Enhancing Sustainable Development in ASEAN: An Integrated Assessment of Education and Health Factors

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Abstract:

Purpose: The aim of this paper is to showcase the practical application of the multi-criteria Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method for expertly assessing the level of sustainable development, education, and health in the countries of Southeast Asia, specifically the ASEAN region, as of 2022.

Design/Methodology/Approach: The research methodology is based on the application of the multi-criteria TOPSIS method, which involves the selection of criteria that determine the level of assessment for education and health development. The chosen criteria, including factors such as crude death rate, prevalence of malaria, HIV prevalence rate, and other relevant variables, are subjectively selected to capture the key dimensions of sustainable development in these domains. The data for these criteria are obtained from the ASEAN Statistical Yearbook 2022, providing a reliable and comprehensive source for analysis. The TOPSIS method calculates performance scores for each country, enabling the ranking and clustering of ASEAN countries based on their education and health development.

Findings: The findings suggest the presence of disparities among ASEAN countries concerning education and health development. They highlight the importance of prioritizing investments and policies to address the specific challenges faced by lower-performing countries, ultimately fostering sustainable development across the region. In the education sector, countries such as Brunei Darussalam and Singapore emerged as high-performing nations, demonstrating significant advancements in educational indicators. On the other hand, countries like Cambodia and Myanmar were found to have lower performance scores, indicating the need for targeted interventions and improvements in their education systems. Similarly, in the health sector, Brunei Darussalam and Singapore exhibited notable achievements, showcasing robust healthcare systems and favorable health outcomes. Conversely, countries like Cambodia and Myanmar faced significant challenges, reflecting the need for enhanced healthcare infrastructure and interventions to address health disparities.

Practical Implications: Firstly, the study provides policymakers and stakeholders in ASEAN countries with valuable insights into the relative performance of education and health development. By identifying high-performing countries, such as Brunei Darussalam and Singapore, as well as lower-performing countries, like Cambodia and Myanmar, policymakers can prioritize and allocate resources to address the specific challenges and disparities within their education and health sectors. Secondly, the methodology employed in this research, specifically the TOPSIS method, offers a practical framework for assessing sustainable development in various domains. This approach can be adapted and applied to

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other areas beyond education and health, such as ecology, demography, and macroeconomics, allowing for a comprehensive analysis of sustainable development across multiple dimensions.
Originality/Value: The study's originality stems from its synthesis of diverse criteria, the identification of clusters among the ASEAN countries, and the implications for policy and decision-making.

Keywords: ASEAN, sustainable development, education, health, MCDM, TOPSIS.

JEL codes: I15, I21, O53, C44.

Paper type: Research article.

1. Introduction

In the current era of advancing globalization and the emergence of the information society, the acquisition of knowledge and the exchange of information play crucial roles in achieving sustainable development and fostering economic growth (Hummels and Argyrou, 2020; Glavic and Lukman, 2007). However, modern decision makers face a significant challenge in dealing with the overwhelming volume of information and the complexities associated with interpreting statistical data.

Numerous institutions and government agencies engage in research aimed at understanding the development of various continents, countries, regions, and social groups. As a result, integrated indicators are formulated to describe the dynamic changes occurring in social and economic development (Steffen *et al.,* 2015; Borys, 2011; Gasparatos, El-Haram, and Horner, 2008; Ness, Urbel-Piirsalu, and Olsson, 2007; Stagl, 2007: Thalassinos *et al.,* 2022).

The presentation of results in this study follows an aggregate approach, offering a synthetic overview of the phenomena or objects being investigated. Specifically, this research focuses on the Association of Southeast Asian Nations (ASEAN) countries within the context of sustainable development. ASEAN comprises ten member states, including Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

Sustainable development, with its multi-dimensional nature encompassing economic, social, and environmental aspects, presents a complex challenge for ASEAN countries. By adopting an aggregate perspective, this study aims to provide a comprehensive understanding of sustainable development in the ASEAN region.

An exemplification of this approach can be observed in the Sustainable Development Goals index (SDG, 2022), a comprehensive measure published by the United Nations that outlines key dimensions of development, such as poverty and hunger, health and education, economic growth, inequality reduction, quality of life, and climate change. The SDG index allows for global-level comparisons in a generalized manner.

However, for researchers desiring more detailed and intricate analyses, it is necessary to possess the requisite computational tools and skills to construct personalized models and indicators that capture complex interdependencies. Consequently, there arises a need to explore data analysis methods that provide a holistic representation of the studied objects while remaining user-friendly for analyzing significant and intricate problems.

To examine sustainable development in the ASEAN countries, researchers face the task of integrating and analyzing various economic, social, and environmental indicators across these nations (Cuyvers, Chen, and Lombaerde, 2019). The aggregate approach employed in this study allows for the synthesis of these indicators, providing a holistic view of sustainable development progress in the ASEAN region. By considering multiple dimensions of development, including poverty alleviation, environmental conservation, and social equity, decision-makers and policymakers can gain valuable insights to inform their strategies and actions.

The ability to compare and assess these diverse factors in relation to one another is essential for deriving meaningful conclusions. As a result, researchers must seek approaches that enable comprehensive analysis across these multifaceted dimensions. In this context, the application of multi-criteria decision making methods (MCDM) emerges as a promising avenue for studying dynamically changing realities, (Ruano, 2018; Nermend, 2017; Bedir, Özder, and Eren, 2016).

MCDM techniques provide a framework for evaluating multiple criteria simultaneously, allowing decision makers to assess and weigh the importance of various factors (Behzadiana, Kazemzadeh, Albadvi, and Aghdasi, 2010; Saaty, 2002). By employing MCDM methods, researchers can address the complex nature of sustainable development and derive insights that guide effective decision-making processes (Saaty and Ergu, 2015; Diech, Korbicz, Rutkowski, and Tadeusiewicz, 2000; Bana e Costa and Vansnick, 1999; Edwards and Barron, 1994; Brans and Vincke, 1985).

The aim of this paper is to showcase the practical application of the multi-criteria Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method for expertly assessing the level of sustainable development, education, and health in the countries of Southeast Asia, specifically the ASEAN region, as of 2022. The TOPSIS method is a well-established multi-criteria decision-making technique that

enables the evaluation and ranking of alternatives based on multiple criteria (Yadav, Kalbar, and Dikshit, 2019).

By utilizing this method, the research seeks to provide an informed assessment of the sustainable development, education, and health statuses of ASEAN countries, taking into account a comprehensive set of indicators and factors.

2. Data and Methods

The research presented in this article follows a structured procedure encompassing three key stages. The initial stage involves a comprehensive discussion of the methodological aspects related to the TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) method. This discussion serves to establish a solid foundation and understanding of the principles and underlying concepts of the TOPSIS method. Methodical issues such as the selection of criteria, determination of weights, normalization of data, and the determination of ideal and anti-ideal solutions are thoroughly examined and addressed. By addressing these methodological concerns, the research ensures the validity and reliability of the subsequent analysis.

The second stage of the research procedure involves presenting the source data and analytical model. This step entails identifying and collecting relevant data sources that provide information on sustainable development, education, and health indicators in the ASEAN countries. These data sources include national statistics, international databases, reports, and scholarly publications. The selected indicators should cover a wide range of aspects within sustainable development, education, and health domains, ensuring a comprehensive assessment. Subsequently, an analytical model is developed to integrate the collected data and apply the TOPSIS method.

Technique for Order of Preference by Similarity to Ideal Solution method involves assessing the proximity of the analyzed phenomena or objects (represented by a finite number of elements) to the ideal and anti-ideal solutions, ultimately generating a synthetic indicator for the purpose of creating a ranking of the alternative objectives.

The optimal element in the study is determined by minimizing the distance to the ideal solution and maximizing the distance from the anti-ideal solution. The use of the TOPSIS method includes the following steps:

1. Determination of weights for selected criteria; in the analyzed example the weight of the each criteria is the same: 14,3%.

2. Establishment of a standardized data matrix according to formula 1.

$$(1) \quad z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}}$$

where:

- $i=1,2,\ldots, m$ and $j=1,2,\ldots,n$
- z – normalized value, x – primary value

3. Taking into account weights according to the formula 2:

$$(2) \quad v_{ij} = w_j \otimes z_{ij}$$

where:

- v_{ij} – normalized weighted value

4. Determination of the vector value of the ideal solution a^+ and anti-ideal a^- (positive ideal solution – formula 3, negative ideal solution – formula 4)

$$(3) \quad a^+ = (a_1^+, a_2^+, \ldots, a_n^+) := \left\{ \left(\max_{i=1,.,m} v_{ij} | j \in J_Q \right), \left(\min_{i=1,.,m} v_{ij} | j \in J_c \right) \right\}$$

$$(4) \quad a^- = (a_1^-, a_2^-, \ldots, a_n^-) := \left\{ \left(\min_{i=1,.,m} v_{ij} | j \in J_Q \right), \left(\max_{i=1,.,m} v_{ij} | j \in J_c \right) \right\}$$

where J_q is a beneficial criteria, and J_c is a non-beneficial (cost) criteria.

5. Calculation of the Euclidean distance of the tested objects from the ideal (formula 5) and anti-ideal solution (formula 6):

$$(5) \quad S_i^+ = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - a_j^+ \right)^2}$$

$$(6) \quad S_i^- = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - a_j^i \right)^2}$$

where $i = 1,2, \ldots, m$ and $j = 1,2, \ldots, n$

6. Calculation of the performance score R_i for the examined objects, according to the formula 7:

$$(7) \quad R_i = \frac{S_i^-}{S_i^+ + S_i^-}$$

The performance score Ri of the highest value are the best solution (the best ASEAN country with the highest level of sustainable development for a given year) in the considered problem of linear ordering (ranking).

The TOPSIS method presented in this context offers a valuable approach for constructing an original indicator that focuses on selected aspects of sustainable development, specifically in the countries of Southeast Asia (ASEAN).

The primary source of statistical data utilized in this study is the ASEAN Statistical Yearbook 2022, an annual report published by The Association of Southeast Asian Nations.

This comprehensive publication provides a wealth of information across various development areas, including population, education and health, employment, macroeconomics, trade, investments, transport, tourism, agriculture, and manufacturing.

With the aim of constructing an original indicator in the domains of education and health, the research study operates under the main assumption that a set of seven variables will be used. These variables, based on statistics from 2022 (ASEANstats, 2022), capture key aspects within education and health. In cases where specific data for individual countries were not available, information from previous years was utilized as a substitute.

The selection of these variables allows for a nuanced understanding of the education and health status within the ASEAN countries, thereby contributing to a comprehensive assessment of sustainable development within the region.

The main assumption in the study was the construction of an original indicator in the area of education and health, containing the following 7 variables:

- C1 – Crude Death Rate;
- C2 – Prevalence of Malaria per 1000 population;
- C3 – HIV Prevalence Rate Among 15-49 Year Old People;
- C4 – Adult Literacy Rate;
- C5 – Life Expectancy at Birth;
- C6 – Access to safe drinking water;
- C7 – Access to improved sanitation.

3. Results

An essential aspect of the TOPSIS analysis is to discern the nature of the assessment, distinguishing between beneficial and non-beneficial (cost) criteria (Table 1). In the context of the analyzed example, several criteria are identified within the education and health domains. Among these criteria, C1 represents the Crude Death Rate, C2 signifies the Prevalence of Malaria per 1000 population, and C3 denotes the HIV Prevalence Rate Among 15-49 Year Old People.

These criteria fall under the category of cost criteria, where the desired values are intended to be minimized or kept to a minimum. (the lower values are considered more favorable and indicative of better performance).

Table 1. *Statistical data for selected variables (decision matrix)*

COUNTRY	C1	C2	C3	C4	C5	C6	C7
Brunei Darussalam	3,900	0,000	0,001	0,973	79,400	1,000	0,940
Cambodia	5,900	0,019	0,006	0,819	72,700	0,797	0,804
Indonesia	6,200	0,011	0,000	0,960	71,600	0,902	0,803
Laos	6,900	0,005	0,004	0,952	67,000	0,775	0,750
Malaysia	6,900	0,001	0,003	0,955	75,600	0,959	0,997
Myanmar	8,500	0,011	0,007	0,851	67,000	0,862	0,801
Philippines	8,000	0,001	0,002	0,957	72,000	0,956	0,804
Singapore	5,800	0,000	0,002	0,989	83,500	1,000	1,000
Thailand	7,500	0,001	0,003	0,979	74,900	0,999	0,967
Vietnam	6,100	0,001	0,003	0,957	73,600	0,981	0,956

Source: Own elaboration.

Conversely, the remaining criteria, C4 through C7, are categorized as beneficial criteria. These criteria encompass various aspects of education and health, such as educational attainment rates, healthcare infrastructure, and other indicators related to sustainable development. For these criteria, higher values are desired as they reflect a more favorable condition or greater progress in the respective domains. The aim is to maximize these criteria to demonstrate advancements in education and health within the ASEAN countries. According to TOPSIS method a normalized matrix with weight is calculated (Table 2).

Table 2. *Normalized decision matrix with weight*

Country/weight	14,3	14,3	14,3	14,3	14,3	14,3	14,3
Brunei Darussalam	2,6377	0,0000	1,2217	4,6771	4,8595	4,8801	4,7920
Cambodia	3,9904	10,8076	7,3304	3,9369	4,4494	3,8894	4,0987
Indonesia	4,1933	6,2571	0,0000	4,6146	4,3821	4,4019	4,0936
Laos	4,6668	2,8441	4,8869	4,5762	4,1006	3,7821	3,8234
Malaysia	4,6668	0,5688	3,6652	4,5906	4,6269	4,6800	5,0826
Myanmar	5,7489	6,2571	8,5521	4,0907	4,1006	4,2066	4,0834
Philippines	5,4108	0,5688	2,4435	4,6002	4,4066	4,6654	4,0987
Singapore	3,9228	0,0000	2,4435	4,7540	5,1104	4,8801	5,0979
Thailand	5,0726	0,5688	3,6652	4,7060	4,5841	4,8752	4,9297
Vietnam	4,1257	0,5688	3,6652	4,6002	4,5045	4,7874	4,8736

Source: Own elaboration.

Based on the results obtained through the TOPSIS analysis, a performance score R_i was calculated, which facilitated the ranking of ASEAN countries according to the specific education and health criteria C1-C7. Table 3 presents the ordered list of ASEAN countries based on their scores, with the countries ranked in descending order. This ranking provides an initial overview of the relative performance of each country in terms of education and health within the ASEAN region.

Table 3. *Ranking for the ASEAN countries in education and health area in 2022*

No.	Country	Ranking
1	**Brunei Darussalam**	0,91326
2	**Singapore**	0,82174
3	**Philippines**	0,75246
4	**Vietnam**	0,74075
5	**Malaysia**	0,73009
6	**Thailand**	0,72016
7	**Indonesia**	0,59964
8	**Laoa**	0,58347
9	**Myanmar**	0,29069
10	**Cambodia**	0,14185

Source: *Own elaboration.*

While a detailed analysis of the results obtained exceeds the scope of this study, it is important to note that further examination would require conducting a specific expert sensitivity analysis for individual criteria. Such an analysis would involve a more in-depth investigation into the influence and impact of each criterion on the overall ranking and performance scores.

This sensitivity analysis would provide valuable insights into the relative importance and weightage of each criterion and enhance the accuracy and robustness of the assessment.

Additionally, it is worth mentioning that the grouping of countries according to the education and health factor and establishing a subjective reference point based on expert knowledge in the area of development is a significant consideration. By utilizing expert knowledge and insights, the results can be contextualized and interpreted within the broader framework of sustainable development in education and health.

This subjective reference point aids in understanding the strengths and weaknesses of each country and can assist policymakers and stakeholders in identifying priority areas for intervention and improvement (Figure 1).

4. Summary and Discussion

A critical approach to the obtained results and the selected research model is crucial in conducting scientific research. In this regard, it is important to acknowledge that the proposed concept of using the TOPSIS method for assessing sustainable development in ASEAN countries serves as a universal framework. However, it should also be recognized as a starting point for further in-depth analyses and scientific discussions, which may lead to potential modifications in specific elements, both in terms of content and methodology.

Figure 1. *Map ranking for the ASEAN countries in education and health area in 2022.*
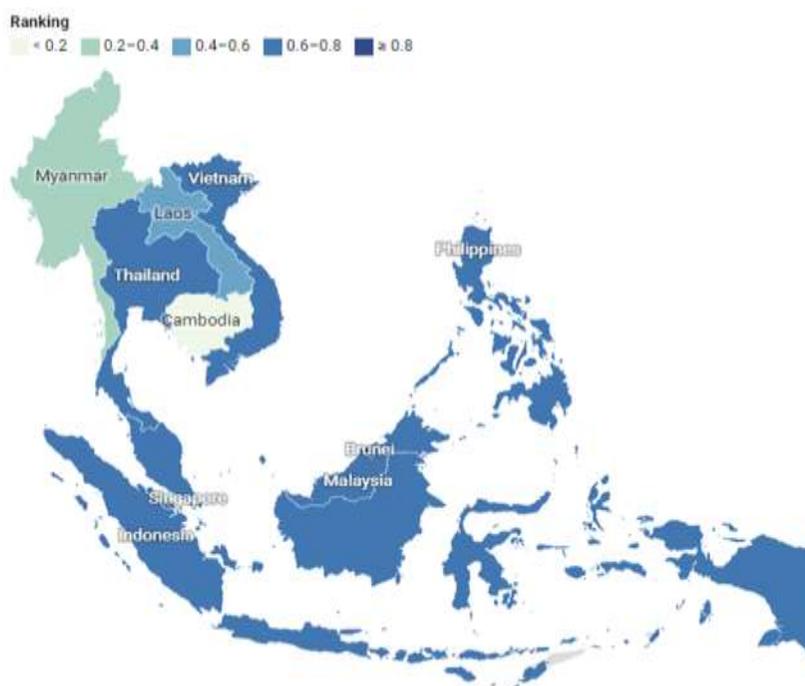
Source: *Own elaboration.*

Based on the provided results, the ASEAN countries can be clustered into three groups based on their performance scores obtained through the TOPSIS analysis. The groups are as follows:

1. Group 1: High Performance: Brunei Darussalam (0,9133) and Singapore (0,8217). These countries demonstrate a high level of performance in both health and education indicators, as indicated by their relatively higher performance scores. They are at the forefront of sustainable development

efforts in the ASEAN region and can serve as benchmarks for other countries.

2. Group 2: Moderate Performance: 3. Philippines (0,7525), Vietnam (0,7408), Malaysia (0,7301) and Thailand (0,7202). These countries exhibit moderate performance in terms of health and education. While they may not have achieved the same level as the high-performing countries, they still demonstrate commendable progress and efforts in sustainable development within these domains.

3. Group 3: Lower Performance: 7. Indonesia (0,5996), Laos (0,5835), Myanmar (0,2907) and Cambodia (0,1418). These countries have relatively lower performance scores in health and education indicators compared to the previous groups. They face greater challenges and may require more targeted interventions and support to improve their sustainable development efforts in these areas.

In the methodological area of assessing sustainable development in ASEAN countries in 2022, it is possible to provide a preliminary summary of the key applications and considerations. These include:

1. Selection of Criteria: One crucial stage in the analysis is the careful selection of criteria that determine the level of assessment for education and health development in ASEAN countries. The proposed C1-C7 factors in the TOPSIS analysis are subjectively chosen and can be modified based on the specific purpose of the analysis. It is important to recognize that the proposed concept is of a general nature and can be adapted to different areas such as ecology, demography, macroeconomics, and others. Depending on the focus of the study, researchers can identify and select appropriate characteristics to capture the specific aspects of sustainable development within those domains.

2. Methodology: The methodology employed in the study, which is based on the TOPSIS method, deserves attention in terms of its application and potential modifications. Researchers can explore the possibility of modifying the computational model both in terms of the choice of models for parallel analysis and the comparison of results. This would involve considering alternative methods and assessing their suitability and effectiveness for the analysis of sustainable development in ASEAN countries. Furthermore, researchers may also explore the use of fuzzy numbers in the TOPSIS analysis to handle uncertainty and vagueness in the data, providing a more nuanced and comprehensive assessment of the education and health indicators.

5. Conclusions

Methodologically, the utilization of the TOPSIS method offers a systematic and structured approach to evaluating education and health criteria, providing a basis for

comparative analysis and rankings. The research model establishes a foundation for assessing the performance of ASEAN countries and can serve as a reference point for future studies.

In terms of substantive findings, the analysis conducted using the TOPSIS method can shed light on the strengths and weaknesses of ASEAN countries' sustainable development efforts in the areas of education and health. The rankings and grouping of countries based on the performance scores provide a preliminary understanding of the relative progress made in these domains. However, a more detailed examination, including expert sensitivity analysis and further research, is necessary to gain deeper insights and draw more conclusive interpretations.

In conclusion, while the research model presented in this study has its merits, it should be viewed critically as a stepping stone for more comprehensive analyses and discussions. The preliminary summary of the methodology and substantive areas offers a foundation for future research endeavors, encouraging scientific dialogue and the refinement of approaches to assessing sustainable development in ASEAN countries.

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