and Information Technology, Khon Kaen, Thailand; Nathaporn.ph@rmuti.ac.th (N.P.A.R.)
[2] Ministry of Higher Education, Science, Research and Innovation, Bangkok, Thailand; Jindamasc@gmail.com (J.S.)
[3] Khon Kaen University, Department of Agricultural Engineering, Faculty of Engineering, Khon Kaen, Thailand; Agricultural Machinery and Postharvest Technology Research Center, Khon Kaen University, Khon Kaen, Thailand; Postharvest Technology Innovation Center, Science, Research and Innovation Promotion and Utilization Division, Office of the Ministry of Higher Education, Science, Research and Innovation, Bangkok, Thailand; chaich@kku.ac.th (C.J.)
[4] Mahasarakham University, Mahasarakham Business School, Mahasarakham, Thailand; duangrat.t@msu.ac.th (D.T.); Pongsatorn@msu.ac.th (P.T.)

Citation: Phong-A-Ran, N., Sutthichaimethee, J., Junsiri, C., Tandamrong, D., & Tantrabundit, P. (2026). A causal relationship model of social and cultural change influencing the future success of integrated and sustainable tourism management in Thailand. *Geojournal of Tourism and Geosites*, 67(3), 2008–2019. https://doi.org/10.30892/gtg.67316-1828

Abstract: This research aims to examine the influence of integrated causal factors affecting the future success of sustainable tourism management in Thailand amid changes in social and cultural dimensions, the Bio-Circular-Green (BCG) economy, and the pro-environmental sector. The study adopts a mixed-methods research approach and applies a Multinomial Logistic Model based on Path Analysis, referred to as the Logit-PA model, which was identified as the best-fitting model for examining the relationships among the relevant factors. The findings indicate that stakeholder participation is the most critical factor influencing the success of sustainable tourism. When this factor was incorporated into the Logit-PA model as a new policy scenario, the true direct effects of the causal factors became more evident. The inclusion of stakeholder participation also contributed to a continuous long-term reduction in greenhouse gas emissions generated by tourism activities. Furthermore, the study identifies several strategic approaches to achieving sustainable tourism development goals. These include enhancing the capacity of tourism service providers to manage resources efficiently, emphasizing social and cultural dimensions in tourism development, and promoting the consumption of tourism products and services that are consistent with the principles of the BCG economy. In addition, supporting factors should be developed to improve the efficiency of environmental resource management and ensure the long-term sustainability of tourism practices. This research provides substantial practical value for policy planning and implementation by guiding Thailand's national development toward long-term sustainability goals. The findings may also be adapted and applied to other sectors in future studies under changing future conditions.

Keywords: social culture, Eco-tourism, scenario analysis, sustainability, sustainable tourism

* * * * * *

INTRODUCTION

The tourism industry is a crucial sector contributing to Thailand's economic growth. In 2029, Thailand generated tourism revenue of approximately 992,050 million baht, creating employment for 4,201,502 people within the economic system (World Travel & Tourism Council, 2025). At the same time, Thailand's tourism competitiveness is evident, as the country ranked 31st out of 140 countries worldwide (Chongbut & Chapman, 2021; The World Bank: Energy Use (Kg of Oil Equivalent Per Capita) Home Page, 2025). Thailand has consistently pursued national development policies that promote economic, social, and environmental growth from the past to the present (1995–2025) (Office of the National Economic and Social Development Council (NESDC, 2025). However, following the economic crisis period (2002–2025), Thailand increasingly emphasized economic expansion to accelerate economic and social recovery (National Statistical Office Ministry of Information and Communication Technology, 2025). The government implemented various policy measures to promote national development, with tourism identified as the highest national policy priority, followed by the promotion of agricultural exports through expanding market share and continuously exploring new international markets (Praprom & Laipaporn, 2023). In particular, Thailand has actively promoted international tourism growth at an accelerated rate by reducing service-related tax rates to stimulate tourist arrivals and encourage foreign

* Corresponding author

Copyright: © 2026 by the authors.This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution 4.0 International (CC BY 4.0) License

companies to conduct business in Thailand, exempting certain fees to facilitate investment entry into the economic system and enhance long-term operational activity, and implementing comprehensive support measures, especially in terms of safety and security, to attract foreign capital inflows (Tourism Authority of Thailand, 2025). Furthermore, the government has adopted an open approach to tourism-related business operations by easing tax burdens on entrepreneurs, enabling higher profitability and fostering sustained growth in the tourism sector (United Nations World Tourism Organization (UNWTO), 2025). With regard to social and cultural dimensions, Thailand has likewise promoted comprehensive development across multiple areas **(**UNWTO, 2024). These efforts include increasing the minimum wage and supporting the re-employment of previously unemployed workers, enhancing educational policies to continuously reduce illiteracy rates, and strengthening public health and safety through the provision of universal healthcare benefits to ensure equitable access for all population groups (UNWTO, 2025; Hasanein & Ayad, 2025).

Investment promotion policies targeting tourism entrepreneurs have led to a steady increase in business participation within the formal economic system, which in turn has generated social benefits by creating employment opportunities for Thai workers and generating income for local communities in tourism destinations, thereby supporting sustained regional income growth **(**NESDB, 2025; Ahmed et al., 2025). Furthermore, tourism-led economic development is closely linked to broader social development, particularly in forms of tourism associated with local cultural practices and community livelihoods. The emphasis on eco-tourism and cultural tourism as pathways toward sustainable tourism has contributed to simultaneous growth in both the tourism sector and social development (UNWTO, 2025; Tuan et al., 2025; Salama et al., 2025). With respect to environmental dimensions, Thailand has placed significant emphasis on achieving internationally agreed development targets following its participation in global cooperation frameworks established at the United Nations General Assembly in Italy, where the Sustainable Development Goals (SDGs) were adopted as a set of global development objectives after 2015. The SDGs were formally endorsed by 193 United Nations Member States on 25 September 2015 and have served as a shared development direction for all countries from 2016 to the present (National Statistical Office Ministry of Information and Communication Technology, 2025; Muna et al., 2025). The commitment document signed by all member states, entitled *"Transforming Our World: the 2030 Agenda for Sustainable Development,"* commonly referred to as the 2030 Agenda, Agenda 2030, or the Global Goals, comprises 17 Sustainable Development Goals (World Economic Forum, 2024). Each goal is supported by specific targets, totalling 169 targets, and measured through 232 indicators designed to guide and monitor progress toward sustainable development. In line with these commitments, the Thai government has established a 20-year National Strategic Plan as a key framework for steering the country toward sustainable development in the future. Implementation is carried out through the exercise of state authority via administrative, civil, and criminal measures under the National Environmental Quality Promotion and Conservation Act B.E. 2535 (1992), which serves as the primary legal instrument for environmental protection and sustainability in Thailand (Thai Travel Agents Association, Ministry of Tourism and Sports, 2025); ONEP, 2025; Office of Natural Resources and Environmental Policy and Planning (DEDE), 2025).

With respect to environmental development, Thailand places strong emphasis on SDG 12: Sustainable Consumption and Production, particularly in promoting sustainable tourism (Thailand Greenhouse Gas Management Organization (Public Organization), 2025; OECD, 2025). The country has developed and implemented monitoring tools to assess the impacts of sustainable development in tourism that generates employment while promoting local culture and products (Junsiri et al., 2024). These efforts are closely aligned with SDG 8: Decent Work and Economic Growth, specifically Target 8.9, which aims to promote sustainable tourism that creates jobs and supports local culture and products by 2030; SDG 11: Sustainable Cities and Communities, which emphasizes the protection of cultural and natural heritage in tourism destinations; and SDG 15: Life on Land, which focuses on the sustainable management of terrestrial ecosystems and the prevention of negative environmental impacts from tourism activities (NESDB, 2025; Sutthichaimethee et al., 2025; Energy Policy and Planning Office, 2025). Achieving these targets is expected to support appropriate long-term sustainable development; however, rapid tourism growth in recent years has generated significant negative impacts on natural resources and the environment, raising concerns across multiple sectors (Ministry of Natural Resources and Environment). This has led to a strategic shift toward a quality-oriented rather than quantity-driven tourism development approach, aiming to achieve a balanced integration of economic growth and environmental conservation in line with the United Nations Sustainable Development Goals (SDGs). These principles are reflected in Thailand's National Strategy, master plans under the National Strategy, national reform plans, and the National Tourism Development Plan, all of which emphasize sustainable tourism (Winyuchakrit et al., 2025; Xiao et al., 2025).

Furthermore, the Thai government has declared the Bio-Circular-Green (BCG) economic model a national agenda since 2021(United Nations Framework Convention on Climate Change, UNFCCC, Bonn, Germany, 2016), positioning it as a key mechanism for leveraging national strengths, addressing structural weaknesses, aligning with sustainable development objectives, expanding employment opportunities, increasing income, generating inclusive wealth, and improving quality of life (UNFCC, 2014). In support of this agenda, the Ministry of Tourism and Sports has mandated its affiliated agencies to advance "white tourism" under the BCG economic model, and the National Tourism Policy Committee has assigned the Office of the Permanent Secretary of the Ministry of Tourism and Sports to revise future plans in alignment with the 13th National Economic and Social Development Plan and the 3rd National Tourism Development Plan (2023–2027) (NESDB, 2025; World Travel & Tourism Council, 2025).

Therefore, the Ministry of Tourism and Sports, as the principal agency responsible for driving tourism development in Thailand, has recognized the importance of prioritizing sustainable tourism in response to the need for natural

resource and environmental conservation, compliance with international and national policy frameworks, and the growing preference of modern tourists for environmentally friendly travel experiences (NESDB, 2025; World Travel & Tourism Council, 2025). Sustainable tourism development is regarded as a key instrument for generating economic, social, and environmental benefits for Thailand. Accordingly, the Ministry of Tourism and Sports has formulated the strategic plan for advancing white tourism under the BCG economic model (2023–2027) to strengthen the role of the tourism sector in driving national development under the Bio-Circular-Green (BCG) economy framework. On the supply side, tourism entrepreneurs are encouraged to adapt and apply the BCG economic model as a guideline for producing tourism-related goods and services, while on the demand side, the tourism sector stimulates demand within the BCG economic system through tourist consumption. This integrated approach positions tourism as a key mechanism for sustainably driving Thailand's economic development in the long term. However, despite Thailand's efforts to improve national strategic planning across multiple dimensions as discussed above, greenhouse gas emissions continue to increase at a steadily rising growth rate. In addition, the expansion of urban society into local communities has led to significant social transformations, particularly the gradual shift in cultural patterns from traditional rural communities to urbanized lifestyles (NESDB, 2025; World Travel & Tourism Council, 2025; DEDE, 2025).

These changes directly affect community ways of life and reflect the encroachment of urban society into rural areas, which has contributed to the gradual erosion of Thailand's traditional cultural heritage passed down through generations. Consequently, substantial weaknesses remain in the social dimension due to rapid cultural change, alongside increasing environmental degradation. These conditions indicate that Thailand's sustainability policies have not yet achieved sufficient success and lack both efficiency and effectiveness. This research, therefore, identifies a critical gap in existing policy implementation and seeks to address it by examining strategic approaches that can support Thailand's long-term national development objectives more effectively. However, although many studies of this kind have been conducted in the past, none has taken a comprehensive approach or developed indicators that are truly appropriate to the specific context under study with strong performance. This research, in contrast, is highly distinctive and significantly different from previous work. Its key strength lies in the development of context-appropriate indicators that meet established criteria for constructing a suitable model, along with a rigorous implementation process grounded in advanced statistical principles. The findings of this study can also be appropriately applied to other contexts in the future.

MATERIALS AND METHODS

The model developed in this study is the Logistic-based Path Analysis model (Logit-PA model). This model integrates quantitative and qualitative research approaches and is constructed by addressing and improving upon the limitations of conventional models. The objective is to ensure that the Logit-PA model can address the research questions as effectively and efficiently as possible. The model is developed under the following assumptions (Baltagi, 2021):

1. The independent or predictor variables (x's) must be measured at least at the interval scale. In cases where the data are categorical, they are transformed into dummy (dichotomous) variables with values of 0 and 1 only. For the dependent variable, in the case of binary logistic regression, two values are specified: 0 and 1.
2. The mean of the error term is zero, or equivalently, the error terms are uncorrelated, that is, $e = 0$.
3. The independent variables are not correlated with each other, implying the absence of multicollinearity. The criteria for assessing correlations follow those commonly used in multiple regression analysis, where the correlation coefficient (r) should not exceed 0.65 or 0.80.

For the Logit-PA model, in the case where the dependent variable (y) is a binary categorical variable with two possible values, and where there is more than one predictor variable (x_i). The function can be expressed as follows (Harvey, 1980).

$$P_y = \frac{e^{b_0+b_1x_1+\cdots b_px_p}}{1+e^{b_0+b_1x_1+\cdots b_px_p}} \qquad (1)$$

From Equation (1), let P_y denote the probability of the occurrence of the event of interest. Accordingly, the probability of the non-occurrence of the event of interest can be obtained using the following expression (Baltagi, 2021; Harvey, 1980).

$$Q_y = 1 - \left(\frac{e^{b_0+b_1x_1+\cdots b_px_p}}{1+e^{b_0+b_1x_1+\cdots b_px_p}}\right) \qquad (2)$$

As shown in Equation (2), the relationship between the dependent variable (y) and the predictor variables (x_i) is not linear. Therefore, the researcher transforms the model into a linear form by expressing it in terms of odds or odds ratios, which represent the ratio between the probability of the event of interest occurring $(y = 1)$ and the probability of the event not occurring $(y = 0)$. This relationship can be expressed as follows (Hoyle,1995).

$$odds = \frac{P_y}{Q_y} \qquad (3)$$

From Equation (3), the value of the odds represents how many times more likely the event of interest is to occur compared to the non-occurrence of the event. For example, the odds of tossing a coin once equal $\frac{0.5}{0.5} = 1$. If the odds equal 3, this indicates that the probability of the event of interest occurring is three times greater than the probability of the event not occurring. When the odds equal 1, the probabilities of the occurrence and non-occurrence of the event are equal. However, when the odds are greater than 1, the probability of the event of interest occurring exceeds that of the non-

occurrence of the event. In this study, the Logit-PA model is specified in terms of the logarithm of the odds, which is referred to as the logistic response function. The log of the odds, or $\log\left(\frac{P_y}{Q_y}\right)$, where $Q_y = 1 - P_y$, can be written in the following standard form (Byrne, 2001).

$$\log \frac{P_y}{1-P_y} = b_0 + b_1 x_1 + \cdots + b_p x_p \qquad (4)$$

From Equation (4), after taking the logarithm, the dependent variable (y) can be predicted using a set of variables that exhibit a linear structure. The Logit-PA model is therefore highly suitable for application in development management across various dimensions, enabling the formulation of appropriate measures or policies. Consequently, the predicted value of y in terms of P_y can be expressed as follows (Dickey & Fuller, 1981).

$$P_y = \frac{e^{b_0+b_1x_1+\cdots b_p x_p}}{1+e^{b_0+b_1x_1+\cdots b_p x_p}} \qquad (5)$$

From Equation (5), various estimation and prediction methods can be employed. In this study, an approach based on causal analysis is selected, in which all variables must pass appropriate procedural criteria and exhibit relationships such that each variable may simultaneously function as both a dependent and an independent variable. Accordingly, this study employs Path Analysis as the estimation technique, whereby variables are reclassified into latent variables and observed variables. Each sector must consistently demonstrate genuine and interconnected relationships with one another (Byrne, 2001). The structural equation model of path analysis, which represents the relationships among latent variables, is expressed as $\eta = b\eta + \Gamma\xi + \zeta$, where η denotes the endogenous variable, ξ represents the exogenous variable, and ζ is the error term. For the measurement model in each block, the following specifications apply (Hoyle, 1995).

$$x = \Lambda x\xi + \delta x \qquad (6)$$

From Equation (6), $(x/\xi) = \Lambda x\xi$ defines the measurement equation for the exogenous variables, where x represents the indicators of ξ, and Λx denotes the factor loadings, which reflect the influence of the latent variable ξ on its observed indicators x.

$$y = \Lambda y\eta + \varepsilon y \qquad (7)$$

From Equation (7), $(y/\eta) = \Lambda y\eta$ defines the measurement equation for the endogenous variables, where y represents the indicators of η, and Λy denotes the factor loadings, which represent the influence of the latent variable η on its observed indicators y.

For this study, the estimation of the Logit-PA model follows an algorithm-based analytical procedure, as outlined below (Byrne, 2001; MacKinnon, 1991; Joreskog & Sorbom, 2012).

1. Estimation of latent variables: The latent variables are estimated based on their observed indicators as $\hat{V}_i \alpha \sum_j w_{ji} P_{ji}$, where the latent variable V is constructed from the standardized values of the indicators P_i, and w_{ji} represents the assigned (arbitrary) weights.
2. Estimation of the dependent variables in the structural equation: The dependent variable in the structural model is estimated as $Z_i \alpha \sum_j c_j \hat{V}_j$, where the latent variable in the structural model is generated as a weighted aggregate of the estimated latent variables from each structural equation. The term c_j represents the appropriate weighting coefficients.
3. Iterative estimation until convergence: Steps 1 and 2 are performed iteratively until the coefficients of all structural paths stabilize and converge, indicating that convergence has been achieved.

The Logit-PA model differs from conventional models in that earlier approaches primarily addressed the issue of multicollinearity alone. In contrast, the model developed in this study is designed to simultaneously avoid multicollinearity, heteroscedasticity, and autocorrelation. As a result, the Logit-PA model exhibits a high degree of reliability and is highly suitable for future forecasting and predictive applications (Harvey, 1980).

A review of relevant domestic and international literature indicates that no prior studies have developed a strategic national management model in this manner. Moreover, analyses of this type remain extremely limited both in Thailand and internationally. Existing studies have largely examined individual dimensions in isolation rather than adopting an integrated analytical framework, thereby limiting their ability to accurately formulate future strategic directions.

In addition, previous research has typically separated quantitative and qualitative approaches, which has constrained the development of robust scenario models and reduced their applicability for national policy and planning in Thailand. To address these limitations, this study adopts a mixed-methods research design, in which quantitative analysis serves as the primary approach, followed by qualitative research to validate, complement, and strengthen the findings.

The quantitative component utilizes secondary data covering the period from 1990 to 2025, while the qualitative component involves in-depth interviews with key experts directly responsible for tourism development in Thailand, including five experts from the National Economic and Social Development Council (NESDC), five experts from the Ministry of Natural Resources and Environment, and five experts from the Ministry of Tourism and Sports, for a total of fifteen participants. The findings from both components are subsequently synthesized to provide a comprehensive analysis, with the research procedures presented in the following section. Figure 1 illustrates the research procedures employed to analyze the causal influences affecting cultural changes within the social sector as a result of the transition toward integrated tourism management for sustainable development in Thailand in the future.

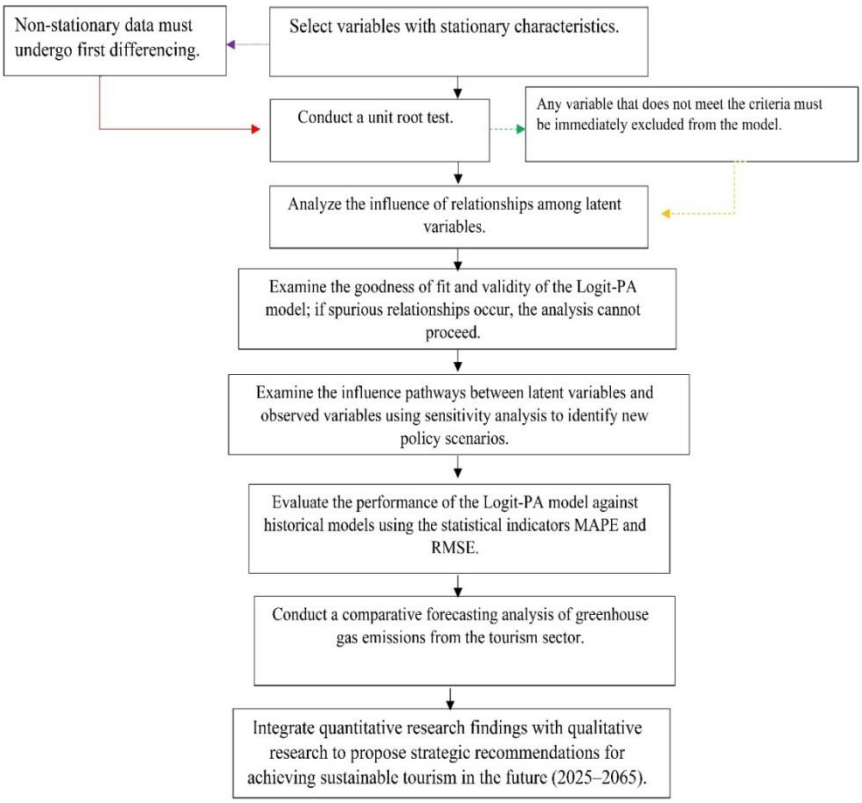

Figure 1. Research Procedure

RESULTS

This study employed a mixed-methods research approach, integrating both quantitative and qualitative methodologies to ensure the robustness and completeness of the research findings. The quantitative component utilized the Logit-PA model, which incorporates integrated variables derived from both quantitative data and qualitative insights. Subsequently, the quantitative results were further examined through qualitative research to enhance the depth, validity, and contextual interpretation of the findings. This sequential research design was intended to maximize the explanatory power of the study and ensure its applicability to real-world policy formulation. The findings of this research can therefore be effectively applied to support national strategic planning for achieving long-term sustainable tourism development in alignment with Thailand's net zero greenhouse gas emissions target by 2065.

Key policy objectives derived from the model include systematic management of tourism operators, local communities involved in tourism activities, and tourists within destination areas under the BCG economic model, as well as maintaining annual greenhouse gas emission growth from the tourism sector within the established carrying capacity limits. Most importantly, the proposed implementation framework must comprehensively incorporate ESG (Environmental, Social, and Governance) principles as a core foundation for sustainable tourism governance.

Screening of Influencing Factors for Model Input

The Logit-PA model was employed to select and define the observed variables used in the analysis. These observed variables consist of key indicators that have been officially established and consistently applied by Thailand in national governance and policy implementation. In this study, only indicators that fully met the required methodological criteria and relevance to sustainability objectives were selected; any indicators deemed inappropriate or insufficient were excluded from the model. The selected observed variables include per capita income ($BCG-A$), urbanization rate ($BCG-B$), industrial structure rate ($BCG-C$), Eco-Tourism rate ($BCG-D$), Cultural and Traditional Tourism rate ($BCG-E$), Health and wellness rate ($So-A$) Public participation rate ($So-B$), education rate ($So-C$), income distribution rate ($So-D$), protection rate ($So-E$), Recreational Attraction ($So-F$), Natural Attraction ($So-G$), energy intensity ($En-A$), Final energy consumption ($En-B$). and Carbon dioxide emission ($En-C$). In addition, the model incorporates latent variables corresponding to Thailand's sustainability policy framework, namely the social and cultural sector, the BCG-based economic sector, and the pro-environmental sector.

These latent variables serve as the foundational constructs for defining and evaluating Thailand's sustainable tourism development goals. The results of the empirical analysis are presented as follows.

Based on Table 1, the results indicate that all selected indicators successfully meet the measurement criteria of the Logit-PA model. Only indicators that passed the evaluation criteria were deemed appropriate for inclusion as observed variables in the Logit-PA model, with statistical significance at the $\alpha = 0.01$ level. All 15 observed variables are stationary at first difference, as the Tau-test values exceed the corresponding MacKinnon critical values. These results demonstrate

that the observed variables used in constructing the model provide a high level of reliability and robustness, making the model appropriate for analyzing the influences and relationships among variables, as presented in the subsequent analysis.

Table 1. Results of validity and reliability tests for observed variables in the Logit-PA model
*** denotes a significance, α = 0.01, Δ is the first difference, and ln is the natural logarithm

Tau Test				MacKinnon Critical Value		
Variables	Level I(0) Value	Variables	First Difference I(1) Value	1%	5%	10%
$\ln(\mathrm{BCG}-\mathrm{A})$	−2.50	$\Delta\ln(\mathrm{BCG}-\mathrm{A})$	−4.50***	−4.25	−3.55	−2.05
$\ln(\mathrm{BCG}-\mathrm{B})$	−2.99	$\Delta\ln(\mathrm{BCG}-\mathrm{B})$	−4.35***	−4.25	−3.55	−2.05
$\ln(\mathrm{BCG}-\mathrm{C})$	−2.05	$\Delta\ln(\mathrm{BCG}-\mathrm{C})$	−4.27***	−4.25	−3.55	−2.05
$\ln(\mathrm{BCG}-\mathrm{D})$	−2.59	$\Delta\ln(\mathrm{BCG}-\mathrm{D})$	−4.99***	−4.25	−3.55	−2.05
$\ln(\mathrm{BCG}-\mathrm{E})$	−3.52	$\Delta\ln(\mathrm{BCG}-\mathrm{E})$	−5.75***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{A})$	−3.25	$\Delta\ln(\mathrm{So}-\mathrm{A})$	−5.10***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{B})$	−3.45	$\Delta\ln(\mathrm{So}-\mathrm{B})$	−5.49***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{C})$	−3.10	$\Delta\ln(\mathrm{So}-\mathrm{C})$	−5.12***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{D})$	−-3.25	$\Delta\ln(\mathrm{So}-\mathrm{D})$	−5.15***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{E})$	−3.01	$\Delta\ln(\mathrm{So}-\mathrm{E})$	−4.99***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{F})$	−3.09	$\Delta\ln(\mathrm{So}-\mathrm{F})$	−4.97***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{G})$	−3.05	$\Delta\ln(\mathrm{So}-\mathrm{G})$	−5.12***	−4.25	−3.55	−2.05
$\ln(\mathrm{En}-\mathrm{A})$	−2.75	$\Delta\ln(\mathrm{En}-\mathrm{A})$	−4.50***	−4.25	−3.55	−2.05
$\ln(\mathrm{En}-\mathrm{B})$	-2.56	$\Delta\ln(\mathrm{En}-\mathrm{B})$	-4.55***	−4.25	−3.55	−2.05
$\ln(\mathrm{En}-\mathrm{C})$	-2.05	$\Delta\ln(\mathrm{En}-\mathrm{C})$	-4.95***	−4.25	−3.55	−2.05

Table 2. Causal relationship effects derived from the Logit-PA model
Note: In the above, *** denotes significance α = 0.01, DE is direct effect and IE is indirect effect

Dependent Variables	**Type of effect**	**Independent Variables**			
		Social-Culture sector	**Pro-environmental sector**	**BCG-economic sector**	**Policy adaptability**
Social-Culture sector	DE	-	0.34***	0.14***	-0.35***
	IE	-	0.10***	0.05***	
Pro-environmental sector	DE	0.62***	-	0.43***	-0.11***
	IE	0.09***	-	0.07***	
BCG-economic sector	DE	0.18***	-	-	-0.24***
	IE	-	-	-	

Formation of the Analytical Model Using the Logit-PA model

The researcher constructed the Logit-PA model to analyze the causal effects of key factors influencing the success of sustainable tourism, while ensuring that development remains within the carrying capacity defined by Thailand in the long term. The model examines the relationships among latent variables, which are influenced by their respective observed variables within each latent construct. The results of the relationship analysis are presented as follows.

Based on Table 2, the results of the causal relationship analysis derived from the Logit-PA model indicate that the social–cultural sector is influenced by two sectors: the pro-environmental sector and the BCG-economic sector, with effect sizes of 0.34% and 0.14%, respectively, at a significance level of α = 0.01. These results demonstrate that changes in the social–cultural sector are most strongly driven by changes in the pro-environmental sector. In addition, the findings reveal that the social–cultural sector exerts the strongest influence on the pro-environmental sector, with an effect size of 0.62%, which is greater than the influence exerted by the BCG-economic sector on the pro-environmental sector (0.43%). The next strongest influence is observed from the BCG-economic sector to the social–cultural sector, with an effect size of 0.18%, also significant at α = 0.01. Overall, the results indicate that the social–cultural sector plays a dominant role in driving changes in the pro-environmental sector. This implies that if the government aims to formulate effective and responsive policies for sustainable tourism, policy interventions should prioritize the social–cultural sector, as it demonstrates the highest responsiveness and transmission effect across sectors. Such an approach would enhance the likelihood of rapid and successful policy implementation compared with interventions targeting other sectors. Nevertheless, within the Logit-PA modeling framework, it is necessary to estimate new policy scenarios based on the observed variables through sensitivity analysis. The results of the sensitivity analysis are presented below.

Based on Figure 2, the three latent variables exhibit both direct and indirect effects, indicating strong interrelationships among them. The Logit-PA model demonstrates high validity and an excellent goodness-of-fit, satisfying all standard criteria: χ^2/df = 1.55, $RMSEA$ = 0.02, RMR = 0.001, GFI = 0.99, $AGFI$ = 0.95, R-squared = 0.93, F-statistic = 215.75 (p = 0.00), ARCH test = 15.85 (p = 0.10), and LM test = 1.20 (p = 0.10). These results confirm that the model is statistically appropriate, robust, and free from spurious relationships, thereby ensuring the reliability of the empirical findings.

Furthermore, the results of the sensitivity analysis indicate that the observed variables with sensitivity values exceeding the 90% threshold are Public Participation Rate $(So-B)$ and Cultural and Traditional Tourism Rate $(BCG-E)$. Specifically, the public participation rate exerts the strongest influence on changes in the social–cultural sector, with a sensitivity value of 92%, followed by the cultural and traditional tourism rate, which influences the BCG-economic sector with a sensitivity value of 90%. All remaining observed variables exhibit sensitivity values below 90%.

Accordingly, this study designates public participation rate and cultural and traditional tourism rate as new policy scenario variables, to be utilized as key instruments for steering long-term sustainable tourism development.

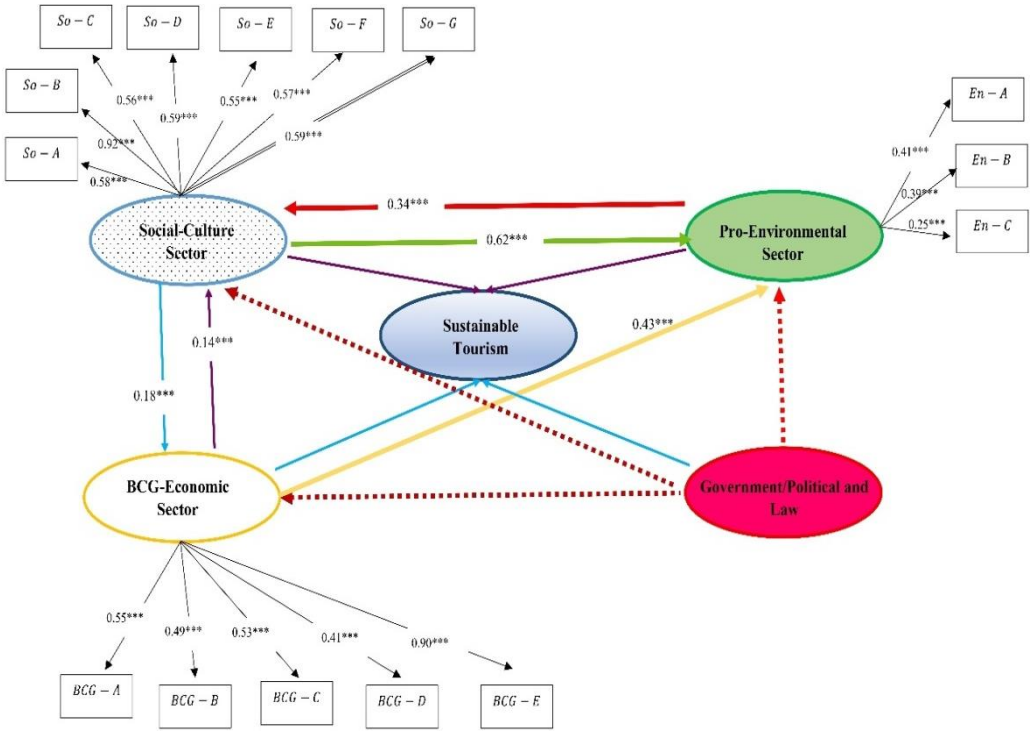

Figure 2. Intersectoral influence relationships derived from sensitivity analysis using the Logit-PA model

Forecasting Greenhouse Gas Emissions under the New Policy Scenario

In this study, a new policy scenario is incorporated into the Logit-PA model, and the resulting forecasts of greenhouse gas (GHG) emissions in the future are presented accordingly. For the forecasting exercise, the performance of the proposed model is evaluated by comparing it with the forecasting models that have been employed by Thailand from 1992 to 2025. The evaluation is conducted using standard accuracy measures, namely the Mean Absolute Percentage Error (MAPE) and the Root Mean Square Error (RMSE). The results of the model performance assessment are reported in Table 3.

Table 3. Model performance evaluation of the Logit-PA model (Source: Author's Estimate (2025)

Forecasting Model	MAPE (%)	RMSE (%)
OLS model	10.49	11.89
ANN model	4.95	5.15
Fuzzy model	4.59	4.98
GM(1,1) model	4.13	4.54
ANIF model	3.90	3.98
ARIMAX model	3.15	3.59
Logit-PA model	1.10	1.25

Based on Table 4, the researcher compares the performance of the Logit-PA model with forecasting models that have previously been used by Thailand for policy formulation and national planning under the sustainability policy framework. These benchmark models include the Autoregressive Integrated Moving Average with Exogenous Variables (ARIMAX) model, Adaptive Neuro-Fuzzy Inference System (ANFIS) model, Grey Model (GM(1,1)), Fuzzy model, Artificial Neural Network (ANN) model, and Ordinary Least Squares (OLS) model. The empirical results indicate that the Logit-PA model exhibits the highest forecasting performance, with MAPE and RMSE values of 1.10% and 1.25%, respectively. The second-best performance is observed for the ARIMAX model, with MAPE and RMSE values of 3.15% and 3.59%, respectively, followed by the ANFIS model (3.90% and 3.98%), the GM(1,1) model (4.13% and 4.54%), the Fuzzy model (4.59% and 4.98%), the ANN model (4.95% and 5.15%), and finally the OLS model, which shows the weakest performance with MAPE and RMSE values of 10.49% and 11.89%, respectively. These findings confirm that the Logit-PA model is highly suitable for long-term forecasting of greenhouse gas emissions.

Based on Figure 3, the results indicate that during the period 2025–2065, despite Thailand having implemented sustainable development policies since 1992, greenhouse gas emissions from the tourism sector continue to increase steadily. The projected growth rate reaches 55.1%, which exceeds the government's target threshold of 40%. However, when the new scenario policy, namely Public Participation Rate and Cultural and Traditional Tourism Rate, is adopted as the primary policy indicators for managing sustainable tourism within the Logit-PA model, the projected greenhouse gas emission growth rate

declines significantly to 29.55%. This level remains within the acceptable range for achieving the national net zero emission target by 2065. These findings demonstrate that the integration of an appropriate scenario-based policy framework with a suitable analytical model enables more effective strategic planning and policy implementation, yielding substantially higher efficiency and accuracy than the conventional models previously employed by the government.

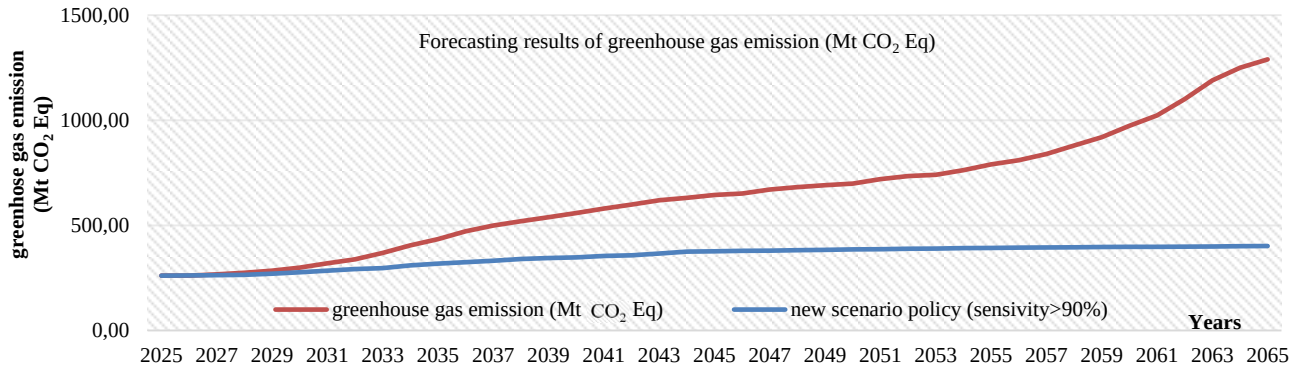

Figure 3. Projected growth of greenhouse gas emissions in the future (2025–2065)
(Source: Thailand Greenhouse Gas Management Organization, 2025)

Results of the Synthesis of Future Sustainable Tourism Development Strategies

Based on the quantitative research findings, the results presented above demonstrate a high level of appropriateness and reveal clear distinctions from previous studies. These differences help explain why Thailand has historically lacked a clear direction for managing tourism in a sustainable manner. In contrast, the findings of this study provide a practical foundation that can be effectively applied to support successful implementation in the future. Sustainable tourism is defined as tourism that fully considers its economic, social, and environmental impacts in both the present and the future, while addressing the needs of tourists, the tourism industry, the environment, and host communities. The principles of sustainability encompass the environmental, economic, and socio-cultural dimensions of tourism development and require an appropriate balance among these three dimensions to ensure long-term sustainability. These principles are consistent with the Global Sustainable Tourism Council (GSTC) standards, which serve as globally recognized benchmarks for sustainability in travel and tourism. The GSTC standards are widely used for education and awareness-building, policy formulation for businesses, government agencies, and other organizations, measurement and evaluation processes, and as a foundation for certification and carrying capacity assessment. These standards emerged from global efforts to establish a common framework for sustainable tourism and are organized around four core pillars: (1) sustainable governance and management, (2) economic impacts, (3) social and cultural impacts, and (4) environmental impacts, including resource use, pollution reduction, and the conservation of biodiversity and landscapes. The GSTC standards are founded on decades of global experience and prior work and were developed through consideration of a wide range of sustainable tourism guidelines and standards from all continents. During the development process, they underwent extensive global consultation across both developed and developing countries and in multiple languages, reflecting a collective effort to achieve a global consensus on sustainable tourism. Accordingly, the GSTC standards represent minimum criteria that businesses, governments, and destinations should meet to achieve social and cultural, environmental, and economic sustainability. As each destination possesses its own unique cultural context, environmental conditions, traditions, and legal frameworks, the standards are designed to be adaptable to local circumstances and supplemented with additional criteria for specific destinations and activities. Thailand, likewise, is required to align its tourism development efforts with these standards in order to achieve sustainable tourism in the future. Furthermore, implementation must be accompanied by integrated ESG analysis, encompassing Environmental sustainability (E), which requires that greenhouse gas emissions do not exceed the carrying capacity of destinations; Social and cultural sustainability (S), which emphasizes equitable income distribution, preservation of traditional culture, and the cultivation of environmental stewardship as a shared social value; and Governance (G), which entails effective regulation and oversight of national policies to ensure appropriate governance across all sectors. Consequently, the formulation of strategies under these frameworks necessitates an integrated, cross-sectoral approach, which is essential for achieving long-term sustainability in the future. The key components of this integrated strategy are presented as follows.

Issue 1: Economic sustainability: enhancing the capacity of tourism service providers for efficient resource management

Tourism service providers, encompassing all twelve sectors of the tourism industry, represent a critical group within the tourism supply chain. These sectors utilize a wide range of resources and consume substantial quantities in the delivery of tourism services, making them a primary target of this strategic framework. Accordingly, the strategy emphasizes strengthening the knowledge and understanding of relevant stakeholders regarding the principles and operational approaches of the Bio-Circular-Green (BCG) economic model, enabling its adaptation and integration into existing operational processes. Such implementation contributes to the sustainable use of natural resources and environmental assets at the local level, thereby allowing Thailand to preserve high-quality tourism destinations that remain attractive and competitive in the long term.

To achieve this objective, the following goals are established:

1. Tourism entrepreneurs adopt clear, standardized operational guidelines aligned with the BCG economic model that can be flexibly adapted to suit specific business contexts.

2. Tourism entrepreneurs enhance business value while reducing carbon dioxide emissions and improving waste management practices through a comprehensive understanding of resource management concepts at both local and community levels.

The strategic implementation under Issue 1: Economic Sustainability comprises three core strategies:

1. Promoting sustainable business operations among tourism service providers (Operations);
2. Developing and upgrading tourism business standards in accordance with the BCG economic model (Standards);
3. Enhancing business capacity and strengthening knowledge related to efficient and sustainable resource utilization among tourism sector personnel (Knowledge).

Issue 2: Social and cultural sustainability: promoting the value and stimulating consumption of tourism products and services under the bcg concept

Encouraging tourism entrepreneurs and related stakeholders to transition toward operations aligned with the Bio-Circular-Green (BCG) economic model requires substantial investment in sustainable practices. Such investments can only be sustained if tourists likewise recognize and value these principles, thereby generating continued consumption of tourism products and services and fostering long-term economic circulation at the local level. This approach supports the practical implementation of circular tourism. Beyond promoting BCG-aligned operational processes among tourism providers, stimulating demand from tourists encourages healthy competition among entrepreneurs, accelerating the development of products and services that better respond to evolving tourist preferences. Accordingly, development in this area should focus on raising awareness among tourists and, most importantly, the general public regarding the significance of various forms of circular tourism, alongside fostering an environmental stewardship culture among local stakeholders. This process encourages a sense of ownership and collective responsibility for preserving cultural and environmental assets, protecting both present and future heritage from degradation.

The key objectives under this issue are as follows:

1. To cultivate a shared sustainability culture among stakeholders and promote comprehensive collaboration at the local level, while enhancing awareness and understanding of the core components of sustainable tourism under the BCG economic model.
2. To ensure that the government provides support mechanisms and policy incentives for tourism entrepreneurs and tourists who prioritize sustainable tourism practices.

The strategic framework under Issue 2: Social and Cultural Sustainability comprises two main strategies:

1. Communicating information to raise awareness among stakeholders, tourism entrepreneurs, and tourists (Awareness);
2. Establishing and enhancing incentive mechanisms to encourage stakeholders, tourism businesses, and tourists to prioritize sustainable tourism practices (Incentives).

Issue 3: Environmental sustainability: strengthening supporting factors to enhance resource management efficiency in the tourism sector. Beyond stimulating operational changes among tourism entrepreneurs and increasing demand from tourists, the effective implementation of circular tourism requires strong emphasis on the development of a comprehensive enabling ecosystem. This ecosystem reflects both the constraints and driving forces that determine whether policy implementation can be successfully realized in practice. Key elements include regulatory frameworks, laws, public policies, support measures, data systems, and collaborative networks that act as partners and leaders at multiple levels. In addition, the government must ensure the transparent and accurate dissemination of information to the general public and all relevant stakeholders. The objectives under this issue are defined as follows:

1. To review, revise, and improve relevant laws and regulations to enable tourism entrepreneurs and related agencies to effectively operate in alignment with the BCG economic model.
2. To integrate tourism-related data with BCG-oriented tourism development and establish inter-agency data governance mechanisms, enabling public agencies to jointly manage tourism sustainably, while also collecting and disseminating information for stakeholders interested in adopting the BCG framework.
3. To establish multi-sectoral collaboration networks involving government agencies, the private sector, and civil society, ensuring coordinated and connected implementation both within and across regions, ultimately contributing to national-level success in sustainable tourism development.

The strategic implementation under Issue 3: Environmental Sustainability comprises three core strategies:

1. Reviewing and revising regulations to promote sustainable tourism development (Regulations);
2. Developing research-based decision-support tools to enable informed and appropriate policy and national management decisions (Decision Support Tools); and
3. Strengthening the integration of data systems, digital technologies, and supporting infrastructure to enable BCG-oriented tourism development (Enablers).

DISCUSSION

Sustainable tourism is considered a fundamental principle of contemporary tourism promotion, as it represents a form of tourism that minimizes negative environmental impacts, maximizes benefits for local communities, and fosters sustainability across three key dimensions. Economic sustainability encompasses infrastructure development, service quality, labor conditions, and tourism-related occupations that support long-term economic resilience. Social and cultural sustainability emphasizes the preservation of local identity and traditional culture for both present and future generations, the prevention of social problems that may undermine community cohesion, and the cultivation of a

participatory culture in which stakeholders develop a strong sense of environmental stewardship and collective ownership, ensuring long-term protection against degradation. Environmental sustainability focuses on conserving natural resources, preventing environmental degradation and excessive waste generation, and reducing greenhouse gas emissions in alignment with Thailand's long-term climate targets, particularly the achievement of net-zero greenhouse gas emissions by 2065. This study finds that the most critical factor in integrating tourism development toward sustainability while achieving higher growth rates across all dimensions is the establishment of a shared culture and comprehensive understanding among all stakeholders regarding conservation, preservation, and responsible resource utilization. The social and cultural dimension emerges as the most sensitive scenario in the development of an integrated sustainable tourism model. Historically, Thailand has insufficiently emphasized this dimension, resulting in ineffective implementation, failure to achieve policy objectives, and an inability to realize long-term national development plans. In addition, sustainable tourism development requires the promotion of multi-dimensional collaboration networks with the active participation of all relevant sectors. The public sector should also ensure the adequate development of tourism infrastructure to meet the needs of target tourist segments, including accommodation facilities, transportation networks, public utilities, waste management systems, energy systems, and landscape management at tourism destinations.

Furthermore, careful prioritization of indicators used in scenario modeling is essential to prevent environmental degradation, particularly to ensure that greenhouse gas emissions do not exceed the carrying capacity of destinations before irreversible damage occurs. The government must therefore adopt clear and coherent strategies to simultaneously enhance sustainability across all dimensions. Although Thailand has introduced various initiatives—such as green tourism, community-based tourism promotion, assessments of urban carrying capacity, and policies to disperse tourists to secondary destinations—these efforts have lacked a clear long-term operational direction. Moreover, Thailand has long relied on outdated policy tools with high levels of error, leading to misaligned national governance outcomes.

The integrated modeling framework developed in this research provides a robust and practical tool that can significantly enhance national governance and support the successful achievement of sustainable tourism in Thailand over the long term. Under the recommendations of this study, the findings indicate that Thailand has not yet managed national development in an appropriately balanced direction, resulting in tourism growth that primarily benefits the economic sector while failing to foster social and cultural development and contributing to the continued degradation of the environmental sector. This research provides the government with an effective strategic management tool to support more accurate and appropriate policy formulation, thereby enhancing both efficiency and effectiveness in the future.

To achieve sustainable tourism development, growth across the three sectors; economic, social and cultural, and environmental, must occur simultaneously. The key recommendations are as follows:

1. Economic Sector: The government should promote greater access for local entrepreneurs to relevant business knowledge and operational principles related to tourism development. Priority should be given to accelerating the development of accommodation facilities that emphasize cleanliness and safety, enforcing appropriate occupational practices aligned with the characteristics of tourism destinations, and upgrading the quality and value of local souvenir products. In addition, local Thai lifestyles and community ways of life should be integrated as unique selling points to create added value, while cultural and traditional activities should be developed to enhance attractiveness for tourists. The government should also support the development of new tourism routes, such as community-based and experiential tourism, by actively encouraging community participation in tourism planning and implementation.

2. Social and Cultural Sector: The government should actively promote meaningful public participation in both the planning and implementation of tourism-related activities. This includes supporting local communities, citizens, and local administrative organizations in playing a direct role in public communication, as well as in the preservation and conservation of local wisdom and valuable cultural heritage. Efforts should focus on improving community well-being by maintaining traditional lifestyles, preserving local customs and cultural practices, and strengthening community identity so that cultural heritage is valued as a shared asset collectively owned and protected by community members, rather than merely as a public good accessible without responsibility. Furthermore, capacity-building programs should be provided to enhance community knowledge and understanding of sustainable tourism development, facilitate knowledge exchange in technology adoption, and strengthen networks with other local communities. The integration of efforts among relevant government agencies and collaboration with the private sector are also essential to ensure that communities play a meaningful role in tourism development and gain a deeper and more comprehensive understanding of sustainable tourism practices.

3. Environmental Sector: The government should enhance tourism routes and surrounding landscapes to ensure they are green, aesthetically pleasing, and well-organized throughout the entire area. Environmentally friendly tourism should be actively promoted through clearly defined guidelines and standards that can be implemented consistently and sustainably in practice. In addition, local communities should be educated on the conservation of natural resources and the environment within their own areas in order to foster environmental awareness, local stewardship, and a sense of responsibility toward their place of origin. Concrete environmental initiatives should be implemented, such as community waste bank programs, renewable energy projects at the community level, and tree bank schemes, alongside continuous efforts to cultivate environmental consciousness, particularly in relation to waste management and sustainable environmental practices. Public communication should also be directed toward tourists to promote environmentally responsible tourism behavior, while local residents and community leaders should serve as role models in environmental conservation.

Most importantly, the government must adopt proactive environmental measures, including the strengthening and enforcement of relevant laws and regulations. These measures must be clearly defined, enforceable, and effectively implemented to ensure tangible and lasting environmental sustainability outcomes. Regarding recommendations for applying this research, the researcher should carefully select indicators to ensure they are appropriate for each specific context. Importantly, all selected indicators must meet the same level of criteria or quality standards. Differences in quality levels may affect the accuracy of parameter estimation and could lead to significant spurious results. The researcher must also carry out every step with great caution in accordance with advanced statistical principles, giving particular consideration to maintaining the properties of white noise as much as possible. As for the limitations of this research, a major concern is the lack of existing studies in this field within the Thai context, as well as the absence of appropriate analytical tools that can effectively support evidence-based policy formulation and national planning.

As a result, Thailand has historically lacked accurate and suitable decision-making instruments, leading to misaligned governance directions and policy formulation. In practice, national policies have tended to prioritize economic growth as the primary objective, while insufficient attention has been given to environmental development alongside social progress. This imbalance has generated negative consequences, particularly the degradation of environmental systems and irreversible changes to social and cultural structures. Cultural values and traditions that have been altered or lost due to unsustainable development cannot be fully restored, similar to environmental resources that have deteriorated beyond recovery.

CONCLUSIONS

This study entitled A Causal Relationship Model of Social and Cultural Change Influencing the Future Success of Integrated and Sustainable Tourism Management in Thailand, developed and validated the Logit-PA model as an integrated analytical framework for examining the causal relationships among the social and cultural, BCG-economic, and pro-environmental sectors influencing sustainable tourism development in Thailand. The empirical findings demonstrate that the proposed model exhibits superior forecasting performance compared with conventional approaches, confirming its suitability for long-term policy analysis and strategic planning. The results further reveal that stakeholder participation within the social and cultural sector is the most influential factor affecting sustainable tourism success. At the same time, incorporating this variable into the proposed policy scenario substantially improves long-term environmental outcomes by reducing projected greenhouse gas emissions to a level consistent with Thailand's net-zero emissions target by 2065.

The study also demonstrates that sustainable tourism can only be achieved through the balanced integration of economic development, social and cultural preservation, and environmental protection under the principles of the BCG economy. Accordingly, enhancing the capacity of tourism service providers, strengthening stakeholder participation, promoting the consumption of sustainable tourism products and services, and improving environmental resource management should be implemented simultaneously to maximize policy effectiveness and long-term sustainability.

The principal contribution of this research lies in the development of a context-specific decision-support model that integrates quantitative forecasting with qualitative policy synthesis to support evidence-based national tourism planning. The proposed framework provides substantial practical value for policy formulation and implementation by enabling governments to identify high-impact policy priorities and evaluate alternative development scenarios with greater precision. Furthermore, although the model was developed within the context of sustainable tourism management in Thailand, its analytical framework may be adapted and applied to other development sectors and geographical contexts where integrated sustainability planning is required under changing future conditions.

Author Contributions: Conceptualization, N.P.A.R., J.S., C.J., D.T., and P.T.; methodology, N.P.A.R., J.S., C.J., D.T., and P.T.; software, N.P.A.R., J.S., C.J., D.T., and P.T.; validation, N.P.A.R., J.S., C.J., D.T., and P.T.; formal analysis, N.P.A.R., J.S., C.J., D.T., and P.T.; investigation, N.P.A.R., J.S., C.J., D.T., and P.T.; data curation, N.P.A.R., J.S., C.J., D.T., and P.T.; writing - original draft preparation, N.P.A.R., J.S., C.J., D.T., and P.T.; writing - review and editing, N.P.A.R. and P.T.; visualization, N.P.A.R. and P.T.; supervision, N.P.A.R. and P.T.; project administration, N.P.A.R. and P.T. All authors have read and agreed to the published version of the manuscript.

Funding: Not applicable.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study may be obtained on request from the corresponding author.

Acknowledgements: This research project was financially supported by Mahasarakham University.

Conflicts of Interest: The authors declare no conflict of interest.

Use of Generative AI: Not applicable.

REFERENCES

Ahmed, H. A. M., Zaki, K., Abdelghani, A. A. A., Abdelfadel, T. A., Abusalim, E., & Elnagar, A. K. (2025). Leveraging corporate social responsibility for sustainable performance: The mediating roles of green organizational culture and employee engagement under regulatory pressure. *Geojournal of Tourism and Geosites*, *62*(4), 2144–2157. https://doi.org/10.30892/gtg.62414-1580

Baltagi, B. H. (2021). *Econometric Analysis of Panel Data.* (6th ed.) Springer Nature, Syracuse, USA. https://doi.org/10.1007/978-3-030-53953-5

Byrne, B. M. (2001). *Structural Equation Modeling with Amos: Basic Concepts, Applications, and Programming (Multivariate Applications Series)*. Lawrence Erlbaum Assoc Inc. Publishers, Mahwah, New Jersey. https://doi.org/10.4324/9781315757421

Chongbut, T., & Chapman, W. (2021). Cultural tourism management for sustainable tourism in Krabi province, Thailand. *Dusit Thani College Journal, 15*(1), 1-19. (accessed on 15 October 2025). https://so01.tci-thaijo.org/index.php/journaldtc/article/view/24753

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica, 49(4)*, 1057–1072. https://doi.org/10.2307/1912517

Energy Policy and Planning Office. Commercial primary energy consumption for the period 2000-2023. (accessed on 15 October 2025). https://eppo.go.th/index.php/th/energy-information/static-energy

Harvey, A. C. (1980). *Forecasting, Structural Time Series Models and the Kalman Filter*; Cambridge University Press: Cambridge, UK.

Hasanein, A., & Ayad, T. (2025). Hospitality goes green: The role of employee environmental engagement in the relationship between green csr and environmental performance. *Geojournal of Tourism and Geosites, 62*(4), 2043–2052. https://doi.org/10.30892/gtg.62404-1570

Hoyle, R. H. (1995). *Structural Equation Modeling: Concepts, Issues, and Applications. Sage publications*, Thou- sand Oaks, California.

Joreskog, K. G., & Sorbom, D. (2012). *LISREL 9.1: LISREL syntax guide.* Chicago, IL, USA: Scientific Software International, Inc.

Junsiri, C., Sutthichaimethee, P., & Phong-a-ran, N. (2024). Modeling CO_2 Emission Forecasting in Energy Consumption of the Industrial Building Sector under Sustainability Policy in Thailand: Enhancing the LISREL-LGM Model. *Forecasting, 6(3)*, 485–501. https://doi.org/10.3390/forecast6030027

MacKinnon, J. (1991). *Critical Values for Cointegration Test in Long-Run Economic Relationships*; Engle, R., Granger, C., Eds.; Oxford University Press: Oxford, UK.

Ministry of Natural Resources and Environment. Available online: https://www.mnre.go.th/th/index, (accessed on 15 October 2025).

Muna, N., Subawa, N. S., & Martini, I. A. O. (2025). Drivers of green consumption among tourists in Bali: Insights from the theory of planned behavior. *Geojournal of Tourism and Geosites, 62*(4), 2086–2095. https://doi.org/10.30892/gtg.62408-1574

National Statistical Office Ministry of Information and Communication Technology. (accessed on 7 October 2025). http://web.nso.go.th/index.htm

OECD. (2025). Historical Crude Oil Import Prices (Indicator), Organization for Economic Co-operation and Development. (accessed on 15 October 2025). https://data.oecd.org/energy/crude-oil-import-prices.htm

Office of Natural Resources and Environmental Policy and Planning (DEDE). (2025). Long-term low greenhouse gas emission development strategy (revised version). (accessed on 9 October 2025). https://www.onep.go.th/

Office of the National Economic and Social Development Council (NESDC). (accessed on 12 October 2025). https://www.nesdc.go.th/nesdb_en/main.php?filename=index

ONEP. Thailand's Fourth Biennial Update Report, Office of Natural Resources and Environmental Policy and Planning. (accessed on 15 October 2025). https://www.onep.go.th

Praprom, C., & Laipaporn, J. (2023). Betong: A potential wellness tourism destination in the deep South of Thailand. *GeoJournal of Tourism and Geosites, 46*(1), 55-62. https://doi.org/10.30892/gtg.46106-1000

Salama, W. M. E., Khairy, H. A., Othman, I. M., Ibrahim, T. M. A. G., Farid, M. B., & Elbanna, S. S. S. A. (2025). Paradoxical leadership, green commitment, and green self-efficacy: The mediating and moderating pathways to green innovative work behavior in the tourism and hospitality businesses. *Geojournal of Tourism and Geosites, 62*(4), 2376–2389. https://doi.org/10.30892/gtg.62433-1599

Sutthichaimethee, P., Sa-Ngiamvibool, W., Wattana, B., Luo, J., & Wattana, S. (2025) Enhancing Sustainable Strategic Governance for Energy Consumption Reduction Towards Carbon Neutrality in the Energy and Transportation Sectors. *Sustainability, 17*, 2659. https://doi.org/10.3390/su17062659

Thai Travel Agents Association, Ministry of Tourism and Sports. (2025). Sustainable Tourism. (accessed on 10 October 2025). https://ttaa.or.th/page/Sustainable%20tourism%20/en

Thailand Greenhouse Gas Management Organization (Public Organization). (2025). Net-zero GHG Emissions. (accessed on 15 October 2025). https://thaicarbonlabel.tgo.or.th/tools/files.php?mod=YjNKbllXNXBlbUYwYVc5dVgyUnZkMjVzYjJGaw&type=WDBaSlRFVlQ&files=TkRrPQ

The World Bank: Energy Use (Kg of Oil Equivalent Per Capita) Home Page. (accessed on 10 October 2025). https://data.worldbank.org/indicator/EG.USE.PCAP.KG.OE

Tourism Authority of Thailand. (2025). *Internal tourism situation.* (accessed on 15 October 2025). https://intelligencecenter.tat.or.th/articles/7805

Tuan, L. P., Tien, N. D., & Nihei, T. (2025). Evaluating the potential of community-based ecotourism as a pathway to sustainable development in a protected area: A case study of Xuan Thuy National Park, Vietnam. *Geojournal of Tourism and Geosites*, *62*(4), 2466–2477. https://doi.org/10.30892/gtg.62441-1607

United Nations Framework Convention on Climate Change, UNFCCC, (2014). The Paris Agreement: An Early Assessment. *Environmental Policy and Law, 44*, 485-488, Bonn, Germany.

United Nations Framework Convention on Climate Change. (2016). UNFCCC, Global Progress in Environmental Law. *Environmental Policy and Law, 46*, 23-27, Bonn, Germany.

United Nations World Tourism Organization (UNWTO). (2024). World Tourism Barometer. (accessed on 17 October 2025. https://www.unwto.org/un-tourism-world tourism-barometer-data

United Nations World Tourism Organization (UNWTO). (2025). *International tourism highlights*, 1134-1136, UNWTO, Madrid.

Winyuchakrit, P., Limmeechokchai, B., Matsuoka, Y., Gomi, K., Kainuma, M., Fujino, J., & Suda, M. (2021). Thailand's low-carbon scenario 2030: Analyses of demand side CO_2 mitigation options. *Energy for Sustainable Development, 15(4)*, 460–466. https://doi.org/10.1016/j.esd.2011.09.002

World Economic Forum. (2024). How travel and tourism can reach net zero. (accessed on 11 October 2025). https://www.weforum.org/agenda/2024/01/travel-tourism-industry-net-zero/

World Travel & Tourism Council. (2025). Travel & Tourism: Global Economic Impact and Issues 2018. (accessed on 25 October 2025). https://www.wttc.org/research/economic-research/economic-impactanalysis/#undefined

Xiao, Y., Yang, C. X., Yang, H., Wattana, S., & Wattana, B. (2025). Policy-driven development of electric and hydrogen fuel cell vehicles for low-carbon transition in Hainan Province. *International Journal of Sustainable Development and Planning, 20*(6), 2257-2268. https://doi.org/10.18280/ijsdp.200601

Article history: Received: 25.12.2025 Revised: 08.04.2026 Accepted: 04.07.2026 Available online: 06.08.2026