International Journal of Applied Economics, Finance and Accounting
ISSN 2577-767X
Vol. 16, No. 1, pp. 33-42.
2023
DOI: 10.33094/ijaefa.v16i1.882

Tourism sustainable competitiveness indicator for ASEAN bloc: A random forest approach

Ann-Ni Soh[1]
Chin-Hong Puah[2*]
Mohammad Affendy Arip[3]

[1,2,3]*Faculty of Economics and Business, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Malaysia.*
[1]*Email: ann_ni0303@hotmail.com*
[2]*Email: chpuah@unimas.my*
[3]*Email: amaffendy@unimas.my*

Keywords:
Competitiveness
Sustainable competitiveness
Sustainable development goals
Sustainable tourism
Tourism indicator.

JEL Classification:
C34; D41; O49; Q01; Z30.

Received: *5 December 2022*
Revised: *16 February 2023*
Accepted: *10 March 2023*
Published: *24 March 2023*
(Corresponding Author)*

Abstract

This study aims to reveal the tourism performance among ASEAN countries by creating a tourism sustainable competitiveness indicator (TSCI). This study introduces an ensemble random forest approach in developing an integrative framework that incorporates tourism, sustainability and competitiveness. It demonstrates the management of multi-faceted tourism development with the constructed indicator. Six main enablers have been identified for TSCI indicator, including policy and regulatory environment, environmental sustainability, socio-cultural sustainability, economic sustainability, infrastructure, and intellectual capital and innovation. As a benchmarking tool for policymakers, organisations, and tourism-related authorities in the implementation of policies and business or marketing strategic planning, the sustainable competitiveness indicator for tourism identified the factors that affect the sustainability and competitiveness of tourism. This indicator enhances the tourism value chains in the Association of Southeast Asian Nations (ASEAN) bloc, as well as it offers significant assistance to the ASEAN Tourism Strategic Plan of 2025. Especially in the context of regionalization, which proceeds along the same trajectory as tourism, it is becoming increasingly significant in building areas of cooperation in the connected Southeast Asian region. Thus, measuring the performance level of the tourism economy is a critical agenda that is worthy of receiving concern as a means of accomplishing sustainable development goals (SDGs).

Funding: This research is supported by Universiti Malaysia Sarawak (Grant number: F01/PGRG/2044/2020).
Competing Interests: The authors declare that they have no competing interests.

1. Introduction

Environmental management is becoming more crucial with the rise of green tourism to reduce any negative organisational effects on the environment. Despite its significant role, the green tourism remains a challenge because the goal is intensive competitiveness. Both the destination countries and organisations must remain competitive and embracing tourism because it is a mean of accomplishing the sustainable development goals (SDGs) to reduce poverty, promote good health, provide access to equitable education, promote gender equality and provide decent employment for the community by ensuring sustainable economic growth. Analysing the factors that affect competitiveness and the sustainable environment of tourist sites should be done in the same vein. Past literature on tourism competitiveness and sustainable tourism are solely familiarized among scholars, however, the dichotomy raises the issue that whether competitiveness and sustainability can coexist.

There were 1.4 billion foreign arrivals in 2019, contributing USD 1.7 trillion to the total international tourism exports that year. This steady rise of tourism worldwide welcomed the ongoing expansion of the global economy. Meanwhile, tourism contributed 10.3% of global gross domestic product (GDP) and 330 million jobs globally, accounting for 1 in every 10 jobs. In 2019 tourism was accounted for 6.8% of total exports and 28.3% of global service exports. (WTTC, 2020). Based on such contribution, it is convincing that tourism is one of the vital contributors in diversify the exports that can lead to a higher economic growth for both advanced and non-advanced economies. The sector of tourism is resilient to occasional shocks as it always claimed the capacity to

rebound. The current research relies on the Association of Southeast Asian Nations (ASEAN), 10-member regional bloc with the third largest population in the world. According to the ASEAN Business Council, ASEAN owned a combined GDP of 2.8 trillion USD and the majority of its member countries contributed more than 10% of GDP from the tourism sector. There is a need to consolidate the previous initiatives and move towards a tourism destination that harmonised the concept of sustainable competitiveness building on the momentum of the ASEAN Tourism Strategic Plan (ATSP) 2016-2025.

Despite the multiple external shocks ranging from health concern to natural disasters, tourism remains vulnerable but always bounced back. This proves that tourism sector has its unique characteristics which are resilient and always have the capacity to rebuilt. In fact, despite some significant setbacks, such as the effects of the September 11 attacks in 2001, SARS in 2003, and the global economic crisis in 2009, international travel has continued to rise. The speedy recovery in the following years build resilience in all economies which make it an important sector. COVID-19 pandemic has been unprecedented crisis to the tourism sector with the relevant economy sectors and jobs crisis. The extensive impacts from COVID-19 pandemic outbreak in the year end of 2019 is significant across world. In the first quarter of 2020, the reports from UNWTO showed that there is 22% of sharp decline in international tourist arrivals. UNWTO also claimed that there are possible scenarios for an annual decline of 60% to 80% based on the pace of easing travel restrictions. Tourism, as one of the worst-affected sectors has urged the governments to deploy measures targeting directly on it. Due to its labor-intensive nature, it is crucial to enhance the participation of stakeholders in reinforcing the tourism-targeted policies, particularly in those countries where tourism has a significant role in the economic stability.

Given their significance to the economy, these two dimensions must be jointly examined for the implementation of future policies. Thus, this study has highlighted the lack of a comprehensive overview of the trinity (i.e., sustainability, tourism and competitiveness, which are rarely combined in the literature); on the other hand, this study describes construction of the Tourism Sustainable Competitiveness Indicator (TSCI) and incorporates use of an ensemble random forest algorithm that can handle complex data with ease; see Figure 1. Furthermore, an intra-country analysis of tourism performance level is also needed to enhance economic convergence and reduce the development gap within the region. The TSCI can help to elevate the industry value chains in the ASEAN bloc to a higher accessibility and sustainability level. In short, the general objective of this paper is to reveal the tourism performance among ASEAN countries by constructing tourism sustainable competitiveness indicator (TSCI). Specifically, the level of tourism sustainable competitiveness performance across different countries with individual index score can be quantified respectively. Meanwhile, a comparison of tourism performance and number of international tourist arrivals among ASEAN countries can be measured. Furthermore, the random forests regressor is explored with an objective, which in turn, the number of candidate explanatory variables can be analyzed using variable importance index.

2. Literature Review

The United Nations World Tourism Organisation's (UNWTO) defined sustainable tourism from three key sustainable aspects which covered the perspective from socio-cultural, economic and environmental side to ensure a long-term growth. The World Economic Forum (WEF) defined term of competitiveness as the ability of a country to produce goods and services and sale them in the market with different and unique ways than their competitors. Nonetheless, it is vital to investigate the indicators that are quantifiable in measuring the sustainable tourism and its competitiveness. Tourism is tradable to generate foreign exchange, Crouch and Ritchie (1999) argued that the comparative advantages theory can be applied to tourism competitiveness. Thus, the dimensions comprising price competitiveness and international price values have been identified. The Heckscher-Ohlin theory further emphasized that an economic comparative advantage rooted in factor endowments including, land, labour capital and accessible resources in a country (Gooroochurn & Sugiyarto, 2005). Several broad categories of factor endowments, including human resources, infrastructure, intellectual capital resources, technology, research and development, biodiversity and natural resources, have been identified in this study, consistent with Evans (2016) and Mendola and Volo (2017). Amoako, Agbemabiese, Bonsu, and Sedalo (2022)discovered that using green advertising can give the hotel industry a long-term competitive advantage. Meanwhile, Asmelash and Kumar (2019); Seguí-Amortegui, Clemente-Almendros, Medina, and Grueso Gala (2019) and Streimikiene, Svagzdiene, Jasinskas, and Simanavicius (2021) highlighted the importance of embracing the sustainability element, which assists in tangible management strategies and acts as an important element in determining tourism growth.

Balkyte and Peleckis (2010) in agreement with a recent study conducted by recognized the mutually reinforcing linkages among those countries possessing sustainable development and competitiveness as depicted by El-Aidie, Alseiari, and Khalifa (2021). Even though the importance of the concept "sustainable competitiveness" was identified, there is a need of research initiatives to focus on the interactions among tourism, sustainability, and competitiveness. Apart from addressing the needs of tourists, the environment, the industry, and the host communities, sustainable tourism embraces the economic, social, and environmental impacts for today and for future. Environmental attitude (Asmelash & Kumar, 2019; Mohaidin, Wei, & Ali Murshid, 2017) and word-of-mouth play a significant role for tourists in choosing sustainable tourism destinations. Contrary, Mohaidin et al. (2017) also revealed that both the destination image and perceived service quality have no significant impact on sustainable tourism destinations. A noble approach to the field of sustainability offered by

Postma, Cavagnaro, and Spruyt (2017) found the connection among the core concepts of sustainability and foresight for business identity. Their study incorporates social, environmental, and economic added value into firm strategic planning. Furthermore, Athanasopoulos, Song, and Sun (2017) proposed bagging in tourism demand modelling and forecasting for Australia over the period 1981-2012. The researchers employed methodologies including general-to-specific approach, measure of predictive accuracy (MPA), and the bagging forecast. The indicators utilized in the study comprising the details of tourist arrivals, consumer price index, exchange rate, gross domestic product, interest rate, government bond, dummy for 9/11 incident and the Sydney Olympics. Meanwhile, Athanasopoulos et al. (2017) strongly recommended that the application of machine learning procedure, especially the broad variable selection procedure for the adoption in the field of tourism studies. Consistent with previous literature in practical stock investment, recent study done by Tan, Yan, and Zhu (2019) also remarked an annual return of 84.9% in the strategy performance for China. It is once again proved that the machine learning model can be economically explained.

Apart from tourism studies (Agyeiwaah, McKercher, & Suntikul, 2017; Font et al., 2021; Ivars-Baidal, Vera-Rebollo, Perles-Ribes, Femenia-Serra, & Celdrán-Bernabeu, 2021; Soh, Puah, & Arip, 2020) the composite indicator approach was popularized in the business (El Gibari, Gómez, & Ruiz, 2019; Karakostas, 2022) and in the financial context (Kuek, Puah, & Arip, 2020). The TSCI distinguishes six tourism sustainable competitiveness dimensions, thereby enabling specific and comparative analysis among the ASEAN member countries. Indicatively, the set of factors influencing tourism sustainable competitiveness performance comprised of six enablers which are policy and regulatory environment, environmental sustainability, socio-cultural sustainability, economic sustainability, infrastructure, and intellectual capital and innovation as shown in Figure 1. The performance indicator for ASEAN countries, in which, Brunei Darussalam, Indonesia, Cambodia, Lao People's Democratic Republic (Lao PDR), Myanmar, Malaysia, Philippines, Singapore, Thailand, and Vietnam are accompanied by an extensive data covering multi-dimensional phenomena of tourism sector.

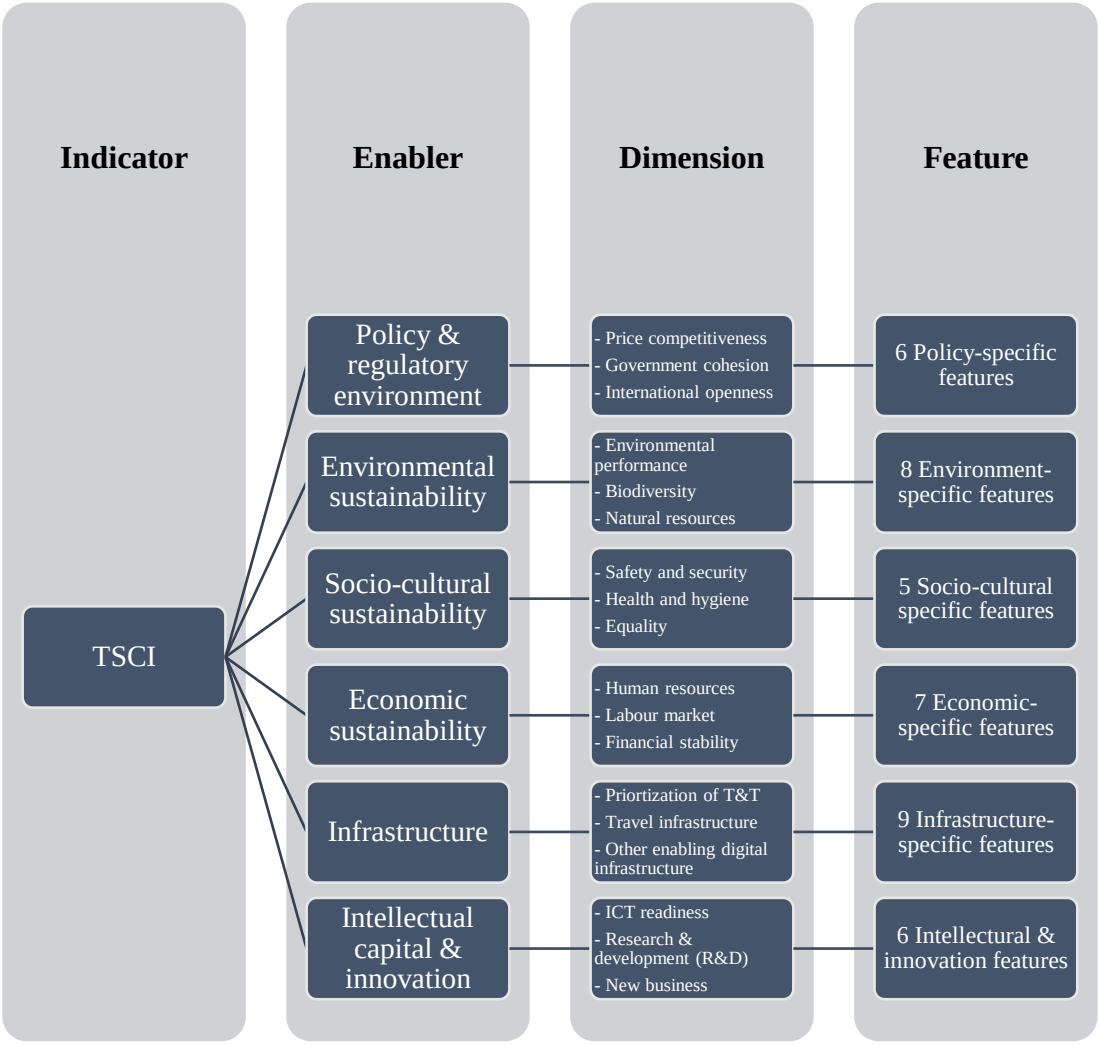

Figure 1. The tourism sustainable competitiveness indicator framework.

2.1. Policy and Regulatory Environment

Ideally, tourism sustainable competitiveness should capture price competitiveness, government cohesion and international openness (Escoto, Boza, & Madrigal, 2019; Khalifa, 2020). Purchasing power parity reflects differences in the cost of goods and services in the country, tax payments are those profits (Mendola & Volo, 2017) which are imposed on tourists, and transportation costs required to be undertaken (Khan, Bibi, Lorenzo, Lyu, & Babar, 2020; Zhao, Li, & Yu, 2017). Relating to the government cohesion dimension, government budget allocation plays a significant role in inducing the positive net effects on tourism. Moreover, government spending on the military lessens the destructive impacts from terrorism-related incidents (David, 2017) which has positive net effects on tourism. Higher educational budget may foster a knowledgeable community (Blancas, Lozano-Oyola, González, & Caballero, 2016; Lopes, Muñoz, & Alarcón-Urbistondo, 2018) and most significantly, health spending, which indicates how eager the government is to support local communities by investing in the medical sector, particularly when a health crisis occurs. (Azqueta-Gavaldón, 2017). Economic progress is also related with trade openness and the existence of numerous regional trade agreements, indicating the degree to which a nation is shielded from outside interference (Azqueta-Gavaldón, 2017; WEF, 2019).

2.2. Environmental Sustainability

In this era of environmental consciousness, any tourism destination that wants to remain competitive must acquire a strategy for sustainability. The environmental dimension captures the physical environment and the extent to which related awareness exists in management (Escoto et al., 2019; Khalifa, 2020). Within this enabler, the dimensions of environmental performance, biodiversity, and natural resources have been identified. The measurement of environmental performance comprises of the energy use per capita kilograms (Carrillo & Jorge, 2017; Khan et al., 2020; Postma et al., 2017) carbon dioxide emissions, and percentage of population with access to electricity. The inclusive of energy and electrical consumption implies the actual demand of energy used in a nation. Increment in energy consumption will negatively affect the tourist arrivals, in which calling for increase attention towards energy efficiency improvement and energy diversity (Nepal, Indra al Irsyad, & Nepal, 2019). The dimension identifies forest rents (WEF, 2019) number of threatened species including flora and fauna, vertebrates and invertebrates, number of world heritage natural sites, total protected areas, participation rate in multilateral environmental agreements and total natural resources rents in the level of tourism sustainable competitiveness. The features inclusion is consistent with the study done by Blancas et al. (2016) and recently Camisón (2020) also enhanced the convergence of environmental competitiveness in ensuring their alignments towards the sustainability in tourism.

2.3. Socio-Cultural Sustainability

The issue of socio-cultural sustainability needs to be addressed when it evokes societal concern during present time or in the future time (Asmelash & Kumar, 2019). Embracing the complexity of socio-cultural development has also taken a mean in accomplishing the Sustainable Development Goals (SDGs) to achieve a better future for all. Specifically, the global challenges of inequality, peace and justice were undertaken in this study. A safe and secure environment is one of the driving forces behind the socio-culture's commitment to improve its sustainability and public awareness (Blancas et al., 2016; Postma et al., 2017). The tourism experience is subjected to the quality of life at the tour destination (Boluk, Cavaliere, & Higgins-Desbiolles, 2019; WEF, 2019). The complexity of socio-cultural development encompasses the homicide rate, absence of violence, child mortality rate, prevalence of human immunodeficiency viruses (HIV), gender parity index and women and business and law indicators to improve performance related to SDGs and achieve a better and more sustainable future for all. Meanwhile, healthcare availability and advancement can nurture the development of medical tourism as well as they ensure the tourists' ease while travelling in-case of any emergency (Azqueta-Gavaldón, 2017; Martín, Mendoza, & Román, 2017; Mendola & Volo, 2017).

2.4. Economic Sustainability

In ensuring practices that support economic growth over time, comparative advantages in the context of human resources suggest greater potential growth in the future (Asmelash & Kumar, 2019). Meanwhile, the adoption of these dimensions also highlights the SDGs on quality education, decent work and gender equality. The features encompass adult literacy, school life expectancy, mean years of schooling (David, 2017) employment in the travel and tourism sector and the youth dependency ratio (WEF, 2019). Furthermore, the diverse female labor participation urged the concern from the government as well (Boluk et al., 2019). Over the last century, female labor participation has been raised and it is one of the most remarkable economic developments. Apart from that, a high youth dependency ratio also implies the need of higher investments in schooling, however, they are economically inactive. That's why, at it is critical to ensure the sustainable competitiveness of the country.

2.5. Infrastructure

Sustainable competitiveness is also related to the development of infrastructure, represented by airport density, automated teller machines per adult population and number of hotel rooms that are feasible and accessible for tourists. It is undeniable that the airport density, automated teller machines per adult population,

and number of hotel rooms may influence travelers' decisions when selecting a tourism destination. (Ampountolas, 2018; Carrillo & Jorge, 2017; Jong, Puah, & Arip, 2020) and thus it is crucial in tourism growth and competitiveness. This may influence tourists' utility curve in their travel destination. The travel infrastructures are important in optimizing the number of people, retention of tourists, increase international openness, and enables people to travel in a more convenient way. Failure in addressing these challenges may cause a reduction in tourism competitiveness and hurting the industry. Prioritisation in travel and tourism, comprising the capital allocations in this sector, indicates the relative importance of the tourism sector in government budgeting. The international internet bandwidth per internet user and online service index score for E-government, on the other hand, have been acknowledged as other key variables to capture tourists' satisfaction level; these mobile applications are made available by other enabling digital infrastructure (Escoto et al., 2019).

2.6. Intellectual Capital and Innovation

In line with the UNWTO's pillar of tourism competitiveness, information communication technology (ICT) readiness and innovation research is conducted to ensure that the country remains competitive. In offering high-quality products at low cost, innovation comes into this practice to respond to the competitive demands. The intellectual capital is a vital asset in creating value-added to the existing economic syndrome. Mobile social media penetration, broadband internet subscribers, cybersecurity, tertiary education enrolment, new business registered and trademarks have been included as features in constructing the TSCI for ASEAN member countries. This is because there are numerous chances for tourists to gather information before travelling, this may promote user-friendly benefits and allow them to plan for entire travel without further delay. Thus, ICT readiness as a factor of tourism competitiveness and the existence of positive interdependence among ICT readiness and tourism competitiveness are solid (Lopes et al., 2018). A new analytical business model or trademarks literally improve the tourism competitiveness. Boluk et al. (2019) emphasised that a highly innovated industry advanced by researchers, especially in tertiary education, can further enhance the sustainable competitiveness of a tour destination.

3. Methodology

As indicated previously on the features and dimensions of each enabler of tourism sustainable competitiveness, six main enablers with total 41 features were identified to apprehend the multi-faceted nature of tourism. A more detailed account of the procedure used in computing the six indexes and an aggregate TSCI is provided in this section. Across all the identified features, the data employed in the construction of TSCI are published by various institutions, including the World Bank, CEIC Database and World Travel and Tourism Council (WTTC).

To ensure this information that the indexes are comparable across countries as emphasised by the WEF (2019) Travel and Tourism Competitiveness Index Report, a similar methodology has been employed. The steps for data normalisation and data aggregation portrayed in Figure 2 were utilised in this study. Despite the usefulness of an aggregate index in representing overall tourism sustainable competitiveness performance, each of the enablers identified carries different importance in determining the performance level of the tourism destination. As a result, combining the six indexes without properly assigning weights to them does not make sense. To address this issue, the so-called Gini significance for classification, the average impurity reduction for regression forests, and an eminent variable important metric in random forests have all been developed. In this research, a splitting measure which is the Gini index or Gini impurity of the random forest technique is utilised to demonstrate the relative importance of features in the aggregate index. The assessment of variable importance using the random forest approach has been carried out using R programming language and software.

In this study, each index takes a value between zero and one or zero and 100 in percentage forms by employing the Min-Max normalization method. The general formula for the features that are perform "better" with higher values, in which satisfactory outcomes are taken as:

$$N_i^c = \frac{X_i^c - min_c X_i^c}{max_c X_i^c - min_c X_i^c} \quad (1)$$

Meanwhile, for those features that imply "worse" scenario with higher values, they indicate the bad outcomes , the general formula is then reversed as:

$$N_i^c = \frac{max_c X_i^c - X_i^c}{max_c X_i^c - min_c X_i^c} \quad (2)$$

where the normalized coefficient, N_i^c is portrayed for the country c and variable i, with the indication of maximum and minimum value in the selected feature. Equations 1 and 2 present the normalization formula that allow the data transformation and obtain a value between zero and one, to ease the comparison more than two data sets with different scales.

The next step is to aggregate the index across each of the six enablers or 18 dimensions using the selected features from the preceding section. The data aggregation process is undertaken by using the following formula:

$$y_k^c = \frac{1}{n_k} \sum N_i^c \quad (3)$$

$$w_i = \frac{|B_i|}{\sum |B_i|} \text{ where } \sum w_i = 1 \quad (4)$$

Where y_k^c is the composite index k (k refers first to sixth dimensions), and the number of features in k represented by n_k. Despite the usefulness of the index construction steps in the previous studies, this study specifically employed the weighting component, w_i before the last step which is aggregating the six enablers into one aggregate of tourism sustainable competitiveness performance indicator. Equation 3 implies the summarization and aggregation process for a large pool of data to allow further analysis. Equation 4 presents the assignment of the selected features, in terms of the feature importance score among the other variables. Next, the aggregate TSCI is given using the following step:

$$z^c = \sum w_i y_k^c \quad (5)$$

Where w_i represents the weightage associated with each dimension obtained through the feature importance score using random forest model. Equation 5 denotes the aggregation score of the selected features to ease the interpretation and smoothen the comparison process among ASEAN countries. The TSCI construction methodology has been summarized into five steps that portrayed in the schematic representation including data treatment, data normalization, data aggregation, weighting, and indices aggregation; see Figure 2.

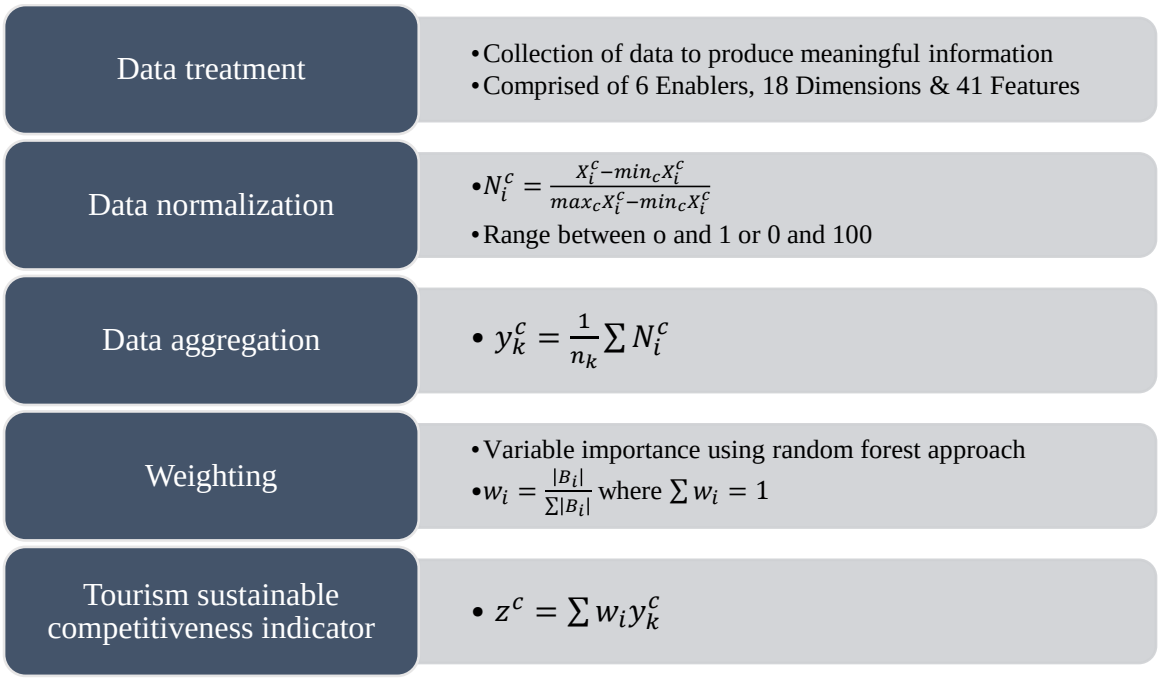

Figure 2. Schematic representation of the tourism sustainable competitiveness indicator construction approach.

In ensuring acceptance of the overall model, the mean squared error (MSE) and the percentage of variance explained are identified. Each variable can be evaluated once the overall model is acceptable with low MSE to ensure its accuracy. The constructed TSCI is described in more detail in the research's next section. The intra-country analysis for ASEAN member countries is also feasible and accessible upon construction of TSCI and the cluster profiling of the countries has been distributed according to the Global System for Mobile Communications (GSMC) Intelligence. Cluster analysis is performed in this study rather than analysing the sustainable and competitiveness levels separately.

4. Findings and Discussions

The distribution of the TSCI across ASEAN member countries indicates that the number of international tourist arrivals is not consistent with the sustainable competitiveness level of the destination countries. Although Thailand welcomed the highest number of tourist arrivals (38.3 million) among ASEAN members, its TSCI's performance level (54.6 score index) is less satisfactory than that of Vietnam and Singapore (57.6 and 79.5 score index respectively), which attracted fewer tourist arrivals; see Figure 3. Generally, the competency level for ASEAN members is relatively low despite the overwhelming attractiveness of the destination. Contrary, Singapore owned the highest TSCI score (79.5 score index) although Singapore recorded only 18.5 million of international tourist arrivals. In such cases, the tourism value chains in the ASEAN bloc require key investment in their respective enablers based on their current tourism performance level. Therefore, the TSCI as a strategic benchmarking tool is vital for serving the needs of the community and society to ensure innovation and profit.

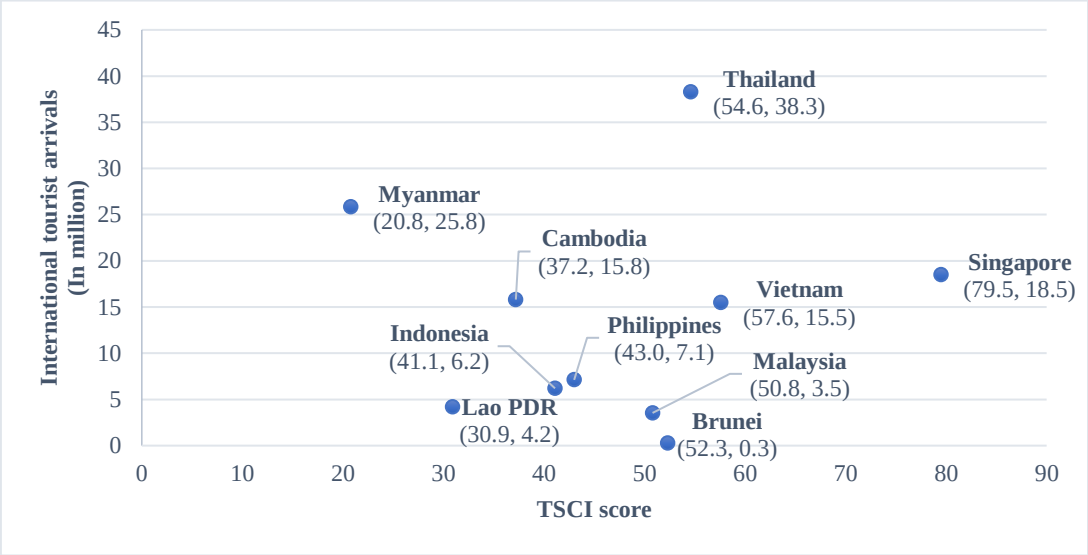

Figure 3. Tourism sustainable competitiveness indicator versus international tourist arrivals.

The usefulness of a composite indicator in tourism performance evaluation and anticipating future scenarios has been widely acknowledged (Martín et al., 2017; Mendola & Volo, 2017; Soh et al., 2020). An evaluation of the varying importance among the selected enablers must be done in order to disclose the relative performance of each enabler that communicates rich and pertinent information. The random forest algorithm was utilised to demonstrate the relative importance in the aggregate index of TSCI. The MSE is 0.0003, showing that the difference between predicted and actual values has an acceptable fit. The percentage of variance explained indicates that 97.98% of the model can be understood using the enablers selected in this study; see Figure 4 and Table 1. Each enabler can be now evaluated according to the algorithm that is accepted and validated everywhere. Empirical analysis found that the enabler of economic sustainability has the highest weights, while environmental sustainability had the lowest. The results can be interpreted as investment in the intellectual capital and innovation enabler having reinforcing effects on the overall economy.

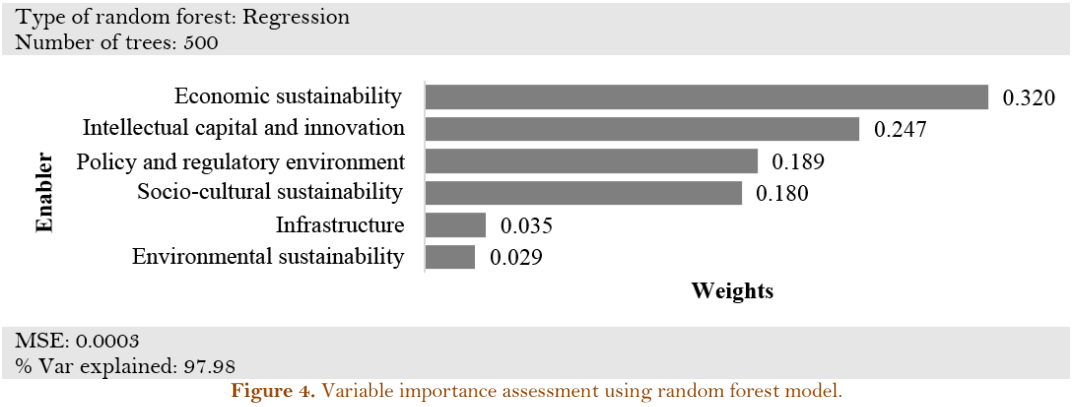

Figure 4. Variable importance assessment using random forest model.

Despite previous studies done by Camisón (2020) that emphasised on the convergence of economic, social and environmental competitiveness in ensuring their alignments towards the sustainability, this paper shed the light on the importance of intellectual capital and innovation in fostering the sustainable competitiveness in a nation. This analysis finding is consistent with Boluk et al. (2019) in which, the researchers stated that one of the remedial measures which could draw the public into the sustainability concern is the development of intellectual capital.

Table 1. Summary of results from the tourism sustainable competitiveness indicator.

Enabler	Mean	SD	Countries
Policy and regulatory environment	41.4	16.7	ASEAN countries (Singapore, Vietnam, Thailand, Brunei Darussalam, Malaysia, Philippines, Indonesia, Cambodia, Lao PDR, Myanmar)
Environmental sustainability	70.4	7.6	
Socio-cultural sustainability	57.2	18.1	
Economic sustainability	45.5	16.5	
Infrastructure	21.1	9.1	
Intellectual capital and innovation	37.3	20.9	

The findings revealed that the mean score for the environmental sustainability enabler is the highest despite having the lowest weights assigned earlier. This finding is consistent with Escoto et al. (2019) who urged the authorities to focus more on environmental care. Among ASEAN countries, the infrastructure enabler achieved the lowest mean score, indicating that the capital allocation in tourism is at a less satisfactory level. Surprisingly, the environmental focus on conservation and preservation of the biodiversity and natural resources achieved the highest mean score among the other enablers. Long-term competitiveness in ASEAN countries as a tourist destination may be undermined by bottlenecks unless appropriate policy and investment are applied in travel infrastructure.

Table 2. Clusters' definition.

Advanced	**TSCI score > 75**
• Perform satisfactory across all enablers and have very high level of sustainable competitiveness. • Singapore	
Transitioners	**TSCI score > 50**
• Perform satisfactory on three enablers and usually have high potential in sustainable competitiveness. • Vietnam, Thailand, Brunei Darussalam, Malaysia	
Emerging	**TSCI score > 35**
• Perform less satisfactory on one or two enablers but having room for improvement on others. • Philippines, Indonesia, Cambodia	
Discoverers	**TSCI score > 35**
• Perform less satisfactory on one enabler and have correspondingly low levels of sustainable competitiveness. • Lao PDR, Myanmar	

Table 2 presents Singapore solely among ASEAN countries have been clustered as advanced category with TSCI score more than 75, in which, Singapore performs satisfactory across all enablers. This is consistent with the findings obtained by Martín et al. (2017) where Singapore is one of the most competitive countries in the world. Martín et al. (2017) further justified that all the competitive countries are considered as high-income countries.

Table 3. Cluster profiling.

Cluster	Policy & regulatory environment	Environmental sustainability	Socio-cultural sustainability	Economic sustainability	Infrastructure	Intellectual capital & innovation
Advanced	81.6	77.3	87.9	79.2	31.2	73.0
Transitioners	46.2	69.7	61.7	51.9	20.8	47.2
Emerging	29.5	70.4	52.5	41.1	23.4	28.3
Discoverers	29.5	68.4	39.6	22.7	13.2	13.3

Instead of emphasising each country in isolation, the results presented in the form of a cluster are preferable; see Table 3. As GSMC Intelligence suggested, the groups have been redefined for suitability in the current study, referring to the TSCI score. Singapore, as a more advanced developing country, plays a leading role in maintaining the tourism sustainable competitiveness level when compared to the rest. Cluster profiling portrays the performance for eight enablers in implementing effective policies. It provides a better understanding for the cluster's portfolio where the emphasis is put on different enablers to enhance future development. Among four clusters, the infrastructure enabler makes the least difference in the TSCI score, whereas the policy and regulatory environment makes the vivid difference. In such cases, the tourism value chains based on their current performance level, the ASEAN bloc has to make significant investments in each of their various enablers.

5. Conclusion

This paper highlights the trinity of tourism, sustainability and competitiveness. The innovative methodology that is using an ensemble learning method that is used to resolve the issues in the process of this research the large numbers of features are used to consolidate complex relevant macroeconomics and tourism-specific data. This study also introduced some ways that place the relevant indicators together and eventually allow effective policy implementation by using the available information. Six main enablers have been identified for TSCI measurement, including policy and regulatory environment, environmental sustainability, socio-cultural sustainability, economic sustainability, infrastructure, intellectual, capital and innovation. This study benefits the sustain growth of the nation. The determination of the tourism sustainable competitiveness performance indicator provides unique insights towards tourism areas their development and in this way, it enhances the tourism competitiveness of ASEAN countries. The inter- and intra-country analysis aims to enhance the economic convergence and reduce the development gap within the ASEAN region. Moreover, it is

a platform for policymakers' dialogue to formulate appropriate policies and remedial measures for ASEAN countries individually.

From the current study, the fundamental elements that significantly influence the sustainable competitiveness of tourism can be revealed. Those factors are identified that affect the international tourist arrivals makes TSCI as an effective tool in policy implementation and business or marketing strategic planning. Such detailed analysis of the strategic benchmarking tool allowed policymakers to make pertinent policies through improving the tourism areas and to propel the member countries towards sustainable tourism destinations. Furthermore, the benefits gained from this study are also inclusive for the tourism industry players or stakeholders in designing the marketing strategy and managing future exploration when the needs are identified. The TSCI could also benefit the community, economy and nation through intensifying regional research and development. Having the information on the tourism performance level, it is possible to minimize the impacts of uncertainties or economic crisis by implementing or altering the policies for the respective countries. In line with accomplishing SGDs, this study also aims to reduce poverty, promote equitable quality education, health and hygiene to ensure the sustainable growth of the nation. Nonetheless, in the light of the interconnectedness and complexity of these features that influence tourism sustainability and competitiveness, tourism-related agencies and industries cannot tackle these issues in isolation. Cross-country collaboration, public-private engagement and the understanding of development or performance gaps must be established to ensure the sustainability of the tourism sector. The construction of TSCI also applies to the rest of the ASEAN countries as the method is comparable when it is applied across the countries.

References

Agyeiwaah, E., McKercher, B., & Suntikul, W. (2017). Identifying core indicators of sustainable tourism: A path forward? *Tourism Management Perspectives*, *24*, 26-33. https://doi.org/10.1016/j.tmp.2017.07.005

Amoako, G. K., Agbemabiese, G. C., Bonsu, G. A., & Sedalo, G. (2022). A conceptual framework: Creating competitive advantage through green communication in tourism and hospitality industry. In (pp. 95-117). Cham: Springer International Publishing.

Ampountolas, A. (2018). Forecasting hotel demand uncertainty using time series bayesian var models. *Tourism Economics*, *25*(5), 734-756. https://doi.org/10.1177/1354816618801741

Asmelash, A. G., & Kumar, S. (2019). Assessing progress of tourism sustainability: Developing and validating sustainability indicators. *Tourism Management*, *71*, 67-83. https://doi.org/10.1016/j.tourman.2018.09.020

Athanasopoulos, G., Song, H., & Sun, J. A. (2017). Bagging in tourism demand modeling and forecasting. *Journal of Travel Research*, *57*(1), 52-68. https://doi.org/10.1177/0047287516682871

Azqueta-Gavaldón, A. (2017). Developing news-based economic policy uncertainty index with unsupervised machine learning. *Economics Letters*, *158*, 47-50. https://doi.org/10.1016/j.econlet.2017.06.032

Balkyte, A., & Peleckis, K. (2010). Mapping the future sustainable competitiveness resources: Aspects of forests ownership. *Journal of Business Economics and Management*, *11*(4), 630-651. https://www.tandfonline.com/doi/abs/10.3846/jbem.2010.31

Blancas, F. J., Lozano-Oyola, M., González, M., & Caballero, R. (2016). Sustainable tourism composite indicators: A dynamic evaluation to manage changes in sustainability. *Journal of Sustainable Tourism*, *24*(10), 1403-1424. https://doi.org/10.1080/09669582.2015.1122014

Boluk, K. A., Cavaliere, C. T., & Higgins-Desbiolles, F. (2019). A critical framework for interrogating the united nations sustainable development goals 2030 agenda in tourism. *Journal of Sustainable Tourism*, *27*(7), 847-864. https://doi.org/10.1080/09669582.2019.1619748

Camisón, C. (2020). Competitiveness and sustainability in tourist firms and destinations. *Sustainability*, *12*(6), 1-6. https://doi.org/10.3390/su12062388

Carrillo, M., & Jorge, J. M. (2017). Multidimensional analysis of regional tourism sustainability in Spain. *Ecological Economics*, *140*, 89-98. https://doi.org/10.1016/j.ecolecon.2017.05.004

Crouch, G. I., & Ritchie, J. R. B. (1999). Tourism, competitiveness, and societal prosperity. *Journal of Business Research*, *44*(3), 137-152. https://doi.org/10.1016/S0148-2963(97)00196-3

David, B. (2017). *Model economic phenomena with CART and random forest algorithms No. 2017-46*. Retrieved from University of Paris Nanterre, EconomiX.

El-Aidie, S., Alseiari, H., & Khalifa, G. (2021). Tourism sustainability and competitiveness: A strategic platform. *City University eJournal of Academic Research*, *3*(2), 1-19.

El Gibari, S., Gómez, T., & Ruiz, F. (2019). Building composite indicators using multicriteria methods: A review. *Journal of Business Economics*, *89*(1), 1-24. https://doi.org/10.1007/s11573-018-0902-z

Escoto, B. E. B., Boza, M. P., & Madrigal, D. F. (2019). Sustainable tourism: A competitiveness strategy perspective in Baja California. *Sustainability*, *11*(24), 1-15. https://doi.org/10.3390/su11246934

Evans, N. G. (2016). Sustainable competitive advantage in tourism organizations: A strategic model applying service dominant logic and tourism's defining characteristics. *Tourism Management Perspectives*, *18*, 14-25. https://doi.org/10.1016/j.tmp.2015.12.015

Font, X., Torres-Delgado, A., Crabolu, G., Palomo Martinez, J., Kantenbacher, J., & Miller, G. (2021). The impact of sustainable tourism indicators on destination competitiveness: The European tourism indicator system. *Journal of Sustainable Tourism*, 1-23. https://doi.org/10.1080/09669582.2021.1910281

Gooroochurn, N., & Sugiyarto, G. (2005). Competitiveness indicators in the travel and tourism industry. *Tourism Economics*, *11*(1), 25-43. https://doi.org/10.5367/0000000053297130

Ivars-Baidal, J. A., Vera-Rebollo, J. F., Perles-Ribes, J., Femenia-Serra, F., & Celdrán-Bernabeu, M. A. (2021). Sustainable tourism indicators: What's new within the smart city/destination approach? *Journal of Sustainable Tourism*, 1-24. https://doi.org/10.1080/09669582.2021.1876075

Jong, M.-C., Puah, C.-H., & Arip, M. A. (2020). Modelling tourism demand: An augmented gravity model. *Jurnal Ekonomi Malaysia*, *54*(2), 105-112. https://doi.org/10.17576/jem-2020-5402-09

Karakostas, E. (2022). What determines the effectiveness of a currency: A composite index. *International Journal of Applied Economics, Finance and Accounting*, *12*(1), 1-11. https://doi.org/10.33094/ijaefa.v12i1.483

Khalifa, G. S. (2020). Factors affecting tourism organization competitiveness: Implications for the egyptian tourism industry. *African Journal of Hospitality, Tourism and Leisure*, *9*(3), 116-130. https://doi.org/10.46222/ajhtl.19770720-8

Khan, A., Bibi, S., Lorenzo, A., Lyu, J., & Babar, Z. U. (2020). Tourism and development in developing economies: A policy implication perspective. *Sustainability*, *12*(4), 1-19. https://doi.org/10.3390/su12041618

Kuek, T.-H., Puah, C.-H., & Arip, M. A. (2020). Financial vulnerability and economic dynamics in Malaysia. *Journal of Central Banking Theory and Practice*, *9*(s1), 55-73. https://doi.org/10.2478/jcbtp-2020-0023

Lopes, A. P. F., Muñoz, M. M., & Alarcón-Urbistondo, P. (2018). Regional tourism competitiveness using the PROMETHEE approach. *Annals of Tourism Research*, *73*, 1-13. https://doi.org/10.1016/j.annals.2018.07.003

Martín, J. C., Mendoza, C., & Román, C. (2017). A DEA travel–tourism competitiveness index. *Social Indicators Research*, *130*(3), 937-957. https://doi.org/10.1007/s11205-015-1211-3

Mendola, D., & Volo, S. (2017). Building composite indicators in tourism studies: Measurements and applications in tourism destination competitiveness. *Tourism Management*, *59*, 541-553. https://doi.org/10.1016/j.tourman.2016.08.011

Mohaidin, Z., Wei, K. T., & Ali Murshid, M. (2017). Factors influencing the tourists' intention to select sustainable tourism destination: A case study of Penang, Malaysia. *International Journal of Tourism Cities*, *3*(4), 442-465. https://doi.org/10.1108/IJTC-11-2016-0049

Nepal, R., Indra al Irsyad, M., & Nepal, S. K. (2019). Tourist arrivals, energy consumption and pollutant emissions in a developing economy–implications for sustainable tourism. *Tourism Management*, *72*, 145-154. https://doi.org/10.1016/j.tourman.2018.08.025

Postma, A., Cavagnaro, E., & Spruyt, E. (2017). Sustainable tourism 2040. *Journal of Tourism Futures*, *3*(1), 13-22. https://doi.org/10.1108/JTF-10-2015-0046

Seguí-Amortegui, L., Clemente-Almendros, J. A., Medina, R., & Grueso Gala, M. (2019). Sustainability and competitiveness in the tourism industry and tourist destinations: A bibliometric study. *Sustainability*, *11*(22), 1-30. https://doi.org/10.3390/su11226351

Soh, A. N., Puah, C. H., & Arip, M. A. (2020). Tourism forecasting and tackling fluctuating patterns: A composite leading indicator approach. *Studies in Business and Economics*, *15*(2), 192-204. https://doi.org/10.2478/sbe-2020-0034

Streimikiene, D., Svagzdiene, B., Jasinskas, E., & Simanavicius, A. (2021). Sustainable tourism development and competitiveness: The systematic literature review. *Sustainable Development*, *29*(1), 259-271. https://doi.org/10.1002/sd.2133

Tan, Z., Yan, Z., & Zhu, G. (2019). Stock selection with random forest: An exploitation of excess return in the Chinese stock market. *Heliyon*, *5*(8), 1-10. https://doi.org/10.1016/j.heliyon.2019.e02310

WEF. (2019). *The travel and tourism competitiveness report*. Geneva: World Economic Forum.

WTTC. (2020). *Economic impact: World travel and tourism council*. Retrieved from https://wttc.org/Research/Economic-Impact

Zhao, Y., Li, J., & Yu, L. (2017). A deep learning ensemble approach for crude oil price forecasting. *Energy Economics*, *66*, 9-16. https://doi.org/10.1016/j.eneco.2017.05.023