Journal of Green Economy and Low-Carbon Development
https://www.acadlore.com/journals/JGELCD

Integrated SWOT-ANP Approach for Prioritizing Carbon Emission Reduction Strategies in Quang Ngai Province, Vietnam

Vo Van Tuyen*

Faculty of Economics, Quang Ngai Campus, Industrial University of Ho Chi Minh City, 700000 Ho Chi Minh City, Vietnam

* Correspondence: Vo Van Tuyen (vovantuyen.quangngai@gmail.com)

Received: 08-11-2025 **Revised:** 09-19-2025 **Accepted:** 09-26-2025

Citation: V. V. Tuyen, "Integrated SWOT-ANP approach for prioritizing carbon emission reduction strategies in Quang Ngai province, Vietnam," *J. Green Econ. Low-Carbon Dev.*, vol. 4, no. 3, pp. 176–196, 2025. https://doi.org/10.56578/jgelcd040304.

© 2025 by the author(s). Licensee Acadlore Publishing Services Limited, Hong Kong. This article can be downloaded for free, and reused and quoted with a citation of the original published version, under the CC BY 4.0 license.

Abstract: This study focused on assessing and prioritizing carbon emission reduction strategies in Quang Ngai province in Vietnam, through an integrated Strengths, Weaknesses, Opportunities, and Threats (SWOT) and Analytic Network Process (ANP) approach. SWOT factors were identified through semi-structured interviews with a panel of 12 experts with expertise in environmental management, renewable energy, sustainable development planning, and local resource governance. This method allowed the identification of internal factors (strengths, weaknesses) and external factors (opportunities, threats) of the province. It also quantified the priority level of each criterion and strategy to support strategic decision-making in a scientific and transparent manner. Based on the results of the SWOT-ANP analysis, the priority level of carbon emission reduction strategy groups in Quang Ngai province was determined by the Utility Index (U) as follows: WO = 0.2867, SO = 0.2410, WT = 0.2389, and ST = 0.2334. Among them, the WO strategy (overcoming weaknesses to take advantage of opportunities) had the highest U value, showing that this was the top priority orientation which focused on improving technological, financial, and infrastructural capacity to meet the trend of green transformation and attract international resources. Next was the SO strategy (U = 0.2410), taking advantage of natural advantages and current policies to expand renewable energy projects, low-carbon agriculture, and green industry development. The two strategic groups, WT (U = 0.2389) and ST (U = 0.2334), had lower values but still played an important supporting role, thus contributing to minimizing risks due to limited resources and enhancing adaptability to the challenges of climate change. The research not only contributes to the development of carbon emission reduction solutions in the specific context of Quang Ngai but also opens up a reference for other localities. It helps to optimize emission reduction strategies in accordance with the specific economic, social, and environmental conditions in each region.

Keywords: Carbon emission reduction; SWOT analysis; Analytic Network Process; ANP; Renewable energy; Industrial decarbonization; Policy strategy; Quang Ngai

1 Introduction

In the context of increasingly serious global climate change, carbon emission reduction is not only an environmental goal but also a key factor in sustainable economic development [1]. Vietnam, with its rapid industrialization and urbanization, is facing the challenge of balancing economic growth and environmental protection [2]. At the local level, provinces such as Quang Ngai play an important role in implementing carbon emission reduction solutions due to their rich natural potential, industrial infrastructure, technical human resources, and local policies supporting green development.

Quang Ngai is an ideal case study for carbon emission reduction. The province owns an area of natural forests and protective forests that play an important role in carbon absorption and biodiversity protection. In addition, the province also has significant renewable energy potential, including solar power and coastal wind power, as well as vacant coastal land that can deploy green energy projects. Economic zones and industrial parks such as Dung Quat Economic Zone and Hoa Binh Industrial Park have developed industrial infrastructure and concentrated technical human resources, hence creating favorable conditions for the application of green technology and carbon emission reduction projects. In addition, local policies encouraging green economic development and environmental management, combined with opportunities to expand the domestic and international carbon credit market, turn Quang Ngai into a "fertile land" for effective and feasible carbon emission reduction strategies. Similar to other medium-developed provinces in Vietnam, the implementation of emission reduction strategies in Quang Ngai still faces many challenges. Emission reduction technology in industry is still backward; renewable energy infrastructure is not synchronized. The awareness of green development between businesses and the community is not uniform, along with limitations in preferential capital, carbon credits, and environmental management resources. These challenges require a systematic approach to identify priority strategies that are effective and feasible in local conditions. In this context, SWOT analysis provides a systematic framework to identify strengths, weaknesses, opportunities, and challenges, thereby proposing appropriate strategies [3]. However, traditional SWOT analysis is often qualitative and cannot clearly determine strategic priorities. Analytic Network Process (ANP) is a multi-criteria decision support tool that is enhanced from Analytic Hierarchy Process (AHP) [4]. ANP helps support decision-making with complex and multi-dimensional problems [5]. Combining SWOT with the ANP method addresses this limitation by converting SWOT factors into quantitative weights based on the interrelationships between factors [6], thereby determining the priority of carbon emission reduction strategies. This combination not only increases the scientific and transparent nature of the decision-making process but also ensures that effective and feasible strategies are designed based on real conditions.

This study has important practical significance. First, it provides a scientific basis for the Quang Ngai provincial government and local businesses to develop policies, plans, and projects to reduce carbon emissions in accordance with real conditions, thus maximizing the natural potential and available infrastructure. Second, the study opens up a new approach to management and strategic planning for sustainable development in other localities in Vietnam, where it is necessary to simultaneously consider economic development and environmental protection. Finally, the SWOT-ANP method can be flexibly applied to many other areas such as energy management, clean agriculture, and green urban development, so as to contribute to improving strategic decision-making capacity in a multivariate and complex context. Quang Ngai, with its natural, industrial, policy, and international opportunities, is a "good model" for implementing carbon emission reduction strategies. The combination of SWOT analysis and ANP not only helps to identify strategic priorities scientifically but also brings high practical value, hence contributing to the realization of national and international emission reduction targets in a feasible and sustainable manner.

2 Literature Review

2.1 Carbon Emission Reduction: International and National

Climate change is becoming one of the most serious challenges to global sustainable development [7]. The concentration of greenhouse gases in the atmosphere, especially CO_2, CH_4, and N_2O_2, increases global warming and causes a series of adverse impacts on ecosystems, economies, and societies [8]. In this context, many countries have been implementing carbon emission reduction strategies, aiming for carbon neutrality by the middle of the 21st century. The key measures include transforming the energy structure towards green, increasing energy efficiency, developing renewable energy, applying clean technology in industry, and promoting sustainable management of forest and land resources. In Southeast Asia, countries such as Thailand, Indonesia, and Vietnam have shown strong commitments within the framework of the Paris Agreement and national strategies on green growth [9]. Vietnam is considered one of the countries that is both heavily affected by climate change and has great potential to implement carbon emission reduction solutions thanks to its diverse natural conditions, abundant renewable energy sources (wind, solar, and biomass), and rapid urbanization and industrialization [10].

At the national level, the Government of Vietnam has issued the National Climate Change Strategy and the Green Growth Strategy for the period of 2021–2030, with a vision to 2050, and committed to achieving net zero emissions by 2050 at COP26 [11]. Many studies have focused on assessing the potential for carbon emission reduction on a national scale, to emphasize the role of key sectors such as energy, processing industry, transportation, agriculture and forestry, and waste management. However, local-level emission reduction strategies still face many barriers in terms of technology, infrastructure, investment capital, policy mechanisms, and public awareness. This raises the urgent need to select strategic priorities based on quantitative analysis and a systems approach. In Quang Ngai province, a locality located in the Central key economic region, rapid industrialization along with the strong development of Dung Quat Economic Zone and Hoa Binh Industrial Park have contributed significantly to economic growth but at the same time increased pressure on greenhouse gas emissions. Quang Ngai possesses great potential to implement carbon emission reduction solutions, including developing coastal wind and solar energy, expanding natural forest areas and planting production forests, and improving energy efficiency in industrial zones, as well as enhancing urban and agricultural waste management.

2.2 Integration of Multicriteria Decision-Making (MCDM) Tools in Strategic Research

In strategic research, decision-making in complex and multi-factor contexts requires MCDM tools to evaluate and select optimal strategies. MCDM is an analytical decision-support method that helps identify strategic priorities based on multiple criteria while taking into account complex relationships and interactions among factors. Among MCDM tools, AHP and ANP are two prominent and widely applied methods. AHP allows the evaluation and ranking of factors based on a hierarchical structure, while ANP extends this capability by modeling the dependencies and interactions between factors, thereby providing more accurate weighting and strategic priority analysis in complex contexts. Kaymaz et al. [12] assessed the sustainable development goals in Erzurum province, Türkiye, by applying the combination of SWOT-AHP. Nguyen and Tuyen [13] applied SWOT-AHP to choose a business strategy for a packaging company. Juharni et al. [14] proposed a public service strategy by using the combination of AHP and SWOT. Rui et al. [15] combined SWOT-AHP for the employment of BIM technology in the construction industry whereas Bayraktar et al. [16] proposed a strategy for biofuels by applying the SWOT-AHP model.

While AHP assumes that the evaluation factors are separate and independent, this sometimes does not reflect the complexity and interaction between internal and external factors in reality [17]. In this study, ANP was preferred to AHP because it allows modeling the dependencies and interactions among SWOT factors, which better represents the real-world complexity of carbon emission reduction strategies in Quang Ngai province. To overcome this limitation, SWOT-ANP has been proposed as an extension of SWOT-AHP, which allows modeling of the interdependencies and interactions between SWOT factors. Many studies have used this improved model; for instance, Liu et al. [18] approached SWOT-ANP for formulating energy service company (ESCO) industry strategies in the construction sector. Dzikrulloh and Mayvani [19] proposed a Halal human resource development strategy in Madura through the combination of ANP and SWOT. Li et al. [20] applied SWOT-ANP for land reclamation strategies in those subsidence areas affected by coal mining.

By constructing a network of interconnected factors, SWOT-ANP not only determines priority weights more accurately but also clearly reflects the interactions between factors, thereby supporting more effective and practical strategic decision making. Combining SWOT and ANP has become one of the most powerful methods in strategic analysis. In the SWOT-ANP model, SWOT factors are converted into evaluation criteria, and then ANP is used to determine the weight and priority of each factor and analyze the dependencies between endogenous and exogenous factors. This not only helps improve the objectivity and scientificity in the decision-making process but also enhances the applicability in practice.

In Vietnam, the application of MCDM methods in the analysis of carbon emission reduction strategy is still quite new. Although there are studies on carbon emission reduction at the national and key economic regional levels, research on carbon emission reduction strategies at the provincial level, especially in provinces with ecological and economic characteristics such as Quang Ngai, is still very limited. This research gap creates a great opportunity to apply SWOT-ANP in building carbon emission reduction strategies at the local level. Therefore, this study aims to fill the current research gap, with the aim of using SWOT-ANP to identify and rank priority carbon emission reduction strategies in Quang Ngai. This method not only helps to enhance the scientific basis of strategic decision-making, but also provides a theoretical and practical basis for policy making and sustainable development in Quang Ngai province in the context of Vietnam while moving towards the goal of net zero emissions by 2050.

3 Methodology

3.1 Research Process

To identify and rank carbon emission reduction strategies in Quang Ngai province in Vietnam, the study applied the integrated SWOT and ANP methods to evaluate internal and external factors and determined the priority weight of each strategy. Figure 1 illustrates the basic steps of the research process.

3.2 SWOT Analysis

SWOT stands for four main factors: Strengths, Weaknesses, Opportunities, and Threats. SWOT analysis is a popular strategic management tool widely used in many fields. This tool helps researchers or managers to evaluate the overall internal and external factors affecting a specific project or strategy [21]. Strengths are positive internal factors that create competitive advantages or support the achievement of goals [22]. Conversely, weaknesses are internal limitations that hinder the implementation of strategies [23]. Opportunities are external factors that can be exploited to promote success [24]. Conversely, threats are risks from the external environment that can negatively affect the effectiveness of strategies [25]. SWOT analysis provides a comprehensive assessment framework, facilitating strategic planners to identify key factors for progressing towards appropriate directions.

In this study, SWOT analysis was first implemented to identify strengths, weaknesses, opportunities, and challenges in carbon emission reduction in Quang Ngai province. A group of 12 experts was selected based on the criteria: expertise in environment, renewable energy, sustainable development planning, and practical experience in local resource management. Semi-structured interviews were conducted to explore expert opinions on strengths, weaknesses, opportunities, and challenges related to developing carbon emission reduction strategies in the province. The collected data were synthesized, analyzed, and standardized to build a full SWOT matrix, reflecting the actual context of Quang Ngai and serving as the foundation for the next step of integrating with the ANP method to determine priority weights for strategies. The SWOT matrix and strategies are shown in Table 1 and Table 2, respectively.

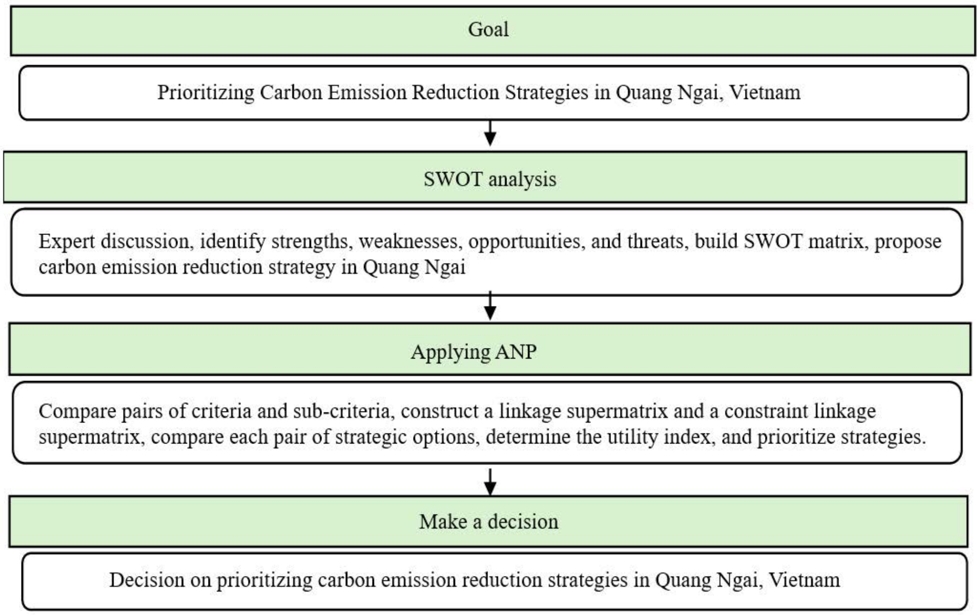

Figure 1. Framework of the research

Table 1. SWOT matrix of carbon emission reduction strategy in Quang Ngai province

Strengths (S)	**Weaknesses (W)**
(S1) Large area of natural and mangrove forests, resulting in high carbon absorption capacity. (S2) Dung Quat Economic Zone and Hoa Binh Industrial Park provide available industrial infrastructure and technical human resources. (S3) Local policies support green economic development, environmental management programs, and sustainable development.	(W1) Emission reduction technology in industry remains backward; carbon capture and storage technology has not been applied. (W2) Awareness of green development is not uniform among businesses and communities. (W3) Limited preferential capital or carbon credits for small and medium enterprises. (W4) Infrastructure supporting renewable energy is not synchronous.
Opportunities (O)	**Threats (T)**
(O1) The domestic and international carbon credit market is expanding, creating participation opportunities for Quang Ngai. (O2) Support from international projects on emission reduction and clean energy. (O3) Significant renewable energy potential, including solar and wind resources.	(T1) Climate change and natural disasters affect carbon sequestration capacity and energy infrastructure. (T2) Industrial growth and urbanization increase emissions without adoption of green technology. (T3) Lack of synchronous local policy mechanisms for carbon projects and green investment.

Table 2. List of carbon emission reduction strategies in Quang Ngai province

Strategy	**Description**
SO Strategy	Leverage natural strengths, green policies, and international resources to develop emission reduction projects.
WO Strategy	Improve technology, awareness, capital, and infrastructure to implement green projects.
ST Strategy	Reduce the impact of climate change and industrial growth; thanks to advantages in infrastructure and human resources.
WT Strategy	Reduce risks due to resource, technology, and policy constraints.

3.3 Analytic Network Process (ANP)

ANP is an advanced multi-criteria decision-making (MCDM) tool that extends AHP by enabling the modeling of dependencies and interactions between elements in a system [26]. ANP is suitable for evaluating complex problems where SWOT factors not only impact the overall objective but also influence each other, hence creating a multidimensional evaluation network [27]. ANP operates on the principle of pairwise comparison, where elements are directly compared to each other according to their importance or impact [28]. From these pairwise matrices, the ANP method uses eigenmatrix theory and weights to determine the overall priority of each element in the network. The strength of ANP lies in its ability to integrate complex relationships between factors, including both internal relationships (e.g., relationships between strengths and weaknesses) and external relationships (e.g., the impact of external opportunities and threats).

This study first identified the criteria in the SWOT matrix and strategies related to carbon emission reduction in Quang Ngai. Experts participating in the study were asked to make pairwise comparisons of the S, W, O, and T criteria and consider the interrelationships between the criteria and sub-criteria. The collected data was used to construct pairwise comparison matrices (Tables A1–A24 in the Appendix).

To ensure accuracy and consistency in data processing, Microsoft Excel was used as a calculation support tool. The calculated value was only accepted when the consistency ratio was $CR \leq 10\%(0.1)$; with CI, CR was calculated according to the following formula: $CR = CI/RI$.

In which: RI is the random consistency index (Table 3); CI is the consistency index, $CI = \frac{\lambda_{\max}-n}{n-1}$; and $\lambda_{\max}$ is the eigenvalue of the matrix, $\lambda_{\max} = \sum_{i=1}^{n} w_i \times \sum_{j=1}^{n} aij$.

Table 3. RI index [29]

n	RI
1	0
2	0
3	0.58
4	0.9
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49
11	1.53
12	1.54
13	1.56
14	1.57
15	1.59

The pairwise comparison matrices are incorporated into the hyperlink matrix (W), which reflects the overall degree of interaction between the criteria in the network. According to Alinezhad and Khalili [30], the hyperlink matrix is formed by defining the priority vectors as the matrix of Eq. (1).

$$W = \begin{array}{c} \\ \text{Goal} \\ \text{Criteria} \\ \text{Sub-criteria} \end{array} \begin{array}{c} \begin{array}{ccc} \text{Goal} & \text{Criteria} & \text{Sub-criteria} \end{array} \\ \begin{bmatrix} 0 & 0 & 0 \\ W_{21} & W_{22} & 0 \\ 0 & W_{32} & W_{33} \end{bmatrix} \end{array} \tag{1}$$

where, W_{21}: Pairwise comparison matrix of criteria; W_{22}: Internal relationship comparison matrix of criteria; W_{32}: Pairwise comparison matrix of sub-criteria; W_{33}: Internal relationship comparison matrix of sub-criteria.

The normalization of the hyperlink matrix was performed according to Eq. (2), and the iteration process was carried out continuously until the matrix reached a state of convergence, that is, the weights no longer changed significantly through the iterations.

$$\lim_{k\to\infty} (W)^k \tag{2}$$

The hyperlink matrix converges, that is, it reaches a steady state, also known as the limit matrix. Then $\lim_{k\to\infty}(W)^k = W_{\text{limit}}$ or $W^k = W^{k+1}$, where W_{limit} is the limit matrix, and *k* is the number of iterations, also known as the exponent.

The final result from the convergent hyperlink matrix could determine the final weights of each sub-criteria in the S, W, O, and T groups. These weights will then be multiplied by the pairwise comparison scores of the strategic options (Tables A25–A38 in the Appendix) to obtain the utility index of the strategic options. This index reflects the priority level in the complex context of the carbon emission reduction strategy.

4 Discussion

4.1 Characteristics of Experts

In this study, the collection of expert opinions played an important role in ensuring the accuracy and feasibility of assessing SWOT factors as well as determining strategic priorities using the ANP method. Experts were selected based on scientific criteria to ensure diversity in knowledge, practical experience, and ability to evaluate carbon emission reduction strategies in Quang Ngai. Specifically, the experts participating in the study all had expertise in environmental management, sustainable development, renewable energy, green industry, or carbon emission reduction policy and possessed practical experience in environmental projects, clean energy development, or emission reduction project management, especially at the provincial level or in the Central region of Vietnam. The expert selection process included determining an initial list of candidates based on expertise, experience, and work position; verifying information through profiles and research works; and consulting reputable colleagues in the industry to ensure accuracy and objectivity. After the evaluation and invitation process, the list of the 12 experts was finalized. They represented many different fields and organizations, including state management agencies, research institutes, universities, industrial and energy enterprises, non-governmental organizations as well as international projects. This group of experts had an average of more than 10 years of experience in related fields and most of them had master's or doctoral degrees. They were responsible for providing comments on the importance and impact of SWOT factors, assessing the relationship between strategies and criteria through the ANP survey, and ensuring objectivity, sciencificity, and feasibility in identifying carbon emission reduction strategies suitable for the practical context of Quang Ngai province. Selecting experts in this way not only enhanced the reliability of the research but also ensured that the proposed strategies were scientifically based, authentic, and feasible in local conditions.

Although the number of experts was 12, they were carefully selected based on predefined scientific criteria to guarantee sufficient knowledge, practical experience, and diversity in relevant fields, including environmental management, renewable energy, sustainable development, and carbon emission reduction policy. This selection process aimed to capture the perspectives of key stakeholders and experienced practitioners relevant to carbon emission reduction in Quang Ngai province. The expert panel collectively met the practical requirements for ANP analysis, as the pairwise comparison matrices were evaluated for consistency ($CR < 0.1$), hence confirming the reliability of their assessments. This approach ensured that the derived priorities of strategies were scientifically robust and reflective of real-world considerations.

4.2 Overall Weighting Results of the Criteria Depending on Groups S, W, O, and T

After comparing the relative priority between each pair of S, W, O, and T criteria, compare the relative priority between each pair of sub-criteria belonging to the S, W, O, and T groups, and compare the relative priority between criteria and sub-criteria. At the same time, having comparing each pair of internal relationships of criteria, as well as comparing the internal relationships of sub-criteria, the hyperlink matrix W has been established as in Table 4. This matrix fully reflects the dependency structure and feedback relationship between criteria; sub-criteria play a key role in calculating the global weight of criteria in the SWOT matrix.

From the hyperlink matrix W, the group of authors proceeded to raise it to the state of convergence. Specifically, through the process of multiplying matrix W 12 times in a row, a new matrix called Wlimit, called the limit hyperlink matrix, was created. This matrix represented the stable weights of the sub-criteria, reflecting the relative importance of each sub-criteria in the S, W, O, and T groups. The results are presented in Table 5.

It is noteworthy that in the Strengths group, S3 (local policy support for green economic development and environmental management) exhibited the highest global weight. This reflects the crucial enabling role of policy in facilitating carbon emission reduction strategies. The national policies in Vietnam, including the National Green Growth Strategy, provide a clear framework for low-carbon development, emission reduction, and sustainable industrial transformation. Quang Ngai Province, as an industrially developing region, operationalizes these national directives through local regulatory support, planning, and investment incentives. Consequently, S3 played a foundational role, influencing the adoption of emission reduction technologies, participation in carbon markets, and development of renewable energy projects, which explained its dominant weight in the SWOT-ANP analysis.

4.3 Utility Index and Priority Ranking of Strategic Options

These weights were then multiplied by the pairwise comparison scores of the strategic options to obtain the utility index (U) of the strategic options. This index reflects the overall impact in the complex context of the carbon emission reduction strategy. The pairwise comparison scores of the strategic options are shown in Table 6. The resulting utility index and priority ranking of the strategic options are listed in Table 7.

Table 4. Hyperlink matrix W

	Goal	S	W	O	T	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4
Goal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	0.3750	0	0.0400	0.1000	0.1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0.3750	0.0500	0	0.0500	0.0500	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	0.1250	0.1000	0.0800	0	0.0500	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	0.1250	0.0500	0.0800	0.0500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S1	0	0.3200	0	0	0	0	0.0585	0.1084	0.0624	0.0736	0.0625	0.0616	0.1262	0.0625	0.1256	0.1215	0.0240	0.0332	0.0257
S2	0	0.1600	0	0	0	0.0755	0	0.0550	0.1166	0.0736	0.0625	0.1214	0.1262	0.0625	0.1256	0.0635	0.1302	0.0600	0.0656
S3	0	0.3200	0	0	0	0.1317	0.0585	0	0.0624	0.1344	0.1250	0.0616	0.1262	0.1250	0.0646	0.0349	0.0240	0.1351	0.1190
W1	0	0	0.2667	0	0	0.0755	0.1134	0.0550	0	0.1344	0.0625	0.1214	0.0264	0.0625	0.0646	0.1215	0.1302	0.0600	0.1190
W2	0	0	0.1333	0	0	0.0411	0.0585	0.1084	0.1166	0	0.0625	0.0218	0.0693	0.0625	0.0228	0.0349	0.0679	0.1351	0.1190
W3	0	0	0.2667	0	0	0.0411	0.0585	0.1084	0.0624	0.0736	0	0.0616	0.0693	0.1250	0.0646	0.0635	0.0679	0.1351	0.1190
W4	0	0	0.1333	0	0	0.0411	0.1134	0.0550	0.1166	0.0272	0.0625	0	0.0693	0.0625	0.1256	0.0635	0.1302	0.0600	0.0656
O1	0	0	0	0.3200	0	0.1317	0.1134	0.1084	0.0350	0.0736	0.0625	0.0616	0	0.1250	0.0646	0.0635	0.0240	0.0600	0.0656
O2	0	0	0	0.1600	0	0.0755	0.0585	0.1084	0.0350	0.0736	0.1250	0.0616	0.1262	0	0.0646	0.0635	0.0679	0.0600	0.0656
O3	0	0	0	0.3200	0	0.1317	0.1134	0.0550	0.0350	0.0272	0.0625	0.1214	0.0693	0.0625	0	0.1215	0.0679	0.0332	0.0257
T1	0	0	0	0	0.2667	0.1317	0.0585	0.0550	0.1166	0.0272	0.0625	0.0616	0.0693	0.0625	0.1256	0	0.1302	0.0332	0.1190
T2	0	0	0	0	0.2667	0.0411	0.1134	0.0550	0.1166	0.0736	0.1250	0.1214	0.0264	0.0625	0.0646	0.1215	0	0.0600	0.0656
T3	0	0	0	0	0.1333	0.0411	0.0585	0.1084	0.0624	0.1344	0.0625	0.0616	0.0693	0.0625	0.0646	0.0635	0.0679	0	0.0257
T4	0	0	0	0	0.1333	0.0411	0.0232	0.0200	0.0624	0.0736	0.0625	0.0616	0.0264	0.0625	0.0228	0.0635	0.0679	0.1351	0

Table 5. Limited hyperlink matrix W_{limit}

	Goal	S	W	O	T	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4
Goal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S1	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688	0.0688
S2	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810	0.0810
S3	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827	0.0827
W1	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807	0.0807
W2	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656	0.0656
W3	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737	0.0737
W4	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720	0.0720
O1	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709	0.0709
O2	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706	0.0706
O3	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677
T1	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746	0.0746
T2	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757	0.0757
T3	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643	0.0643
T4	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517	0.0517

Table 6. Pairwise comparison scores of strategic alternatives

	SO	WO	ST	WT
S1	0.4824	0.1575	0.2718	0.0883
S2	0.2630	0.1411	0.4547	0.1411
S3	0.3333	0.1667	0.1667	0.3333
W1	0.0819	0.3589	0.2003	0.3589
W2	0.0960	0.4658	0.1611	0.2771
W3	0.2272	0.4231	0.1225	0.2272
W4	0.2391	0.4328	0.0890	0.2391
O1	0.3507	0.3507	0.1892	0.1093
O2	0.3333	0.3333	0.1667	0.1667
O3	0.3682	0.3682	0.1930	0.0705
T1	0.1411	0.1411	0.4547	0.2630
T2	0.0890	0.2391	0.4328	0.2391
T3	0.2347	0.2347	0.0820	0.4486
T4	0.1225	0.2272	0.2272	0.4231

Table 7. Utility index and priority ranking of strategic options

Strategy	Utility Index	Rank
SO	0.2410	2
WO	0.2867	1
ST	0.2334	4
WT	0.2389	3

The results of the weight analysis of the sub-criteria in Table 5 exhibited a relatively even distribution among the factors of strengths, weaknesses, opportunities, and threats in the context of carbon emission reduction in Quang Ngai province. In the group of Strengths, criterion S3 (local policies supporting green economic development and environmental management programs) was assessed to have the highest weight (0.0827), showing the important role of local policies in promoting emission reduction initiatives. Similarly, in the group of weaknesses, W1 (outdated technology for emission reduction in industry) had the highest weight (0.0807), clearly reflecting that technological limitations are a significant barrier for the province to effectively reduce emissions. Regarding Opportunities, O1 (expanding domestic and international carbon credit markets) and O2 (support from international projects on emission reduction and clean energy) had almost equal weights (0.0709 and 0.0706), emphasizing the great potential from international opportunities and markets to promote green projects in Quang Ngai. In the group of Challenges, T2 (industrial growth and urbanization-increased emissions if green technology is not applied) and T1 (climate change and natural disasters affecting the capacity of carbon absorption and energy infrastructure) had the highest weights of 0.0757 and 0.0746, respectively, indicating the urgency in controlling emissions amid industrial development and risks from climate change.

Regarding the utility index of the strategies in Table 7 and the visual chart displayed in Figure 2, the WO strategy (overcoming weaknesses to exploit opportunities) had the highest weight of 0.2867, which shows that improving internal constraints such as technology, awareness, and infrastructure will open up many new opportunities for Quang Ngai province in reducing carbon emissions. The SO strategy (taking advantage of strengths to exploit opportunities) was also highly appreciated with a weight of 0.2410, showing the potential to take advantage of available advantages such as support policies and natural resources to develop green projects.

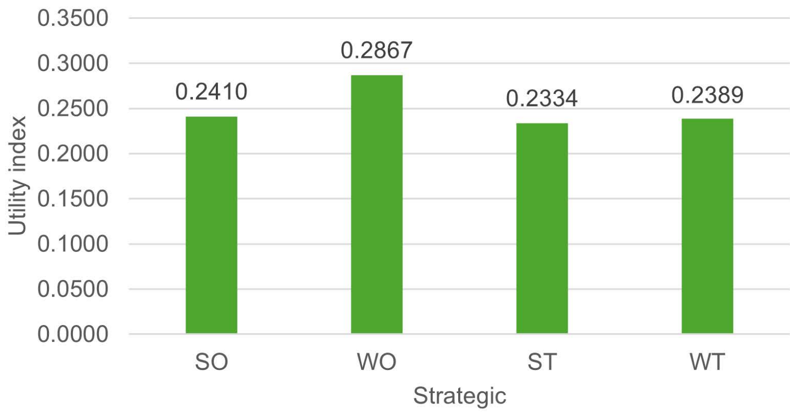

Figure 2. Utility index of strategic options

The WT strategy (minimizing risks from weaknesses and challenges) and ST strategy (taking advantage of strengths to minimize challenges) had weights of 0.2389 and 0.2334, respectively, showing that controlling risks and exploiting strengths to minimize negative impacts is necessary to ensure sustainable development.

Overall, the weighted results of the criteria and strategies depicted a balanced picture in which measures focusing on enhancing internal capacity, especially technology and infrastructure, as well as taking advantage of market and policy opportunities, are key factors for Quang Ngai province to achieve its carbon emission reduction target effectively and sustainably.

Given that the prioritization of strategic options was derived from expert-based ANP weights, it was necessary to examine the robustness of the obtained rankings under potential variations in weight assignments.

To examine the stability of the strategy prioritization results derived from the integrated SWOT-ANP model, a sensitivity analysis was conducted under three weight-adjustment scenarios: (i) the baseline scenario using the original ANP-derived weights; (ii) a $+10\%$ scenario representing moderate upward adjustments in expert judgments; and (iii) a -10% scenario simulating reduced importance of weight. These variations reflected realistic fluctuations in expert assessments commonly encountered in MCDM applications such as ANP.

Figure 3 illustrates the sensitivity of the rankings of the four strategic options (WO, SO, WT, and ST) across the three scenarios. The results demonstrated a high degree of ranking stability. Notably, the WO strategy consistently maintained the top rank under all weight-adjustment scenarios, indicating strong robustness and insensitivity to moderate variations in ANP weights. This flat sensitivity pattern suggests that the prioritization of the WO strategy is reliable and not driven by marginal changes in expert evaluations.

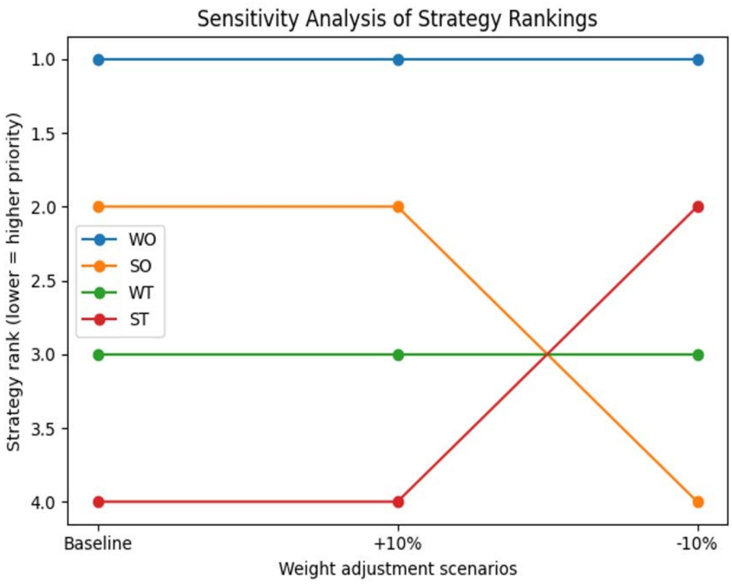

Figure 3. Sensitivity analysis of strategy ranking stability under ANP weight variations

In contrast, the mid-ranked strategies (SO and WT) exhibited moderate sensitivity to weight variations. Under the -10% scenario, a ranking shift was observed between SO and ST, reflecting the closer utility indices among these strategies and their greater dependence on fluctuating SWOT-related weights. Nevertheless, these changes are limited to lower-ranked positions and do not affect the overall prioritization structure.

The ST strategy remained among the lowest-ranked options across all scenarios, despite minor rank fluctuations underweight reductions. This consistently lower prioritization indicates that ST is less competitive relative to the other strategies, regardless of reasonable variations in ANP weights.

The sensitivity analysis confirms that the integrated SWOT-ANP approach yields robust and stable strategy rankings. The persistence of the top-ranked strategy and the limited scope of ranking change under moderate weight perturbations and provide confidence in the reliability of the proposed prioritization of carbon emission reduction strategy for policy decision making.

It should be acknowledged that the proposed carbon emission reduction strategies were derived from an integrated SWOT-ANP framework based on expert judgments. Therefore, it represents a strategic decision-support perspective rather than empirically validated policy outcomes. The study does not aim to test the operational feasibility of each strategy through on-site implementation or case-based evaluation. Instead, the results are intended to provide a structured and transparent prioritization of strategic directions that can support policymakers in identifying focus areas for the planning of emission reduction.

Moreover, several of the highly ranked strategies, particularly those associated with the WO and SO groups, are consistent with the general orientation of existing national and provincial policies in Vietnam, such as the promotion of green technologies, energy efficiency, and market-based mechanisms for carbon reduction. This alignment suggests that the proposed strategies are not detached from current policy practices, rather they offer an analytical refinement and prioritization of policy directions.

Future research could extend this work by validating the proposed strategies through empirical case studies, pilot projects, or comparative analysis with implemented emission reduction programs at the provincial level, thereby strengthening their practical applicability.

5 Conclusions, Recommendations, and Limitations

5.1 Conclusions

The study applied the integrated SWOT-ANP method to analyze and evaluate factors affecting the carbon emission reduction strategy in Quang Ngai province, hence identifying strategic priorities suitable to locally practical conditions. The results of the weighted analysis demonstrated that Quang Ngai province possessed many outstanding strengths, such as local policies supporting green economic development and abundant natural resources, while at the same time facing limitations in emission reduction technology and asynchronous renewable energy infrastructure.

Opportunities from the domestic and international carbon credit market and support from international projects create favorable conditions for Quang Ngai to promote effective emission reduction solutions. However, challenges such as climate change, industrial growth not coupled with green technology, and lack of synchronization in investment policies still pose many difficulties to be overcome.

In this context, the priority strategy focused on overcoming internal weaknesses to maximize opportunities (WO), which were assessed as having the most potential and urgency, followed by the strategy of leveraging strengths to exploit opportunities (SO). At the same time, strategies to minimize risks from weaknesses and challenges (WT) and leverage strengths to cope with challenges (ST) also played an important role in building a sustainable and feasible emission reduction plan.

The SWOT-ANP method not only helps quantify the priority of factors and strategies but also creates a solid scientific foundation for making decisions on emission reduction strategies in Quang Ngai, hence contributing to promoting green transformation and sustainable development in the region. This study also opens up a new approach for other localities in selecting and implementing emission reduction solutions suitable to the specific characteristics of each region.

5.2 Recommendations

Based on the results of the SWOT analysis and SWOT-ANP priority strategies, some specific policy recommendations for Quang Ngai province to promote the effectiveness of carbon emission reduction are as follows:

Increase investment and transfer of green technology in industry.

The results showed that the current backward emission reduction technology (W1) is a major weakness affecting the emission reduction target. Therefore, local authorities need to prioritize supporting businesses, especially in Dung Quat Economic Zone and Hoa Binh Industrial Park, in accessing, transferring, and applying carbon capture and storage technology and other clean technologies. This can be done through tax incentives, financial support, and cooperation with international projects.

Develop synchronous and scalable renewable energy infrastructure.

Renewable energy infrastructure in Quang Ngai is currently not synchronous (W4), while the potential for solar energy and coastal wind power is very large (O3). Therefore, it is necessary to develop policies to prioritize investment in renewable energy development while improving the energy distribution and storage network, thus increasing the ability to absorb and effectively use clean energy sources.

Build and perfect the domestic and international carbon credit market mechanism.

With the opportunity from the expanding carbon credit market (O1), Quang Ngai needs to coordinate with central authorities to establish a legal framework and transparent regulations on carbon credits and, at the same time, support small and medium enterprises to access preferential capital sources and carbon credits (W3). This will encourage enterprises to proactively participate in emission reduction projects and raise awareness of green development (W2).

Strengthen management capacity and training of environmental experts.

The challenge of lack of experts and environmental management resources (T4) is a major barrier to implementing large-scale emission reduction projects. Therefore, the province needs to develop specialized training programs, improve management capacity for local officials, and cooperate with international organizations to attract technical resources and professional advice.

Develop a synchronous policy on green economic development and response to climate change.

Climate change and natural disasters (T1), along with pressure on industrial growth and urbanization (T2), pose an urgent demand for cross-sectoral policies to control emissions while enhancing adaptability. Quang Ngai needs to issue synchronous policies and coordinate between departments and branches to develop green projects that are both environmentally effective and socio-economically sustainable.

5.3 Limitations

Although the study applied the integrated SWOT-ANP method to improve the accuracy in assessing factors and strategies for carbon emission reduction in Quang Ngai, there are still some limitations that should be noted. First, the selection of experts was mainly based on a group of 12 individuals with experience in the fields of environmental management, renewable energy, and sustainable development. Despite their expertise, the limited number of experts might affect the representativeness and comprehensiveness of the assessment results. Second, the input data in the SWOT analysis was largely based on subjective judgments and assessments from experts, so there might be bias or differences in opinions, thus affecting the weighting of factors and the overall objectivity of the study. Third, the study focused on the analysis within the scope of Quang Ngai province, with its own geographical, economic, and policy characteristics. Therefore, the results and proposed strategies may not be completely suitable or applicable to other provinces and regions with different conditions and contexts.

Data Availability

The data used to support the findings of this study is available from the corresponding author upon request.

Conflicts of Interest

The author declares that they have no conflicts of interest.

References

[1] M. Kang, W. Zhao, L. Jia, and Y. Liu, "Balancing carbon emission reductions and social economic development for sustainable development: Experience from 24 countries," *Chin. Geogr. Sci.*, vol. 30, no. 3, pp. 379–396, 2020. https://doi.org/10.1007/s11769-020-1117-0

[2] P. Fan, Z. Ouyang, D. D. Nguyen, T. T. H. Nguyen, H. Park, and J. Chen, "Urbanization, economic development, environmental and social changes in transitional economies: Vietnam after Doimoi," *Landsc. Urban Plan.*, vol. 187, pp. 145–155, 2019. https://doi.org/10.1016/j.landurbplan.2018.10.014

[3] P. Mupfumira, M. Mutingi, and M. Sony, "Smart city frameworks swot analysis: A systematic literature review," *Front. Sustain. Cities*, vol. 6, p. 1449983, 2024. https://doi.org/10.3389/frsc.2024.1449983

[4] T. L. Saaty, "Relative measurement and its generalization in decision making why pairwise comparisons are central in mathematics for the measurement of intangible factors the analytic hierarchy/network process," *Rev. R. Acad. Cien. Serie A. Mat.*, vol. 102, pp. 251–318, 2008. https://doi.org/10.1007/BF03191825

[5] M. H. Fahamsyah, Y. Soejarminto, H. A. Yaqin, and A. S. Rakhmat, "Analytic network process (ANP) method: Factor analysis of the non-implementation of municipal Islamic bonds in Sukuk potential areas in Indonesia," *East Asian J. Multidiscip. Res.*, vol. 2, no. 8, pp. 3305–3322, 2023. https://doi.org/10.55927/eajmr.v2i8.5409

[6] P. Sobhani, H. Esmaeilzadeh, I. D. Wolf, M. V. Marcu, M. Lück, and S. M. M. Sadeghi, "Strategies to manage ecotourism sustainably: Insights from a SWOT-ANP analysis and IUCN guidelines," *Sustainability*, vol. 15, no. 14, p. 11013, 2023. https://doi.org/10.3390/su151411013

[7] V. V. Tuyen, "Prioritization of coastal environmental risks under climate change in Quang Ngai, Vietnam: An integrated analytic network process–risk score approach," *Acadlore Trans. Geosci.*, vol. 3, no. 4, pp. 237–251, 2024. https://doi.org/10.56578/atg030405

[8] M. Filonchyk, M. P. Peterson, L. Zhang, V. Hurynovich, and Y. He, "Greenhouse gases emissions and global climate change: Examining the influence of CO_2, CH_4, and N_2O," *Sci. Total Environ.*, vol. 935, p. 173359, 2024. https://doi.org/10.1016/j.scitotenv.2024.173359

[9] T. Chankrajang, K. Talerngsri-Teerasuwannajak, and S. N. Seo, *An analysis of the Paris Agreement: Commitments versus performances in Thailand and Vietnam*. Edward Elgar Publishing, 2022.

[10] Y. T. H. Nguyen and D. P. Nguyen, "The efforts to respond to climate change and implementation of the Sustainable Development Goals (SDGs) from the hardest-affected countries: Vietnam case analysis," *Braz. J. Int'l L.*, vol. 19, p. 165, 2022.

[11] V. H. Thi Ha, N. B. Nong, and H. T. Van Nguyen, "Managing renewable energy in the context of Southeast Asia: A case study of Vietnam," in *2024 IEEE 5th International Conference on Electro-Computing Technologies for Humanity (NIGERCON), Ado Ekiti, Nigeria*, 2024, pp. 1–5. https://doi.org/10.1109/NIGERCON62786.2024.10927210

[12] Ç. K. Kaymaz, S. Birinci, and Y. Kızılkan, "Sustainable development goals assessment of Erzurum province with SWOT-AHP analysis," *Environ. Dev. Sustain.*, vol. 24, pp. 2986–3012, 2022. https://doi.org/10.1007/s10668-021-01584-w

[13] A. T. Nguyen and V. V. Tuyen, "Combination of the SWOT analysis technique and the AHP method to prioritize the selection of business strategy at packaging manufacturing companies," *Int. J. Sustain. Dev. Plan.*, vol. 20, no. 2, pp. 555–563, 2025. https://doi.org/10.18280/ijsdp.200208

[14] J. Juharni, S. Bahri, D. Mustafa, and S. H. Arhas, "SWOT-AHP as a method of public service strategy," *Sosiohumaniora*, vol. 25, no. 2, pp. 226–234, 2023. https://doi.org/10.24198/sosiohumaniora.v25i2.46124

[15] S. Rui, K. Makanae, M. Fujiu, and Y. Morisaki, "SWOT-AHP analysis of BIM technology utilization in the Japanese construction industry," *Buildings*, vol. 14, no. 11, p. 3549, 2024. https://doi.org/10.3390/buildings14113549

[16] M. Bayraktar, M. Pamik, M. Sokukcu, and O. Yuksel, "A SWOT-AHP analysis on biodiesel as an alternative future marine fuel," *Clean Technol. Environ. Policy*, vol. 25, pp. 2233–2248, 2023. https://doi.org/10.1007/s10098-023-02501-7

[17] A. Görener, "Comparing AHP and ANP: An application of strategic decisions making in a manufacturing company," *Int. J. Bus. Soc. Sci.*, vol. 3, no. 11, pp. 194–208, 2012.

[18] G. Liu, S. Zheng, P. Xu, and T. Zhuang, "An ANP-SWOT approach for ESCOs industry strategies in Chinese building sectors," *Renew. Sustain. Energy Rev.*, vol. 93, pp. 90–99, 2018. https://doi.org/10.1016/j.rser.2018.03.090

[19] Dzikrulloh and T. C. Mayvani, "Halal human capital development strategy in Madura: ANP-SWOT approach," *BIO Web Conf.*, vol. 146, p. 01006, 2024. https://doi.org/10.1051/bioconf/202414601006

[20] Z. Li, Y. Huang, S. Zhang, P. Zhang, Z. Zhai, Y. Zhou, and H. Zhao, "Study on land reclamation strategy of coal mining subsidence area with high groundwater level in plain based on ANP-SWOT model," *China Min. Mag.*, vol. 30, no. 6, pp. 82–88, 2021. https://dx.doi.org/10.12075/j.issn.1004-4051.2021.06.004

[21] M. K. Ghorbani, H. Hamidifar, C. Skoulikaris, and M. Nones, "Concept-based integration of project management and strategic magement of rubber dam projects using the SWOT–AHP method," *Sustainability*, vol. 14, no. 5, p. 2541, 2022. https://doi.org/10.3390/su14052541

[22] M. Ramadan, T. Amer, B. Salah, and M. Ruzayqat, "The impact of integration of industry 4.0 and internal organizational forces on sustaining competitive advantages and achieving strategic objectives," *Sustainability*, vol. 14, no. 10, p. 5841, 2022. https://doi.org/10.3390/su14105841

[23] J. A. Mangarin, "Threats, opportunities, weaknesses, and strengths of the school management strategies used by the Augustinian Recollect (AR) schools," *GET Int. Res. J.*, vol. 1, no. 4, pp. 1–288, 2023. https://doi.org/10.5281/zenodo.10567672

[24] M. Mardiyana, M. Ihsan, A. Adrial, H. Parida, S. Sidiq, and T. Hidayat, "A SWOT (strength weakness opportunity and threat) analysis as a strategy to enhance competitiveness," *Int. J. Manag. Sci. Appl.*, vol. 1, no. 1, pp. 18–27, 2022. https://doi.org/10.58291/ijmsa.v1i1.8

[25] D. Wahyudi, T. Taryana, M. R. Tawil, Z. Zulkifli, and B. Sipayung, "SWOT analysis in business risk awareness in MSMEs," *Technovate J. Inf. Technol. Strat. Innov. Manag.*, vol. 1, no. 2, pp. 56–61, 2024. https://doi.org/10.52432/technovate.1.2.2024.56-61

[26] S. K. Sahoo and S. S. Goswami, "A comprehensive review of multiple criteria decision-making (MCDM) methods: Advancements, applications, and future directions," *Decis. Mak. Adv.*, vol. 1, no. 1, pp. 25–48, 2023. https://doi.org/10.31181/dma1120237

[27] L. Agnusdei, M. Krstić, P. Palmi, and P. P. Miglietta, "Digitalization as driver to achieve circularity in the agroindustry: A SWOT-ANP-ADAM approach," *Sci. Total Environ.*, vol. 882, p. 163441, 2023. https://doi.org/10.1016/j.scitotenv.2023.163441

[28] D. Jorge-García and V. Estruch-Guitart, "Comparative analysis between AHP and ANP in prioritization of ecosystem services—A case study in a rice field area raised in the Guadalquivir marshes (Spain)," *Ecol. Inform.*, vol. 70, p. 101739, 2022. https://doi.org/10.1016/j.ecoinf.2022.101739

[29] A. Dikshit, R. Sarkar, B. Pradhan, R. Jena, D. Drukpa, and A. M. Alamri, "Temporal probability assessment and its use in landslide susceptibility mapping for eastern Bhutan," *Water*, vol. 12, no. 1, p. 267, 2020. https://doi.org/10.3390/w12010267

[30] A. Alinezhad and J. Khalili, *New Methods and Applications in Multiple Attribute Decision Making (MADM)*. Springer Cham, 2019.

Appendix

Table A1. Pairwise comparison matrix of criteria

	S	**W**	**O**	**T**	**Priority Vector**
S	1	1	3	3	0.3750
W	1	1	3	3	0.3750
O	1/3	1/3	1	1	0.1250
T	1/3	1/3	1	1	0.1250
$RI = 0.9;\ \lambda_{\max} = 4;\ CI = 0;\ CR = 0 < 0.1$					

Table A2. Pairwise comparison matrix of the interrelationships between criteria (S)

	S	**W**	**O**	**T**	**Priority Vector**
S	-	-	-	-	0
W	-	1	$1/2$	1	0.2500
O	-	2	1	2	0.5000
T	-	1	$1/2$	1	0.2500
$RI = 0.58;\ \lambda_{\max} = 3;\ CI = 0;\ CR = 0 < 0.1$					

Table A3. Pairwise comparison matrix of the interrelationships between criteria (W)

	S	W	O	T	Priority Vector
S	1	-	$1/2$	$1/2$	0.2000
W	-	-	-	-	0
O	2	-	1	1	0.4000
T	2	-	1	1	0.4000
$RI = 0.58;\ \lambda_{\max} = 3;\ CI = 0; and\, CR = 0 < 0.1$					

Table A4. Pairwise comparison matrix of the interrelationships between criteria (O)

	S	W	O	T	Priority Vector
S	1	2	-	2	0.5000
W	1/2	1	-	1	0.2500
O	-	-	-	-	0
T	1/2	1	-	1	0.2500
$RI = 0.58;\ \lambda_{\max} = 3;\ CI = 0; and\, CR = 0 < 0.1$					

Table A5. Pairwise comparison matrix of the interrelationships between criteria (T)

	S	W	O	T	Priority Vector
S	1	2	2	-	0.5000
W	1/2	1	1	-	0.2500
O	1/2	1	1	-	0.2500
T	-	-	-	-	0
$RI = 0.58;\ \lambda_{\max} = 3;\ CI = 0; and\, CR = 0 < 0.1$					

Table A6. Pairwise comparison matrix of sub-criteria (S)

	S1	S2	S3	Priority Vector
S1	1	2	1	0.4000
S2	1/2	1	1/2	0.2000
S3	1	2	1	0.4000
$RI = 0.58;\ \lambda_{\max} = 3;\ CI = 0; and\, CR = 0 < 0.1$				

Table A7. Pairwise comparison matrix of sub-criteria (W)

	W1	W2	W3	W4	Priority Vector
W1	1	2	1	2	0.3333
W2	1/2	1	1/2	1	0.1667
W3	1	2	1	2	0.3333
W4	1/2	1	1/2	1	0.1667
$RI = 0.9;\ \lambda_{\max} = 4;\ CI = 0; and\, CR = 0 < 0.1$					

Table A8. Pairwise comparison matrix of sub-criteria (O)

	O1	O2	O3	Priority Vector
O1	1	2	1	0.4000
O2	1/2	1	1/2	0.2000
O3	1	2	1	0.4000
$RI = 0.58;\ \lambda_{\max} = 3;\ CI = 0; and\, CR = 0 < 0.1$				

Table A9. Pairwise comparison matrix of sub-criteria (T)

	T1	T2	T3	T4	Priority Vector
T1	1	1	2	2	0.3333
T2	1	1	2	2	0.3333
T3	1/2	1/2	1	1	0.1667
T4	1/2	1/2	1	1	0.1667
$RI = 0.9;\ \lambda_{\max} = 4;\ CI = 0; and\, CR = 0 < 0.1$					

Table A10. Pairwise comparison matrix of criteria and sub-criteria

	Criteria	Sub-criteria	Priority Vector
Criteria	1	1/4	0.200
Sub-criteria	4	1	0.800
$n = 2, consistent$			

Table A11. Pairwise comparison matrix of the interrelationships between sub-criteria (S1)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
S2	-	1	1/2	1	2	2	2	1/2	1	1/2	1/2	2	2	2	0.0755
S3	-	2	1	2	3	3	3	1	2	1	1	3	3	3	0.1317
W1	-	1	1/2	1	2	2	2	1/2	1	1/2	1/2	2	2	2	0.0755
W2	-	1/2	1/3	1/2	1	1	1	1/3	1/2	1/3	1/3	1	1	1	0.0411
W3	-	1/2	1/3	1/2	1	1	1	1/3	1/2	1/3	1/3	1	1	1	0.0411
W4	-	1/2	1/3	1/2	1	1	1	1/3	1/2	1/3	1/3	1	1	1	0.0411
O1	-	2	1	2	3	3	3	1	2	1	1	3	3	3	0.1317
O2	-	1	1/2	1	2	2	2	1/2	1	1/2	1/2	2	2	2	0.0755
O3	-	2	1	2	3	3	3	1	2	1	1	3	3	3	0.1317
T1	-	2	1	2	3	3	3	1	2	1	1	3	3	3	0.1317
T2	-	1/2	1/3	1/2	1	1	1	1/3	1/2	1/3	1/3	1	1	1	0.0411
T3	-	1/2	1/3	1/2	1	1	1	1/3	1/2	1/3	1/3	1	1	1	0.0411
T4	-	1/2	1/3	1/2	1	1	1	1/3	1/2	1/3	1/3	1	1	1	0.0411
$RI = 1.56;\ \lambda_{\max} = 13.0451;\ CI = 0.0038; and\, CR = 0.0003 < 0.1$															

Table A12. Pairwise comparison matrix of the interrelationships between sub-criteria (S2)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	-	1	1/2	1	1	1/2	1/2	1	1/2	1	1/2	1	3	0.0585
S2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
S3	1	-	1	1/2	1	1	1/2	1/2	1	1/2	1	1/2	1	3	0.0585
W1	2	-	2	1	2	2	1	1	2	1	2	1	2	4	0.1134
W2	1	-	1	1/2	1	1	1/2	1/2	1	1/2	1	1/2	1	3	0.0585
W3	1	-	1	1/2	1	1	1/2	1/2	1	1/2	1	1/2	1	3	0.0585
W4	2	-	2	1	2	2	1	1	2	1	2	1	2	4	0.1134
O1	2	-	2	1	2	2	1	1	2	1	2	1	2	4	0.1134
O2	1	-	1	1/2	1	1	1/2	1/2	1	1/2	1	1/2	1	3	0.0585
O3	2	-	2	1	2	2	1	1	2	1	2	1	2	4	0.1134
T1	1	-	1	1/2	1	1	1/2	1/2	1	1/2	1	1/2	1	3	0.0585
T2	2	-	2	1	2	2	1	1	2	1	2	1	2	4	0.1134
T3	1	-	1	1/2	1	1	1/2	1/2	1	1/2	1	1/2	1	3	0.0585
T4	1/3	-	1/3	1/4	1/3	1/3	1/4	1/4	1/3	1/4	1/3	1/4	1/3	1	0.0232
$RI = 1.56;\ \lambda_{\max} = 13.0377;\ CI = 0.0031; and\, CR = 0.0002 < 0.1$															

Table A13. Pairwise comparison matrix of the interrelationships between sub-criteria (S3)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	2	-	2	1	1	2	1	1	2	2	2	1	5	0.1084
S2	1/2	1	-	1	1/2	1/2	1	1/2	1/2	1	1	1	1/2	3	0.0550
S3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
W1	1/2	1	-	1	1/2	1/2	1	1/2	1/2	1	1	1	1/2	3	0.0550
W2	1	2	-	2	1	1	2	1	1	2	2	2	1	5	0.1084
W3	1	2	-	2	1	1	2	1	1	2	2	2	1	5	0.1084
W4	1/2	1	-	1	1/2	1/2	1	1/2	1/2	1	1	1	1/2	3	0.0550
O1	1	2	-	2	1	1	2	1	1	2	2	2	1	5	0.1084
O2	1	2	-	2	1	1	2	1	1	2	2	2	1	5	0.1084
O3	1/2	1	-	1	1/2	1/2	1	1/2	1/2	1	1	1	1/2	3	0.0550
T1	1/2	1	-	1	1/2	1/2	1	1/2	1/2	1	1	1	1/2	3	0.0550
T2	1/2	1	-	1	1/2	1/2	1	1/2	1/2	1	1	1	1/2	3	0.0550
T3	1	2	-	2	1	1	2	1	1	2	2	2	1	5	0.1084
T4	1/5	1/3	-	1/3	1/5	1/5	1/3	1/5	1/5	1/3	1/3	1/3	1/5	1	0.0200
$RI = 1.56;\ \lambda_{\max} = 13.0080;\ CI = 0.0007; and\, CR = 0.0001 < 0.1$															

Table A14. Pairwise comparison matrix of the interrelationships between sub-criteria (W1)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	1/2	1	-	1/2	1	1/2	2	2	2	1/2	1/2	1	1	0.0624
S2	2	1	2	-	1	2	1	3	3	3	1	1	2	2	0.1166
S3	1	1/2	1	-	1/2	1	1/2	2	2	2	1/2	1/2	1	1	0.0624
W1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
W2	2	1	2	-	1	2	1	3	3	3	1	1	2	2	0.1166
W3	1	1/2	1	-	1/2	1	1/2	2	2	2	1/2	1/2	1	1	0.0624
W4	2	1	2	-	1	2	1	3	3	3	1	1	2	2	0.1166
O1	1/2	1/3	1/2	-	1/3	1/2	1/3	1	1	1	1/3	1/3	1/2	1/2	0.0350
O2	1/2	1/3	1/2	-	1/3	1/2	1/3	1	1	1	1/3	1/3	1/2	1/2	0.0350
O3	1/2	1/3	1/2	-	1/3	1/2	1/3	1	1	1	1/3	1/3	1/2	1/2	0.0350
T1	2	1	2	-	1	2	1	3	3	3	1	1	2	2	0.1166
T2	2	1	2	-	1	2	1	3	3	3	1	1	2	2	0.1166
T3	1	1/2	1	-	1/2	1	1/2	2	2	2	1/2	1/2	1	1	0.0624
T4	1	1/2	1	-	1/2	1	1/2	2	2	2	1/2	1/2	1	1	0.0624
$RI = 1.56;\ \lambda_{\max} = 13.0430;\ CI = 0.0036; and\, CR = 0.0003 < 0.1$															

Table A15. Pairwise comparison matrix of the interrelationships between sub-criteria (W2)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	1	1/2	1/2	-	1	3	1	1	3	3	1	1/2	1	0.0736
S2	1	1	1/2	1/2	-	1	3	1	1	3	3	1	1/2	1	0.0736
S3	2	2	1	1	-	2	4	2	2	4	4	2	1	2	0.1344
W1	2	2	1	1	-	2	4	2	2	4	4	2	1	2	0.1344
W2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
W3	1	1	1/2	1/2	-	1	1/3	1	1	4	1/3	3	4	4	0.0736
W4	1/3	1/3	1/4	1/4	-	3	1	3	3	7	1	6	7	7	0.0272
O1	1	1	1/2	1/2	-	1	1/3	1	1	4	1/3	3	4	4	0.0736
O2	1	1	1/2	1/2	-	1	1/3	1	1	4	1/3	3	4	4	0.0736
O3	1/3	1/3	1/4	1/4	-	1/4	1/7	1/4	1/4	1	1/7	1/2	1	1	0.0272
T1	1/3	1/3	1/4	1/4	-	3	1	3	3	7	1	6	7	7	0.0272
T2	1	1	1/2	1/2	-	1/3	1/6	1/3	1/3	2	1/6	1	2	2	0.0736
T3	2	2	1	1	-	1/4	1/7	1/4	1/4	1	1/7	1/2	1	1	0.1344
T4	1	1	1/2	1/2	-	1/4	1/7	1/4	1/4	1	1/7	1/2	1	1	0.0736
$RI = 1.56;\ \lambda_{\max} = 13.0729;\ CI = 0.0061; and\, CR = 0.0005 < 0.1$															

Table A16. Pairwise comparison matrix of the interrelationships between sub-criteria (W3)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	1	1/2	1	1	-	1	1	1/2	1	1	1/2	1	1	0.0625
S2	1	1	1/2	1	1	-	1	1	1/2	1	1	1/2	1	1	0.0625
S3	2	2	1	2	2	-	2	2	1	2	2	1	2	2	0.1250
W1	1	1	1/2	1	1	-	1	1	1/2	1	1	1/2	1	1	0.0625
W2	1	1	1/2	1	1	-	1	1	1/2	1	1	1/2	1	1	0.0625
W3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
W4	1	1	1/2	1	1	-	1	1	1/2	1	1	1/2	1	1	0.0625
O1	1	1	1/2	1	1	-	1	1	1/2	1	1	1/2	1	1	0.0625
O2	2	2	1	2	2	-	2	2	1	2	2	1	2	2	0.1250
O3	1	1	1/2	1	1	-	1	1	1/2	1	1	1/2	1	1	0.0625
T1	1	1	1/2	1	1	-	1	1	1/2	1	1	1/2	1	1	0.0625
T2	2	2	1	2	2	-	2	2	1	2	2	1	2	2	0.1250
T3	1	1	1/2	1	1	-	1	1	1/2	1	1	1/2	1	1	0.0625
T4	1	1	1/2	1	1	-	1	1	1/2	1	1	1/2	1	1	0.0625
$RI = 1.56;\ \lambda_{\max} = 13.0000;\ CI = 0; and\, CR = 0 < 0.1$															

Table A17. Pairwise comparison matrix of the interrelationships between sub-criteria (W4)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	1/2	1	1/2	3	1	-	1	1	1/2	1	1/2	1	1	0.0616
S2	2	1	2	1	5	2	-	2	2	1	2	1	2	2	0.1214
S3	1	1/2	1	1/2	3	1	-	1	1	1/2	1	1/2	1	1	0.0616
W1	2	1	2	1	5	2	-	2	2	1	2	1	2	2	0.1214
W2	1/3	1/5	1/3	1/5	1	1/3	-	1/3	1/3	1/5	1/3	1/5	1/3	1/3	0.0218
W3	1	1/2	1	1/2	3	1	-	1	1	1/2	1	1/2	1	1	0.0616
W4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
O1	1	1/2	1	1/2	3	1	-	1	1	1/2	1	1/2	1	1	0.0616
O2	1	1/2	1	1/2	3	1	-	1	1	1/2	1	1/2	1	1	0.0616
O3	2	1	2	1	5	2	-	2	2	1	2	1	2	2	0.1214
T1	1	1/2	1	1/2	3	1	-	1	1	1/2	1	1/2	1	1	0.0616
T2	2	1	2	1	5	2	-	2	2	1	2	1	2	2	0.1214
T3	1	1/2	1	1/2	3	1	-	1	1	1/2	1	1/2	1	1	0.0616
T4	1	1/2	1	1/2	3	1	-	1	1	1/2	1	1/2	1	1	0.0616
$RI = 1.56;\ \lambda_{\max} = 13.0072;\ CI = 0.0006; and\, CR = 0.000046 < 0.1$															

Table A18. Pairwise comparison matrix of the interrelationships between sub-criteria (O1)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	1	1	4	2	2	2	-	1	2	2	4	2	4	0.1262
S2	1	1	1	4	2	2	2	-	1	2	2	4	2	4	0.1262
S3	1	1	1	4	2	2	2	-	1	2	2	4	2	4	0.1262
W1	1/4	1/4	1/4	1	1/3	1/3	1/3	-	1/4	1/3	1/3	1	1/3	1	0.0264
W2	1/2	1/2	1/2	3	1	1	1	-	1/2	1	1	3	1	3	0.0693
W3	1/2	1/2	1/2	3	1	1	1	-	1/2	1	1	3	1	3	0.0693
W4	1/2	1/2	1/2	3	1	1	1	-	1/2	1	1	3	1	3	0.0693
O1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
O2	1	1	1	4	2	2	2	-	1	2	2	4	2	4	0.1262
O3	1/2	1/2	1/2	3	1	1	1	-	1/2	1	1	3	1	3	0.0693
T1	1/2	1/2	1/2	3	1	1	1	-	1/2	1	1	3	1	3	0.0693
T2	1/4	1/4	1/4	1	1/3	1/3	1/3	-	1/4	1/3	1/3	1	1/3	1	0.0264
T3	1/2	1/2	1/2	3	1	1	1	-	1/2	1	1	3	1	3	0.0693
T4	1/4	1/4	1/4	1	1/3	1/3	1/3	-	1/4	1/3	1/3	1	1/3	1	0.0264
$RI = 1.56;\ \lambda_{\max} = 13.0842;\ CI = 0.0070; and\, CR = 0.000540 < 0.1$															

Table A19. Pairwise comparison matrix of the interrelationships between sub-criteria (O2)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	1	1/2	1	1	1/2	1	1/2	-	1	1	1	1	1	0.0625
S2	1	1	1/2	1	1	1/2	1	1/2	-	1	1	1	1	1	0.0625
S3	2	2	1	2	2	1	2	1	-	2	2	2	2	2	0.1250
W1	1	1	1/2	1	1	1/2	1	1/2	-	1	1	1	1	1	0.0625
W2	1	1	1/2	1	1	1/2	1	1/2	-	1	1	1	1	1	0.0625
W3	2	2	1	2	2	1	2	1	-	2	2	2	2	2	0.1250
W4	1	1	1/2	1	1	1/2	1	1/2	-	1	1	1	1	1	0.0625
O1	2	2	1	2	2	1	2	1	-	2	2	2	2	2	0.1250
O2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
O3	1	1	1/2	1	1	1/2	1	1/2	-	1	1	1	1	1	0.0625
T1	1	1	1/2	1	1	1/2	1	1/2	-	1	1	1	1	1	0.0625
T2	1	1	1/2	1	1	1/2	1	1/2	-	1	1	1	1	1	0.0625
T3	1	1	1/2	1	1	1/2	1	1/2	-	1	1	1	1	1	0.0625
T4	1	1	1/2	1	1	1/2	1	1/2	-	1	1	1	1	1	0.0625
$RI = 1.56;\ \lambda_{\max} = 13.0000;\ CI = 0; and\, CR = 0 < 0.1$															

Table A20. Pairwise comparison matrix of the interrelationships between sub-criteria (O3)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	1	2	2	5	2	1	2	2	-	1	2	2	5	0.1256
S2	1	1	2	2	5	2	1	2	2	-	1	2	2	5	0.1256
S3	1/2	1/2	1	1	3	1	1/2	1	1	-	1/2	1	1	3	0.0646
W1	1/2	1/2	1	1	3	1	1/2	1	1	-	1/2	1	1	3	0.0646
W2	1/5	1/5	1/3	1/3	1	1/3	1/5	1/3	1/3	-	1/5	1/3	1/3	1	0.0228
W3	1/2	1/2	1	1	3	1	1/2	1	1	-	1/2	1	1	3	0.0646
W4	1	1	2	2	5	2	1	2	2	-	1	2	2	5	0.1256
O1	1/2	1/2	1	1	3	1	1/2	1	1	-	1/2	1	1	3	0.0646
O2	1/2	1/2	1	1	3	1	1/2	1	1	-	1/2	1	1	3	0.0646
O3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
T1	1	1	2	2	5	2	1	2	2	-	1	2	2	5	0.1256
T2	1/2	1/2	1	1	3	1	1/2	1	1	-	1/2	1	1	3	0.0646
T3	1/2	1/2	1	1	3	1	1/2	1	1	-	1/2	1	1	3	0.0646
T4	1/5	1/5	1/3	1/3	1	1/3	1/5	1/3	1/3	-	1/5	1/3	1/3	1	0.0228
$RI = 1.56;\ \lambda_{\max} = 13.0131;\ CI = 0.0011; and\, CR = 0.000085 < 0.1$															

Table A21. Pairwise comparison matrix of the interrelationships between sub-criteria (T1)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	2	3	1	3	2	2	2	2	1	-	1	2	2	0.1215
S2	1/2	1	2	1/2	2	1	1	1	1	1/2	-	1/2	1	1	0.0635
S3	1/3	1/2	1	1/3	1	1/2	1/2	1/2	1/2	1/3	-	1/3	1/2	1/2	0.0349
W1	1	2	3	1	3	2	2	2	2	1	-	1	2	2	0.1215
W2	1/3	1/2	1	1/3	1	1/2	1/2	1/2	1/2	1/3	-	1/3	1/2	1/2	0.0349
W3	1/2	1	2	1/2	2	1	1	1	1	1/2	-	1/2	1	1	0.0635
W4	1/2	1	2	1/2	2	1	1	1	1	1/2	-	1/2	1	1	0.0635
O1	1/2	1	2	1/2	2	1	1	1	1	1/2	-	1/2	1	1	0.0635
O2	1/2	1	2	1/2	2	1	1	1	1	1/2	-	1/2	1	1	0.0635
O3	1	2	3	1	3	2	2	2	2	1	-	1	2	2	0.1215
T1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
T2	1	2	3	1	3	2	2	2	2	1	-	1	2	2	0.1215
T3	1/2	1	2	1/2	2	1	1	1	1	1/2	-	1/2	1	1	0.0635
T4	1/2	1	2	1/2	2	1	1	1	1	1/2	-	1/2	1	1	0.0635
$RI = 1.56;\ \lambda_{\max} = 13.0311;\ CI = 0.0026; and\, CR = 0.00020 < 0.1$															

Table A22. Pairwise comparison matrix of the interrelationships between sub-criteria (T2)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	1/5	1	1/5	1/3	1/3	1/5	1	1/3	1/3	1/5	-	1/3	1/3	0.0240
S2	5	1	5	1	2	2	1	5	2	2	1	-	2	2	0.1302
S3	1	1/5	1	1/5	1/3	1/3	1/5	1	1/3	1/3	1/5	-	1/3	1/3	0.0240
W1	5	1	5	1	2	2	1	5	2	2	1	-	2	2	0.1302
W2	3	1/2	3	1/2	1	1	1/2	3	1	1	1/2	-	1	1	0.0679
W3	3	1/2	3	1/2	1	1	1/2	3	1	1	1/2	-	1	1	0.0679
W4	5	1	5	1	2	2	1	5	2	2	1	-	2	2	0.1302
O1	1	1/5	1	1/5	1/3	1/3	1/5	1	1/3	1/3	1/5	-	1/3	1/3	0.0240
O2	3	1/2	3	1/2	1	1	1/2	3	1	1	1/2	-	1	1	0.0679
O3	3	1/2	3	1/2	1	1	1/2	3	1	1	1/2	-	1	1	0.0679
T1	5	1	5	1	2	2	1	5	2	2	1	-	2	2	0.1302
T2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
T3	3	1/2	3	1/2	1	1	1/2	3	1	1	1/2	-	1	1	0.0679
T4	3	1/2	3	1/2	1	1	1/2	3	1	1	1/2	-	1	1	0.0679
$RI = 1.56;\ \lambda_{\max} = 13.0177;\ CI = 0.0015; and\, CR = 0.00011 < 0.1$															

Table A23. Pairwise comparison matrix of the interrelationships between sub-criteria (T3)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	1/2	1/3	1/2	1/3	1/3	1/2	1/2	1/2	1	1	1/2	-	1/3	0.0332
S2	2	1	1/2	1	1/2	1/2	1	1	1	2	2	1	-	1/2	0.0600
S3	3	3	1	3	1	1	3	3	3	3	3	3	-	1	0.1351
W1	2	1	1/2	1	1/2	1/2	1	1	1	2	2	1	-	1/2	0.0600
W2	3	3	1	3	1	1	3	3	3	3	3	3	-	1	0.1351
W3	3	3	1	3	1	1	3	3	3	3	3	3	-	1	0.1351
W4	2	1	1/2	1	1/2	1/2	1	1	1	2	2	1	-	1/2	0.0600
O1	2	1	1/2	1	1/2	1/2	1	1	1	2	2	1	-	1/2	0.0600
O2	2	1	1/2	1	1/2	1/2	1	1	1	2	2	1	-	1/2	0.0600
O3	1	1/2	1/3	1/2	1/3	1/3	1/2	1/2	1/2	1	1	1/2	-	1/3	0.0332
T1	1	1/2	1/3	1/2	1/3	1/3	1/2	1/2	1/2	1	1	1/2	-	1/3	0.0332
T2	2	1	1/2	1	1/2	1/2	1	1	1	2	2	1	-	1/2	0.0600
T3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
T4	3	3	1	3	1	1	3	3	3	3	3	3	-	1	0.1351
$RI = 1.56;\ \lambda_{\max} = 14.0321;\ CI = 0.0860; and\, CR = 0.0067 < 0.1$															

Table A24. Pairwise comparison matrix of the interrelationships between sub-criteria (T4)

	S1	S2	S3	W1	W2	W3	W4	O1	O2	O3	T1	T2	T3	T4	Priority Vector
S1	1	1/3	1/4	1/4	1/4	1/4	1/3	1/3	1/3	1	1/4	1/3	1	-	0.0257
S2	3	1	1/2	1/2	1/2	1/2	1	1	1	3	1/2	1	3	-	0.0656
S3	4	2	1	1	1	1	2	2	2	4	1	2	4	-	0.1190
W1	4	2	1	1	1	1	2	2	2	4	1	2	4	-	0.1190
W2	4	2	1	1	1	1	2	2	2	4	1	2	4	-	0.1190
W3	4	2	1	1	1	1	2	2	2	4	1	2	4	-	0.1190
W4	3	1	1/2	1/2	1/2	1/2	1	1	1	3	1/2	1	3	-	0.0656
O1	3	1	1/2	1/2	1/2	1/2	1	1	1	3	1/2	1	3	-	0.0656
O2	3	1	1/2	1/2	1/2	1/2	1	1	1	3	1/2	1	3	-	0.0656
O3	1	1/3	1/4	1/4	1/4	1/4	1/3	1/3	1/3	1	1/4	1/3	1	-	0.0257
T1	4	2	1	1	1	1	2	2	2	4	1	2	4	-	0.1190
T2	3	1	1/2	1/2	1/2	1/2	1	1	1	3	1/2	1	3	-	0.0656
T3	1	1/3	1/4	1/4	1/4	1/4	1/3	1/3	1/3	1	1/4	1/3	1	-	0.0257
T4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
$RI = 1.56;\ \lambda_{\max} = 13.0881;\ CI = 0.0073; and\, CR = 0.00056 < 0.1$															

Table A25. Pairwise comparison matrix of strategy (S1)

	SO	WO	ST	WT	Priority Vector
SO	1	3	2	5	0.4824
WO	1/3	1	1/2	2	0.1575
ST	1/2	2	1	3	0.2718
WT	1/5	1/2	1/3	1	0.0883
$RI = 0.9;\ \lambda_{\max} = 4.0177;\ CI = 0.0059; and\, CR = 0.0015 < 0.1$					

Table A26. Pairwise comparison matrix of strategy (S2)

	SO	WO	ST	WT	Priority Vector
SO	1	2	1/2	2	0.2630
WO	1/2	1	1/3	1	0.1411
ST	2	3	1	3	0.4547
WT	1/2	1	1/3	1	0.1411
$RI = 0.9;\ \lambda_{\max} = 4.0133;\ CI = 0.0044; and\, CR = 0.0011 < 0.1$					

Table A27. Pairwise comparison matrix of strategy (S3)

	SO	WO	ST	WT	Priority Vector
SO	1	2	2	1	0.3333
WO	1/2	1	1	1/2	0.1667
ST	1/2	1	1	1/2	0.1667
WT	1	2	2	1	0.3333
$RI = 0.9;\ \lambda_{\max} = 4;\ CI = 0; and\, CR = 0 < 0.1$					

Table A28. Pairwise comparison matrix of strategy (W1)

	SO	WO	ST	WT	Priority Vector
SO	1	1/4	1/3	1/4	0.0819
WO	4	1	2	1	0.3589
ST	3	1/2	1	1/2	0.2003
WT	4	1	2	1	0.3589
$RI = 0.9;\ \lambda_{\max} = 4.0251;\ CI = 0.0084; and\, CR = 0.0021 < 0.1$					

Table A29. Pairwise comparison matrix of strategy (W2)

	SO	WO	ST	WT	Priority Vector
SO	1	1/4	1/2	1/3	0.0960
WO	4	1	3	2	0.4658
ST	2	1/3	1	1/2	0.1611
WT	3	1/2	2	1	0.2771
$RI = 0.9;\ \lambda_{\max} = 4.0395;\ CI = 0.0132; and\, CR = 0.0033 < 0.1$					

Table A30. Pairwise comparison matrix of strategy (W3)

	SO	WO	ST	WT	Priority Vector
SO	1	1/2	2	1	0.2272
WO	2	1	3	2	0.4231
ST	1/2	1/3	1	1/2	0.1225
WT	1	1/2	2	1	0.2272
$RI = 0.9;\ \lambda_{\max} = 4.0121;\ CI = 0.0040; and\, CR = 0.0010 < 0.1$					

Table A31. Pairwise comparison matrix of strategy (W4)

	SO	WO	ST	WT	Priority Vector
SO	1	1/2	3	1	0.2391
WO	2	1	4	2	0.4328
ST	1/3	1/4	1	1/3	0.0890
WT	1	1/2	3	1	0.2391
$RI = 0.9;\ \lambda_{\max} = 4.0248;\ CI = 0.0083; and\, CR = 0.0021 < 0.1$					

Table A32. Pairwise comparison matrix of strategy (O1)

	SO	WO	ST	WT	Priority Vector
SO	1	1	2	3	0.3507
WO	1	1	2	3	0.3507
ST	1/2	1/2	1	2	0.1892
WT	1/3	1/3	1/2	1	0.1093
$RI = 0.9;\ \lambda_{\max} = 4.0122;\ CI = 0.0041; and\, CR = 0.0010 < 0.1$					

Table A33. Pairwise comparison matrix of strategy (O2)

	SO	WO	ST	WT	Priority Vector
SO	1	1	2	2	0.3333
WO	1	1	2	2	0.3333
ST	1/2	1/2	1	1	0.1667
WT	1/2	1/2	1	1	0.1667
$RI = 0.9;\ \lambda_{\max} = 4;\ CI = 0; and\, CR = 0 < 0.1$					

Table A34. Pairwise comparison matrix of strategy (O3)

	SO	WO	ST	WT	Priority Vector
SO	1	1	2	5	0.3682
WO	1	1	2	5	0.3682
ST	1/2	1/2	1	3	0.1930
WT	1/5	1/5	1/3	1	0.0705
$RI = 0.9;\ \lambda_{\max} = 4.0052;\ CI = 0.0017; and\, CR = 0.0004 < 0.1$					

Table A35. Pairwise comparison matrix of strategy (T1)

	SO	WO	ST	WT	Priority Vector
SO	1	1	1/3	1/2	0.1411
WO	1	1	1/3	1/2	0.1411
ST	3	3	1	2	0.4547
WT	2	2	1/2	1	0.2630
$RI = 0.9;\ \lambda_{\max} = 4.0133;\ CI = 0.0044; and\, CR = 0.0011 < 0.1$					

Table A36. Pairwise comparison matrix of strategy (T2)

	SO	WO	ST	WT	Priority Vector
SO	1	1/3	1/4	1/3	0.0890
WO	3	1	1/2	1	0.2391
ST	4	2	1	2	0.4328
WT	3	1	1/2	1	0.2391
$RI = 0.9;\ \lambda_{\max} = 4.0248;\ CI = 0.0083; and\, CR = 0.0021 < 0.1$					

Table A37. Pairwise comparison matrix of strategy (T3)

	SO	WO	ST	WT	Priority Vector
SO	1	1	3	1/2	0.2347
WO	1	1	3	1/2	0.2347
ST	1/3	1/3	1	1/5	0.0820
WT	2	2	5	1	0.4486
$RI = 0.9;\ \lambda_{\max} = 4.0052;\ CI = 0.0017; and\, CR = 0.0004 < 0.1$					

Table A38. Pairwise comparison matrix of strategy (T4)

	SO	WO	ST	WT	Priority Vector
SO	1	1/2	1/2	1/3	0.1225
WO	2	1	1	1/2	0.2272
ST	2	1	1	1/2	0.2272
WT	3	2	2	1	0.4231
$RI = 0.9;\ \lambda_{\max} = 4.0121;\ CI = 0.0040; and\, CR = 0.0010 < 0.1$					