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Strengthening Agricultural Cultivation Technology to Increase Food Security for Farmer Households in Food-Vulnerable Areas

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***Abstract*: This research aims to identify the strategic internal and external factors influencing household food security in food-insecure areas and to select appropriate strategies to enhance household food security in these regions on Lombok Island. A qualitative method with a descriptive approach was employed. The research locations were purposively selected in four food-insecure sub-districts: Sekotong. Praya Barat Daya. Sambelia. and Bayan. Respondents consisted of 45 food-farming households. along with key informants from relevant government agencies and institutions. Data collection techniques included interviews. observation. and documentation. while data analysis was conducted using the IFE Matrix. EFE Matrix. SWOT Analysis. and the QSPM Matrix. The findings indicate that internal factors of household food security include five strengths and five weaknesses. while external factors comprise seven opportunities and four threats. The recommended priority strategy is to optimize access to agricultural technology through agricultural training programs and technology development. which received the highest Total Attractive Score (TAS) of 7.866.**

***Keywords*: Food Security. Technology. Lombok Island. SWOT Strategy. QSPM Priorities.**

I. INTRODUCTION

Food security is a strategic issue in national development, encompassing not only the availability of food at the national level but also its accessibility and stability at the household level [28]. [21] Emphasize that food safety is also an essential component of food security strategies. Farming households in food-insecure areas are among the most vulnerable groups to food insecurity [18]. This condition is generally characterized by low production, reliance on a single commodity, and limited access to technology and markets [5]. Therefore, increasing production alone is not sufficient; a comprehensive approach is needed to address issues of food distribution and access [23]. A study in Sekotong Barat Village revealed that 43.33% of farming households are classified as food-insecure, indicating serious vulnerability within the local food system [13]. One of the causes of low food security is the suboptimal use of agricultural cultivation technology. In fact, technologies such as superior seeds, water-efficient irrigation, balanced fertilization, and environmentally friendly farming techniques have been proven to enhance the efficiency and sustainability of agricultural enterprises [7];[17]. Barriers such as low farmer literacy, limited capital, and weak institutions further exacerbate the situation [19]. As a result, the actual production potential that could be increased has not been fully utilized. Strengthening agricultural cultivation technology is therefore one of the key strategies to address these challenges. Various studies have shown that innovative approaches such as sequential planting systems and product diversification can enhance household food security among farmers. [22] Demonstrated that integrating *Physalis* and *Brassica rapa* (caisim) into a sequential cropping system significantly improved farmers' knowledge, reduced production risks, and generated new sources of income. In addition, the utilization of digital technology and local strategies based on SWOT analysis have proven effective in formulating food security strategies across different contexts [1];[9].

Based on the description above. a study was conducted on strengthening food security. under the title: "Strengthening Agricultural Cultivation Technology to Increase Food Security for Farmer Households in Food-Vulnerable Areas." The objectives of this research are to identify the internal and external strategic factors influencing household food security in food-insecure areas and to determine applicable strategies to improve household food security in such regions on Lombok Island.

II. RESEARCH METHOD

This study employed a qualitative descriptive method. The research locations were selected using purposive sampling. specifically by choosing four sub-districts categorized as food-insecure areas based on the 2023 Food Security and Vulnerability Atlas (FSVA) analysis. These sub-districts are Sekotong (West Lombok Regency). Praya Barat Daya (Central Lombok Regency). Sambelia (East Lombok Regency). and Bayan (North Lombok Regency). The respondents in this study were food-farming households residing in those areas. along with key informants consisting of representatives from the Agriculture Office. Food Security Office. Faculty of Agriculture lecturers. field agricultural extension workers. and farmer group leaders. The number of sample units or respondent households was determined using Slovin's formula with a margin of error of 15% [12]. Based on the calculation. a total sample of 45 food-farming households was obtained. The distribution of samples was determined using proportional sampling. while household respondents were selected using accidental sampling in each sub-district. The data in this study consisted of both primary and secondary data [25]. Data collection techniques include interviews with farmers. direct observations at the research site. and documentation of interview results with key informants at each research location[26].

Data analysis in this study was carried out through three strategic stages as developed by [4] : the Input Stage. the Matching Stage. and the Decision Stage.

1. In the Input Stage. internal factors (strengths and weaknesses) and external factors (opportunities and threats) affecting household food security in food-insecure areas were identified. These factors were analyzed using the IFE (Internal Factor Evaluation) Matrix and EFE (External Factor Evaluation) Matrix [15]. Each factor was assigned a weight ranging from 0.0 to 1.0 based on its level of importance and rated from 1 to 5 to reflect its degree of influence or response to household conditions. The weight and rating were then multiplied to obtain weighted scores. which were summed to produce the total IFE and EFE scores. to be used in the next stage of analysis.
2. In the Matching Stage. a SWOT Matrix was used to combine internal and external analysis results to generate four types of alternative strategies: S-O (Strengths-Opportunities). W-O (Weaknesses-Opportunities). S-T (Strengths-Threats). and W-T (Weaknesses-Threats) strategies [6]; [3]. Additionally. the IE (Internal-External) Matrix was used to map strategic positioning based on the total IFE and EFE scores. thereby indicating the most suitable strategic quadrant (growth. stability. or defensive) [10].
3. In the Decision Stage. the QSPM (Quantitative Strategic Planning Matrix) was employed to select the most feasible priority strategy for implementation. This process involved assigning an Attractiveness Score (AS) to each alternative strategy. reflecting how appealing the strategy is in responding to SWOT factors. The weight and AS were then multiplied to obtain the Total Attractiveness Score (TAS). and the strategy with the highest TAS was chosen as the primary strategy deemed most effective for strengthening household food security in food-insecure areas on Lombok Island [24] ; [4].

III. RESULTS AND DISCUSSION

1. Analysis of Internal and External Factors

a. Internal Factors of Food Security

The internal factors influencing household food security on Lombok Island encompass various household-level aspects that affect their ability to meet food needs independently and sustainably. These internal factors include the availability of resources such as family labor. farming experience. knowledge of cultivation practices. as well as consumption patterns and the management of agricultural yields. This analysis is crucial for understanding the strengths and weaknesses of farming households in maintaining food security amid climatic challenges and limited production resources.

Table 1. Internal Factors Affecting Food Security of Farming Households

Strengths:	**Weaknesses:**
1. Adequate food availability	1. Lack of food diversification
2. Sufficient access to agricultural technology	2. Limited income diversification
3. Extensive farming experience	3. Poor understanding of nutrition
4. Knowledge of good cultivation practices	4. Dependence on external assistance
5. Availability of family labor	5. Limited ability to access data and information

b. External Factors of Food Security

The external factors affecting household food security on Lombok Island include elements beyond the household's control that influence their ability to meet food needs. The identification of internal factors includes the availability of resources such as family labor. farming experience. knowledge of cultivation. as well as consumption patterns and management of agricultural produce. Analyzing these external factors is crucial for identifying opportunities that can be leveraged and threats that need to be anticipated in efforts to strengthen food security in food-insecure areas.

Table 2. External Factors Affecting Food Security of Farming Households

Opportunities:	**Threats:**
1. Availability of agricultural training programs	1. Unpredictable climate change
2. Abundant natural resources	2. Land-use conversion
3. Availability of infrastructure and transportation	3. Fluctuations in staple food prices
4. Collaboration between government. private sector. and communities	4. Price disparity between local and imported food
5. Implementation of stunting reduction programs	-
6. Potential for agricultural technology development	-
7. Support from farmer groups	-

c. IFE Matrix Analysis

The Internal Factor Evaluation (IFE) Matrix is an analytical tool used to assess the strengths and weaknesses of farming households in maintaining food security in food-insecure areas. This matrix identifies various influential internal factors. each of which is assigned a weight and a rating to determine its level of importance and influence on the household's food security status. The results of this assessment serve as the foundation for formulating appropriate strategies. The IFE Matrix used in this study is presented in Table 8.

Table 3. IFE Matrix of Farming Household Food Security

INTERNAL STRATEGIC FACTORS	**WEIGHT**	**RATING**	**SCORE**
Strengths :			
1. Adequate food availability	0.099	3.04	0.30
2. Sufficient access to agricultural technology	0.100	2.96	0.29
3. Extensive farming experience	0.101	3.13	0.32
4. Knowledge of good cultivation practices	0.103	3.36	0.34
5. Availability of family labor	0.103	2.89	0.30
TOTAL	**0.51**	**15.38**	**1.55**
Weaknesses:			
1. Lack of food diversification	0.097	2.69	0.26
2. Limited income diversification	0.100	3.04	0.30
3. Poor understanding of nutrition	0.101	2.80	0.28
4. Dependence on external assistance	0.101	3.00	0.30
5. Limited ability to access data and information	0.096	2.89	0.28
TOTAL	**0.49**	**14.42**	**1.43**
TOTAL INTERNAL FACTORS	1.00		

Source: Primary data processed (2025)

The analysis of internal strategic factors influencing household food security on Lombok Island indicates that the primary strengths lie in knowledge of good cultivation practices. sufficient farming experience. availability of family labor. and adequate access to agricultural technology. In addition. the availability of sufficient food at the household level is a fundamental strength in maintaining food security. Knowledge of proper farming techniques is also a key asset for supporting sustainable agricultural production. The total strength score of 1.55 demonstrates that these aspects make a significant contribution to strengthening household food security. On the other hand. the weaknesses faced by farming

households include a lack of food and income diversification. limited understanding of nutrition. and dependency on government assistance. Furthermore. the limited ability to access data and information presents a barrier to making informed decisions. The total weakness score of 1.43 indicates that although these weaknesses are relatively balanced with the strengths. targeted interventions are necessary to prevent them from undermining household food self-sufficiency. Overall. the total internal factor score of 2.98 suggests that the internal condition of farming households in Lombok is relatively strong in supporting food security. Therefore. existing strengths need to be maintained and enhanced through agricultural training and extension programs. while weaknesses should be addressed through strategies such as household capacity building. development of productive enterprises. and improved access to information and support services [16] ; [20].

d. EFE Matrix Analysis

The External Factor Evaluation (EFE) Matrix is an analytical tool used to assess the extent to which external opportunities and threats influence household food security in food-insecure areas. This matrix organizes relevant external factors. each of which is assigned a weight and a rating to measure its importance and impact on the condition of farming households. This assessment helps to identify external environmental aspects that can be either leveraged or anticipated in the strategy formulation process. The EFE Matrix used in this study is presented in Table 9.

Table 4. EFE Matrix of Farming Household Food Security

EKSTERNAL STRATEGIC FACTORS	WEIGHT	RATING	SCORE
Opportunities:			
1. Availability of agricultural training programs	0.092	3.07	0.28
2. Abundant natural resources	0.090	3.20	0.29
3. Availability of infrastructure and transportation	0.092	3.04	0.28
4. Collaboration between government. private sector. and communities	0.088	2.80	0.25
5. Implementation of stunting reduction programs	0.093	3.00	0.28
6. Potential for agricultural technology development	0.089	2.91	0.26
7. Support from farmer groups	0.091	3.31	0.30
TOTAL	0.63	21.33	1.93
Threats:			
1. Unpredictable climate change	0.091	3.29	0.30
2. Land-use conversion	0.093	2.84	0.26
3. Fluctuations in staple food prices	0.091	3.09	0.28
4. Price disparity between local and imported food	0.092	2.73	0.25
TOTAL	0.37	11.96	1.09
TOTAL EKSTERNAL FACTORS	1.00		

Source: Primary data processed (2025)

The analysis of external strategic factors affecting household food security in Lombok Island reveals several opportunities. including the availability of agricultural training programs; the presence of natural resources that support agricultural activities; adequate infrastructure and transportation for food distribution; collaboration among government. private sector. and communities; stunting reduction programs; the potential for agricultural technology development; and support from farmer groups to enhance agricultural productivity. These factors provide an opportunity for farming households to strengthen food security through capacity building. market access. and agricultural innovation.The total opportunity score of 1.93 indicates that external conditions significantly contribute to supporting food security. However. farming households also face various threats such as unpredictable climate change. the conversion of agricultural land to non-agricultural uses. fluctuations in staple food prices. and disparities between local and imported food prices. These threats have the potential to disrupt the stability of household food production and consumption. The total threat score of 1.09 suggests that. although these factors are not yet dominant. they must still be strategically anticipated to prevent negative impacts on food security. Overall. the total external factor score of 3.03 indicates that farming households in Lombok Island are in a relatively strong position to respond to existing opportunities while also possessing the capacity to manage and mitigate external threats.

2. Internal–External (IE) Matrix Analysis

The Internal–External (IE) Matrix is a strategic analysis tool used to evaluate internal and external factors influencing the strengthening of household food security in food-insecure areas of Lombok Island [27]. This matrix determines the position of food security strategies based on the total score of internal factors obtained through the Internal Factor Evaluation (IFE) analysis. which is plotted on the X-axis. and the total score of external factors obtained through the External Factor Evaluation (EFE) analysis. which is plotted on the Y-axis.

a. SWOT Diagram

The internal analysis coordinate is obtained by subtracting the total score of weaknesses from the total score of strengths. i.e.. 1.55 – 1.43 = 0.12. Next. the external analysis coordinate is calculated by subtracting the total score of threats from the total score of opportunities. i.e.. 1.93 – 1.09 = 0.84. The result of this calculation indicates that the SWOT coordinate point lies at (0.12; 0.84). This position reflects the condition of household food security among farmers in Lombok Island within the SWOT matrix. which can be used as the basis for formulating appropriate development strategies. as illustrated in Figure 1.

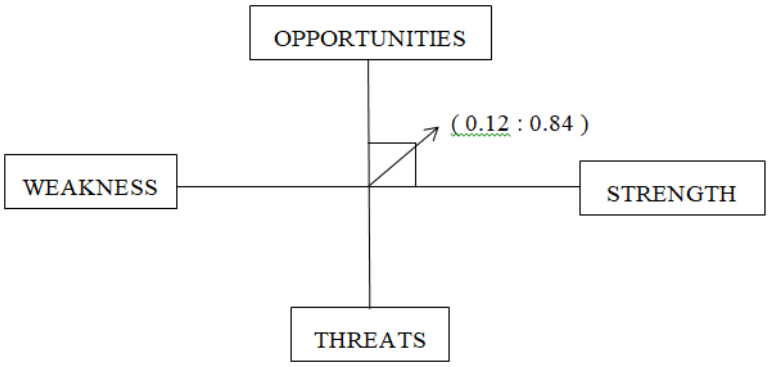

Figure 1. SWOT Analysis of Household Food Security among Farmers

Based on the diagram above. food security in Lombok Island is positioned in Quadrant I of the SWOT matrix. indicating a favorable position (Strength–Opportunity). This suggests that strengths (S) and opportunities (O) are more dominant than weaknesses (W) and threats (T). making a growth-oriented strategy the most appropriate. In this strategy. internal strengths are optimally mobilized to capture external opportunities in order to strengthen food security. particularly in vulnerable areas. The S–O strategies generated in this study focus on leveraging local resources. such as fertile agricultural land. sufficient labor. and local wisdom in food management. These strengths should be directed toward seizing opportunities such as increased attention to food security. the development of digital technology. and government support for sustainable agriculture programs.

One of the main strategies that can be implemented is the utilization of digital technology to strengthen local capabilities. expand market access. improve food distribution chains. and increase production efficiency. This is in line with the findings of [1]. who emphasized that the use of digital platforms such as mobile apps. e-commerce. and digital wallets has proven effective in stabilizing prices and strengthening producer–consumer collaboration during crisis conditions like the COVID-19 pandemic. This strategy is also supported by [9]. whose study on watershed management in Iran showed that a combination of local strengths and external opportunities can be directed toward growth strategies when stakeholder participation and data-driven decision-making are involved. In addition. artificial intelligence (AI) technology can support food security through improved production efficiency. [2] found that the use of machine learning algorithms for pest detection significantly reduces pesticide usage and prevents environmental damage. Thus. the S–O strategy in the context of Lombok Island not only leverages existing resources but also promotes digital transformation in local food systems. This approach must be supported by digital literacy training for farmers. the development of local market applications. and cross-sector collaboration to ensure the sustainability of food systems in vulnerable areas.

b. SWOT Matrix Analysis

The SWOT analysis was employed in this study to evaluate strategies for strengthening household food security in food-insecure areas of Lombok Island by identifying strengths. weaknesses. opportunities. and threats. This method was chosen because it provides a comprehensive overview of internal conditions (such as household capacity. local resources. and food

accessibility) as well as external conditions (including institutional support. government policies. market dynamics. and environmental threats). The SWOT approach is considered highly flexible and applicable to local contexts. as it integrates both qualitative and participatory data. As explained by [1]. SWOT analysis can serve as an important tool in formulating adaptive food security strategies. particularly when used to describe the resilience of food systems in times of crisis. such as during the pandemic and global supply chain disruptions. Furthermore. the SWOT method has been effectively applied in the context of natural resource management in vulnerable areas. as demonstrated in a study by [9]. They emphasized the importance of involving local stakeholders in developing the SWOT matrix to ensure that the strategies formulated are contextual and participatory in nature.

Table 5. SWOT Matrix of Household Food Security of Farmers

IFAS / EFAS	**Strength = S**	**Weakness = W**
	1. Adequate food availability 2. Sufficient access to agricultural technology 3. Extensive farming experience 4. Knowledge of good cultivation practices 5. Availability of family labor	1. Lack of food diversification 2. Limited income diversification 3. Poor understanding of nutrition 4. Dependence on external assistance 5. Limited ability to access data and information
Opportunities = O 1. Availability of agricultural training programs 2. Abundant natural resources 3. Availability of infrastructure and transportation 4. Collaboration between government. private sector. and communities 5. Implementation of stunting reduction programs 6. Potential for agricultural technology development 7. Support from farmer groups	**S-O Strategies** 1. Utilize sufficient food availability to support the stunting reduction program and enhance community food security (S1. O2. O5) 2. Optimize access to agricultural technology through agricultural training programs and the development of agricultural technology (S2. O1. O6) 3. Improve food distribution by utilizing available infrastructure and transportation (S3. O3) 4. Encourage the involvement of all relevant parties for market expansion and access to capital (S5. O4. O7)	**W-O Strategies** 1. Increase food diversification through education and integrated agricultural programs (W1. W2. O2. O5) 2. Encourage the utilization of government and private assistance to improve access to infrastructure and transportation (W4. W5. O3. O4) 3. Enhance understanding of nutrition through educational programs and stunting reduction efforts (W3. O1. O5)
Threats = T 1. Unpredictable climate change 2. Land-use conversion 3. Fluctuations in staple food prices 4. Price disparity between local and imported food.	**S–T Strategies** 1. Develop climate-resilient agricultural systems (S2. S4. T1) 2. Improve production and marketing efficiency to compete with imported food products (S1. S3. T4) 3. Utilize family labor to minimize the impact of price fluctuations (S5. T3)	**W–T Strategies** 1. Improve access to modern irrigation to reduce the impact of climate change on agricultural productivity (W5. T1) 2. Address difficulties in accessing aid and irrigation through the strengthening of community-based agricultural systems (W4. W5. T2. T3) 3. Enhance local-based food security (W1. W3. T4)

Source: Primary data processed (2025)

3. QSPM Matrix Analysis

The QSPM (Quantitative Strategic Planning Matrix) is used in this study to evaluate and determine the priority strategies for strengthening household food security in food-insecure areas of Lombok Island objectively. based on the SWOT factors that have been previously analyzed [8]. The four main strategies derived from the SWOT analysis. particularly the S-O strategies. are analyzed using the QSPM matrix with the calculation of the Total Attractiveness Score (TAS) based on the weight and attractiveness score of each strategic factor [11]. The strategy with the highest TAS value is designated as the priority strategy recommended for implementation in efforts to improve food security in a sustainable and targeted manner in the research area.

Table 6. Ranking of Alternative Strategies

No.	Alternatif Strategi	TAS Value	Ranking
1.	Utilize the adequate food supply to support the stunting alleviation program and enhance community food security.	7.514	3
2.	Optimize access to agricultural technology through agricultural training programs and the development of agricultural technology.	7.866	1
3.	Improve food distribution by utilizing available infrastructure and transportation.	7.497	4
4.	Encourage the involvement of all relevant parties to expand markets and access to capital.	7.692	2

Source: Primary data processed (2025)

Based on the ranking results. it can be seen that the alternative strategy with the highest attractiveness score is optimizing access to agricultural technology through agricultural training programs and the development of agricultural technology. with a Total Attractive Score (TAS) of 7.866. This strategy becomes the top priority in efforts to improve household food security among farmers. It is the preferred choice because increasing access to agricultural technology has been proven to enhance productivity and farming efficiency. thereby helping farmers address food production challenges. This is supported by research from [14]. which states that the use of digital technology in agriculture can improve production efficiency and accelerate the distribution of harvests. According to [17]. agricultural training has a positive impact on the adoption of technology and farmers' welfare. which ultimately contributes to the improvement of household food security.

The second-highest attractiveness score is found in the strategy of encouraging the involvement of all relevant parties to expand markets and access to capital. with a TAS of 7.692. The third-ranking strategy is utilizing the adequate food supply to support the stunting alleviation program and enhance community food security. with a TAS of 7.514. Meanwhile. the strategy with the lowest attractiveness score is improving food distribution by utilizing available infrastructure and transportation. with a TAS of 7.497.

IV. CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the results of the research and discussion. it can be concluded that:

1. Internal and External Factors in Household Food Security among Farmers:
    a. Internal factors in strengthening household food security on Lombok Island are as follows: (a) Strength factors consist of: adequate food availability; access to sufficient agricultural technology; sufficient farming experience; knowledge of good farming practices; and the availability of labor within the family to manage the farm. (b) Weakness factors consist of: lack of food diversification; lack of income diversification among farmers; limited understanding of nutrition; dependency on aid; and limited capacity to access data and information.
    b. External factors in strengthening household food security on Lombok Island are as follows: (a) Opportunities consist of: agricultural training programs; availability of natural resources supporting agriculture; adequate infrastructure and transportation for food distribution; collaboration between government. private sector. and communities; stunting alleviation programs; potential for agricultural technology development; and farmer group support in increasing farmer productivity. (b) Threats consist of: uncertain climate change; land conversion for non-agricultural purposes; fluctuations in the prices of basic commodities affecting farmers' economic stability; and the price gap between local food and imported food. which may threaten the competitiveness of local farmers.
2. Strategies for Improving Household Food Security among Farmers in Vulnerable Areas on Lombok Island: The strategies prioritized for implementation according to their rankings are as follows: (a) Optimizing access to agricultural technology through agricultural training programs and the development of agricultural technology. (b) Encouraging the involvement of all relevant parties to expand markets and access to capital. (c) Utilizing adequate food availability to support stunting alleviation programs and improve community food security. (d) Improving food distribution by utilizing available infrastructure and transportation.

Recommendations

1. For Farming Households:
   a. Develop a more diversified planting pattern.
   b. Optimize the use of backyard land for planting.
   c. Participate in agricultural training and nutrition education programs provided by the government or communities.
   d. Manage finances more wisely by setting aside a portion of the harvest.
2. For the Government:
   a. Regularly update the data of aid recipients.
   b. Better manage assistance to ensure it is targeted and effective.
   c. Increase subsidies for fertilizers and quality seeds.
   d. Improve local infrastructure that is still inadequate.
3. For Academics:
   a. Develop evidence-based nutrition education modules.
   b. Conduct agricultural research based on the needs of local farmers using technologies that are easy to implement. such as organic fertilizers or water-saving irrigation systems.

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