Prioritizing the Development Strategy of Ethnic Minority Farms in Central Highlands of Vietnam Using SWOT-AHP-TOWS Analysis

Thi Ngoc Loi Nguyen and Inna Vasilievna Mitrofanova

Abstract The increasing division of farms, caused by internal and external circumstances, requires the formulation of a farm economic development strategy that ensures access to a trajectory of sustainability and enhancing competitive capacity, especially in ethnic minority farms. In order to achieve this, a methodology to estimate the impact of factors and prioritize alternative strategies on development of ethnic minority farms is presented and applied to the Central Highlands of Vietnam. The study combines a SWOT-AHP-TOWS analysis, in which the SWOT technique examines internal and external factors of these farms and then prioritizes the use of analytical hierarchy process (AHP). Finally, the TOWS matrix is built with nine strategies to comprehensively prioritize each alternative in relation to the SWOT factors. Hence, factors that pertain to weakness are becoming prevalent such as low educational attainment, lack of access to credit, as well as cultural, tradition, and language barriers. Along with the orientation of farm economic development and long-term goals, it is important to minimize weaknesses to avoid threats to the development of ethnic minority farms. Therefore, in such context the following policy considerations are significant: (1) Developing and issuing specific policies for ethnic minority farms; (2) Encouraging alliances between farms; (3) Promoting the "four-house" linkage model; (4) Optimizing of production resources, and (5) Developing human resources.

Keywords Ethnic minority farm · SWOT · AHP analysis · TOWS matrix · Vietnam

T. N. L. Nguyen (✉) · I. V. Mitrofanova
Volgograd State University, Volgograd, Russian Federation
e-mail: ngocloi99@gmail.com

T. N. L. Nguyen
The University of Danang–Campus in Kontum, Kontum, Vietnam

I. V. Mitrofanova
Federal Research Centre Southern Scientific Centre of the Russian Academy of Sciences (SSC RAS), Rostov-on-Don, Russian Federation

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1 Introduction

Agriculture is the basis and the most integral component of the Vietnamese economy (Song et al., 2020). During more than 30 years of comprehensive economic reform, significant changes in formal institutions, the introduction, and improvement of the institution of private ownership of land, the incorporation of new models of transactions into management practices led to the formation of many small agricultural organizations, a significant part of which began their activities in the form of farms. It plays a leading role not only in advancing agricultural development but also in addressing important social problems, particularly of the villages: creating jobs for rural people; contributing in preserving traditional lifestyles; acting as an additional source for local budgets (Bui, 2015). However, the period of intensive growth of farm's number, which took place during the years of active state support for farming, was replaced by a phase of a remarkable reduction in the number of farms the background of a significant increase in their size. As a result, increasing economic efficiency in the operation of farms and their adaptation to a constantly changing environment becomes an objective necessity (Nguyen & Mitrofanova, 2022). Concerns about the development of minority farms, in particular, should be addressed through the production capacity constraints of minority households, such as nomadic farming, rudimentary production tools, low labor productivity, small-scale, concentrated production (Vu et al., 2020), their resilience to climate change is relatively low (Sen et al., 2020) and there is always a development gap with the main group (Fujii, 2017).

Furthermore, the collection of relevant literature in Vietnam is lacking in-depth analysis on issues regarding the development of ethnic minority farms. Meanwhile, current studies based on various qualitative and quantitative methods such as regression equations, mathematical programming, descriptive analysis, synthesis, and scientific reports focus on proposing general farm development strategies. This includes optimal allocation of inputs for farms (Nguyen et al., 2020), enhancing the application of 4.0 agriculture (Tran et al., 2020), stimulating digital transformation, improving the quality of labor resources, providing credit support, and promoting farms to join the global value chain (Nguyen & Mitrofanova, 2021a). However, these methods do not take into account all factors affecting the development of farms, such as the history of the establishment, the development of local farms, the support of the state, pests and diseases, or damaged crops. Furthermore, in such an uncertain environment, the interdependencies among these factors, as well as the judgments of decision makers, have also not been addressed in those studies. In addition, depending on the material, socio-cultural, economic, and ecological issues and contexts, specific strategies need to be developed for each geographical region.

Therefore, a systematic approach is necessary in the strategy of developing ethnic minority farms. SWOT is an acronym for strengths, weaknesses, opportunities, and threats, which is a powerful tool that assists decision-making and helps to identify internal and external influences that may have a positive or negative impact on the achievement or development of goals (Kolotov, 2018). In the agricultural sector, this matrix is also well known for assessing bottlenecks and identifying potentials of

programs and projects in developing countries. For example, in Ukraine, the SWOT analysis is employed to develop strategies for sustainable development in rural areas (Shcherbak et al., 2020). Meanwhile in Nepal, the analysis was used to formulate agricultural policy (Arun & Ghimire, 2018). Whilst in Iran it was implemented to determine the agricultural development strategy, especially the management of the farm system (Ommani, 2011). However, the main limitation of this traditional tool is that it does not quantify the significance of each factor in the decision-making process, and it is also difficult to assess which factor has more influence on the strategic decision (Pesonen et al., 2001).

The decision-making process is the act of choosing the most suitable tactics to accomplish desired tasks and goals. Thereby, the establishment of the multi-criteria decision making (MCDM) aims to improve the SWOT analysis method. In particular, the Analytical Hierarchy Process (AHP) is a common technique within the MCDM method used to prioritize factors affecting decision-making in order to choose an alternative based on the relative importance of such factors (Saaty, 2013). The SWOT-AHP integration is the leading method that most decision-makers refer to in order to make more reliable and effective choices in agricultural and rural development, proven in the scientific work by Ali et al. (2021). A case study demonstrating the feasibility of SWOT and AHP analysis to incorporate stakeholder priorities in strategic decision-making on beef farm development in Indonesia (Budi et al., 2020). Particularly as follows: after identifying strengths, weaknesses, opportunities, and threats in the beef farm business; followed by group weights and SWOT factors calculated by AHP method; the result is that three priority strategies have the highest scores.

On the other hand, the SWOT matrix is a planning tool, whilst the TOWS matrix is an action tool. Because based on the relationship between threats, opportunities, weaknesses and strengths indicated by a precursory SWOT, the TOWS matrix is developed to reveal alternative strategies (Weihrich, 1982). In other words, the TOWS analysis is applied to develop the tactics needed to execute the strategies and to find more specific actions that support these tactics. Despite the advantage of a systematic approach to creating strategies, TOWS analysis has inherent drawbacks like SWOT (Jafari et al., 2013). Therefore, the SWOT-AHP-TOWS analysis is a more in-depth combination of analytical tools to further improve the decision-making process and develop policies based on the results of SWOT-AHP analysis. This model allows for integrated analysis, prioritization of individual factors, and development of appropriate policies. The strength of this model is to provide structured, systematic support and analysis that combines both qualitative and quantitative attributes. The integral SWOT-AHP-TOWS model is a multi-step process in which AHP is based on a previous SWOT analysis and its subsequent further strategic choices are derived using the TOWS matrix. Insights into this process were proposed in many countries during the design of agricultural and rural development strategies. Examples include identifying transition strategies of Turkey's sustainable food system (Seçkin & Özdil, 2022), optimal decision-making to develop adaptation strategies among small-scale farmers in drought conditions in Iran (Savari & Amghani, 2022), and agricultural development measures in the context of drought in

Vietnam (Nguyen & Truong, 2022). Consequently, quickly and objectively demonstrate countermeasures to overcome agricultural crises is considered an advantage of the SWOT-AHP-TOWS analysis.

With the considerations presented, the aim of this chapter is to develop a scientific and methodological approach to the formulation and selection of ethnic minority farm development strategies applicable in the Central Highlands of Vietnam. Therefore, an integrated SWOT-AHP-TOWS analysis serves as a platform to identify comprehensive factors affecting ethnic minority farms in the Central Highlands, determining its development strategy, prioritizing, and identifying the best strategies in the current context. The rest of this chapter is structured as follows: Sect. 2 describes the location and methods of the study. Section 3 presents the results of the SWOT-AHP-TOWS analysis and discusses the policy implications, as well as conclusions summarized in Sect. 4.

2 Methodologies

2.1 Study Area

The Central Highlands of Vietnam locates in the southeast of the Indochina Peninsula, sharing borders with Laos and Cambodia, adjacent to the Southeast region. This location has made the Central Highlands a place with great potential and many advantages for development in renewable energy, agriculture, and tourism. In terms of administrative boundaries, the Central Highlands consist of five provinces: Kon Tum, Gia Lai, Dak Lak, Dak Nong, and Lam Dong. Total natural area is 54,508 sq km (accounting for 16.46% of the whole country); population is 5.93 million people (6.1% of the national population); the average population density is 109 people per sq km (GSO, 2022). The Central Highlands has a large proportion of ethnic minorities, accounting for about 38% of the total population. The Jarai, Bahnar, Ede, Tay, and Nung are the largest ethnic groups. This is also the region with the second highest percentage of poor and near-poor ethnic minority households in the country, comes after the Northern Midlands and Mountains with 35.5% (GSO & CEMA, 2019).

Farm economy in the Central Highlands was formed and established under specific conditions: firstly, due to the policy mechanism of State, creating a new management mechanism, new awareness in agriculture, rural areas, and farmers. Subsequently, because the Central Highlands is a region with many comparative advantages in terms of climate, land, soil, water resources, resources, as well as the people for agricultural and forestry production (Nguyen & Mitrofanova, 2021b). It is a necessary trajectory that contributes to increasing arable land, creating more jobs, eradicating hunger, reducing poverty, increasing commodity production, and transforming the economic structure of agriculture in the Central Highlands (Nguyen, 2019). This highlights how the farm economy has been discovered as a viable poverty reduction intervention strategy. The application and execution of guidelines and policies of

the Central Highlands provinces on land, forests, and development of commodity production have been implemented early and effectively. From 2020, implementing the Circular No. 02/2020/TT-BNNPTNT dated February 28, 2020 of the Ministry of Agriculture and Rural Development, the number of farms in the Central Highlands decreased to 1,740 farms, accounting for 7.4% of farms nationwide (only 193 ethnic minority farms) as determined by new criteria (GSO, 2021). Many farms do not meet both criteria in terms of scale and value, while they are still operating well by contributing to promoting agricultural production in the direction of large commodity production (Nguyen & Mitrofanova, 2021b). According to statistics in 2020, the Central Highlands has 1,018,260 households (439,699 ethnic minority households) producing agricultural goods with a scale of 0.5–2 hectares/household; more households than two hectares—this is the core force, some of which will thrive and become farms (GSO, 2021). Currently, a number of restrictions (information, prices, markets, investment, resources, management, etc.) have hindered the development of the farm economy, reducing its stability and competitive capacity (Nguyen, 2019; Nguyen & Mitrofanova, 2021b). Especially for ethnic minority households, agricultural production development is affected by natural conditions, economic infrastructure, social culture, customs, and policies of the government as well as internal factors (Duong & Truong, 2022). These are good bases for determining strategies to develop ethnic minority farms in the Central Highlands, contributing to the successful implementation of national target programs for socio-economic development in ethnic minority and mountainous areas in the period of 2021–2030.

2.2 Data Collection

The issue of ensuring the sustainability of farm operations at the present time and forecasting future trends in Vietnam has been outlined on the basis of an assessment of the main stages of farm institutionalization in the Vietnamese agricultural system (Nguyen & Mitrofanova, 2022). Along with these data, the trends and performance characteristics of ethnic minority farms in the Central Highlands were specifically analyzed based on a survey of 193 ethnic minority farms to better describe the prospects for developing these farms and their respective challenges. The above information will serve as an input for the analysis of strengths, weaknesses, opportunities, and threats to the development of ethnic minority farms in the Central Highlands.

Then, 12 experts were purposefully selected, from the University of the Central Highlands, the University of Danang Campus in Kon Tum, the Institute of Social Sciences in the Central Highlands, the Committee for Ethnic Minority Affairs and the Department of Science and Technology of Lam Dong Province, the Agricultural Extension Center of Dak Lak Province, and the Sub-Department of Rural Development of Kon Tum Province. All participants are over 40 years old and have more than 15 years of research and work experience in agriculture and policy. The data required for this study was collected over two periods through two different questionnaires from March to June 2022. In stage 1, using an open-ended questionnaire,

experts were asked to identify the strengths, weaknesses, opportunities, and threats of the Central Highlands selected for ethnic minority farms. Combined with the information gathered previously, a list of the most relevant SWOT with sub-factors is displayed. This is also an important basis for building the TOWS strategy matrix. In stage 2, they were asked to score strengths, weaknesses, opportunities, and threats in pairwise comparisons as well as evaluate the priority of suggested strategies.

2.3 Research Model and Analytical Steps

Based on the above analysis, an integrated SWOT-AHP-TOWS analysis is necessary to identify priority areas in the development of ethnic minority farms in the Central Highlands as presented in the diagram in Fig. 1. This process is carried out in the following four steps: (1) Building strategic information and assessing the situation through internal factors and external factors; (2) Comparing each pair of criteria to calculate the weight in the SWOT factors (strengths, weaknesses, opportunities, and threats); (3) Using AHP analysis to prioritize each criterion in the four analysis groups; and (4) Using the TOWS matrix to rank and choose the optimal strategy.

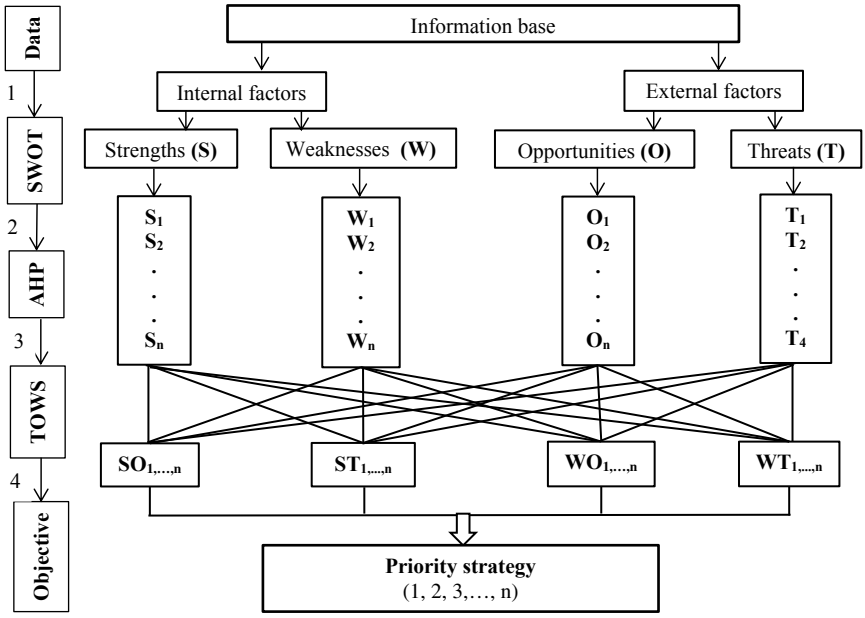

Fig. 1 Research model (*Source* Authors' elaboration)

3 Results and Discussion

Step 1: Situational Assessment (SWOT Analysis)
In order to identify possible development strategies for ethnic minority farms in the Central Highlands, a regional situational SWOT analysis was carried out on the potential for further development of these farms. Participants' responses to the SWOT analysis were listed, weighed, selected, and sorted into a number of relevant and meaningful subgroups. Although there are benefits to considering many factors, the calculation is very complicated because the number of pairwise comparisons in the AHP increases exponentially with the number of factors. Therefore, the current process offers seven strengths, seven weaknesses, four opportunities, and four threats for the future development of ethnic minority farms in the Central Highlands as shown in Table 1.

Step 2: Calculate the Weight of each SWOT Factor Group Using AHP Analysis
Figure 1 shows the hierarchy used in the study. Determining the best strategic plan to the economic development of ethnic minority farms in the Central Highlands, therefore, is the ultimate goal. The lowest level contains the specified criteria for each group of strengths (S), weaknesses (W), opportunities (O), and threats (T).

The weights of the factors and the SWOT criteria are determined by considering the degree of influence on the development of ethnic minority farms in the Central Highlands. The weights reflect the relative importance of each factor and must therefore be chosen carefully (Mishra et al., 2015). The weights of all the SWOT factors and the TOWS matrix were determined using the AHP method. In order to assign weights to different criteria (i.e., different factors considered in the SWOT analysis), a pairwise comparison matrix is then derived using Eq. (1), where A is the pairwise matrix, assuming that the element a_{ij} is equal to $1/a_{ij}$, so if i equals j, a_{ij} is also equal to 1. The intensity-Si weighting can also vary from 1 to 9, with 1/1 representing equal importance and 9/1 absolute importance (Satty, 1990).

$$A = \left(a_{ij}\right) = \begin{bmatrix} 1 & S_1/S_2 & \ldots & S_1/S_n \\ S_2/S_1 & 1 & \ldots & S_2/S_n \\ \vdots & \vdots & \ldots & \vdots \\ S_n/S_1 & S_n/S_2 & \ldots & 1 \end{bmatrix} \quad (1)$$

Some inconsistencies may arise when making sensible pairwise comparisons between decision-makers' determinants. In the case where A contains inconsistencies (provided by an expert), the estimated preference can be obtained using the matrix given in Eq. (1) as input to the eigenvalue technique shown in Eq. (2) (Tafida & Fiagbomeh, 2021).

$$(A - \lambda_{\max} I)q = 0 \quad (2)$$

Table 1 Identified attributes of SWOT factors

Factors			Criteria / sub-factors
Internal factors	Strengths (***S***)	S_1	Farm owners have a lot of experience
		S_2	Large area of agricultural production land
		S_3	Abundant and cheap labor resources
		S_4	The locality has many preferential policies for farm development
		S_5	Natural conditions are suitable for agricultural production
		S_6	Convenient rural transport infrastructure
		S_7	Branded agricultural products with great export potential
	Weaknesses (***W***)	W_1	The level of education and expertise of farmers is still very low
		W_2	Lack of capital to expand production and mechanization in production is low
		W_3	Lack of linkages between farms
		W_4	Insufficient product sales channel due to lack of information
		W_5	Failing to manage the quality of inputs and products
		W_6	Farm owners are not actively participating in technical assistance and related training programs
		W_7	Barriers to language, culture, production practices of ethnic minorities
External factors	Opportunities (***O***)	O_1	The demand for agricultural products is large and growing
		O_2	The State's policy to support the development of farm economy
		O_3	The development of science and technology has created new varieties of plants and new techniques
		O_4	Many guidelines and policies for ethnic minorities
	Threats (***T***)	T_1	Unable to keep up with advanced technology in production
		T_2	Environmental pollution and resource depletion
		T_3	Climate change, natural disasters, epidemics
		T_4	Requires high product quality

Source Authors' elaboration

In Eq. (2), λ_{max} is the largest eigenfactor of a matrix A of size n; q is the coherence vector, and I represent the identity matrix of size n. Saaty (1980) proved that when comparing SWOT factors, λ_{max} must be equal to n to satisfy the consistency condition.

Consistency in the decisions of experts is controlled by the magnitude of acceptable values, called the consistency ratio (CR). It is calculated by the quotient of the

Table 2 Value of random consistency index (RI)

n	1	2	3	4	5	6	7	8	9	10	11	12
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.56

Source Saaty (1980, 2008)

consistency index (CI) value and the random inconsistency (RI) (Ali et al., 2021; Budi et al., 2020; Nguyen &Truong., 2022), shown in Eq. (3)

$$\mathrm{CR} = \mathrm{CI}/\mathrm{RI} \tag{3}$$

$$\mathrm{CI} = (\lambda_{\max} - n)/(n-1) \tag{4}$$

Equation (4) represents the CI value, where $\lambda_{\max}$ is the largest eigenvalue of the pairwise comparison matrix and n is the number of elements found in each matrix. RI denotes the random index, which depends on the order of the matrix specified by Saaty (1980) in Table 2. If the value of CR is ≤ 0.10 or 10%, it is acceptable and used for further analysis. Conversely, if the CR value is > 0.1, the assessment process needs to repeat and improve.

The identification of priority strategies is done by looking at the results of a joint assessment of experts. Through the AHP method, quantitative values of each expert from the group of factors and SWOT criteria are used to calculate the geometric mean in Eq. (5), resulting in an overall rating.

$$\mathrm{GM} = \sqrt[n]{(X_1)(X_2)\ldots(X_n)} \tag{5}$$

where GM is the geometric mean of a series containing (n = 12), experts' assessment is the nth root of the product of the values, and X is the value of each element in the pairwise comparison matrix (1–9 scale). This combined assessment generates new weights for each factor and SWOT attributes (Budi et al., 2020; Saaty, 2008).

The Excel hierarchical analysis procedure was used to support the calculations in this study. Therefore, the results of the wise pairwise comparison for weighting of each group in the SWOT analysis are presented below.

Table 3 shows the results of pairwise comparisons between the four SWOT factors that make up the second level of the hierarchy. The consistency ratio (CR) of this evaluation group was extracted as 0.0565, which guarantees the consistency of the answers. Using the weighting of the relative priorities of the four factors, the calculated weaknesses were 0.3966, which was identified as having the greatest effect on ethnic minority farms in the Central Highlands. Whilst opportunities are calculated as having the second highest impact with a weight of 0.3360, followed by strengths and threats with weights of 0.1453 and 0.1221, respectively. In terms of the magnitude of the influence factors on the development of farms, strengths are nearly two and three times stronger than strengths and weaknesses, respectively, but only 0.061 points stronger than opportunities. This indicates that minimizing the weaknesses is

Table 3 Priorities of SWOT factors (CR = 5.65%)

Factors	*S*	*W*	*O*	*T*	Factor weights	Ranking
Strengths (*S*)	1	1/4	1/3	2	0.1453	3
Weaknesses (*W*)	4	1	1	3	0.3966	1
Opportunities (*O*)	3	1	1	2	0.3360	2
Threats (*T*)	1/2	1/3	1/2	1	0.1221	4

Source Authors'calculation

very important in supporting the development of ethnic minority farms in the Central Highlands.

In each group of strengths, weaknesses, opportunities, and threats, the local weights of factors with criteria directly or indirectly related to the development of ethnic minority farms in the Central Highlands has been calculated. The ranking of strength criteria shows that S_2 (0.2704), S_3 (0.2664), and S_1 (0.2404), with a consistent ratio of CR = 0.0531, as the top three influencing factors in seven criteria are considered (Table 4). Similarly, at CR = 0.0525, the criteria W_1 (0.2886), W_2 (0.1784), and W_7 (0.1541) are the most important weaknesses, with their associated factor weights (Table 5), which are likely to have the maximum effect on achieving the goals of improving the competitive capability of farms.

From the comparison weights, the chance factors are ranked as O_1 (0.3585), O_3 (0.3200), and O_2 (0.1807) with a CR of 0.0435 (Table 6). A pairwise comparison of threat criteria with a consistency ratio of 0.0161 ranked T_1 (0.4228), T_4 (0.2709), and T_3 (0.1623) as the first, second, and third threats pose the greatest challenge to the operation of ethnic minority farms (Table 7). In addition, the ranking of the most integral strengths (S_2), weaknesses (W_1), opportunities (O_1), and threats (T_1) indicates that the failure to keep up with scientific and technical advances in agricultural production (T_1) is ranked as the most important factor affecting the performance of farms. Moreover, high demand for agricultural products (O_1), low education level (W_1), and large agricultural land area (S_2) are ranked second, third, and fourth,

Table 4 Priorities of Strengths factor (CR = 5.31%)

Criterias	S_1	S_2	S_3	S_4	S_5	S_6	S_7	Local weights	Ranking
S_1	1	1/2	1/2	2	4	3	2	0.2404	3
S_2	2	1	1	2	3	2	2	0.2704	1
S_3	2	1	1	2	2	2	3	0.2664	2
S_4	1/2	1/2	1/2	1	1	2	3	0.1547	4
S_5	1/4	1/3	1/2	1	1	0.5	2	0.1042	6
S_6	1/3	1/2	1/2	1/2	2	1	2	0.1261	5
S_7	1/2	0.33	0.33	0.33	0.5	0.5	1	0.0781	7

Source Authors' calculation

Table 5 Priorities of Weaknesses factor (CR = 5.25%)

Criterias	W_1	W_2	W_3	W_4	W_5	W_6	W_7	Local weights	Ranking
W_1	1	3	3	2	4	2	2	0.2866	1
W_2	1/3	1	2	2	2	2	2	0.1784	2
W_3	1/3	1/2	1	2	2	2	1/2	0.1218	4
W_4	1/2	1/2	1/2	1	2	2	1/2	0.1071	5
W_5	1/4	1/2	1/2	1/2	1	2	1/2	0.0789	6
W_6	1/2	1/2	1/2	1/2	1/2	1	1/2	0.0731	7
W_7	1/2	1/2	2	2	2	2	1	0.1541	3

Source Authors'calculation

respectively, are the most notable influencing criteria shaping overall performance results.

Step 3: Prioritize Each Criterion Applied to the Factors After Comparing Each Pair Using the AHP Method

In this step, the weights of the global priorities of the 22 criteria are generated by multiplying each criterion's local priority by the weight of its main SWOT factor. Equation (6) is given below:

$$\text{Global weights} = \text{Factor weights} \times \text{Local weights of each factor} \tag{6}$$

By carefully reviewing global priority rankings, two criteria from opportunities ranked in the top five criteria according to the level of importance that have significant

Table 6 Priorities of Opportunities factor (CR = 4.35%)

Criterias	O_1	O_2	O_3	O_4	Local weights	Ranking
O_1	1	3	1	2	0.3585	1
O_2	1/3	1	1/2	2	0.1807	3
O_3	1	2	1	2	0.3200	2
O_4	1/2	1/2	1/2	1	0.1408	4

Source Authors'calculation

Table 7 Priorities of Threats factor (CR = 1.61%)

Criterias	T_1	T_2	T_3	T_4	Local weights	Ranking
T_1	1	3	2	2	0.4228	1
T_2	1/3	1	1	1/2	0.1440	4
T_3	1/2	1	1	1/2	0.1623	3
T_4	1/2	2	2	1	0.2709	2

Source Authors'calculation

impact on the farm economy of ethnic minorities. That is the large demand for agricultural products ($O_1 = 0.1205$) and the strong development of science and technology ($O_3 = 0.1075$). The three criteria of weakness are low education level (W_1) with the proportion of 0.1137, followed by lack of access to credit (W_2), and cultural and language barriers (W_7) with the proportions of 0.0708 and 0.0611, respectively.

On the other hand, most of the threat criteria have a low rank, indicating a low level of impact on farms. However, failing to keep up with scientific and technical advances in agricultural production (T_1) ranked 7th, with a proportion of 0.0516. Thus, in order to improve the productivity of current ethnic minority farms, it is necessary to accelerate the application of new and efficient production techniques.

Two criteria of strength have the bottom rank of the rankings. In which, local preferential policies ($S_5 = 0.0151$) and export potential ($S_7 = 0.0113$) are ranked at the 21st position and followed by the last position (22nd). This indicates that these two criteria are considered as attributes that need to be promoted last to increase the competitiveness of farms.

In the SWOT criteria, most of the weaknesses and opportunities are more influential than the strengths and threats. Table 8 therefore shows that the results of the SWOT criteria analysis have the same meaning as the results of the SWOT factors.

Step 4: Ranking and Selecting Priority Strategies, Constructed in the TOWS Matrix

The basic objective of strategy formulation is to transform existing conditions or reconstruct the disrupted image in the region into desired scenarios (Prager & Wiebe, 2021; Wickramasinghe & Takano, 2009). In fact, the agricultural sector can propose diverse farm economic development strategies; however, limited financial and other resources or internal and external environmental conditions make it difficult for all the proposed strategies to work, especially for ethnic minorities. Therefore, it is imperative to choose which strategy should be prioritized, and which should be scaled down. In order to form the combined strategies, a TOWS matrix (Table 9) was performed on the basis of the strengths, weaknesses, opportunities, and threats for the study area identified in the above analysis.

Weihrich (1982) developed TOWS matrix with four different types of strategies: (1) SO strategy: take advantage of opportunities to develop strengths, (2) ST strategies: use strengths to avoid external threats, (3) WO strategies: reduce weaknesses to utilize opportunities, and (4) WT Strategy: reduce weaknesses to prevent threats. This does not mean that a particular strategy is influenced only by two respective groups. It can be supported or influenced by other SWOT factors. For example, a strategy of optimizing production resources on top of an SO strategy may receive support from weaknesses and threats to a lesser extent than strengths and opportunities.

The procedure for prioritizing alternative strategies has been established in this step. In order to better represent the impact of strategies on the objective, a verbal/linguistic ranking is provided to display the relationships between SWOT factors and suggested strategies in Table 10.

Table 8 The importance of the factors and criterias of the SWOT—AHP analysis

SWOT factors		Factor weights	SWOT criterias	Local weight	Global weight	Ranking
Internal factors	Strengths (*S*)	0.1453	S_1	0.2404	0.0349	13
			S_2	0.2704	0.0393	11
			S_3	0.2664	0.0387	12
			S_4	0.1547	0.0225	17
			S_5	0.1042	0.0151	21
			S_6	0.1261	0.0183	19
			S_7	0.0781	0.0113	22
	Weaknesses (*W*)	0.3966	W_1	0.2866	0.1137	2
			W_2	0.1784	0.0708	4
			W_3	0.1218	0.0483	8
			W_4	0.1071	0.0425	10
			W_5	0.0789	0.0313	15
			W_6	0.0731	0.0290	16
			W_7	0.1541	0.0611	5
External factors	Opportunities (*O*)	0.3360	O_1	0.3585	0.1205	1
			O_2	0.1807	0.0607	6
			O_3	0.3200	0.1075	3
			O_4	0.1408	0.0473	9
	Threats (*T*)	0.1221	T_1	0.4228	0.0516	7
			T_2	0.1440	0.0176	20
			T_3	0.1623	0.0198	18
			T_4	0.2709	0.0331	14

Source Authors' calculation

The strategic relationship represents the contribution of factors (strengths and opportunities) contribute to the implementation of the strategy and the expected improvements to the factors (weaknesses and threats) when a particular strategy is implemented. The weights of these relationships were quantified using the pairwise matrices in the usual manner as presented earlier (Table 11).

With the verbal/linguistic relationships as an input, the weight of the proposed strategies is calculated as an explicit value using Eq. (7) below (Nguyen & Truong, 2022; Wickramasinghe & Takano, 2009).

$$S_i = \sum_{j=1}^{n} G_j R_{ij} \tag{7}$$

In which (S_i) is the sum of the weights of the *i*th strategy, (G_j) is the global weight of the *j*th SWOT criterion, (R_{ij}) is the degree of relationship between the *i*th strategy and the *j*th SWOT criterion, (n) is the number of SWOT criteria.

Table 9 TOWS matrix for ethnic minority farm development strategy in the central highlands

SO strategies (SO_1)–combination of S_1, S_2, S_3, S_4, O_2, O_3, O_4: Forming a strategy to optimize production resources, defining a model farm (SO_2)–combination of S_4, S_5, S_6, S_7, O_1, O_2: Forming a market development strategy	ST strategies (ST_1)–combination of S_2, S_3, S_4, S_6, S_7, T_1, T_3: Forming an in-depth investment strategy (ST_2)–combination of S_1, S_2, S_4, S_5, T_1, T_2, T_3, T_4: Forming a strategy to build a technical information system
WO Strategies (WO_1)–combination of W_1, W_5, W_6, W_7, O_2, O_3, O_4: Forming human resource development strategy. The focus is on capacity building training for ethnic minority farm owners (WO_2)–combination of W_2, W_3, W_4, W_5, W_6, W_7, O_1, O_2, O_3, O_4: Form an alliance strategy between farms	WT Strategies (WT_1)–combination of W_1, W_2, W_5, T_1, T_4: Forming a planning strategy for a concentrated production area (WT_2)–combination of W_1, W_2, W_3, W_4, W_5, T_2, T_3: Forming a strategy of "four houses" linking the state–researchers–farmers–enterprises (WT_3)–combination of W_1, W_2, W_3, W_4, W_5, W_6, W_7, T_1, T_2, T_3, T_4: formulating strategies for formulating and promulgating specific policies for ethnic minority farms

Source Authors' elaboration

Table 10 Degree of relationship evaluation

Number	0	1	2	3	4	5
Level of relationship	None	Very weak	Weak	Moderate	Stong	Very strong

Source Nguyen and Truong (2022); Wickramasinghe and Takano (2009)

Table 11 Weights of relationship between strategy and SWOT factors

Levels of relationship	Very weak	Weak	Moderate	Strong	Very strong	Weights of relationship
Very weak	1	1/2	1/3	1/4	1/5	0.06
Weak	2	1	1/2	1/3	1/4	0.10
Moderate	3	2	1	1/2	1/3	0.16
Strong	4	3	2	1	1/2	0.26
Very strong	5	4	3	2	1	0.42

Source Authors'calculation

Subsequently, the normalized value of the strategy weights is calculated using Eq. (8), where (N_i) is the normalized weight of strategy i and (m) is the number of strategies.

$$N_i = \frac{S_i}{\sum_{i=1}^{m} S_i} \tag{8}$$

The proposed strategies with the different relationship weights of the SWOT factor are described in Table 12. Along with the orientation of farm economic development and long-term goals, the order of implementation of the economic development strategies for ethnic minority farms in the Central Highlands is divided into two phases. The preferred strategy could be established to select general or individual strategies.

The first phase focuses on ethnic minority farms. The first priority is to implement the WT_3 strategy—develop and issue-specific policies for ethnic minority farms, with

Table 12 Priority strategy evaluation matrix for ethnic minority farms in Central Highlands

SWOT criterias	Strategy with the degree of relationship								
	SO_1	SO_2	ST_1	ST_2	WO_1	WO_2	WT_1	WT_2	WT_3
S_1	4	2	0	5	2	2	0	3	0
S_2	5	0	2	4	0	2	3	2	4
S_3	5	1	5	5	3	2	2	3	4
S_4	3	5	3	4	0	0	0	0	0
S_5	4	0	0	3	0	0	0	0	0
S_6	1	4	5	0	0	0	2	0	0
S_7	0	5	0	0	0	0	1	0	0
W_1	3	0	3	3	5	0	4	5	4
W_2	2	0	2	3	0	3	3	4	5
W_3	1	4	0	0	0	5	0	5	3
W_4	0	3	0	0	0	5	0	4	5
W_5	0	4	0	0	5	4	4	3	4
W_6	0	1	0	0	3	2	0	0	3
W_7	3	0	1	1	4	3	0	0	4
O_1	0	5	0	0	0	4	0	0	0
O_2	5	4	2	4	4	5	3	4	4
O_3	4	2	3	2	4	5	2	3	3
O_4	3	1	2	0	5	5	3	4	5
T_1	3	2	5	5	0	3	4	0	4
T_2	0	0	4	3	0	2	0	4	5
T_3	2	0	0	4	0	0	0	5	5
T_4	2	0	5	4	0	0	5	0	3
Total weights (S_i)	0.1630	0.1391	0.1253	0.1474	0.1486	0.2216	0.1170	0.1764	0.2603
Normalized (N_i)	0.1094	0.0933	0.0840	0.0989	0.0997	0.1432	0.0785	0.1183	0.1746
Ranking	4	7	8	6	5	2	9	3	1

Source Authors' calculation

a weighting factor of 0.1746. Evidently, experts also agree that minimizing weaknesses is the most important factor. Furthermore, low level of education, lack of access to credit, as well as barriers in culture, language, and customs are basic characteristics of ethnic minority farms. Therefore, it is extremely important to add a separate policy group or integrate more details into the general policies—specific solutions directly related to ethnic minority farms. Thereafter, the preferred strategy must focus on alliances between farms ($WO_2 = 0.1432$); development of a "four houses" model ($WT_2 = 0.1183$), optimization of production resources ($SO_1 = 0.1094$), and development of human resources ($WO_1 = 0.0997$).

The next phase focuses on general agricultural policies such as building a technical information system ($ST_2 = 0.989$), market development ($SO_2 = 0.0933$), in-depth investment strategy ($ST_1 = 0.0840$), and concentrated production area planning ($WT_1 = 0.785$).

4 Conclusion

This chapter has successfully introduced a systematic approach and methods of SWOT-AHP-TOWS analysis to select the best strategies for developing ethnic minority farms in the Central Highlands. This is an unexplored area of research in the agricultural literature for vulnerable ethnic minority farmers. However, the decisions based on individual factors without considering the network of criteria are the limitation of the study. Certainly, further research is required to address this issue in order to improve and enhance reliability in the future.

Given the size of the normalized values (Step 4), the final order of strategies is considered as follows: $WT_3 \rightarrow WO_2 \rightarrow WT_2 \rightarrow SO_1 \rightarrow WO_1 \rightarrow ST_2 \rightarrow SO_2 \rightarrow ST_1 \rightarrow WT_1$. The first task is to develop and issue-specific policies for ethnic minority farms. Due to the low starting point and the change in the criteria for determining farms in the Circular of the Ministry of Agriculture and Rural Development No. 02/2020/TT-BNNPTNT dated February 28, 2020, the number of ethnic minority farms that were unable to obtain farm certificates increased sharply. Therefore, it is necessary to have criteria to define separate farms in the direction of reducing output value compared to the prescribed average level to better suit the characteristics of ethnic minority farms. At the same time, it is necessary to amend and concretize the conditions for ethnic minority farms to benefit more from the State's incentive policies, which are stipulated in the Resolution on farm economy No. 03/2000/NQ-CP dated February 2, 2000. Finally, the results of this study will help policymakers and minority farmers to plan appropriate policies to improve the situation in the Central Highlands and address their weaknesses. The methodological achievements of this chapter will also be useful in relation to Vietnam's ethnic minority regions.

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