Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6, 4067-4077
2024
Publisher: Learning Gate
DOI: 10.55214/25768484.v8i6.2897

SWOT-AHP integration for determining development strategy of Pangkep Pomelo Citrus Agro-industry

Andi Ridwan Makkulawu[1,3*], Soemarno[2], Imam Santoso[3], Siti Asmaul Mustaniroh[3]
[1]Department of Agricultural Technology, Pangkep State Polytechnic of Agriculture, Pangkep 90761, Indonesia; andiridwanm@polipangkep.ac.id (A.R.M.).
[2]Department of Soil Science, University of Brawijaya, Malang 65145, Indonesia; smno@ub.ac.id (S.).
[3]Department of Agroindustrial Technology, University of Brawijaya, Malang 65145, Indonesia.

Abstract: This research proposes a development strategy for the Pomelo Citrus agro-industry in the Pangkep Regency, utilising a combined SWOT and Analytical Hierarchy Process (AHP) approach. The purpose of this study is to identify key factors influencing the industry's competitiveness and growth potential, providing a strategic framework for stakeholders. The methodology involves SWOT analysis to evaluate internal and external factors, followed by AHP to prioritise these factors for strategic decision-making. Findings indicate that strengths and opportunities are the most influential factors, with abundant raw materials and strong government support as major growth drivers. In contrast, limitations in technological mastery and the threat of land-use changes present relevant but less significant challenges. The SWOT quadrant analysis places the Pangkep Pomelo agro-industry in Quadrant I (Growth), suggesting a strategy focused on expansion, capacity building, innovation, and market utilisation. The conclusion underscores that a growth-oriented strategy can enhance regional economic resilience by maximising the value of local commodities. Practical implications of this study include actionable insights for policymakers and business actors to leverage local strengths and address constraints, promoting sustainable development in the agro-industry sector.

Keywords: *AHP, Agro-industry, Development Strategy, Pomelo citrus, SWOT.*

1. Introduction

Pomelo citrus is one of Indonesia's native plants, and it has great prospects of being developed into various high-value-added processed products. This citrus not only has regional and national economic potential but can also contribute to improving people's nutrition [1]. Based on data from the Central Bureau of Statistics of South Sulawesi Province regarding large orange production at the district/city level in 2021, Pangkep Regency is the area with the highest production, which is 239,123 quintals. This production far exceeds other districts, making Pangkep the centre of large orange production in South Sulawesi. In comparison, the district with the second highest production of large oranges is Gowa Regency, with a total production of 65,841 quintals. In percentage terms, Pangkep district contributed around 61.63% of the total large orange production in the province in 2021 [2].

Pomelo Pangkep has become one of the region's leading commodities, known by the jargon 'BOLEDONG,' which stands for Bolu (milkfish), Lemo (Pomelo citrus), and Doang (shrimp) [3]. Pomelo cultivation is spread across various sub-districts in Pangkep Regency and has become an important source of livelihood for the local community. Pomelo citrus is popular in both domestic and international markets due to its large size, distinctive sweet taste, and high nutritional content, such as vitamin C, potassium, and fibre. Pomelo citrus also contains pectin which is useful in making processed products such as jams and cosmetics [1], [4], [5].

* Correspondence: andiridwanm@polipangkep.ac.id

In supporting the development of Pomelo citrus agro-industry in Pangkep Regency, a clear and measurable strategy is needed so that this product can become a flagship in the domestic and international markets, as well as contribute to the improvement of the local economy.

This research aims to formulate a strategy for Pomelo agro-industry development in Pangkep using SWOT analysis combined with the Analytical Hierarchy Process (AHP) method. This approach will provide strategic guidance for stakeholders to improve competitiveness, add value to products, and support local economic growth through the optimisation of regional superior commodities.

2. Related Literature

2.1. Pangkep Pomelo Citrus

Large oranges known as Pomelo Pangkep often referred to as Bali oranges are one of the fruits that are quite popular among the public. The fruit is known for its amazing health benefits, especially its pectin content which serves to lower cholesterol levels, thus reducing the risk of diseases such as cancer, stroke, and heart disease [6], [7]. In addition, the fruit is also rich in antioxidants and vitamins, which are beneficial for the health of the skin, gums, and digestive system [8].

The development of Pangkep pomelo varieties of red pomelo, white pomelo, and sugar pomelo is widely developed in three sub-districts namely Ma'rang, Labakkang and Mandalle sub-districts in Pangkep Regency [9].

2.2. Geographical and Administrative Areas of Pangkep Regency

Geographically, Pangkep Regency is located between 4˚40‘ to 8˚00’ South latitude and 110° to 119°48'67’ East longitude [10]. The regency is at the northwestern tip of South Sulawesi Province and serves as the main administrative centre for the region. Its strategic location near the main provincial highway makes Pangkep Regency one of the important regions in South Sulawesi. It is only about 50 kilometres from the capital of South Sulawesi Province, Makassar, which makes it easily accessible [11].

Administratively, Pangkep Regency covers an area of 1,112.29 km², having 133 islands. The area is divided into 13 sub-districts and 103 villages. The administrative and physical boundaries of Pangkep Regency are as follows: (1) The north borders Barru Regency, (2) The east borders Bone Regency and Maros Regency, (3) The south borders Maros Regency, and (4) The west borders the waters of the Makassar Strait [11].

2.3. SWOT Analysis

The SWOT method is one of the most widely used frameworks in the preparation of management strategies, both by academics and practitioners [12]. SWOT includes two types of analysis, namely an analysis of the external environment that aims to identify opportunities and threats, and an internal analysis of the organisation that examines the strengths and weaknesses of the company [12], [13]. In simple terms, SWOT analysis serves as a tool that helps the decision-making process by systematically analysing internal and external factors.

The main advantage of the SWOT method lies in its ability to link specific internal and external factors, which then results in a matrix of relevant strategies [14]. Internal factors are aspects that are within the control of the organisation, such as finance, operations, marketing, and human resources. In contrast, external factors include things that are beyond the control of the organisation, such as changes in the economy, political conditions, technological advances, and competition in the market [15], [16].

In SWOT Analysis, an organisation's strengths and weaknesses are identified through an assessment of its internal environment, while opportunities and threats are evaluated by examining external factors [17], [18]. SWOT is a strategic tool used to analyse the strengths, weaknesses, opportunities, and threats facing an organisation [19]. This analysis provides information that enables the organisation to adapt its objectives and capacities to the existing environmental conditions.

2.4. AHP

Analytic Hierarchy Process (AHP) is a decision-making model developed by Thomas L. Saaty. In group decision making the Analytic Hierarchy Process is a systematic representation of a problem

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 4067-4077, 2024
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involving multiple factors or criteria, with a multi-level arrangement consisting of main objectives at the first level, intermediate objectives at the next level, and alternatives at the bottom level. Thus, complex problems can be broken down into smaller, more manageable groups before being organised into a systematic hierarchy [20].

AHP is often chosen as a method to solve problems over other methods because of several advantages: (1) Its hierarchical structure allows in-depth analysis down to the sub-criteria level [21], (2) AHP can maintain the validity of results despite inconsistencies in the choice of criteria and alternatives set by decision-makers [22], and (3) AHP increases sensitivity in assessing the robustness of the results of decisions made [23].

AHP is particularly useful in research that focuses on the formulation of prioritisation strategies. The advantage of AHP is its ability to determine the priorities of various factors that have previously been broken down into smaller components [21]. Thus, decisions taken through AHP are based on information that has been systematically analysed and arranged in a clear hierarchical form.

Through the application of AHP, complex problems can be simplified by first identifying important criteria informally, and then considering other factors to determine the right priority or decision weight. One of the main elements in AHP is the use of a functional hierarchy that involves the role of humans in the decision-making process. This hierarchical structure allows large problems to be broken down into smaller parts so that they can be organised in a more structured and easily analysed manner.

2.5. SWOT-AHP

The combined SWOT-AHP method has been applied in various studies to support strategic decision-making in various sectors. Kurttila et al. [24] used this method in forest certification in Finland to quantitatively prioritise SWOT factors. Görener et al. [25] utilised it in a manufacturing company to weigh internal and external factors to strengthen strategic planning. Ghorbani et al. [26] adapted this method in rubber dam project management to overcome organisational weaknesses by exploiting opportunities. Lee et al. [27] applied it to analyse the public acceptance of hydrogen stations in South Korea, finding that strengths were the top priority. In addition, Anser et al. [28] and Zare et al. [29] used the SWOT-AHP method for renewable energy planning and integration in Turkey, emphasising solar energy potential and electricity supply chain management.

Based on several studies, the use of the SWOT-AHP method has proven effective in assisting strategic decision-making in various industries. The successful application of this method shows its potential to provide valuable strategic guidance for the development of the Pomelo citrus agro-industry in Pangkep Regency. This research aims to apply the SWOT-AHP method to the agricultural sector, particularly in the development of local superior commodities such as Pomelo citrus, which has not been widely explored in previous studies.

3. Methodology

3.1. Research Site and Data Collection

This research was conducted from February to July 2024, in Pangkep Regency, South Sulawesi Province, Indonesia. The selection of this location was based on the potential of the area as one of the main centres of Pomelo citrus production in Indonesia. The research was conducted in stages, starting with the preparation and data collection stages from February to May, then continued with the analysis and presentation of research results from June to July 2024. Research data collection was carried out in several locations including the Pangkep Regency Agriculture Office, Pangkep Pomelo Citrus Farmers, and SMEs managing pomelo citrus processed products.

3.2. Hierarchical Structure and Phases of the Methodology

In this research, the AHP structure was generated from the SWOT matrix and separated into three parts: (a) the objectives to be achieved by the decision, (b) the SWOT groups, and (c) the factors included in each SWOT group (sub-criteria). A hierarchical representation of the SWOT structure is shown in Figure 1.

Edelweiss Applied Science and Technology
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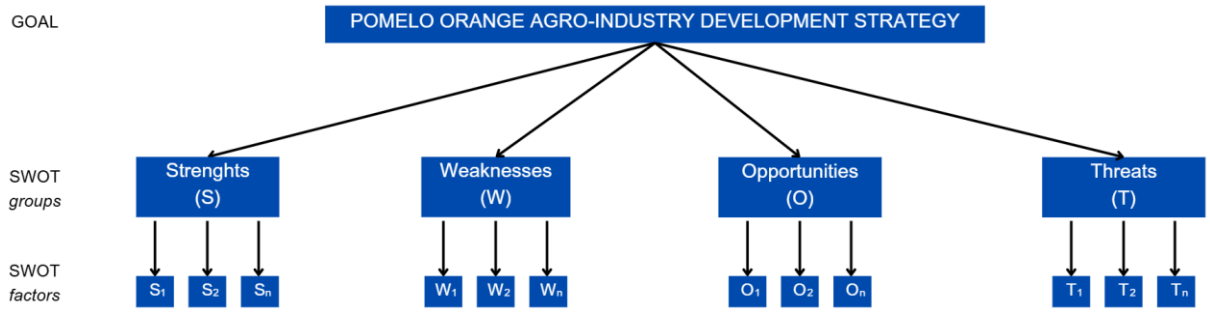

Figure 1.
Hierarchical structure of the SWOT matrix.

In this research, SWOT analysis enhanced with AHP was conducted to obtain strategic factors for the pomelo pangkep citrus agro-industry in Pangkep Regency, South Sulawesi Province, Indonesia. A comparison scale to conduct pairwise comparisons and determine the level of importance among each SWOT factor, thereby obtaining a SWOT analysis matrix.

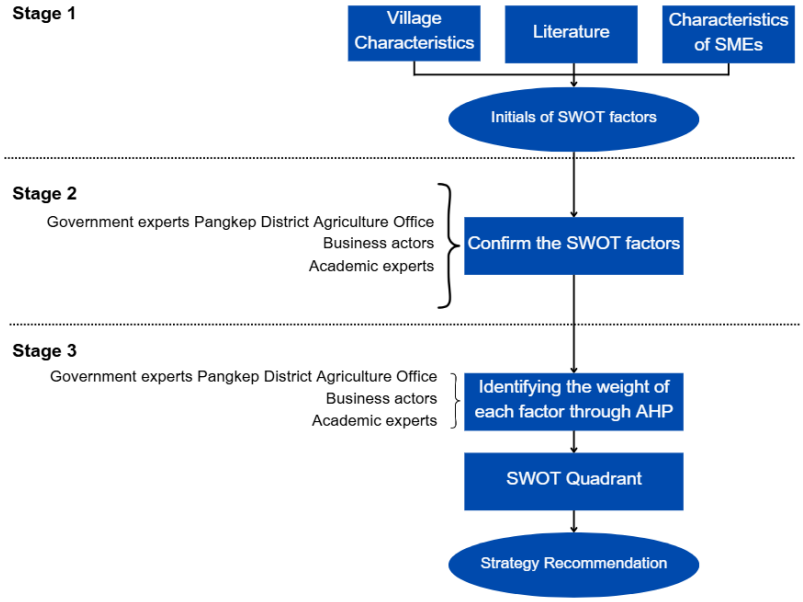

Figure 2.
Stages in obtaining strategy recommendations.

Figure 2 shows the stages in obtaining strategy recommendations, explained in stage 1 initialising SWOT factors based on data obtained from village characteristics, literature, and SME characteristics. Stage 2 confirmation from experts on the factors that have been initialised. Stage 3 identifying the weight of each factor through AHP based on the assessment of experts, then the SWOT Quadrant is made, so that the final result is obtained for development strategy recommendations.

4. Results

Relevant factors and the internal and external environment were defined and confirmed by a team of experts consisting of the Government agricultural department, business people, and academics, resulting in a SWOT matrix. Table 1 shows the results of the SWOT matrix.

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Table 1.
SWOT matrix.

Strengths (S)	**Weaknesses (W)**
(S1) Abundant availability of raw materials	(W1) The scale of MSME businesses conducted is relatively low
(S2) Sufficient local labour available	(W2) Relatively low level of education
(S3) Pomelo citrus is the mainstay commodity of the community	(W3) Facilities and infrastructure are inadequate
(S4) Market availability of pomelo citrus processed products	(W4) Mastery of technology is still low
(S5) Appropriate processing technology already exists	(W5) There is no expert, pomelo citrus processed production process personnel
	(W6) Limited capital
Opportunities (O)	Threats (T)
(O1) Availability of appropriate processing technology	(T1) Uncertainty of raw material prices at the farm level
(O2) The demand for pomelo citrus processed products is increasing	(T2) The government has not been consistent in implementing policies
(O3) Limitations of the pomelo citrus processing industry	(T3) Pests on pomelo citrus plants
(O4) Support from local government	(T4) Lack of strong business partnerships
(O5) Community economic growth	(T5) Lack of coordination between related agencies
	(T6) Land conversion of pomelo citrus plantations

4.1. SWOT-AHP

Next, AHP is applied to the SWOT matrix. Pairwise comparisons of the SWOT groups are performed using a rating scale consisting of a 9 to 1 scale for positive judgements, and 1 to 1/9 for negative judgements. In this scale, a value of 9 is given if an element is considered much more important than the other element, while a value of 1/9 is used if an element is much less important than the other element. A value of 1 indicates that both elements are considered to be of equal importance. The results of this comparison are shown in Table 2, where each element in the SWOT matrix is compared to each other, considering each SWOT group. All pairwise comparisons in this study were conducted by a team of experts to ensure consistency and accuracy of the results obtained.

Table 2.
Pairwise comparison of SWOT factors.

SWOT groups	**S**	**W**	**O**	**T**	**Level of importance of SWOT groups**
S	1.000	1.833	1.447	1.856	0.345
W	0.545	1.000	0.337	1.494	0.177
O	0.691	2.966	1.000	1.444	0.311
T	0.539	0.669	0.692	1.000	0.167

Table 2 shows that the two most important factors in this SWOT analysis are Strengths (S) and Opportunities (O), with weights of 0.345 and 0.311 respectively, while Weaknesses (W) and Threats (T) are considered less important in decision-making, with weights of 0.177 and 0.167 respectively.

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Table 3.
Comparison matrix.

Strengths group	**S1**	**S2**	**S3**	**S4**	**S5**		**Level of importance**
S1	1.000	3.400	5.400	7.400	8.800		0.530
S2	0.294	1.000	2.400	3.400	5.400		0.212
S3	0.185	0.417	1.000	2.833	6.400		0.148
S4	0.135	0.294	0.353	1.000	3.400		0.075
S5	0.114	0.185	0.154	0.294	1.000		0.035
CR = 0.09							
Weaknesses group	W1	W2	W3	W4	W5	W6	
W1	1.000	0.567	0.164	0.164	1.400	0.230	0.049
W2	6.105	1.000	0.283	0.237	3.400	0.433	0.089
W3	6.105	3.529	1.000	0.237	6.200	1.400	0.231
W4	0.714	4.225	4.225	1.000	8.000	1.400	0.386
W5	4.348	0.294	0.161	0.125	1.000	0.157	0.035
W6	1.765	2.308	0.714	0.714	6.364	1.000	0.211
CR = 0.06							
Opportunities group	O1	O2	O3	O4	O5		
O1	1.000	3.040	2.100	0.924	4.225		0.309
O2	0.329	1.000	0.467	0.300	3.273		0.126
O3	0.476	2.143	1.000	0.250	1.300		0.136
O4	1.082	3.333	4.000	1.000	2.700		0.347
O5	0.237	0.305	0.769	0.370	1.000		0.082
CR = 0.08							
Threats group	T1	T2	T3	T4	T5	T6	
T1	1.000	1.400	3.400	3.600	8.000	0.517	0.236
T2	0.714	1.000	2.200	3.200	6.200	0.273	0.167
T3	0.294	0.455	1.000	3.200	3.200	0.162	0.096
T4	0.278	0.313	0.313	1.000	1.400	0.149	0.051
T5	0.125	0.161	0.313	0.714	1.000	0.155	0.037
T6	1.935	3.659	6.167	6.706	6.432	1.000	0.414
CR = 0.05							

Table 3 shows that factor S1 (Abundant availability of raw materials) is the most important strength, while S5 (Appropriate processing technology already exists) is considered the least significant. On the weakness side, W4 (Low mastery of technology) is a major weakness that must be corrected immediately, while W5 (No experts) is a relatively minor weakness. On the opportunity side, O4 (Support from the local government) is considered the biggest opportunity, while O5 (Growth of the community economy) is the weakest opportunity. As for threats, T6 (Land conversion of pomelo citrus plantations) is the most significant threat, while T5 (Lack of coordination between agencies) is considered the least threat. Finally, the overall priority scores of the SWOT factors are calculated. Overall priorities are shown in Table 4.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 4067-4077, 2024
DOI: 10.55214/25768484.v8i6.2897

Table 4.
Overall priority scores of SWOT factors.

Swot factors	Group priority	Factor priority within the group	Overall priority of factor
S1	0.345	0.530	0.183
S2	0.345	0.212	0.073
S3	0.345	0.148	0.051
S4	0.345	0.075	0.026
S5	0.345	0.035	0.012
W1	0.177	0.049	0.009
W2	0.177	0.089	0.016
W3	0.177	0.231	0.041
W4	0.177	0.386	0.068
W5	0.177	0.035	0.006
W6	0.177	0.211	0.037
O1	0.311	0.309	0.096
O2	0.311	0.126	0.039
O3	0.311	0.136	0.042
04	0.311	0.347	0.108
05	0.311	0.082	0.026
T1	0.167	0.236	0.039
T2	0.167	0.167	0.028
T3	0.167	0.096	0.016
T4	0.167	0.051	0.009
T5	0.167	0.037	0.006
T6	0.167	0.414	0.006

Table 4 above shows the Overall Priority Scores of the SWOT factors. Each factor is analysed based on the Group Priority (priority of the SWOT group: Strengths, Weaknesses, Opportunities, Threats) and Factor Priority within the Group, which then results in the Overall Priority of Factor.

The analysis showed that S1 (Abundant availability of raw materials) had the highest overall priority of 0.183, making it the most important strength, while S5 (Appropriate processing technology already exists) with a priority of 0.012 was the least significant. On the weakness side, W4 (Mastery of technology is still low) is the most significant with an overall priority of 0.068, while W5 (No experts) has the least impact with a value of 0.006. On the opportunity side, O4 (Support from the local government) is the biggest opportunity with an overall priority of 0.108, while O5 (Community economic growth) has the lowest priority of 0.026. The biggest threat is T6 (Land conversion of pomelo citrus plantations) with an overall priority of 0.006, followed by T5 (Lack of coordination between related agencies) with the same value.

4.2. SWOT Quadrant

Based on the results of calculations that have been carried out through SWOT analysis, the final value of internal factors, namely strengths and weaknesses, as well as external factors, namely opportunities and threats, is obtained as shown in Table 5 with the following results:

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Table 5.
Recapitulation of total factor priority calculation.

No.	SWOT group	Total factor priority
1	Strengths	0.345
2	Weaknesses	0.177
3	Opportunities	0.311
4	Threats	0.104

Table 5 summarises the overall priority sum of the factors in each SWOT group (Strengths, Weaknesses, Opportunities, and Threats). This overall priority sum indicates how much each SWOT group contributes to the decision or analysis being conducted. It shows that Strengths and Opportunities are the two main factors that dominate and need to be focused on for development strategies. Weaknesses and Threats, have a lower priority and need to be addressed but are not a major concern compared to strengths and opportunities.

SWOT quadrant mapping is used to analyse the strengths, weaknesses, opportunities and threats of an organisation or entity. The coordinates (X, Y) indicate the strategic position based on the difference between internal factors (Strengths and Weaknesses) and external factors (Opportunities and Threats). The X-axis (Strengths - Weaknesses) shows the difference between strengths and weaknesses. A positive value on this axis means that strengths are more dominant than weaknesses. The Y-axis (Opportunities - Threats) shows the difference between opportunities and threats. A positive value on this axis indicates that opportunities are greater than threats.

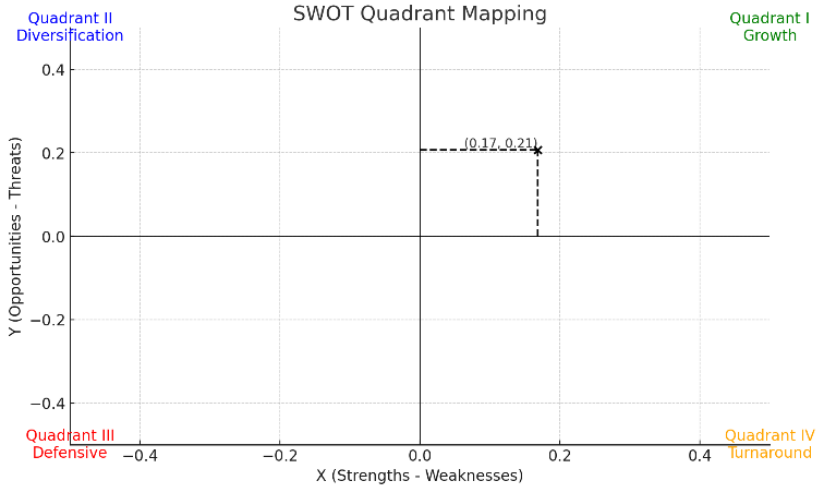

Figure 3.
SWOT quadrant mapping.

Figure 3 shows the X-Axis (Strengths - Weaknesses) X=. 0.168, YAxis (Opportunities - Threats) Y= 0.207. This coordinate point shows a position in the positive quadrant on both the X and Y axes, which means that strength factors are more dominant than weaknesses and opportunities are greater than threats.

The point is in Quadrant I (Growth), which is the most favourable quadrant in SWOT analysis. This signifies that the organisation or entity has sufficient strengths to take advantage of existing opportunities. The recommended strategy in this quadrant is a growth strategy that focuses on expansion, capacity building, innovation, and maximising profits from favourable market conditions.

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5. Discussion

The results of this study indicate that strengths and opportunities are the two main factors in the development of the Pomelo citrus agro-industry in Pangkep, which is in line with the research of Ghorbani et al. [26] who also stressed the importance of leveraging organisational strengths to take advantage of opportunities in the dam project development sector. This finding is also consistent with the research of Lee et al. [27], which found that the factors of strength and government support are prioritised in the development of hydrogen station infrastructure in South Korea. The strong government support in this study, as reflected by factor O4 (Local Government Support), is also consistent with the research of Anser et al. [28], where the government plays an important role in the development of renewable energy projects in Turkey. Thus, the results of this study support the findings of previous studies that emphasise the importance of government support and resource management for industrial sector growth.

However, in contrast to the findings of Kurttila et al. [24] who stated that external threats are factors that must be addressed in the context of forest certification, this study shows that threats such as land conversion (T6), although significant, have a lower priority weight than strengths and opportunities. This suggests that, although threats remain relevant, they are not a major obstacle to the growth of the Pomelo citrus agro-industry in Pangkep. Weakness factors, such as low technological mastery (W4), also received more attention in this study compared to the findings of Görener et al. [25] in the manufacturing sector, where technology was not prioritised as a key issue.

6. Conclusions

Based on the results of the SWOT analysis combined with the AHP method, the findings show that the strength and opportunity factors are the two most dominant elements and should be the main focus in the development of the Pomelo citrus agro-industry in Pangkep. The primary strength lies in the abundant availability of raw materials, while support from the local government represents the greatest opportunity to support the industry's growth. On the other hand, weaknesses such as limited technological mastery and the threat of land conversion of Pomelo citrus plantations need to be considered. The SWOT quadrant mapping places the Pomelo citrus agro-industry in Quadrant I (Growth), which is the most favourable position. This indicates that a growth strategy focusing on expansion, capacity building, innovation, and the utilisation of local superior commodities such as Pomelo citrus is highly recommended to enhance competitiveness and support local economic growth.

Future research could focus on industry adaptation to shifting market dynamics and evolving government policies. Additionally, studies on strengthening strategic partnerships and collaborations between small and medium enterprises, the government, and the private sector could help to mitigate existing threats and accelerate sustainable growth.

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ISSN: 2576-8484
Vol. 8, No. 6: 4067-4077, 2024
DOI: 10.55214/25768484.v8i6.2897

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