



INNOVATIVE APPROACHES TO SUSTAINABLE AGRICULTURE: STRATEGY FOR EMPOWERING WOMEN FARMERS IN RESOURCE LIMITED RURAL COMMUNITIES IN SLEMAN, INDONESIA

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Abstract. Sustainable agriculture has become a critical framework for addressing food security challenges, particularly in resource-limited rural communities where women farmer groups play a pivotal yet underexplored role in sustaining local food systems. This research aims to examine the role of the Bukle Women Farmer Group (WFG Bukle) in advancing sustainable agriculture through strategic innovations despite resource limitations. Conducted in Klegung Hamlet, Donokerto Village, Sleman Regency, this study adopts a mixed-method case study approach involving eleven purposively selected key informants: one group leader, one deputy leader, seven active members of WFG Bukle, and two non-member community participants. Data were collected through surveys, semi-structured interviews, field observations, and Focus Group Discussions (FGDs) to evaluate farming practices and land use. The findings place WFG Bukle in Quadrant IV of the Internal-External (IE) matrix, indicating strong internal potential (IFE = 3.04) alongside moderate external challenges (EFE = 2.51). Through SWOT-based strategies and a Quantitative Strategic Planning Matrix (QSPM), three priority strategies emerged: empowering women in sustainable farm management (TAS = 5.49), strengthening collaboration with academic and governmental institutions (TAS = 5.09), and improving financial access for farmer groups (TAS = 5.00). The study highlights the importance of eco-friendly farming, technological access, and market linkages in enhancing food security and economic resilience. Strengthening women's roles in decision-making and financial management is crucial for sustainable agriculture, underscoring the need for gender-inclusive policies and cross-sector collaboration to support long-term rural development.

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INTRODUCTION

Innovative approaches to sustainable agriculture referring to innovative approaches like organic farming and efficient resource management that can enhance sustainable food security for the well-being of communities (Mutlu et al., 2024). Innovative approaches to sustainable agriculture enable the management of precision farming, which is beneficial for enhancing environmentally friendly

agricultural sustainability (Hussain et al., 2024). Sustainable agriculture integrates various social, ecological, and economic aspects to promote the advancement of agricultural practices, the well-being of communities, and environmental sustainability (Yohanes & Kamakula, 2024).

Rural farmers in Indonesia face various food security challenges caused by poverty, food shortages, limited market access, and gender inequality, which affect food productivity (Yusriadi et al., 2024). One of the causes of this food security issue is the loss of agricultural land, which is influenced by the decline in the farmer population in rural areas (Litvinova, 2022). The presence of farmers is essential for maintaining food security by increasing agricultural production through effective farming practices (Musostova et al., 2023). Efforts to ensure food security are supported by empowering women farmer groups (WFG), which contributes to developing agricultural practices that enhance social welfare (Defi et al., 2023). The contribution of female farming groups significantly contributes to sustainable agriculture by enhancing problem-solving skills and implementing better farming practices (Antriandarti et al., 2023).

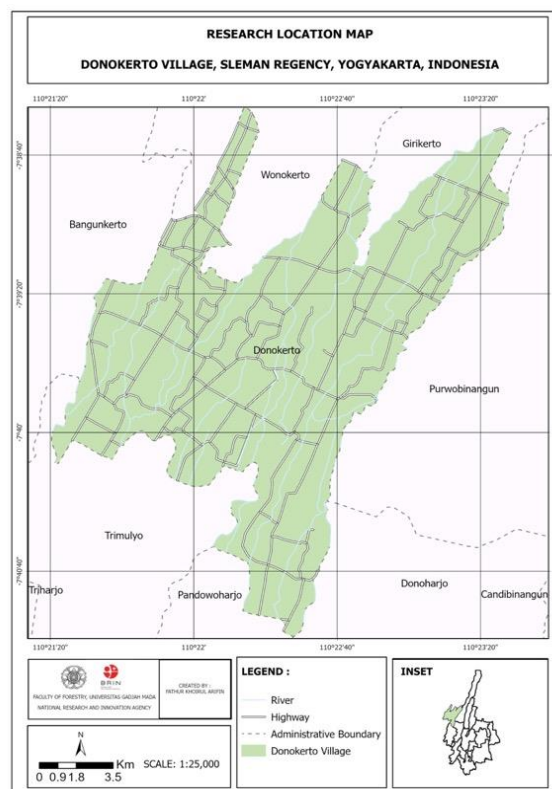
Agricultural innovation is essential for increasing women participation in enhancing productivity and sustainability in farming (McGuire et al., 2022). Challenges, such as the limited resources available in villages, create pressure on the important contributions of women farmers in Indonesian villages to existing agricultural practices (Puspita, 2024). The use of local resource limitations by women farmer groups, supported by local government and academia, can foster agricultural innovations that drive progress (Wahyuni & Santosa, 2020). The optimization of empowerment initiatives for women farming groups in areas with limited land not only meets their daily needs but also enhances the overall well-being of the surrounding community (Ulfa & Irmawita, 2023).

Despite this growing body of evidence, a critical research gap persists in the strategic planning literature on women farmer groups. Previous studies applying strategic frameworks to agricultural contexts have done so in domain-specific or resource-abundant settings. Syamruddin (2020) applied IFE, EFE, and IE matrix analyses to a vegetable farming enterprise, while Wulandari et al. (2022) employed SWOT and QSPM to formulate marketing strategies for a ginger agribusiness group in Banyuwangi, and a parallel study on Kelompok Wanita Tani Suka Makmur in Semarang applied the same integrated framework exclusively to assess coffee marketing performance. While these studies demonstrate the utility of strategic planning tools in agricultural settings, none addresses the question of empowerment strategy prioritization for women farmer groups operating under simultaneous constraints of land scarcity, limited capital, and restricted technological access. Furthermore, studies focused on women's participation in agriculture, such as McGuire et al. (2022) and Antriandarti et al. (2023), remain largely descriptive, documenting roles and contributions without producing ranked, actionable strategies. This gap leaves policymakers and development practitioners without empirically grounded guidance on which empowerment interventions to prioritize for maximum impact in resource-constrained rural contexts.

This study extends the application of the integrated SWOT-IE-QSPM framework beyond marketing and production optimization toward gender-inclusive empowerment strategy prioritization in resource-constrained communities, focusing on WFG Bukle in Klegung Hamlet, Sleman Regency, as a representative case of resource-constrained rural agricultural communities in Yogyakarta. The novelty of this study is threefold: first, it incorporates participatory FGDs to ground the strategic analysis in lived community experience rather than relying solely on secondary indicators; second, it produces a ranked, empirically validated set of priority strategies tailored to the conditions of women farmers with restricted land, capital, and technological access; and third, it offers a replicable analytical model applicable to similar resource-constrained rural settings across Indonesia. The findings are expected to generate actionable recommendations for empowering women farmers and strengthening sustainable agriculture in rural communities with restricted resources.

METHOD

This study was designed to assess the views of female farming groups towards the integration of innovative approaches in sustainable agricultural practices using a case study approach. This research was conducted from July to October 2024. The research location was deliberately chosen in Sleman Regency with a focus on Klegung Hamlet, Donokerto Village. Klegung Hamlet was selected through purposive criteria directly aligned with the research objectives. Field observations confirmed that this location exemplifies the compounding resource constraints central to this study: group members hold no individual land ownership and rely on voluntary land-sharing arrangements among members, capital access is restricted to personal funds that frequently prove insufficient for sustained agricultural operations, and exposure to agricultural information and technology remains limited despite periodic government-organized training. These site-specific conditions make Klegung Hamlet a contextually appropriate and analytically relevant location for examining empowerment strategies in resource-constrained women farmer communities. The focus of this study was on the Bukle women farmer community within Klegung Hamlet (Figure 1). Bukle is an acronym for “Ibu-ibu Klegung” (Klegung Women), reflecting the group’s identity as women residents of Klegung Hamlet. The Bukle women farming group was selected as the focus of this study because this group can represent the real conditions of women empowerment in the agricultural sector in the area.



Source: Data processed by the authors using ArcGIS (2025)

Figure 1. Research site of the Bukle Women Farmer Group

Data collection was conducted through surveys, interviews, field observations, documentation, and FGDs. Surveys provided an overview of the existing agricultural conditions, while interviews explored the members’ perceptions, experiences, and motivations regarding the adoption of sustainable agricultural practices. Field observations recorded land-use patterns, crop diversity, and farming techniques. Documentation included group meeting notes, photographs, and written records of

agricultural activities. FGDs, each involving 13 participants, were organized to encourage community participation, identify local agricultural innovations, explore constraints to adopting environmentally friendly technologies, and discuss opportunities to strengthen women's roles in agricultural decision-making. The participatory nature of the FGDs supported collective problem-solving, triangulation of survey and interview data, and enhanced community ownership of sustainable agricultural initiatives.

Data analysis utilized both descriptive quantitative and qualitative techniques. Quantitative descriptive analysis examined the relationship between group participation and the implementation of sustainable agricultural practices under conditions with restricted resources. Qualitative data analysis applied the interactive model by Miles and Huberman, consisting of data reduction, data display, and conclusion drawing to ensure an iterative and systematic analytical process. Furthermore, strategic decision making followed a structured three stage framework. The input stage utilized the Internal Factor Evaluation and External Factor Evaluation matrices to quantify internal strengths and weaknesses alongside external opportunities and threats. The matching stage mapped these scores onto an Internal and External matrix (Figure 2) to position the group within specific strategic quadrants, such as grow and build or hold and maintain, while a SWOT matrix (Figure 3) formulated specific tactical alternatives. Finally, the decision stage employed the Quantitative Strategic Planning Matrix (Figure 4) to objectively evaluate and determine priority strategies based on the highest Total Attractiveness Score. This integrated analytical framework provided a holistic perspective on empowering women in agriculture and aligned the findings with local policies supporting inclusive and sustainable agricultural development in Sleman Regency.

		Total IFE Score		
		Strong 3,00 – 4,00	Moderate 2,00 – 2,99	Weak 1,00 – 1,99
Total EFE Score	High 3,00 – 4,00	I	II	III
	Moderate 2,00 – 2,99	IV	V	VI
	Low 1,00 – 1,99	VII	VIII	IX

Source: Data processed, 2025

Figure 2. Internal-External (IE) matrix framework

RESULT AND DISCUSSION

Identification of Internal and External Factors

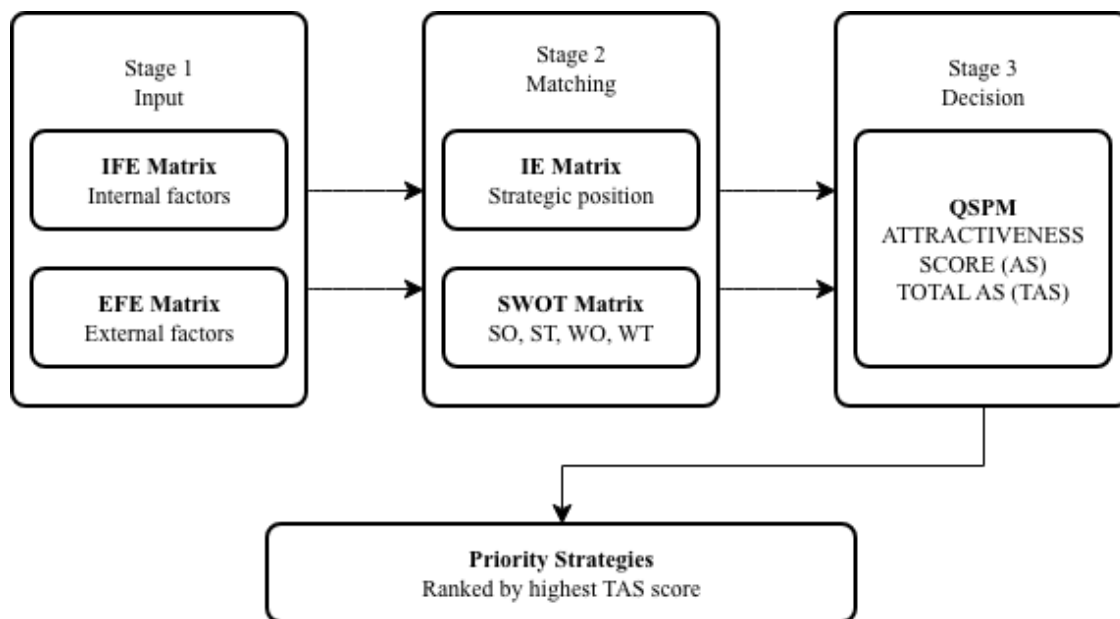
Internal and external factors influencing agricultural practice sustainability were revealed via FGDs and observations with WFG Bukle. SWOT analysis served to examine the strengths, weaknesses, opportunities, and threats informing the innovation of sustainable farming. Understanding these forces is crucial to formulating strategies that ensure agricultural resilience and long-term sustainability. The outcomes were also analyzed by the External Factor Evaluation (EFE) matrix and the Internal Factor Evaluation (IFE) matrix to determine significant strategic priorities. The evaluation helps to support the identification of critical improvement opportunities and growth areas in women's agricultural empowerment. Using the combined findings, the research aims to enhance sustainable farming innovations, encourage food security, and improve the overall well-being of the community. These

findings are consistent with Yohanes and Kamakula (2024), who reported that integrating social, ecological, and economic dimensions is fundamental for achieving agricultural sustainability. Similarly, Mutlu et al. (2024) confirmed that innovative approaches such as organic farming and precision agriculture significantly improve food security outcomes. The data obtained from WFG Bukle further reinforce these observations, as the group's IFE total score of 3.04 indicates strong internal capabilities, while the EFE total score of 2.51 reflects moderate external positioning, placing the group in Quadrant IV of the IE matrix. This positioning is comparable to the findings of Syamruddin (2020), who demonstrated that farmer groups with strong internal resources but moderate external support benefit most from growth and build strategies based on figure 3 and figure 4.

SWOT Analysis Matrix FrameWork		
	STRENGTHS (S)	WEAKNESSES (W)
OPPORTUNITY (O)	S-O STRATEGY	W-O STRATEGY
	Use strengths to take advantage of opportunities	Overcoming weakness by taking advantage of opportunities
THREAT (T)	S-T STRATEGY	W-T STRATEGY
	Using strength to avoid threats	Minimize weaknesses and avoid threats

Source: Data processed, 2025

Figure 3. SWOT matrix–strategic formulation for WFG Bukle



Source: Data processed 2025

Figure 4. Strategic decision-making framework

Table 1. Internal Factors

Internal Factors		
Strength	1)	The presence of active women's farmer groups in sustainable agriculture
	2)	Experience in implementing environmentally friendly farming systems (organic practices, crop diversification)
	3)	Internal group support through mutual cooperation and land sharing
	4)	Group awareness of the importance of sustainable agriculture
	5)	The existence of an independent seed nursery
Weakness	1)	Limited agricultural land
	2)	Limited capital and access to financial resources
	3)	Lack of access to agricultural information and modern technology
	4)	Low awareness among the surrounding community

Source: Data processed, 2025

Table 2. External Factors

External Factors		
Opportunities	1)	Government and academic institution support
	2)	Increasing local food demand
	3)	Global trends toward sustainable agriculture and organic food consumption
	4)	Access to training, mentoring, and technological assistance from external parties
	5)	Implementation of multi-crop planting patterns and crop rotation
Threats	1)	Uncertainty regarding land ownership status
	2)	Fluctuations in agricultural product market prices
	3)	Competition with conventional or large-scale agriculture
	4)	Limited access to broader marketing networks

Source: Data processed, 2025

The weight and rating values assigned to each internal factor in Table 3 were determined through a participatory scoring process conducted during FGDs with the eleven key informants. Weights reflect the relative importance of each factor to the group's overall performance, while ratings indicate the group's current capacity to manage each factor effectively. The highest-weighted strength, the presence of an active women farmer group (weight = 0.16, rating = 4, score = 0.64), was consistently emphasized across all FGD sessions as the foundational asset enabling collective action and knowledge sharing among members. The second-ranked strength, experience in environmentally friendly farming systems (weight = 0.14, rating = 3, score = 0.42), was corroborated by field observations confirming that WFG Bukle members already apply organic compost and animal manure in their farming practices, with members explicitly stating their awareness that inorganic inputs degrade soil fertility and harm surrounding biodiversity. Internal group support through mutual cooperation and land-sharing (score = 0.30) reflects the gotong royong tradition that underpins the group's collective farming arrangements, while the independent seed nursery (score = 0.24) was confirmed through observation to already supply planting material for the group's land needs, reducing dependence on external seed procurement. On the weakness side, limited agricultural land received the highest weakness rating (weight = 0.12, rating = 4, score = 0.48), directly corroborated by field observations confirming that no members hold individual land ownership and all land is managed through voluntary informal lending arrangements among members, creating uncertainty in long-term agricultural investment. The resulting IFE total score of 3.04 confirms that internal strengths substantially outweigh weaknesses, providing a favorable foundation for strategic development based on table 1 and table 2.

Table 3. IFE Analysis Results

A	Strength	Weight (0.0 – 1.0)	Rating (1 – 4)	Score
1	The presence of an active women farmers' group engaged in sustainable agriculture	0.16	4	0.64
2	Experience in implementing environmentally friendly farming systems (organic farming, crop diversification)	0.14	3	0.42
3	Internal group support through mutual cooperation and land-sharing	0.10	3	0.30
4	Group awareness of the importance of sustainable agriculture	0.12	3	0.36
5	The existence of an independent seed nursery	0.12	2	0.24
Total Strength Score		0.64		1.96
B	Weakness			
1	Limited agricultural land	0.12	4	0.48
2	Limited capital and access to financial resources	0.10	3	0.30
3	Lack of access to agricultural information and modern technology	0.08	3	0.24
4	Low awareness among the surrounding community	0.06	1	0.06
Total Weakness Score		0.36		1.08
Total Score IFE		1.00		3.04

Source: Data processed, 2025

Table 4. EFE Analysis Results

A	Opportunity	Weight (0.0 – 1.0)	Rating (1 – 4)	Score
1	Government and academic institution support	0.18	2	0.36
2	Increasing local food demand	0.12	3	0.36
3	Global trends toward sustainable agriculture and organic food consumption	0.14	2	0.28
4	Access to training, mentoring, and technological assistance from external parties	0.15	3	0.45
5	Implementation of multi-crop planting patterns and crop rotation	0.11	2	0.22
Total Opportunity Score		0.70		1.67
B	Threat			
1	Uncertainty regarding land ownership status	0.16	3	0.48
2	Fluctuations in agricultural product market prices	0.06	2	0.12
3	Competition with conventional or large-scale agriculture	0.05	3	0.15
4	Limited access to broader marketing networks	0.03	3	0.09
Total Threat Score		0.30		0.84
Total EFE Score		1.00		2.51

Source: Data processed, 2025

EFE weights and ratings in Table 4 were similarly derived from the FGD process, where participants collectively assessed the relative importance of each external factor and the group's current capacity to respond to it. Government and academic institutional support received the highest opportunity weight (0.18), reflecting participants' collective recognition that external institutional partnerships represent the most strategically significant opportunity available to the group. However, the rating of 2 indicates that the group's current response to this opportunity remains limited, a finding consistent with interview data revealing that formal collaboration with government and universities has been infrequent, largely confined to periodic technical training events (Bimtek) that members acknowledged as highly influential when they occurred but insufficiently continuous to sustain skills development. Access to training and technological assistance from external parties (weight = 0.15, rating = 3, score = 0.45) ranked as the highest-scoring opportunity, indicating that when such support is available, the group demonstrates reasonable capacity to leverage it. On the threat side, uncertainty regarding land ownership status received the highest weight (0.16, rating = 3, score = 0.48), validated by observational data showing that all land used by the group is borrowed informally without legal tenure, creating instability in long-term agricultural planning. The EFE total score of 2.51 reflects moderate external positioning, confirming that while meaningful opportunities exist, the group's capacity to consistently leverage them remains constrained by structural resource limitations.

Internal and external factor analysis of WFG Bukle was conducted using the IE matrix. This matrix helps farmer groups identify their strategic position and determine appropriate development strategies (Syamruddin, 2020). The total scores for IFE and EFE were calculated as 3.04 and 2.51, respectively. These values were then analyzed using the IE matrix and categorized based on vertical and horizontal groupings within the quadrant. According to Figure 5, the IE matrix classification places the group in Quadrant IV, indicating strong internal strengths but moderate external challenges.

Internal-External (IE) Matrix Analysis

		Total IFE Score		
		Strong 3.00 – 4.00	Moderate 2.00 – 2.99	Weak 1.00 – 1.99
Total EFE Score	High 3.00 – 4.00	I	II	III
	Moderate 2.00 – 2.99	IV	V	VI
	Low 1.00 – 1.99	VII	VIII	IX

Source: Data processed, 2025

Figure 5. Result of Matrix Internal and External

SWOT Analysis

SWOT analysis in this study was conducted to formulate empowerment strategies for the women's farmer group based on their available resources. The SWOT analysis matrix in Table 5 presents several strategic formulations derived from the group's internal and external factors. Table 5 illustrates opportunity-based strategies that can be utilized to develop recommendations for empowering WFG Bukle by formulating SO (Strength-Opportunity), ST (Strength-Threats), WO (Weakness-Opportunity), and WT (Weakness-Threats) strategies. The formulation of these strategies is based on considerations of internal and external factors that influence the group's dynamics.

Table 5. EFE Matrix SWOT

IFE		Opportunities		Threats	
		SO Strategies		ST Strategies	
EFE	1	Optimizing the role of farmer groups through collaboration with academic institutions and the government (S1, S2, O1, O4)		1	Utilizing sustainable agriculture to address land uncertainty (S2, S3, T1, T4)
Strengths	2	Developing environmentally friendly agricultural technology based on local wisdom (S2, S5, O3, O5)		2	Strengthening marketing networks to reduce dependence on conventional markets (S1, S3, T3, T4)
		WO Strategies		WT Strategies	
Weakness	1	Facilitating access to funding and capital for farmer groups (W1, W2, O1, O4)		1	Diversifying agricultural products to mitigate market risks (W1, W3, T2, T3)
	2	Improving access to technology and information to accelerate agricultural innovation (W3, W4, O1, O4)		2	Empowering women farmers in sustainable agricultural business management (W2, W3, T3, T4)

Source: Data processed, 2025

Based on the IFE and EFE analysis and validated through FGD sessions conducted with WFG Bukle members, the following strategies were formulated to address challenges and leverage opportunities in supporting sustainable agriculture. Participants confirmed the relevance of each strategy through direct discussion of their lived constraints, ensuring that the strategic formulations reflect ground-level conditions rather than theoretical projections alone. The Strength-Opportunity (SO) strategy emphasizes the importance of optimizing the role of farmer groups through collaboration with academic institutions and the government (S1, S2, O1, O4). This support can enhance access to knowledge and more innovative agricultural technologies. Additionally, developing environmentally friendly agricultural technologies based on local wisdom (S2, S5, O3, O5) is a strategic step in strengthening food security and ensuring the sustainability of the agricultural sector.

In addressing external threats, the Strength-Threats (ST) strategy focuses on utilizing sustainable agriculture to overcome land tenure uncertainties (S2, S3, T1, T4). By implementing adaptive and sustainable agricultural practices, farmer groups can maintain productivity despite land constraints. Additionally, strengthening market networks (S1, S3, T3, T4) is a crucial step in reducing dependence on conventional markets and expanding access to more profitable market opportunities.

The Weakness-Opportunity (WO) strategy emphasizes the importance of improving access to funding and capital for farmer groups (W1, W2, O1, O4). Easier access to financial resources will support farmers in expanding their businesses and adopting technological innovations. Additionally, enhancing access to technology and information (W3, W4, O1, O4) will accelerate agricultural innovation processes and assist farmers in increasing productivity and operational efficiency.

Meanwhile, the Weakness-Threats (WT) strategy aims to mitigate the risks faced by farmer groups due to resource limitations and external threats. Agricultural product diversification (W1, W3, T2, T3) serves as a key measure to reduce market risks, ensuring that farmers are not solely reliant on a single commodity. Additionally, empowering women farmers in sustainable agricultural business management (W2, W3, T3, T4) plays a crucial role in enhancing economic resilience and strengthening the independence of farmer groups.

From the formulated strategies, certain strategies should be prioritized for implementation. The most relevant strategies are selected based on the internal and external conditions of the group. To facilitate the identification of priority strategies, a Quantitative Strategic Planning Matrix (QSPM)

analysis is necessary to determine which strategies should be implemented first based on their relevance and feasibility.

QSPM Analysis

Quantitative Strategic Planning Matrix (QSPM) analysis is conducted to simplify and determine the most critical strategy for prioritization. The Attractiveness Scores (AS) assigned to each strategy were determined through a structured scoring process during FGD sessions, in which participants evaluated the relative attractiveness of each strategic alternative in response to each identified internal and external factor. This participatory scoring approach ensured that the resulting Total Attractiveness Scores (TAS) reflect the priorities and contextual judgments of WFG Bukle members and key informants rather than researcher assumptions alone. QSPM is applied alongside SWOT analysis to provide a comprehensive strategic assessment (Wulandari et al., 2022). Additionally, this analysis strengthens strategic planning by presenting a clear structure for prioritizing strategies (Anisa et al., 2023).

Table 6. Prioritizing Strategies Using QSPM Analysis

No	Prioritizing Strategies	Σ TAS
1	Empowering women farmers in sustainable agricultural business management (WT2)	5.49
2	Optimizing the role of farmer groups through collaboration with academic institutions and the government (SO1)	5.09
3	Facilitating access to funding and capital for farmer groups (WO1)	5
4	Utilizing sustainable agriculture to address land uncertainty (ST1)	4.97
5	Improving access to technology and information to accelerate agricultural innovation (WO2)	4.91
6	Strengthening marketing networks to reduce dependence on conventional markets (ST2)	4.86
7	Developing environmentally friendly agricultural technology based on local wisdom (SO2)	4.78
8	Diversifying agricultural products to mitigate market risks (WT1)	4.59

Source: Data processed, 2025

Based on the QSPM calculations in Table 6, the highest priority strategy, with the highest Total Attractiveness Score (TAS), is empowering women in the management of sustainable agricultural enterprises. If the top three priorities are selected, the two additional strategies include collaborating between farmer groups, academic institutions, and the government, and facilitating access to funding and capital for farmer groups. These priority strategies can serve as a foundation for recommending strategies to empower women farmers.

The TAS value of 5.49 for women's empowerment in sustainable agricultural business management substantially exceeds the second-ranked strategy (5.09), indicating a clear strategic priority. This result corroborates the findings of Yuliyanti et al. (2023), who reported that strengthening women's autonomy in farmer groups is the most impactful driver of agricultural advancement in rural communities. Compared to the QSPM analysis conducted by Wulandari et al. (2022) in Banyuwangi, where market-oriented strategies ranked highest, the present study reveals that empowerment-oriented strategies are more relevant in resource-limited contexts such as Sleman. Furthermore, the relatively narrow range of TAS values across all eight strategies (4.59 to 5.49) suggests that a comprehensive, multi-strategy approach would yield optimal outcomes, as also recommended by Anisa et al. (2023) in

their assessment of strategic planning matrices. The data comparison demonstrates that women farmer groups operating under severe resource constraints require a different strategic emphasis from those operating in more resource-abundant settings.

Innovative Approaches Women Farmers

Based on the findings, an innovative approach can be implemented through the development of local agricultural strategies that incorporate environmentally friendly technology and improve access to technology and information to support agricultural innovation. These strategies can be developed as part of efforts toward sustainable agriculture, empowering women farmers to innovate in their agricultural practices within their communities.

An innovative approach can be applied through the adoption of environmentally friendly farming to enhance sustainability and food security (Kapsdorferová et al., 2023). Environmentally friendly agricultural technology is a farming practice that focuses on ecosystem restoration by utilizing organic materials (Pontius et al., 2024). Furthermore, combining local farming practices with technology can help mitigate the risks of declining agricultural yields, promoting sustainability (Andhikari et al., 2023). Organic farming, as an innovative approach, emphasizes the use of eco-friendly organic materials to improve soil health and preserve biodiversity (Sani et al., 2024). Field observations confirmed that WFG Bukle members already apply organic compost and animal manure in their farming practices. Members explicitly stated during interviews that they are aware inorganic inputs damage soil fertility and kill surrounding biodiversity, demonstrating that this practice reflects an internally driven environmental commitment rather than a response to external mandates.

As part of the development of local agriculture-based strategies, utilizing innovative technology and environmentally friendly information systems can optimize crop yields despite land limitations (Schneider et al., 2022). Meanwhile, the implementation of sustainable farming can be achieved through multicultural planting patterns and crop rotation (Nasiro, 2024). These strategies also contribute to food security and help mitigate the environmental impact of biodiversity loss (Londoño, 2023). Interview data from WFG Bukle members further revealed that the multicrop planting pattern allows them to harvest different crops on a daily, weekly, and monthly basis, ensuring continuous agricultural output without accumulation gaps. Members also noted that crop rotation was practiced as a deliberate preventive measure against the spread of pests and diseases, a practice-based insight directly consistent with Nasiro (2024), demonstrating that empirical knowledge within the group aligns with established agronomic principles even without formal technical education.

Empowering Women Farmer

Empowering women in the management of sustainable agricultural enterprises plays a crucial role in strengthening the involvement of WFG Bukle members in developing a more independent and innovative agricultural sector. Through training and mentoring, women farmers can enhance their skills in managing agricultural businesses, including the application of environmentally friendly practices, financial management, and marketing strategies for agricultural products. This strategy aligns with the findings of Yuliyanti et al. (2023), which emphasize the importance of increasing women's autonomy in farmer groups to drive agricultural advancement in their communities. Furthermore, women's empowerment in agriculture contributes to greater participation in sustainable agricultural practices and strengthens local food systems (Zhang et al., 2023). Increasing their decision-making authority and involvement in sustainable farming is also recognized as a key aspect of women's empowerment (Sheeba & Raj, 2024).

Collaboration between farmer groups, academic institutions, and government agencies serves as a strategic approach to enhancing farmers' capacities and providing access to the latest agricultural technology and information. Support from multiple stakeholders enables farmer groups to receive further training on sustainable farming and effective farm business management. Research by Gusti et al. (2022) highlights that women's participation in agricultural innovation plays a significant role in

fostering the development of a more sustainable and environmentally oriented agricultural sector. Collaborations with academic institutions are crucial in enhancing the performance and competitiveness of the agricultural sector, particularly in developing countries (Shahlehi et al., 2024). Additionally, cooperation between farmers, government bodies, and academics has been shown to be highly beneficial, particularly in rural settings with limited resources (Miao et al., 2025). This dynamic was directly observed in WFG Bukle, where members reported that participation in government-organized technical training (Bimtek) significantly influenced the quality of their farming practices, improving their understanding of environmentally friendly agriculture. However, interview data also revealed that such collaboration remains event-based and infrequent rather than continuous, limiting sustained knowledge transfer, a gap that the SO1 strategy (TAS = 5.09) explicitly aims to address by formalizing and extending these institutional partnerships.

Moreover, access to funding and capital is a critical factor in supporting the sustainability of farmer group enterprises. Improved access to financial resources enables women farmers to expand their agricultural businesses without being hindered by capital constraints. This effort contributes to enhancing the well-being of farmer group members while fostering agriculture-based economic growth. In line with this, research by Zhang et al. (2023) affirms that broader financial access for women farmers significantly boosts productivity and local food security. Additionally, financial capital access has a substantial impact on increasing farmers' productivity (Ar et al., 2024). Agricultural capital financing plays a vital role in enhancing farmers' income and ensuring economic stability (Iqbal et al., 2023). Furthermore, financial education through seminars and workshops on capital financing and financial management can improve the efficient use of funds and assist farmers in managing their expenses effectively to maintain the financial stability of their groups (Villena et al., 2024).

Sustainable Agriculture

The combination of organic farming, multicrop planting patterns, and crop rotation already practiced by WFG Bukle demonstrates a locally adapted form of sustainable agriculture directly responsive to the group's resource constraints. Despite operating without individual land ownership and relying entirely on informal land-sharing arrangements among members, field observations confirmed that the group has maintained continuous agricultural productivity through these integrated practices. Members reported that cultivating multiple crop types with staggered harvest cycles, ranging from daily to weekly and monthly, reduces dependence on any single commodity and provides a buffer against market price fluctuations, a finding consistent with Jose et al. (2024) and Chaudhary et al. (2024). Furthermore, the sustainable agriculture strategy aimed at addressing land uncertainty (ST1, TAS = 4.97) directly responds to this observed condition: by optimizing available borrowed land through crop rotation, organic fertilizers, and land-efficient techniques, the group can maintain and enhance productivity without requiring land expansion (Chandel et al., 2024). This strategy supports the sustainability of agricultural ecosystems while simultaneously strengthening the food security of WFG Bukle members and the surrounding Klegung Hamlet community.

CONCLUSION

This study confirms that empowering women in sustainable agricultural business management is the highest strategic priority for WFG Bukle, as indicated by the highest QSPM score (TAS = 5.49). The IE matrix positioned the group in Quadrant IV, reflecting strong internal capabilities (IFE = 3.04) alongside moderate external challenges (EFE = 2.51), which supports a grow-and-build strategic direction. Three priority strategies emerged: empowering women in farm enterprise management, strengthening collaboration with academic and governmental institutions, and improving financial access for farmer groups. These strategies are essential for enhancing food security, economic resilience, and women's participation in agricultural decision-making. This study contributes to the body of knowledge by applying an integrated SWOT–IE–QSPM framework within the specific context

of a resource-limited women farmer group in Sleman, Indonesia, providing empirically grounded and actionable recommendations for gender-inclusive agricultural development policies.

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