INTEGRATION OF SWOT AND AHP-GROUP (AHPG) FOR BUILDING SOCIAL-ECONOMIC DEVELOPMENT STRATEGIES: A CASE STUDY IN DAK NONG PROVINCE, VIETNAM

DINH, Le Canh
Sub-National Institute of Agricultural Planning and Projection (Sub-NIAPP)
Vietnam
lecanhdinh@gmail.com

ABSTRACT

In the decision-making process for socio-economic development strategies, decision-makers prioritize selecting strategies based on their weights, from highest to lowest. This study employed the integration of SWOT and AHP-Group (AHPG) to propose strategies that align with these requirements. The process is as follows: first, the SWOT framework was applied to analyze strengths (S), weaknesses (W), opportunities (O), and threats (T). Next, AHPG was used to calculate the weights of the level 1 factors (SWOT objectives) and level 2 factors (SWOT factors). Finally, strategies were ranked and prioritized by calculating the weights of the relationships between level 2 factors (SWOT factors) and the proposed strategies (SO1, SO2, SO3, WO1, WO2, ST1, ST2, WT1, WT2, WT3). The calculated results identified strategies with varying weights. Without following this method, the strategies would be implemented based on groups such as SO (SO1, SO2, SO3), WO (WO1, WO2), ST (ST1, ST2), and WT (WT1, WT2, WT3), rather than implementing individual strategies separately according to their priority, from highest to lowest (SO_3: 0.118 > ST_2: 0.104 > SO_2: 0.103 > ST_1: 0.102 > WT_3: 0.101 > WT_1: 0.098 > WT_2: 0.096 > SO_1: 0.095 > WO_2: 0.094 > WO_1: 0.089). The study was conducted in Dak Nong province and involved the participation of planners, ensuring that the results have a high degree of feasibility.

Keywords: SWOT; AHP-Group (AHPG); ranked strategies; Dak Nong province

1. Introduction

Developing and selecting strategies for socio-economic development is a crucial task that assists managers and planners in achieving their established objectives. Typically, when analyzing proposed strategies, authors often employ the SWOT framework (Tuan and Canh, 2022; Polat et al., 2017) to examine strengths (S), weaknesses (W), opportunities (O), and threats (T). This analysis leads to the formulation of four strategic groups: leveraging strengths to capitalize on opportunities (SO), addressing weaknesses to take advantage of opportunities (WO), utilizing strengths to mitigate risks (ST), and implementing defensive strategies to prevent worsening challenges (WT).

However, these strategies cannot be quantitatively assessed using SWOT alone; they need to be combined with the AHP (Polat et al., 2017) to quantify the strategies and determine their priority for implementation in socio-economic development (Tuan

and Canh, 2022; Wickramasinghe and Takano, 2010; Kandakoglu et al., 2007).

The AHP by itself is utilized to calculate the weights of criteria (Shiwakoti and Regmi, 2022), but it is often characterized by subjectivity (Thapa and Murayama, 2008; Chen et al., 2010; Akaa O.U et al., 2016). Meanwhile, the selection of criteria and the formulation of strategies involve diverse domains and necessitate the engagement of various stakeholders. Consequently, the application of the Analytic Hierarchy Process (AHP) in group decision-making becomes crucial (Srdjevic B. et al., 2013; Srdjevic, Blagojevic, and Cukaliev, 2014; Srdjevic Z. et al., 2014; Dragincic and Korac, 2015; Amenta, Luacadamo, and Marcarelli, 2021; Grošeli and Dolina, 2023). This methodology facilitates the determination of weights for factors and strategies, thereby mitigating subjectivity and harnessing the collective expertise of multiple specialists (Dinh and Duc, 2012).

In 2020, Dak Nong Province began developing its provincial planning for the 2021–2025 period with a vision toward 2050. Taking advantage of this opportunity, the integrated SWOT and group Analytic Hierarchy Process (AHP-Group, abbreviated as AHPG) model was applied to formulate and evaluate strategies supporting the province's socioeconomic development planning. In this context, SWOT was utilized to analyze criteria and propose strategies, while AHPG served as a multi-criteria analysis tool to assess and quantify these strategies. This approach supports decision-makers in prioritizing strategies for the socioeconomic development of Dak Nong Province.

2. Research methodology

2.1. SWOT model

SWOT analysis (Weihrich, 1982) was first applied in the field of economics in the 1970s, and today is utilized across a wide range of fields. SWOT is an analytical and planning tool used to identify future strategies by examining the current situation from multiple perspectives.

Table 1
SWOT analysis matrix

	SWOT matrix	Internal Factors	
		Strengths **(S)** (S_1, S_2, …S_n)	Weaknesses **(W)** (W_1, W_2, …W_n)
External Factors	Opportunities **(O):** O_1, O_2…O_n	**SO: Strategies (max-max)** Maximize strengths to capitalize on opportunities from external sources.	**WO: Strategies (min-max)** Overcome weaknesses to fully leverage opportunities from external sources.
	Threats **(T):** T_1, T_2…T_n	**ST: Strategies (max – min)** Leverage strengths to mitigate external threats.	**WT: Strategies (min – min)** A "defensive" plan to avoid further burdens.

Source: Weihrich, H., 1982; Polat et al., 2017.

In this analysis, it is essential to accurately identify the internal factors (Strengths - S, Weaknesses - W) and external factors (Opportunities – O, Threats - T). The internal and external factors of SWOT are strategic and crucial for preparing for a healthy and realistic future (Shiwakoti and Regmi, 2022). Consequently, fuzzy analysis is employed to propose subsidiary strategies within the four main solution categories (SO, WO, ST, WT).

2.2. AHP-Group (AHPG)

AHP (alone): The process of calculating priorities using the AHP technique involves the following steps: pairwise comparison, weight calculation (W), and consistency ratio (CR) assessment.

1) **Pairwise comparison** is used to determine the relative importance of each alternative with respect to each criterion. Decision-makers express their judgments regarding the value of these comparisons, resulting in a pairwise comparison matrix.

For example, consider the pairwise comparison matrix of alternatives (A_1, A_2, A_3, ...) with respect to criterion C. Here, A_1 is equally important as A_1 (value of 1), and alternative A_1 is a_{12} times more important than A_2 (meaning A_2 is $1/a_{12}$ times as important as A_1).

C	A_1	A_2	A_3	…
A_1	1	a_{12}	a_{13}	
A_2	$1/a_{12}$	1	a_{23}	
A_3	$1/a_{13}$	$1/a_{23}$	1	
….				1

The pairwise comparison matrix is a symmetric matrix, meaning only the values on one side of the diagonal need to be determined; the remaining values are the

reciprocals of the established ones. The levels of importance for the alternatives are categorized into nine scales (Table 2).

Table 2
Saaty's rating scale (Saaty, 1996)

Intensity of importance	**Definition**	**Explanation**
1	Equal importance	Two factors contribute equally to the objective.
3	Somewhat more important	Experience and judgement slightly favor one over the other.
5	Much more important	Experience and judgement slightly favor one over the other.
7	Very much more important	Experience and judgement strongly favor one over the other. Its importance is demonstrated in practice.
9	Absolutely more important	The evidence favoring one over the other is of the highest possible validity.
2,4,6,8	Intermediate values	When compromise is needed.

2) Weight calculation*:* Based on the pairwise comparison matrix, the importance levels of the alternatives are determined. The calculation process follows the method outlined by Saaty (1996).

Let k=1k = 1k=1; in this case, the pairwise comparison matrix is represented as [P1]=[aij] (a square matrix of size n×n).

Step (a): Consider the k^{th} iteration:
Calculate: $[P^k] = [P^{k-1}]^2$

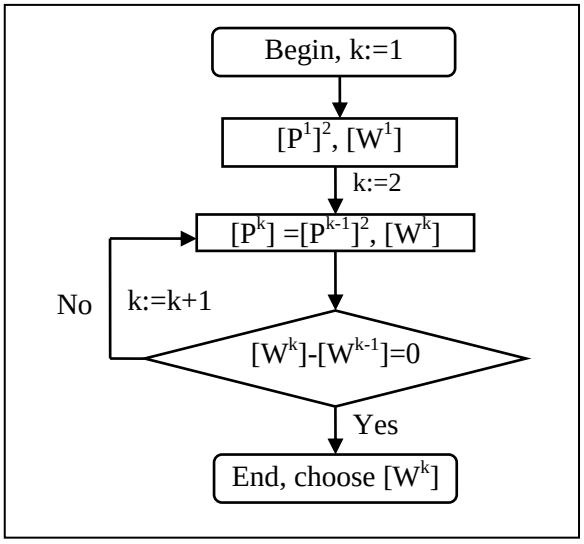

Figure 1 Algorithm for calculating weights (Saaty, 1996)

Row sum: $\sum_{j=1}^{n} a_{ij} (i = 1,2,..., n)$;

Calculate each value of the vector: $w_i^k = \frac{\sum_{j=1}^{n} a_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n} a_{ij}}$;

Determine the vector: $[W^k] = [w_1^k \ w_2^k \ ... \ w_n^k]^T$

Step (b): If $[W^k] - [W^{k-1}] \neq 0$, set k:=k+1 and return to **step (a)**;

If $[W^k] - [W^{k-1}] = 0$, the weight to be calculated is: $[W^k]$.

3) Calculate the consistency ratio (CR):

We have: $[P^1] \times [W^k] = \lambda_{max}[W^k]$ (λ_{max}: the eigenvalue of the comparison matrix $[P^1]$).

Calculate the consistency vector (CR): $[C] = \frac{[P^1] \times [W^k]}{[W^k]}$

Calculate $\lambda_{\max} = \frac{c_1 + c_2 + ... + c_n}{n}$, with vector $[C] = [c_1 \ c_2 \ \ldots c_n]^T$

Calculate Consistency index: $CI = \frac{\lambda_{\max} - n}{n-1}$

The random index (RI) is obtained from an existing table as follows:

N	3	4	5	6	7	8	9
RI	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Consistency ratio $\boldsymbol{CR} = \frac{\boldsymbol{C\,I}}{\boldsymbol{R\,I}}$ (%)

- If CR > 10%, the judgment is considered inconsistent, and **step (a)** should be repeated.
- If CR ≤ 10%, then $[W^k]$ is the weight vector to be determined.

AHP-Group (AHPG):

The model for determining weights in group decision-making consists of the following steps (Jaskowski et al., 2010; Lu et al., 2007) (Figure 2):

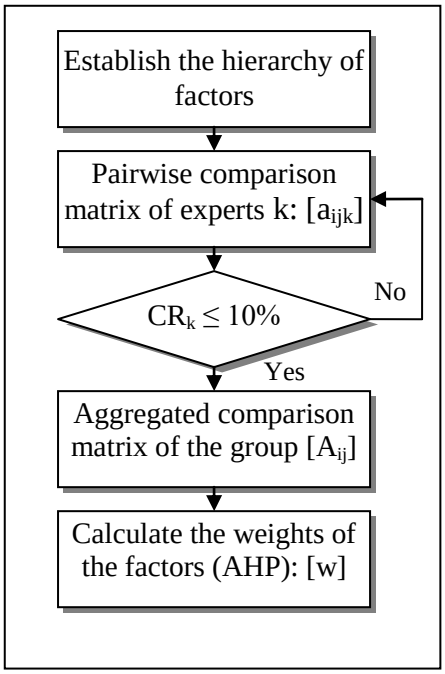

Figure 2 AHPG in determining factor weights

Establish the hierarchy of factors, with experts evaluating separately (k pairwise comparison matrices from k experts). a_{ijk} represents the importance level of criterion i relative to criterion j for expert k; the importance of criterion j relative to criterion i is $a_{jik}=1/a_{ijk}$; $a_{ijk} \in [1/9,1] \cup [1,9]$.

Calculate the consistency ratio (CR) of each comparison matrix. Only the comparison matrices with CR ≤ 10% are included in the aggregated calculations.

Aggregate the pairwise comparison matrices provided by experts (Goepel, 2018):

$$A_{ij} = \left(\prod_{k=1}^{n} a_{ijk} \right)^{1/n} .$$

Based on the aggregated comparison matrix $[A_{ij}]$ from k experts, calculate the factor weights [w] using Saaty's (1996), as illustrated in Figure 1.

2.3. Integration of SWOT and AHPG

The SWOT analysis is a useful tool for identifying different factors, but it has limitations in quantifying each element, making it difficult to measure the proposed strategies (Yuksel and Dagdeviren, 2007; Hill and Westbrook, 1997). To address this, integrating the AHP model is necessary to assess the importance of the various factors (Polat et al., 2017). The SWOT and AHPG approach has been widely used in policy planning for the education sector (Malik et al., 2013), agricultural development (Nasab and Azizi, 2014), and the strategic development of the satellite and aerospace industries (Lee et al., 2021).

The integrated SWOT and AHPG model, combining qualitative and quantitative

approaches to prioritize strategy selection, has been widely applied in policy development. Examples include a case study for a manufacturing company (Görener et al., 2012), ecotourism strategy in India (Sahani N., 2021), and agroforestry practices (Etongo et al., 2023). These studies do not pertain to Vietnam, specifically regarding the socioeconomic development strategy of Dak Nong province. The SWOT and AHPG model offers a more objective basis for decision-making in selecting strategies.

According to Saaty's (1996) classification of importance and consultation with experts, we have identified key factors that influence socioeconomic development. The results, as established by Lee and Walsh (2011), have identified primary factor groups (SWOT objectives) and secondary factors (SWOT factors) that affect the outcomes of socioeconomic development alternatives: SO, WO, ST, WT, and the corresponding strategies.

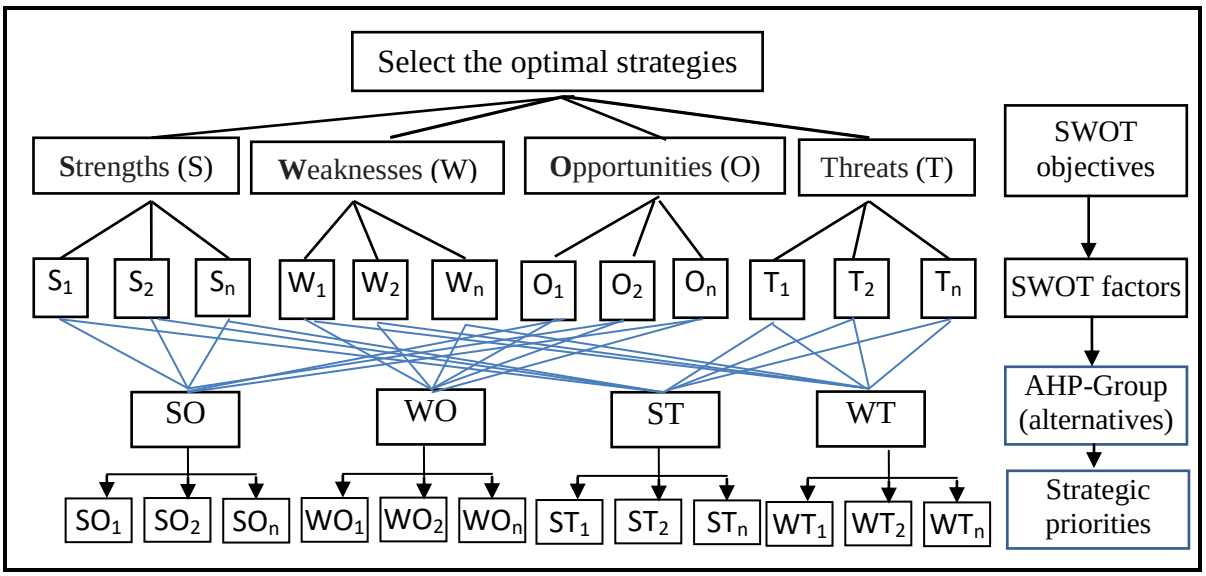

Figure 3 Hierarchical structure of the SWOT -AHP model

Step 1: Identify the factors in the SWOT matrix (see Table 4). The issues to be addressed are developed according to a hierarchical structure, with the main objective being to ensure that the alternatives are quantified using the AHP (Polat et al., 2017) (see Figure 3).

Step 2: Compare fuzzy pairwise, perform fuzzy calculations, and convert them into crisp numbers to determine the importance levels of first-level factors (SWOT objectives: S, W, O, T), second-level factors (SWOT factors), and the overall weight (Polat et al., 2017).

Step 3: Rank and select priority strategies (Wickramasinghe and Takano, 2010; Kandakoglu et al., 2007). The priority level of the strategies depends on expert selection using a 0 to 9 scale (see Table 3). The weights of the SWOT strategies are calculated using Equation 1, normalized according to Equation 2, and the proposed strategies are listed in order of priority from highest to lowest weight.

To evaluate the selection of strategic priorities, Equation 1 is applied (Tuan and Canh, 2022; Wickramasinghe and Takano, 2010; Kandakoglu et al., 2007):

Table 3
Scale of evaluation levels (Saaty, 1996)

Degree of relationship	Nil	Very low	Low	Medium	High	Very high
Equivalent number.	0	1	3	5	7	9

$$T_i = \sum_{j=1}^{n} G_j R_{ij} \quad (1)$$

in which, T_i: the weight of solution i; G_j: the overall weight of the second-level criterion (SWOT-factors) in the SWOT matrix; R_{ij}: the degree of relationship between strategy i and SWOT factor j; n: the number of SWOT factors. Next, the values of the strategies are normalized:

$$N_i = \frac{T_i}{\sum_{i=1}^{m} T_i} \quad (2)$$

in which, Ni represents the normalized value of the weight for each solution i, and m is the total number of proposed strategies (SO_1, .., SO_n; WO_1,… WO_n; ST_1, …ST_n; WT_1, ... WT_n). Strategies are chosen based on their priority, starting from the highest to the lowest weight.

2.4. Number of experts evaluated

In the planning of Dak Nong province, experts were divided into four groups: economic, social, urban and infrastructure, and environmental resources. In total, there were 90 experts, including 3 associate professors, 24 doctoral candidates, 28 scholars with master's degrees, and 35 engineers, all who possessed six or more years of experience. For the group of economic experts, each associate professor was responsible for a specific topic in the economic sector including agriculture, industry, and services (these three topics are the main components in the planning of Dak Nong Province, thus assigning three associate professors to oversee them). Each doctoral candidate was responsible for the remaining provincial-level topics, while each scholar with a master's degree was in charge of the district-level topics (these topics are simpler than the provincial-level ones, so scholars with master's degree were assigned to oversee them). Additionally, one engineer collaborated with each associate professor, doctoral candidate, and scholar with a master's degree to manage mapping and data compilation (the engineer possessed strong expertise, with over ten years of experience, and was skilled in both mapping and data synthesis). For the remaining three groups of experts, each doctoral candidate was responsible for a provincial-level topic, accompanied by a scholar with a master's degree for data synthesis and an engineer responsible for mapping. The specifics are as follows:

The economic expert group was composed of 3 associate professors, 4 doctoral candidates, 8 scholars with master's degrees, and 15 engineers with expertise in economics, They were responsible for 15 topics (these included 7 provincial-level topics), including development plans for services, trade, and border gates; development of agriculture, forestry, aquaculture, and high-tech agriculture; industrial development, industrial zones, and clusters; national defense, security, and foreign economic relations; regional development, special areas for national defense, security,

and defense infrastructure; regional linkage between Dak Nong and the Central Highlands, Southeastern region, and neighboring localities; business development, investment attraction, and improving the investment environment in Dak Nong Province; as well as 8 topics concerning economic development plans at the district level.

The social expert group consisted of 6 doctoral candidates, 6 scholars with master's degrees, and 6 engineers with in-depth expertise in social issues, responsible for the following 6 topics: the current status of tourism development; the development of science and technology; culture and sports; healthcare development; education and training; and attracting human resources.

The urban and infrastructure expert group consisted of 9 doctoral candidates, 9 scholars with master's degrees, and 9 engineers with in-depth expertise in urban development and infrastructure, responsible for the following 9 topics: development plans for information and communication infrastructure, media networks, broadcasting, television, electronic information, and information technology; irrigation infrastructure and disaster prevention; healthcare, education and training infrastructure, and cultural institutions; transportation and logistics infrastructure; energy, electricity, fuel supply, and natural gas; special national defense and security areas; inter-district regions of Dak Nong Province; water supply and drainage; and urban and rural systems, along with functional subdivisions.

The natural resources and environment expert group consisted of 5 doctoral candidates, 5 scholars with master's degrees, and 5 engineers with in-depth expertise in natural resources and environmental issues, responsible for 5 topics such as the global geopark of Dak Nong; mineral geology; environmental protection, nature conservation, and biodiversity; water resources; and land zoning by functional areas and land types for each administrative unit.

Consultations with 90 experts from the four following groups were conducted: economics (group 1): 30 individuals; social issues (group 2): 18 individuals; urban and infrastructure (group 3): 27 individuals; and natural resources and environment (group 4): 15 individuals. The experts from each group were fixed throughout this study.

3. Application with a case study of Dak Nong province

3.1. Dak Nong province

Dak Nong province has 8 administrative units and is strategically positioned as a gateway to the Central Highlands. Its geographical location is highly advantageous for connecting the vertical axis and facilitating trade between the two economic regions: the Central Highlands and Southeast Region, which is a key economic area in southern Vietnam. It also supports horizontal trade connections with the South Central Coast region and is part of the East-West economic corridor linking to Cambodia and Laos. However, the province is relatively distant from dynamic economic development centers and far from seaports.

The climate is relatively mild throughout the year, allowing for the cultivation of subtropical crops (such as vegetables, flowers, and ornamental plants) and effectively attracting tourism and leisure services, especially when the expressway is connected.

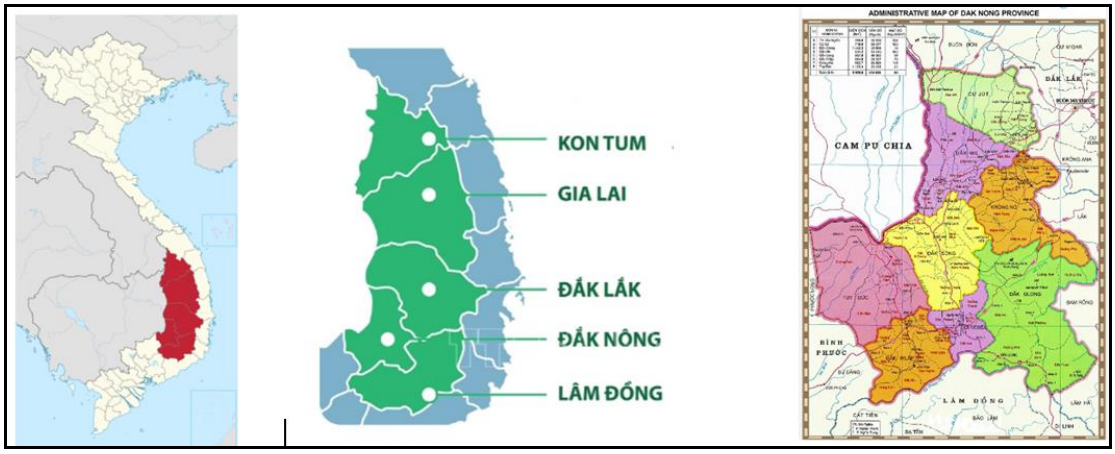

Figure 4 Location of Dak Nong province, Vietnam

The province has a total natural land area of 650,927 hectares, with basalt soil covering approximately 60.34% of the area (People's Committee of Dak Nong Province, 2023). This soil type is suitable for growing a variety of industrial and short-term crops with high yields. The province also has abundant mineral resources, with bauxite reserves accounting for about 48% of the national total (People's Committee of Dak Nong Province, 2023).

The province is home to many beautiful natural landscapes with great potential for tourism development. Notable attractions include Ta Dung Lake, the Nam Nung Nature Reserve, the Dray Sap-Gia Long protected landscape area (which has cultural, historical, and environmental significance), and the geological heritage system of the UNESCO global geopark of Dak Nong.

The population of Dak Nong province by the end of 2023 was estimated at approximately 710,600 people, with the labor force accounting for 59% of the population. The province's average labor productivity has shown steady growth, increasing from 35.3 million VND in 2010 to 86.5 million VND in 2020 (People's Committee of Dak Nong Province, 2023).

Among the five Central Highlands provinces, Dak Nong has the smallest total natural area. In terms of total population and total Gross Regional Domestic Product (GRDP), it ranks fourth, surpassing only Kon Tum province. From 2011 to 2020, the province experienced strong economic growth, averaging 6.67% per year. This growth rate increased to 7.19% from 2021 to 2023. During this period, the share of the agriculture and forestry sector decreased by 8.8%, while the share of the industrial and construction sector increased by 6.5% and the service sector by 1.6%. Product tax minus product subsidies also increased by 0.7%. The GRDP/person grew by 1.99 times over the 10-year period. In 2020, the province's GRDP/person exceeded the average of the Central Highlands region, and by 2023, it reached 60.5 million VND (2.376 USD) (People's Committee of Dak Nong Province, 2023).

By 2030, Dak Nong aims to become a relatively developed province within the Central Highlands region. The GRDP is expected to grow at an average rate of 9.05% per year. The economic structure will consist of agriculture and forestry (26.3%); industry and construction (27.7%); services (40.8%); and product tax minus product subsidies (5.2%). The GRDP/person is projected to reach 130 million VND (5.105

USD) at current prices. The province will see synchronized investment in infrastructure, positioning itself as the national hub for the bauxite-alumina-aluminum industry and the regional center for renewable energy. Dak Nong will also capitalize on its advantages in climate, natural landscapes, unique cultural heritage, and the UNESCO global geopark of Dak Nong (People's Committee of Dak Nong Province, 2023).

3.2. Identifying the factors in the SWOT

This study consulted 90 experts in the planning of Dak Nong province (People's Committee of Dak Nong province, 2023) across various fields, including economics, society, urban and development infrastructure, and environmental resources. This provided the foundation for identifying 7 strengths (S), 6 weaknesses (W), 5 opportunities (O), and 5 challenges/threats (T). These steps facilitated the selection of internal factors (S, W) and external factors (O, T), leading to the development of four main groups of strategies: leveraging strengths to capitalize on opportunities (SO: SO_1,…, SO_n), addressing weaknesses to take advantage of opportunities (WO: WO_1,…, WO_n), utilizing strengths to mitigate risks (ST: ST_1,…, ST_n), and implementing defensive strategies to prevent worsening challenges (WT: WT_1,…, WT_n). The socio-economic development of Dak Nong province is highly dependent on the aforementioned S, W, O, and T characteristics, as analyzed in the SWOT framework, with results summarized in Table 4.

Table 4
SWOT analysis matrix and proposed strategies for socio-economic development in Dak Nong province

	Internal Factors	
	Strengths (S)	**Weaknesses (W)**
	[S_1] - A strategically advantageous geographical location for national defense and security, as well as favorable geo-economic conditions. [S_2] - A rare, moderate, and cool climate; abundant bauxite mineral resources with large reserves; extensive and fertile basalt land; clean land available after bauxite extraction; and a combination of land resources with favorable climatic conditions. [S_3] - Significant potential for forestry land and forest economic development; diverse natural landscapes with unique scenic attractions; a combination of varied natural landscapes with a cool climate, distinctive cultural spaces, and numerous preserved intangible cultural values. [S_4] - Potential for the development of renewable energy, including wind and solar power. [S_5] - The province's key products account for a significant proportion of the national commodity structure. [S_6] - Key management personnel in Dak Nong possess strong aspirations and dedication. [S_7] - The province's population is rapidly increasing, facilitating the replenishment of a young labor force.	[W_1]- The geographical location is relatively distant from dynamic economic development centers and far from the seaport. [W_2] - The capacity to formulate and implement policies is still weak. [W_3] - Weak competitiveness; a low economic starting point, lower than that of other provinces in the Central Highlands; low quality of the labor force, with a low contribution rate of TFP (Total Factor Productivity) to growth; and a lack of distinctive tourism products. [W_4]- The local private economic sector is still small in scale and lacks strong internal capacity; the poverty rate remains high, particularly among ethnic minority communities. [W_5]- The capacity of civil servants within the state apparatus is still weak, with many existing issues. [W_6] - The availability of clean land is limited; deforestation is quite severe; and there is a concerning decline in land and water resources.
External factors		

Opportunities (O)

[O_1]- Vietnam has increasingly deepened its international integration; the trend of shifting foreign direct investment (FDI) flows has become more pronounced, particularly since the onset of the Covid-19.

[O_2]- The Fourth Industrial Revolution presents new opportunities; it fosters international regional integration for the Central Highlands. Additionally, specific policies for the development of the Central Highlands, along with a strengthened national infrastructure, enhance connectivity between the Central Highlands and the South Central Coast and Southeast regions.

[O_3]- Global raw material prices are trending upward as economies recover from the pandemic, including aluminum; moreover, global investment trends are increasingly focused on regions with advantageous raw material resources.

[O_4] - The development of high-tech agriculture is a priority in the national development strategy

[O_5] - The private economic sector is emerging as the primary driver of growth in Vietnam

Strategies (SO)

[SO_1] - It is necessary to leverage the strong advantages of the province's natural conditions, beautiful landscapes, and temperate climate to attract investment in tourism development, particularly in eco-tourism.

[SO_2] Efforts to attract investment in the mining and industrial sectors should continue, while ensuring alignment with sustainable development goals. Particular emphasis should be placed on green and clean energy industries to attract capital from global impact funds.

[SO_3] - Leverage the ambitions of Dak Nong provincial officials to capitalize on the opportunities presented by the Fourth Industrial Revolution, promote deeper international integration, and strengthen regional connections with global networks and the Central Highlands. These efforts should prioritize advancing agriculture and fostering economic sectors through the application of cutting-edge technologies.

Strategies (WO)

[WO_1] - It is essential to address the province's limitations, particularly in the areas of training and developing a high-quality workforce. This is a crucial factor in attracting investment capital alongside new technologies.

[WO_2] - Strategies to improve the investment environment must be developed, along with breakthrough policies to attract investment. These efforts should be directed toward high-quality capital investment and focus on key sectors aligned with the province's sustainable development goals.

Threats (T)

[T_1]-The political and social landscape, both globally and regionally, continues to be characterized by significant potential for instability.

[T_2]-Deepening international integration will pose significant challenges for Vietnamese businesses, compelling them to compete fiercely with global enterprises; moreover, the Fourth Industrial Revolution presents numerous obstacles to development.

[T_3]-The geopolitical landscape of Dak Nong remains quite complex.

[T_4]-Due to the impacts of natural disasters, climate change, environmental factors, and disease, there is a prevailing issue of free migration.

[T_5]-Competition from neighboring provinces and regions, which possess similar advantages and potential as Dak Nong, is intensified by their superior technical and social infrastructure.

Strategies (ST)

[ST_1] - Leveraging geographic advantages and natural resources are essential to mitigate the impacts of the global macroeconomic crisis and disruptions in global supply chains.

[ST_2] - Leveraging strengths such as the potential for forest land and the development of renewable energy is essential for overcoming competition from neighboring provinces that have superior technical and social infrastructure compared to Dak Nong.

Strategies (WT)

[WT_1] - There is a need to focus on administrative reform, improve the investment environment, ensure political institutional stability, attract both domestic and foreign direct investment (FDI), and implement policies for asset protection and financing for investors.

[WT_2] - Strengthening the internal capabilities of enterprises within the province is essential to effectively navigate the intense competition from both domestic and foreign businesses concerning the province's key products

[WT_3] - Mitigating the impacts of natural disasters, climate change, environmental factors, and disease is essential to reduce the prevalence of free migration

3.3. Weights of factors

a) SWOT-objectives (S, W, O, T):

An investigation involving 90 experts engaged in the planning of Dak Nong province was conducted, divided into four groups (see section 2.4), with independent evaluations resulting in the findings presented in Table 5. Among these, 100% of the experts assessed that the strength factors (S) were more important than the weakness factors (W). Most experts evaluated that S > opportunities (O), S > challenges (T), W > O, W > T, and O > T; however, group 3 assessed that S < O, S < T, W < T, and O < T, while both groups 3 and 4 rated W < O.

Table 5
Pairwise comparison of SWOT-objectives by experts

Factors		Grouping of expert evaluations				A_{ij}
I	j	Group 1	Group 2	Group 3	Group 4	
S	W	2	2	2	3	166/75
	O	3	2	1/3	3	36/23
	T	4	3	1/2	2	67/36
W	O	3	3	1/5	1/2	75/77
	T	3	2	1/6	2	44/37
O	T	4	2	1/3	2	38/25
Consistency Ratio *(CR%)*		*9.00*	*6.10*	*7.90*	*8.00*	
Number of experts evaluated		30	18	27	15	

For each group of results, the geometric mean of each parameter a_{ij} was calculated to obtain the pairwise comparison matrix (Goepel K., 2018). Considering group 1 (Table 5), 30 experts evaluated that factor S (strengths) is twice as important as W (weaknesses), with the geometric mean of a_{S-W} (S compared to W) calculated as follows:

$$a_{ij.1} = a_{S\text{-}W.Group\ 1} = \left(\prod_{k=1}^{30} a_{ijk}\right)^{1/30} = \sqrt[30]{2\times 2\times ...\times 2\times 2} = 2$$

k=30 is the number of experts in group 1. Similarly, the geometric mean of the parameters a_{S-O}, a_{S-T}, a_{W-O}, a_{W-T}, a_{O-T} for group 1 and the parameters a_{ij} of the other groups (group 2, group 3, group 4; table 5) were calculated. We obtained similar results as group 1 (Table 5).

All pairwise comparison matrices of the groups (group 1, 2, 3, 4) have a consistency ratio (CR) ≤ 10% (Table 5). The aggregated pairwise comparison matrix of the expert groups (Jaskowski et al., 2010; Lu et al., 2007) (Figure 2) shows the comparison results of the importance level S relative to W (A_{S-W}) across the four groups (Goepel, 2018).

$$A_{ij} = A_{S\text{-}W} = \left(\prod_{k=1}^{4} a_{ijk}\right)^{1/4} = \sqrt[4]{2\times 2\times 2\times 3} = 166/75$$, k=4 is the numbers of group.

Similarly, A_{S-O} = 36/23, A_{S-T} = 67/36; A_{W-O} = 75/77, A_{W-T} = 44/37; A_{O-T} = 38/25 (table 5). From this, the pairwise comparison matrix of the first factors (SWOT-Objective) for 90 experts is derived, as shown in Table 6:

Table 6
Pairwise comparison matrix (by 4 groups) of first-level factors

Factors	S	W	O	T	Weight
S	1/1	166/75	36/23	67/36	0.3814
W	75/166	1/1	75/77	44/37	0.2035
O	23/36	77/75	1/1	38/25	0.2386
T	36/67	37/44	25/38	1/1	0.1765

From Table 6, by applying Saaty's algorithm (1996) (see Figure 1), the weights of the factors are calculated [W_S; W_W; W_O; W_T] = [0.0814; 0.2035; 0.2386; 0.1765], CR=0.77%.

b) Secondary factors (SWOT-factors):
Internal factors (S, W):
Strengths (S): Using the same method as for primary factors, four groups of experts participated in the evaluation (as in the case of primary factors, section 3.3.a). The results, shown in Table 7, indicate the following levels of importance: S1 ≥ S2, S3, S5, S6, S7; only group 1 rated S1 < S4; S2 < S3, S4, S5, S6, and S2 ≥ S7; S3 < S4, S6, and S3 ≥ S5, S7; only groups 4 and 2 rated S3 < S5, S7; S4 ≥ S5, S7, and S4 < S6; S5 ≥ S7 and S5 < S6; S6 > S7.

Table 7
Pairwise comparison of secondary factors, Strengths (S)

Factors		Grouping of expert evaluations				A_{ij}
I	j	Group 1	Group 2	Group 3	Group 4	
S_1	S_2	3	4	3	4	97/28
	S_3	1	3	5	3	158/61
	S_4	1/3	1	3	3	25/19
	S_5	3	5	5	3	244/63
	S_6	2	1	1	2	44/37
	S_7	2	2	4	3	229/87
S_2	S_3	1/3	1/2	2	2	75/83
	S_4	1/3	1/3	1	½	17/35
	S_5	1/3	2	2	1/3	40/49
	S_6	1/5	1/7	1/3	1/5	14/67
	S_7	2	2	1	2	37/22
S_3	S_4	1/2	1/3	1/2	½	14/31
	S_5	1	2	1	½	1/1
	S_6	1/2	1/4	1/4	1/5	9/32
	S_7	2	1/2	1	1	1/1
S_4	S_5	1	4	1	2	37/22

Factors		Grouping of expert evaluations				A_{ij}
I	j	Group 1	Group 2	Group 3	Group 4	
	S_6	1/2	1/3	2	½	23/36
	S_7	3	4	4	4	67/18
S_5	S_6	1/3	1/8	1/5	1/3	14/61
	S_7	1	3	3	2	138/67
S_6	S_7	4	4	4	6	332/75
Consistency Ratio (CR%)		*8.97*	*8.78*	*3.14*	*4.74*	

Similarly to above (section 3.3.a), the consistency ratio of the 4 groups (group 1, 2, 3, 4) is CR ≤ 10% (Table 7). Based on the results of the comparison of the importance levels of the factors (A_{ij}, Table 7), the pairwise comparison matrix of the second factors (SWOT-factors) for 90 experts is derived, as shown in Table 8:

Table 8
Pairwise comparison matrix (4 groups) of second factors, strengths (S)

Factors	S_1	S_2	S_3	S_4	S_5	S_6	S_7	Weight
S_1	1/1	97/28	158/61	25/19	244/63	44/37	229/87	0.2461
S_2	28/97	1/1	75/83	17/35	40/49	14/67	37/22	0.0741
S_3	61/158	83/75	1/1	14/31	1/1	9/32	1/1	0.0781
S_4	19/25	35/17	31/14	1/1	37/22	23/36	67/18	0.1726
S_5	63/244	49/40	1/1	22/37	1/1	14/61	138/67	0.0852
S_6	37/44	67/14	32/9	36/23	61/14	1/1	332/75	0.2841
S_7	87/229	22/37	1/1	18/67	67/138	75/332	1/1	0.0598

From Table 8, using Saaty's algorithm (1996) (Figure 1), the weights of the strength factors are calculated [W_{S1}; W_{S2}; W_{S3}; W_{S4}; W_{S5}; W_{S6}; W_{S7}] = [0.2461; 0.0741; 0.0781; 0.1726; 0.0852; 0.2841; 0.0598], CR =1.80%.

Weaknesses (W): Similar to the previous section (3.3.a), four groups of experts evaluated the factors (Table 9). The importance rankings were as follows: W1 > W6, with only group 4 rating W1 < W2, W4; groups 3 and 4 rated W1 < W3, and groups 1 and 2 rated W1 < W5; W2 ≥ W4, with groups 1, 2, and 3 rating W2 < W3, W5, and groups 1 and 2 rating W2 < W6; W3 ≥ W4, W6, with groups 1 and 2 rating W3 < W5; only group 1 rated W4 < W6, and only group 4 rated W4 > W5; W5 > W6.

Table 9
Pairwise comparison of secondary factors, Weaknesses (W)

Factors		Grouping of expert evaluations				A_{ij}
I	j	Group 1	Group 2	Group 3	Group 4	
W_1	W_2	3	5	3	1/3	61/31
	W_3	2	3	1/3	1/2	1/1
	W_4	4	3	4	1/3	2/1
	W_5	1/2	1/5	2	2	66/83
	W_6	2	3	5	3	77/25
W_2	W_3	1/2	1/3	1/3	3	23/36
	W_4	3	2	2	1	67/36
	W_5	1/7	1/3	1/2	4	5/9
	W_6	1/2	1/2	2	2	1/1
W_3	W_4	4	2	6	2	72/23
	W_5	1/5	1/7	5	3	17/21
	W_6	1	3	4	4	229/87
W_4	W_5	1/6	1/3	1/3	4	12/23
	W_6	1/2	3	2	3	97/56
W_5	W_6	2	4	3	3	67/23
Consistency Ratio (CR%)		*3.79*	*8.68*	*4.96*	*9.69*	

Similarly to section 3.3.a, the consistency ratio of the four groups (groups 1, 2, 3, 4) is CR ≤ 10% (Table 9). Based on the results of the importance level comparisons of the factors (A_{ij}, Table 9), the pairwise comparison matrix of the second factors (SWOT-factors) for 90 experts is derived, as shown in Table 10:

Table 10
Pairwise comparison matrix (4 groups) of second factors, Weaknesses (W)

Factors	W_1	W_2	W_3	W_4	W_5	W_6	Weight
W_1	1/1	61/31	1/1	2/1	66/83	77/25	0.2207
W_2	31/61	1/1	23/36	67/36	5/9	1/1	0.1292
W_3	1/1	36/23	1/1	72/23	17/21	229/87	0.2254
W_4	1/2	36/67	23/72	1/1	12/23	97/56	0.1017
W_5	83/66	9/5	21/17	23/12	1/1	67/23	0.2395
W_6	25/77	1/1	87/229	56/97	23/67	1/1	0.0834

From Table 10, using Saaty's algorithm (1996) (Figure 1), the weights of the weakness factors are calculated [W_{W1}; W_{W2}; W_{W3}; W_{W4}; W_{W5}; W_{W6}] = [0.2207; 0.1292; 0.2254; 0.1017; 0.2395; 0.0834], CR = 1.98%.

External factors (O, T):

Opportunities (O): Similar to the previous section (3.3.a), four groups of experts evaluated the factors (Table 11). The importance levels indicate that O1 > O3; only group 1 rated O1 < O2, while groups 3 and 4 rated O1 < O4, groups 1 and 2 rated O1

< O5; O2 > O3, with only group 3 rating O2 < O5, and groups 3 and 4 rating O2 < O4, groups 1 and 2 rated O3 > O4, with only group 4 rating O3 > O5; only group 2 rated O4 < O5.

Table 11
Pairwise comparison of secondary factors, Opportunities (O)

Factors		Grouping of expert evaluations				A_{ij}
I	j	Group 1	Group 2	Group 3	Group 4	
O_1	O_2	1/3	2	3	3	36/23
	O_3	2	3	5	3	77/25
	O_4	3	5	1/3	1/5	1/1
	O_5	1/2	1/5	3	5	83/75
O_2	O_3	5	2	2	2	83/33
	O_4	7	4	1/6	1/6	77/82
	O_5	2	1/6	2	2	72/67
O_3	O_4	2	2	1/5	1/5	43/68
	O_5	1/3	1/7	1/2	2	7/15
O_4	O_5	1	1/5	6	7	143/84
Consistency Ratio (CR%)		*8.20*	*8.20*	*4.17*	*5.39*	

Similarly to section 3.3.a, the consistency ratio of the four groups (groups 1, 2, 3, 4) is CR ≤ 10% (Table 11). Based on the results of the importance level comparisons of the factors (A_{ij}, Table 11), the pairwise comparison matrix of the second factors (SWOT-factors) for 90 experts is derived, as shown in Table 12:

Table 12
Pairwise comparison matrix (4 groups) of the second factors, Opportunities (O)

Factors	O_1	O_2	O_3	O_4	O_5	Weight
O_1	1/1	36/23	77/25	1/1	83/75	0.2642
O_2	23/36	1/1	83/33	77/82	72/67	0.2074
O_3	25/77	33/83	1/1	43/68	7/15	0.0997
O_4	1/1	82/77	68/43	1/1	143/84	0.2370
O_5	75/83	67/72	15/7	84/143	1/1	0.1918

From Table 12, using Saaty's algorithm (1996) (Figure 1), the weights of the opportunity factors are calculated [W_{O1}; W_{O2}; W_{O3}; W_{O4}; W_{O5}] = [0.2642; 0.2074; 0.0997; 0.2370; 0.1918], CR = 2.0%.

Threats (T): Similar to the previous section (3.3.a), the factors are evaluated in Table 13. Most experts rated the importance level of T1 > T2, T3, T4, with only group 2 rating T1 < T2, T3, and T4, group 4 rated T1 > T5; T2 > T3, with only group 4 rating T2 < T4, while groups 1 and 3 rated T2 < T5. For T3 > T4, only group 4 rated T3 < T4, while groups 1 and 3 rated T3 < T5. Groups 2 and 4 rated T4 > T5.

Table 13
Pairwise comparison of secondary factors, Threats (T)

Factors		Grouping of expert evaluations				A_{ij}
I	j	Group 1	Group 2	Group 3	Group 4	
T_1	T_2	3	1/2	2	5	61/31
	T_3	2	1/3	3	7	118/61
	T_4	4	1/2	3	4	166/75
	T_5	1/3	1/3	1/3	7	5/7
T_2	T_3	2	2	2	3	166/75
	T_4	2	3	2	1/4	25/19
	T_5	1/6	2	1/5	2	29/48
T_3	T_4	3	2	3	1/3	36/23
	T_5	1/5	2	¼	2	2/3
T_4	T_5	¼	3	1/3	3	67/72
Consistency Ratio (CR%)		*7.26*	*9.79*	*8.10*	*7.12*	

Similarly to section 3.3.a, the consistency ratio of the four groups (groups 1, 2, 3, 4) is CR ≤ 10% (Table 13). Based on the results of the importance level comparisons of the factors (A_{ij}, Table 13), the pairwise comparison matrix of the second factors (SWOT-factors) for 90 experts is derived, as shown in Table 14:

Table 14
Pairwise comparison matrix (by 4 groups) of the second factors, Threats (T)

Factors	T_1	T_2	T_3	T_4	T_5	Weight
T_1	1/1	61/31	118/61	166/75	5/7	0.2718
T_2	31/61	1/1	166/75	25/19	29/48	0.1893
T_3	61/118	75/166	1/1	36/23	2/3	0.1458
T_4	75/166	19/25	23/36	1/1	67/72	0.1409
T_5	7/5	48/29	3/2	72/67	1/1	0.2521

From Table 14, using Saaty's algorithm (1996) (Figure 1), the weights of the threat factors are calculated [W_{T1}; W_{T2}; W_{T3}; W_{T4}; W_{T5}] = [0.2718; 0.1893; 0.1458; 0.1409; 0.2521], CR = 4.9%. The global weights of the second factors (SWOT-factors) are presented in Table 15.

Table 15
Global weights of SWOT-factors criteria

SWOT - Objectives		Objectives weights (W_{ob})	SWOT-factors	Factors weights (W_{fa})	Global Weights (W_{ob}*W_{fa})
Internal	S	0.3814	S_1	0.2461	0.0939
			S_2	0.0741	0.0283
			S_3	0.0781	0.0298
			S_4	0.1726	0.0658
			S_5	0.0852	0.0325
			S_6	0.2841	0.1084
			S_7	0.0598	0.0228
	W	0.2035	W_1	0.2207	0.0449
			W_2	0.1292	0.0263
			W_3	0.2254	0.0459
			W_4	0.1017	0.0207
			W_5	0.2395	0.0487
			W_6	0.0834	0.0170
External	O	0.2386	O_1	0.2642	0.0631
			O_2	0.2074	0.0495
			O_3	0.0997	0.0238
			O_4	0.2370	0.0565
			O_5	0.1918	0.0458
	T	0.1765	T_1	0.2718	0.0480
			T_2	0.1893	0.0334
			T_3	0.1458	0.0257
			T_4	0.1409	0.0249
			T_5	0.2521	0.0445

3.4. Ranking and selection of priority strategies

Consultation with experts (section 2.4) indicates that the prioritization of strategies is contingent upon the selections made by the experts on a scale from 0 to 9 (Table 3). The relationship weights of the factors and SWOT strategies (Table 16) are calculated using Equation 1 section 2.3 (Tuan and Canh, 2022; Wickramasinghe and Takano, 2010; and Kandakoglu et al., 2007).

The weights of the relationships between the second factors (SWOT-factors) and the proposed strategies are presented in Table 16. The calculated results identify strategies with varying weights, with solution SO3 having the highest weight (0.118) and being implemented first, followed by ST2 with the second-highest weight (0.104), and finally WO1 (0.089). If not implemented in this order, strategies are grouped and executed according to their categories: SO (SO1, SO2, SO3), WO

(WO1, WO2), ST (ST1, ST2), and WT (WT1, WT2, WT3), rather than individually prioritizing smaller strategies based on descending weights (SO3: 0.118 > ST2: 0.104 > SO2: 0.103 > ST1: 0.102 > WT3: 0.101 > WT1: 0.098 > WT2: 0.096 > SO1: 0.095 > WO2: 0.094 > WO1: 0.089).

Table 16
Matrix of priority strategies selection

SWOT -factors	Degree of strategies relationships									
	SO_1	SO_2	SO_3	WO_1	WO_2	ST_1	ST_2	WT_1	WT_2	WT_3
S_1	7	5	5	5	4	7	6	7	6	6
S_2	9	9	6	5	6	7	7	5	5	5
S_3	3	3	6	3	5	5	7	5	6	5
S_4	5	7	7	6	6	6	7	5	5	6
S_5	4	5	7	3	4	6	5	4	6	4
S_6	6	7	9	5	6	7	7	6	4	6
S_7	3	8	5	6	4	5	5	6	6	6
W_1	3	2	5	2	2	3	3	5	5	5
W_2	1	1	3	1	1	1	1	1	3	5
W_3	3	1	4	3	2	3	4	2	5	5
W_4	3	2	3	1	2	3	2	2	3	4
W_5	0	5	1	3	2	3	3	3	3	3
W_6	2	3	5	1	1	2	3	3	3	1
O_1	8	9	9	7	8	7	8	6	6	5
O_2	7	7	9	6	7	6	7	6	6	7
O_3	5	8	5	6	7	5	7	7	7	5
O_4	7	5	8	5	6	7	5	6	5	6
O_5	5	6	5	6	5	6	5	5	7	7
T_1	5	5	6	5	5	3	3	5	5	5
T_2	4	3	7	6	7	4	6	5	5	5
T_3	3	1	5	5	6	3	3	4	4	5
T_4	2	3	2	3	3	3	4	3	2	1
T_5	4	6	5	4	5	5	5	5	4	5
Total weight	4.846	5.244	6.013	4.569	4.835	5.187	5.321	4.991	4.906	5.174
Weight of relationship	0.095	0.103	0.118	0.089	0.095	0.102	0.104	0.098	0.096	0.101
Ranking	8	3	1	10	9	4	2	6	7	5

The prioritized strategies for development include leveraging the aspirations of the officials in Dak Nong province to seize the opportunities presented by the Fourth Industrial Revolution, international integration, and the development of high-tech industries. Next, the province should capitalize on its potential in forestry land and renewable energy development to surpass neighboring provinces that have more

advantages. It is also important to continue attracting investment in mining and industrial sectors, focusing on green energy industries. Additionally, Dak Nong should take advantage of its geographical strengths and natural resources to mitigate the impacts of the global economic crisis. Reducing the effects of natural disasters, climate change, environmental issues, and epidemics is crucial. Efforts should be focused on administrative reforms, improving the investment environment, and attracting both domestic and foreign investment (FDI). Strengthening the internal capacity of local enterprises is necessary to face the fierce competition from both domestic and foreign businesses. The province should leverage its natural advantages, beautiful landscapes, and mild climate to promote tourism development, especially ecotourism. Breakthrough policies should be developed to attract investment and guide high-quality investment sources. Finally, improving the training and development of high-quality human resources is vital, as this is an extremely important factor in attracting investment that comes with new technologies (Table 17).

The strategies demonstrate high feasibility as they incorporate the insights of scientists from four research groups (economy, society, urban development and infrastructure, and natural resources and environment) engaged in the planning process for Dak Nong province.

Table 17
Order of strategy implementation

Ranking	Strategies	Explanation
1	SO_3	[SO_3] - Leveraging the aspirations of officials in Dak Nong Province to capitalize on the opportunities presented by the Fourth Industrial Revolution, promote extensive international integration, and establish regional connections both globally and within the Central Highlands is essential for advancing agricultural development and fostering high-tech industries.
2	ST_2	[ST_2] - Capitalizing on strengths such as the potential for forest land and the development of renewable energy is crucial to overcoming competition from neighboring provinces that possess superior technical and social infrastructure compared to Dak Nong.
3	SO_2	[SO_2] - Continuing to attract investment in the mining and industrial sectors should be integrated with sustainable development goals, with a particular emphasis on green and clean energy industries to draw capital from global impact funds.
4	ST_1	[ST_1] - Leveraging geographic advantages and natural resources is essential for continuing to mitigate the impacts of global macroeconomic crises and disruptions in global supply chains.
5	WT_3	[WT_3] - Mitigating the effects of natural disasters, climate change, environmental degradation, and epidemics, while also limiting the phenomenon of unrestricted migration, is essential.

Ranking	Strategies	Explanation
6	WT_1	[WT_1] - Attention must be focused on administrative reforms, enhancing the investment climate, ensuring political stability within institutions, attracting both domestic and foreign direct investment (FDI), and establishing asset insurance policies to safeguard investors.
7	WT_2	[WT_2] - Strengthening the internal capacities of local enterprises is essential to effectively respond to the intense competition from both domestic and international companies regarding the province's key products.
8	SO_1	[SO_1] - It is necessary to leverage the province's strong natural advantages, including its beautiful landscapes and temperate climate, to enhance investment attraction in tourism development, particularly in the eco-tourism sector.
9	WO_2	[WO_2] - It is essential to develop strategies to enhance the investment environment while simultaneously formulating breakthrough policies to attract investment; these should target high-quality capital inflows and focus on key sectors aligned with the province's sustainable development goals.
10	WO_1	[WO_1] - It is imperative to address the limitations faced by the province, especially regarding the training and development of a high-quality workforce, as this is a crucial factor in attracting investment linked to new technologies.

The experts within each research group possess varying levels of qualifications (Associate Professor, PhD, Master's degree, Engineer), but their roles in the decision-making process are equal. On the other hand, in a crisp environment, experts use only precise numerical values $[1/9,1]\cup[1,9]$ to compare the importance of pairs (i,j). Due to the uncertainty inherent in expert evaluations, the results may be insufficient and lack accuracy, which constitutes a limitation of this study.

4. Conclusion

The SWOT model is crucial for analyzing strengths (S), weaknesses (W), opportunities (O), and threats (T) to formulate four main groups of strategies: leveraging strengths to capitalize on opportunities (SO1, SO2, SO3); addressing weaknesses to take advantage of opportunities (WO1, WO2); utilizing strengths to mitigate risks (ST1, ST2); and implementing defensive strategies to prevent worsening challenges/threats (WT1, WT2, WT3). However, the SWOT matrix alone cannot quantify the strategies or determine which strategies should be prioritized for implementation.

Therefore, it is essential to integrate SWOT and AHPG into the case study of socio-economic development in Dak Nong province to calculate the weights of the first-level factors (SWOT-objectives): strengths (S): 0.3814, weaknesses (W): 0.2035, opportunities (O): 0.2386, and threats (T): 0.1765; as well as the second-level factors (SWOT-factors) and global weights (Table 15). Ranking and selecting priority strategies must follow this approach; otherwise, strategies will be executed within the groups SO (SO1, SO2, SO3), WO (WO1, WO2), ST (ST1, ST2), and WT (WT1,

WT2, WT3), rather than being implemented as separate strategies prioritized from highest to lowest (SO3: 0.118 > ST2: 0.104 > SO2: 0.103 > ST1: 0.102 > WT3: 0.101 > WT1: 0.098 > WT2: 0.096 > SO1: 0.095 > WO2: 0.094 > WO1: 0.089). The application of AHPG reduces subjectivity by incorporating the expertise of multiple specialists, prioritizing strategies based on descending weights (Table 17). The study of Dak Nong province, involving planners, ensures a high level of feasibility.

In the decision-making process within a crisp environment, experts often hesitate between two consecutive integers but are required to select one (the original AHP). To overcome the limitations of the original crisp AHP, it is necessary to explore a solution that combines group AHP with fuzzy logic (fuzzy AHP-group, abbreviated as FAHPG) for evaluating factor weights. This approach allows for a more accurate representation during the decision-making process.

REFERENCES

Akaa O.U et al. (2016). A group-AHP decision analysis for the selection of applied fire protection to steel structures. *Fire Safety Journal*, 86, 95-105. https://doi.org/10.1016/j.firesaf.2016.10.005

Amenta P., Luacadamo A., Marcarelli G. (2021). On the choice of weights for aggregating judgments in non-negotiable AHP group decision making. *European Journal of Operational Research, 288*(1), 294-301. https://doi.org/10.1016/j.ejor.2020.05.048

Chen Y., Yu J, Khan S. (2010). Spatial sensitivity analysis of multi-criteria weights in GIS-based land suitability evaluation. *Environmental Modelling & Software*. *25*(12), 1582-1591. https://doi.org/10.1016/j.envsoft.2010.06.001

Dragincic J.B.B., Korac N. (2015). Group multi-criteria decision making (GMCDM) approach for selecting the most suitable table grape variety intended for organic viticulture. *Computers and Electronics in Agriculture*, *111*, 194–202. https://doi.org/10.1016/j.compag.2014.12.023

Dinh L.C., Duc T. T. (2012). GIS and Analytic Hierarchy Process for land evaluation, *Asia Geospatial Digest*, *2*(2). https://www.geospatialworld.net/article/gis-and-analytic-hierarchy-process-for-land-evaluation/

Etongo D., Bristol U., Epule T. E., Bandara A., Sinon S. (2023). Expert elicitations of smallholder agroforestry practices in Seychelles: A SWOT-AHP analysis. *Regional Sustainability*, *4*(3), 282-295. https://doi.org/10.1016/j.regsus.2023.08.006

Friedrichsen M., Zarea H., Tayebi A., Abad F.A.S. (2017).Competitive strategies of knowledge and innovation commercialization: A unified SWOT and Fuzzy AHP approach. *AD-minnister*, *30*, 45-72. https://doi.org/10.17230/ad-minister.30.3

Goepel. K. (2018). Implementation of an online software tool for the Analytic Hierarchy Process (AHP-OS). *International Journal of the Analytic Hierarchy Process*, *10*(3), 469-487. https://doi.org/10.13033/ijahp.v10i3.590

Grošeli P., Dolina G. (2023). Group AHP framework based on geometric standard deviation and interval group pairwise comparisons. *Information Sciences*, *626*, 370-389. https://doi.org/10.1016/j.ins.2023.01.034

Görener A., Toker K., Uluçay K. (2012). Application of combined SWOT and AHP: A case study for a manufacturing firm. *Procedia - Social and Behavioral Sciences*, *58*, 1525 – 1534. https://doi.org/10.1016/j.sbspro.2012.09.1139

Hill, T., & Westbrook, R. (1997). SWOT analysis: It's time for a product recall. *Long Range Planning*, *30*(1), 46–52. https://doi.org/10.1016/s0024-6301(96)00095-7

Jaskowski P., Biruk S., Bucon R. (2010). Assessing contractor selection criteria weight with fuzzy AHP method application in group decision making. *Automation in Construction*, *19*(2), 120-126. https://doi.org/10.1016/j.autcon.2009.12.014

Kandakoglu A., Akgun I., Topcu Y. I. (2007). Strategy development & evaluation in the battlefield using quantified SWOT analytical method. *9th International Symposium on Analytic Hierarchy Process (ISAHP)*, 9. https://doi.org/10.13033/isahp.y2007.022

Lee S. and Walsh P. (2011). SWOT and AHP hybrid model for sport marketing outsourcing using a case of intercollegiate sport. *Sport Management Review*, *14*(4), 361-369. https://doi.org/10.1016/j.smr.2010.12.003

Lee, J., Kim, I., Kim, H., Kang, J. (2021). SWOT-AHP analysis of the Korean satellite and space industry: Strategy recommendations for development. *Technological Forecasting and Social Change*, 164, 120515. https://doi.org/10.1016/j.techfore.2020.120515

Lu J., Zhang G., Ruan D., Wu F. (2007). *Multi-objective group decision making: Method, software, and application with fuzzy techniques*. Singapore: World Scientific Publishing.

Malik, S.A, Khaitani, N.S.A, Naushad M. (2013). Integrating AHP, SWOT and QSPM in strategic planning- an application to college of business administration in Saudi Arabia. *Proceedings of the International Symposium of the Analytic Hierarchy Process*. http://dx.doi.org/10.13033/isahp.y2013.049

Nasab, M. N., Azizi, M. (2014). Analysis of agricultural mechanization in Zanjan Province, Iran: Application of SWOT-AHP method. *International Symposium on the Analytic Hierarchy Process*, Washington, DC, USA. https://doi.org/10.13033/isahp.y2014.034

People's Committee of Dak Nong Province (2023). Dak Nong Provincial Planning for the 2021–2030 Period with a Vision to 2050, approved by the Prime Minister under Decision No. 1757/QĐ-TTg, December 31.

Polat Z.A., et al. (2017). Determining strategies for the cadastre 2034 vision using an AHP-Based SWOT analysis: A case study for the Turkish cadastral and land administration system. *Land Use Policy*, 67, 151–166. https://doi.org/10.1016/j.landusepol.2017.05.004

Srdjevic B., Pipan M., Srdjevic Z., Blagojevic B., Zoranovic T. (2013). Virtually combining the Analytical Hierarchy Process and voting methods in order to make group decisions. *Universal Access in the Information Society*, *14*(2), 231–245. https://doi.org/10.1007/s10209-013-0337-9

Srdjevic B., Blagojevic B., Cukaliev O. (2014). *Multi-criteria evaluation of groundwater ponds as suppliers to urban water distribution systems.* Springer Netherlands. https://doi.org/10.1007/978-94-007-7161-1_9

Srdjevic Z., Srdjevic B., Blagojevic B., Pipan M. (2014). *Innovative group decision making framework for sustainable management of regional hydro-systems. NATO Science for Peace and Security Series C: Environmental Security.* Springer Netherlands. https://doi.org/10.1007/978-94-007-7161-1_7

Saaty, T.L. (1996). *The Analytic Hierarchy Process.* Pittsburgh: RWS Publications.

Sahani N. (2021). Application of hybrid SWOT-AHP-FuzzyAHP model for formulation and prioritization of ecotourism strategies in Western Himalaya, India. *International Journal of Geoheritage and Parks*, *39*(3), 349–362. https://doi.org/10.1016/j.ijgeop.2021.08.001

Shiwakoti S., Regmi S. (2022). Strategic analysis of the Nepal electricity authority: a SWOT-AHP analysis based on stakeholders' perceptions. *International Journal of the Analytic Hierarchy Process, 14*(1), 1-31. https://doi.org/10.13033/ijahp.v14i1.944

Thapa, R.B, Murayama, Y. (2008). Land evaluation for peri-urban agriculture using analytical hierarchical process and geographic information system techniques: A case study of Hanoi. *Land Use Policy*, *25*(2), 225-239. https://doi.org/10.1016/j.landusepol.2007.06.004

Tuan N.H., Canh T.T., (2022). Integral SWOT-AHP-TOWS model for strategic agricultural development in the context of drought: A case study in Ninh Thuan, Vietnam, *International Journal of the Analytic Hierarchy Process*, 14(1), 1-30. https://doi.org/10.13033/ijahp.v14i1.890

Wickramasinghe V., Takano S. (2010). Application of combined SWOT and Analytic Hierarchy Process (AHP) for tourism revival strategic marketing planning: A case of Sri Lanka tourism. *Journal of the Eastern Asia Society for Transportation Studies*, 8, 954– 969.

Wang Y., Xu L., Solangi Y. A. (2019). strategic renewable energy resources selection for Pakistan: Based on SWOT-Fuzzy AHP approach. *Sustainable Cities and Society*, *52*, 101861. https://doi.org/10.1016/j.scs.2019.101861

Weihrich H. (1982). The TOWS matrix: A tool for situational analysis. *Long Range Planning, 15*(2), 54–66. https://doi.org/10.1016/0024-6301(82)90120-0

Yuksel, I., & Dagdeviren, M. (2007). Using the analytic network process (ANP) in a SWOT analysis - A case study for a textile firm. *Information Sciences*, 177, 3364–3382. https://doi.org/10.1016/j.ins.2007.01.001