

Potential and strategies for revitalizing smallholder pig farming in Sonder District, Minahasa Regency, Indonesia

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ABSTRACT

This study aims to identify potential, analyze internal and external factors, and formulate strategies for revitalizing smallholder pig farming in Sonder District, Minahasa Regency. The survey was conducted in June–July 2025 in five villages and involved 96 livestock households: 7 active livestock farmers (7.3%) and 89 inactive livestock farmers (92.7%). Data were collected through questionnaires, interviews, field observations, and documentation, then analysed descriptively and through a SWOT analysis. The strengths score (1.79) was higher than the weaknesses (0.85), while the opportunities (1.79) were higher than the threats (0.76), resulting in coordinates $X=0.94$ and $Y=1.03$ in Quadrant I. The main strengths include livestock farming experience, family labor, pen assets, and household business flexibility. In contrast, the main opportunities come from market and socio-cultural demand, local feed sources, and village government support. Revitalization should distinguish between strengthening active farms and supporting inactive farmers through gradual re-entry, restocking, capital access, and technical assistance. Overall, smallholder pig farming in Sonder retains substantial revitalization potential when strategies are matched to household capacity and farmer readiness.

INTRODUCTION

Smallholder pig farming is an important livelihood for rural households, providing cash income, savings, and readily convertible assets to meet household needs. Pig farming is also closely linked to social and cultural practices, making it an integral part of rural (Dargantes et al., 2025; Irma et al., 2025; Ligue-Sabio et al., 2025). In North Sulawesi, pig farming has long occupied an important position in the regional livestock economy, supported by strong sociocultural demand and its contribution to rural livelihoods.

The urgency of revitalizing smallholder pig farming is reflected in the sharp decline in pig populations in North Sulawesi. The provincial

pig population decreased from 418,297 head in 2018 to 65,095 head in 2024, representing an 84.4% decline. A similar trend occurred in Minahasa Regency, where the pig population fell from 127,400 head in 2018 to 25,413 head in 2024, a decline of approximately 80.1%. This substantial contraction indicates that the decline in pig farming is not limited to individual households or villages but reflects a broader regional reduction in production capacity (Badan Pusat Statistik Sulawesi Utara, 2026).

In this study, smallholder pig farming refers to household-based livestock enterprises integrated into daily family life. These enterprises generally operate with limited capital and market access, rely heavily on family



labor, and adjust production scale according to the availability of labor, feed, cash, and other household resources. Before production declined or ceased, most respondents kept around three to four sows, although some households managed larger herds. This household-based system provides flexibility but may also limit investment capacity, weaken market bargaining power, and increase vulnerability to shocks such as disease outbreaks, rising feed prices, and market disruptions (Santa et al., 2025).

In Sonder District, these broader regional pressures have been reflected in a sharp decline in the number of active smallholder pig farmers. Many households ceased production because of disease outbreaks, rising feed costs, limited capital to purchase replacement stock and restart production, market uncertainty, and increased risk of loss. The decline had already begun in 2020, when approximately 45% of farmers stopped production, while most inactive farmers ceased raising pigs in 2024. Despite this decline, many households remain inactive yet retain pig pens, farming experience, family labour, practical knowledge, and market connections. These households therefore retain residual production capacity that could support gradual business re-entry if adequate technical, financial, market, animal-health, and institutional support become available. Consequently, revitalization strategies need to distinguish between supporting active farmers to maintain production and assisting inactive farmers to gradually re-enter pig farming according to their resources and readiness.

Revitalization in this context extends beyond simply increasing livestock numbers. It also involves reactivating unused pens, utilizing accumulated farming knowledge, optimizing family labor, rebuilding farmers' confidence, and reducing the risks associated with restarting production. Economic, social, and environmental sustainability remain important long-term goals, but households can achieve them only if they first restore and maintain viable production activities (FAO, 2023). Sustainability can therefore be viewed as a long-term outcome of a gradual revitalization process adapted to household capacity (Gagaoua et al., 2025; Gunnarsson et al., 2020).

A meaningful revitalization strategy must consider household conditions, locally available

resources, and the specific constraints faced by farmers. Pig-farming systems differ across regions in terms of resource availability, farming traditions, market access, and production constraints (Wea et al., 2020). In rural North Sulawesi, pig farming is closely associated with family labor, locally available feed ingredients, household production scale, pen location, and disease risk. These characteristics indicate that revitalization strategies should be grounded in local business realities rather than applied uniformly.

Revitalization is also closely related to village-level institutional capacity. Village governments can support local economic development by linking livestock activities to development planning, community empowerment, farmer group strengthening, and access to productive resources. Institutional support is therefore important for connecting the remaining capacities of farming households with broader village development opportunities.

Previous studies on smallholder pig farming have largely examined farm performance, profitability, production risk, disease, feed management, and marketing. In North Sulawesi, (Santa et al., 2025) focused on production risks and business dynamics, while (Manese et al., 2021) examined the contribution of pig farming to household income. (Wea et al., 2020) addressed pig-farming development strategies in another Indonesian region. However, these studies primarily focus on active farms or on individual production constraints. Research remains limited on inactive farming households that still retain productive assets, experience, family labor, and market connections that could support re-entry into pig farming. In addition, the interaction between these residual household capacities, local resource potential, and village-level institutional support has received limited attention within a single revitalization framework. Addressing this gap is important for designing differentiated strategies for active and inactive farmers.

Therefore, this study aims to identify revitalization potential, analyze internal and external factors affecting smallholder pig farming, and formulate revitalization strategies for five villages in Sonder District, Minahasa Regency, Indonesia. The main contribution of this study is the integration of farmer and

business characteristics, remaining household resources, local resource potential, and village-level institutional support within a single IFAS-EFAS-SWOT framework.

MATERIALS AND METHODS

The Site, Sample, and Data Collection Technique

This study was conducted from June to July 2025 in Sonder District, Minahasa Regency, North Sulawesi Province. The five villages selected as research sites were Talikuran, Talikuran Satu, Kauneran, Kauneran Satu, and Tounalet Satu. Sonder District was purposively selected due to its strong history of smallholder pig farming and its past reputation as an area where pig farming thrived as part of household economic activities. In recent years, the number of active farmers in the area has declined sharply; thus, Sonder District was deemed a relevant setting for examining the potential, constraints, and opportunities for revitalising smallholder pig farming. The researchers used purposive site selection because the area's characteristics aligned with the research objectives (Sugiyono, 2019). The study's findings aim to elucidate the conditions and revitalization strategies within the selected villages and are not intended to represent all smallholder pig farming operations in North Sulawesi.

The study respondents comprised two groups. The first group consisted of farming households or pig pen owners selected purposively based on three criteria: owning a pig pen, possessing experience in pig farming (whether currently active or having ceased operations), and willingness to participate in the study (Sugiyono, 2019). A total of 96 respondents from the five villages met these criteria and completed the survey. At the time of data collection, 7 respondents (7.3%) were still actively raising pigs, while 89 respondents (92.7%) had ceased production but retained pens, farming experience, practical knowledge, and household resources that could support a potential resumption of the business. Inactive respondents were included because they represent a significant portion of the remaining production capacity and are relevant for assessing the potential to revitalize smallholder pig farming.

The second group consisted of 11 key respondents with direct knowledge and experience regarding pig farming conditions, livestock institutions, extension services, and village development planning. These key respondents included five heads of village planning affairs, two agricultural extension workers, and four livestock farmer group leaders. They were used to supplement and verify information on business conditions, institutional support, local resource potential, extension services, market access, and revitalization constraints. Key respondents were also involved in reviewing internal and external factors and providing weighting and ratings during the SWOT analysis.

The research used primary and secondary data. The researchers collected primary data through structured questionnaires, interviews, field observations, and documentation. Data from the 96 farming households covered socioeconomic characteristics, farming experience, recent farming conditions, family labor, pig-pen ownership, previous herd size, feed sources, capital sources, access to production inputs, market access, and business constraints. Data from 11 key respondents were used to supplement and verify field information, particularly regarding institutional conditions, village government support, extension services, local resource potential, and strategic factors influencing business revitalization.

The team identified strengths, weaknesses, opportunities, and threats by integrating results from a survey of 96 livestock farming households, interviews with key respondents, field observations, and documentation. Thus, livestock farming households served as the primary source for describing business conditions and identifying strategic factors, while key respondents played a role in completing, verifying, and analyzing these factors, as well as providing assessments during the weighting and SWOT rating stages. Before primary data collection, the questionnaire and structured interview instruments were pilot-tested with respondents with characteristics similar to those in the study but not included in the final sample. Pilot testing assessed question clarity, ease of understanding, appropriate question order, and the relevance of the collected information to the research objectives. Pilot-test results were used

to refine some question wording, simplify poorly understood terms, and adjust the question order before using the instruments in the main survey.

Secondary data were obtained from government agencies, statistical publications, village documents, and other relevant sources related to smallholder pig farming in the Sonder District and Minahasa Regency.

Data Analysis

The data were analyzed descriptively to characterize the respondents, the conditions of household-based pig farming operations, available local resources, and constraints related to business revitalization (Sugiyono, 2019). Categorical variables were presented as frequencies and percentages. The results of the descriptive analysis served as an empirical basis for identifying the internal and external factors influencing the revitalization of smallholder pig farming.

SWOT analysis was conducted in four stages: identifying strategic factors, assigning weights, assigning ratings, and determining the strategic position (Rangkuti, 2015; Sunarsi, 2024; Wheelen et al., 2018). Strengths, weaknesses, opportunities, and threats were initially identified by synthesizing data from surveys of 96 farming households, interviews with key informants, field observations, and documentation. The study then compiled factors that consistently emerged from more than one information source into a preliminary list of internal and external factors.

To strengthen the validity of the identified factors, the study triangulated sources, data collection techniques, and researchers. The study conducted source triangulation by comparing information from 96 livestock farming households with information from 11 key respondents, including 5 Village Planning Heads, 2 agricultural extension workers, and 4 livestock farming group leaders. The study triangulated data collection techniques by comparing questionnaire and interview results with field observations and documentation. Meanwhile, researcher triangulation was conducted by involving more than one researcher to review the data separately, then comparing and harmonizing the interpretations through joint discussions. The study then identified factors

consistently supported by multiple sources and methods as strategic factors in the SWOT analysis.

The initial list of internal and external factors was then reviewed by 11 key respondents to ensure they were relevant, understandable, and aligned with actual conditions on the ground. After this review, the factors deemed relevant were used in the SWOT questionnaire for weighting and rating.

The assessments provided by key respondents were analyzed independently by more than one researcher. More than one researcher processed the questionnaire responses from the 11 key respondents independently. Each researcher calculated the normalized weights and weighted scores using the same questionnaire data. The results were then compared and harmonized through joint discussion before the final IFAS and EFAS matrices were established.

Each internal and external factor was assigned an importance score (a_i) based on assessments from 11 key respondents through the SWOT questionnaire. The normalised weight was calculated using:

$$w_i = \frac{a_i}{\sum a_i}$$

Ensuring that the total weight in each IFAS and EFAS matrix was equal to 1.00. Ratings were assigned on a four-point scale: 4 represented a major strength or opportunity, 3 a minor strength or opportunity, 2 a minor weakness or threat, and 1 a major weakness or threat. The weighted score for each factor was calculated using:

$$s_i = w_i \times r_i$$

Where r_i represents the rating, the scores for strengths, weaknesses, opportunities, and threats were then added separately. The strategic coordinates were calculated as $X = \sum S - \sum W$ and $Y = \sum O - \sum T$. A positive X value indicates that the farming system's strengths exceed its weaknesses. In contrast, a positive Y value indicates that available opportunities exceed external threats.

The X and Y values determine the strategy position. Quadrant I ($X > 0$; $Y > 0$) indicates an SO

strategy, which uses existing strengths to take advantage of available opportunities. Quadrant II ($X<0$; $Y>0$) indicates a WO strategy; Quadrant III ($X<0$; $Y<0$) indicates a WT strategy; and Quadrant IV ($X>0$; $Y<0$) indicates an ST strategy. The resulting position then serves as the basis for formulating revitalisation strategies for active and inactive livestock farmers, farmer groups, village governments, extension workers, and other stakeholders.

RESULTS AND DISCUSSION

Socioeconomic Profile and Revitalisation Potential of Pig-Farming Households

As a first step in assessing the potential for revitalizing smallholder pig farms, this study compared the socioeconomic profiles of active and inactive pig farmers. This comparison is important because the two groups have different positions in the revitalization process: active farmers need to maintain business continuity, while inactive farmers face the challenge of restarting production activities. Characteristics analyzed included age, education level, and farming experience, which reflect the human

resource capacity and potential of households to support business sustainability or recovery. Table 1 presents the comparison results.

Table 1 shows that the most obvious differences between the two groups are in age and livestock farming experience. All active respondents were aged 50 years or younger, whereas 52 of the 89 inactive respondents (58.4%) were older than 50 years. This suggests that regeneration is a major issue in the inactive group, while the active group still has a workforce of productive age. The dominance of older farmers warrants attention, as regeneration and the involvement of the younger generation are crucial to the sustainability of family farming and livestock businesses (Elly et al., 2024).

In terms of education and experience, both groups have relatively strong human capital. All active farmers have more than 10 years of livestock farming experience, while most inactive farmers also have more than 10 years of experience. Most respondents have a high school education or higher. The reported farming experience represents a potential resource for revitalization, although the study did not directly

Table 1. Socio-economic profile of active and inactive smallholder pig farmers in Sonder District

Variable	Category	Active	Inactive	Implications for revitalization
		(n=7)	(n=89)	
Age	< 35 years	2	10	Younger farmers provide potential for innovation and business regeneration.
	35–50 years	5	27	Productive-age farmers can support business continuity and possible re-entry into farming.
	> 50 years		52	The predominance of older inactive farmers highlights the need for succession and involvement of younger household members.
Education level	Elementary school		0	–
	Junior high school		10	May require more intensive technical and business assistance when restarting production.
	Senior high school	5	69	Provides a favorable basis for adopting improved production and business practices.
	Higher education	2	10	Can support business management, innovation, and group development.
Farming experience	< 5 years		0	–
	5–10 years		10	Existing experience can support re-entry with appropriate assistance.
	> 10 years	7	79	Extensive farming experience is an important asset for maintaining active farms and restarting inactive farms.

Source: Primary data analysis, 2025.

assess respondents current technical knowledge or readiness to resume production. Smallholder pig farming systems generally rely on household experience, family labor, and knowledge developed through long-term practice (Santa et al., 2025; Tembei et al., 2019).

This socioeconomic profile should be considered together with business characteristics, including livestock ownership, feeding practices, labor, capital, and market access. Table 2 compares these characteristics between active and inactive farmers. Table 2

compares the characteristics of active livestock farmers' businesses with the last business conditions of inactive farmers. For inactive farmers, the variables of feed, labor, business status, capital sources, and market access refer to the last conditions before production activities ceased, while the number of broodstock reflects the conditions at the time of the survey. This comparison is used to identify remaining resources and the different obstacles faced by active and inactive farmers in the revitalization process.

Table 2. Business characteristics of active and inactive smallholder pig farmers in Sonder District

Variable	Category	Active	Inactive	Implications for revitalization
		(n=7)	(n=89)	
Current number of sows	0 sows		89	The absence of breeding stock among inactive farmers indicates the need for restocking support and access to capital before production can resume.
	3 - 4 sows	7		Active farmers still maintain a smallholder breeding base that can support business continuity.
	> 4 sows			–
Main feed source	Local feed		16	Experience with local feed may support lower-cost re-entry.
	Commercial feed		60	Previous dependence on commercial feed indicates vulnerability to rising feed costs.
	Mixed	7	13	Mixed feeding may provide greater flexibility in managing feed costs.
Labor source	Family labor	7	61	Family labor remains an important resource for maintaining production and reducing restart costs.
	Family and hired labor		28	Re-entry may involve additional labor costs.
Business status	Secondary business	7	73	Revitalization should remain flexible and compatible with other household livelihood activities.
	Main business		16	These households may require stronger support to restore pig farming as an income source.
Source of capital	Own capital	7	26	Self-financing supports independence but may constrain expansion.
	Loans		20	Dependence on borrowing may create barriers to restarting production.
	Mixed		43	Indicates the importance of improved access to affordable financing.
Market access	Direct to consumers		5	Previous direct marketing experience could be developed to improve margins.
	Through collectors	7	53	Dependence on collectors suggests limited bargaining power and a need to diversify market channels.
	Mixed		31	Previous use of several market channels provides potential for more flexible marketing.

Note: Sow ownership reflects conditions at the time of the survey; other business variables for inactive farmers refer to their most recent farming activities before cessation.

Source: Primary data analysis, 2025.

Table 2 shows that all active farmers still kept 3–4 sows, while all inactive farmers had no sows at the time of the survey. Inactive households retained pig housing and reported previous farming experience. These resources may support business re-entry, subject to an assessment of housing condition, current household resources, and willingness to resume production. This difference suggests that revitalization needs to be directed differently: active farmers need support to maintain production, while inactive farmers require initial support such as replacement livestock, access to capital, and technical assistance to resume production. Approaches to smallholder livestock business recovery need to consider the capacity and resources remaining available after business disruptions (Dargantes et al., 2025; Santa et al., 2025).

Differences are also evident in feeding patterns, labor, and business status. All active farmers used mixed feed and family labor, while most inactive farmers previously relied more on commercial feed and some employed hired labor. In both groups, pig farming was generally a sideline. This situation suggests that revitalization needs to maintain the household-based nature of the business by strengthening feed efficiency, utilizing family labor, and providing flexibility in business management. The use of local resources and family labor is crucial for the sustainability of small-scale livestock businesses (Makkar, 2018; Tembei et al., 2019).

In terms of capital and marketing, all active farmers use their own capital and sell livestock through collectors, while inactive farmers previously had more diverse capital sources and marketing channels. The observed financing patterns and marketing channels suggest areas for further assessment, including access to restart capital and farmers’ bargaining position. However, these characteristics alone do not establish the severity of financial or marketing constraints. Therefore, the results of this comparison provide a quantitative basis for distinguishing between revitalization strategies that strengthen efficiency, production, and market access for active farmers and support for financing, restocking, and gradual mentoring for inactive farmers.

Local Resources and Institutional Potential for Revitalizing Smallholder Pig Farming

After describing the socioeconomic profile of farmers and the characteristics of their businesses, the next step is to identify local rural potential that can serve as a basis for developing sustainable smallholder pig farming.

Table 3 shows that the development of smallholder pig farming is based on strong local potential, particularly the availability of family labor, hereditary livestock farming experience, and community socio-cultural support for pig farming. These three components are crucial for business sustainability because they provide a relatively stable foundation for livestock maintenance, the transfer of practical

Table 3. Identification of local rural potential to support the development of smallholder pig farming

Local potential component	Field condition	Level of support	Relevance for strategy
Family labor	Available within farmer households	High	Supports business sustainability and labor efficiency
Inherited farming experience	Still maintained by farmers	High	Becomes social and technical capital in business management
Socio-cultural support	Pigs are still needed in community socio-cultural activities	High	Maintains local demand and strengthens the business position in the rural economy
Local feed resources	Available, but not yet utilized optimally	Moderate	Has the potential to reduce production costs and decrease dependence on commercial feed
Village government support	Not yet optimal, but there is room for development	Moderate	Important for integrating village programs with livestock business development
Farmer groups	Still limited and not yet functioning optimally	Low	Need to be strengthened to support access to information, markets, and business institutions

knowledge, and the sustenance of local demand. In smallholder farming systems, the combination of experience, family base, and socio-cultural ties is often a crucial factor supporting the sustainability of smallholder businesses, especially when the business is still run as a household-based smallholder farm (Santa et al., 2025; Tembei et al., 2019). This situation suggests that development strategies do not need to start from scratch but can build on local strengths already present in households and rural communities.

On the other hand, Table 3 also shows that not all local potentials have functioned optimally to support business development. The availability of local feed ingredients and opportunities for village government support are still at a moderate level, indicating significant potential that has not been fully utilized. Meanwhile, livestock farmer groups remain a weak point due to their low support and inability to play a strong role in collective business strengthening. This situation clearly suggests that future development strategies should focus on strengthening the utilization of local resources, integrating livestock development with village government support, and strengthening livestock group institutions so that existing local potential can be fully realized as a strategic strength for the sustainability of smallholder pig farming. From a village development perspective, the development of local economic potential is significantly influenced by the village government's capacity to facilitate community participation and link local potential with village development programs (Permatasari et al., 2021)

Internal and External Factors of Smallholder Pig Farming

Based on the socioeconomic profiles of farmers, business characteristics, and the potential of rural areas described in Tables 1 and 2, the next step was to identify the internal and external factors affecting the development of smallholder pig farming. In business development studies, internal factors generally relate to the strengths and weaknesses inherent in farmers and their businesses, while external factors include opportunities and threats originating from markets, policies, institutional

support, and business-environment dynamics (Purnomo et al., 2017; Sunarsi, 2024; Trabachini et al., 2025; Wheelen et al., 2018).

The identification of internal factors indicates that smallholder pig farming has major strengths in long farming experience, the dominance of family labor, a relatively adequate education level, retained pig housing and previous breeding experience, and the flexibility of household-based businesses. These findings are consistent with the characteristics of smallholder pig farming, which generally survives because it relies on household-based systems, local experience, and the socioeconomic functions of livestock in rural life (Santa et al., 2020; Tembei et al., 2019). However, these strengths are undermined by fundamental weaknesses that require attention, namely the dominance of older farmers, heavy dependence on commercial feed, pig farming as a side business, marketing dependence on collectors, and limited business capital. This indicates that the existing internal strengths are not yet fully supported by adequate business capacity, so future development should focus on improving business efficiency, reducing dependence on external inputs, strengthening farmer capacity, and improving market access.

Opportunities for revitalizing smallholder pig farming remain open through sustained local and sociocultural demand, the potential use of local feed resources, and village government support for local economic development (Permatasari et al., 2021). At the same time, farmers and key respondents reported that ASF affected four of the five study villages, causing widespread pig mortality and contributing to business cessation. These reports were corroborated by village planning officials, agricultural extension workers, records from the Agricultural Extension Center in Sonder District, and information from the Sonder District government. Although this study did not epidemiologically measure ASF prevalence or mortality, the field findings indicate that ASF strongly influenced household risk perceptions and decisions to stop or delay restarting pig farming.

Nevertheless, farmers also face several real threats, including disease risks, fluctuations in feed prices, unstable selling prices, and

Table 4. Identification of internal and external factors affecting smallholder pig farming development

No	Internal factors	Description	Category
1	Long farming experience	Most farmers have more than 10 years of pig-farming experience	Strength
2	Dominance of family labor	Household members provide the main labor for pig-farming activities	Strength
3	Relatively adequate education level	Most farmers have completed senior high school or higher education	Strength
4	Retained pig housing and previous breeding experience	Inactive farmers still retain pig housing and previous breeding experience that can support business re-entry.	Strength
5	Flexibility of household-based businesses	Smallholder household businesses are relatively adaptable to available resources	Strength
6	Farmers are dominated by those aged over 50 years	Farmer regeneration is needed to support business sustainability	Weakness
7	High dependence on commercial feed	Dependence on external feed inputs increases production costs	Weakness
8	Pig farming is still predominantly a side business	Pig farming has not yet become the main source of household income for most farmers	Weakness
9	Marketing dependence on collectors	Farmers' bargaining position remains limited in the marketing process	Weakness
10	Limited business capital	Limited capital constrains business expansion and improvement	Weakness
No	External factors	Description	Category
1	Local market demand	Demand for pigs is still available in the local market	Opportunity
2	Sociocultural demand for pigs	Pigs are still needed for community sociocultural activities	Opportunity
3	Potential of local feed resources	Local feed resources can be developed to reduce dependence on commercial feed	Opportunity
4	Village government support	Village government support can be linked to local economic development	Opportunity
5	Village economic empowerment programs	Village programs have the potential to support smallholder livestock businesses	Opportunity
6	Animal disease risk	ASF outbreaks have severely affected pig farming in Sonder District, causing widespread livestock mortality and business cessation in almost all surveyed locations, with only one location reported as unaffected.	Threat
7	Feed price fluctuations	Increasing feed prices can raise production costs	Threat
8	Fluctuations in livestock selling prices	Unstable selling prices can affect farmers' income	Threat
9	Limited veterinary services	Limited access to animal health services can hamper disease control	Threat
10	Weak bargaining position of smallholder farmers	Weak bargaining power can limit farmers' marketing benefits	Threat

smallholders' weak bargaining position in the marketing process. This mix of opportunities and threats suggests that development strategies should not rely solely on internal strengths but should also improve farmers' ability to seize opportunities while reducing vulnerability to external pressures.

The IFAS matrix shows that the internal strengths of smallholder pig farming outweigh its weaknesses, with a total strength score of 1.79 and a total weakness score of 0.85. The main strengths include long farming experience, family labor, relatively adequate education, retained pig housing and previous breeding experience, and

Table 5. IFAS matrix of smallholder pig farming

Number	Internal factors	Weight	Rating	Score
Strengths				
1	Long farming experience	0.14	4	0.56
2	Dominance of family labor	0.12	4	0.48
3	Relatively adequate education level	0.10	3	0.30
4	Retained pig housing and previous breeding experience	0.08	3	0.24
5	Flexibility of household-based businesses	0.07	3	0.21
Subtotal Strengths		0.51		1.79
Weaknesses				
1	Farmers are dominated by those aged over 50 years	0.11	2	0.22
2	High dependence on commercial feed	0.13	1	0.13
3	Pig farming is still predominantly a side business	0.10	2	0.20
4	Marketing dependence on collectors	0.09	2	0.18
5	Limited business capital	0.06	2	0.12
Subtotal Weaknesses		0.49		0.85
Total IFAS		1.00		2.64

the flexibility of household-based businesses. The main weaknesses are the predominance of older farmers, heavy dependence on commercial feed, pig farming as a side business, dependence on collectors, and limited business capital. These findings indicate that the revitalization process can build on existing household resources, but still requires improvements in business efficiency, farmer capacity, access to inputs, and market organization.

The EFAS matrix results indicate that external opportunities for smallholder pig farming are relatively greater than the threats, with an opportunity score of 1.79 and a threat score of 0.76. The main opportunities are local market demand, sociocultural demand for pigs, the potential of local feed resources, village government support, and village economic empowerment programs. The main threats that need attention are animal disease risk, feed price

Table 6. EFAS matrix of smallholder pig farming

No	External factors	Weight	Rating	Score
Opportunities				
1	Local market demand	0.14	4	0.56
2	Sociocultural demand for pigs	0.10	3	0.30
3	Potential of local feed resources	0.09	3	0.27
4	Village government support	0.12	3	0.36
5	Village economic empowerment programs	0.10	3	0.30
Subtotal Opportunities		0.55		1.79
Threats				
1	Animal disease risk	0.14	1	0.14
2	Feed price fluctuations	0.12	2	0.24
3	Fluctuations in livestock selling prices	0.08	2	0.16
4	Limited veterinary services	0.07	2	0.14
5	Weak bargaining position of smallholder farmers	0.04	2	0.08
Subtotal Threats		0.45		0.76
Total EFAS		1.00		2.55

fluctuations, fluctuations in livestock selling prices, limited veterinary services, and the weak bargaining position of smallholder farmers. These conditions indicate that the external environment is still supportive of smallholder pig farming development, but strategies are needed to reduce farmers' vulnerability to business risks.

The strategic position was determined based on the results of the IFAS and EFAS analyses. The coordinate values in the SWOT diagram were calculated using the formulas $X=S-W$ and $Y=O-T$, where S is the total strength score, W is the total weakness score, O is the total opportunity score, and T is the total threat score. The analysis showed that the total strength score was 1.79, the weakness score was 0.85, the opportunity score was 1.79, and the threat score was 0.76. Thus, the values obtained were $X=0.94$ and $Y=1.03$. These coordinates place smallholder pig farming development in Quadrant I, which means that the most appropriate strategy is the SO strategy, namely, using internal strengths to capture external opportunities. Based on these calculations, the strategic position of smallholder pig farming development can be seen in Figure 1.

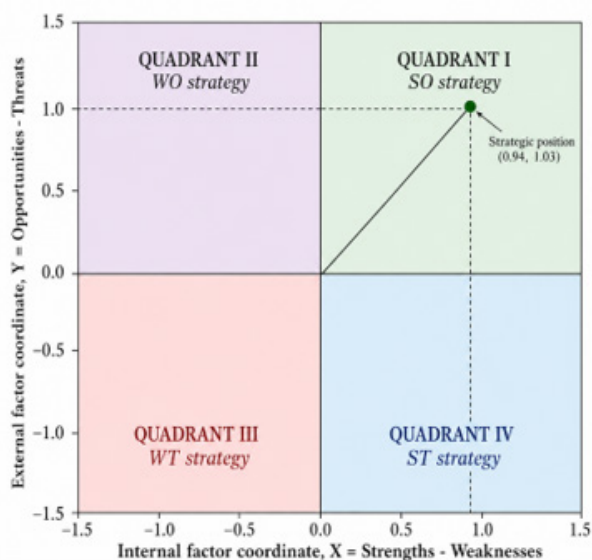


Figure 1. SWOT Matrix

Based on the SWOT matrix calculation, the strategic position of smallholder pig farming development is in Quadrant I, with coordinates $(X, Y) = (0.94; 1.03)$. This position indicates that smallholder pig farming has relatively greater internal strengths than weaknesses, while also facing greater external opportunities than threats. These conditions show that smallholder

pig farming remains in a favorable position for development, so the most appropriate strategy is the SO strategy, which uses internal strengths to capture external opportunities.

The position in Quadrant I also shows that smallholder pig farming in Sonder District still has a strong foundation for recovery and development. This foundation is reflected in farmers' long experience, the use of family labor, relatively adequate education levels, retained pig housing, previous breeding experience, and the flexibility of household-based businesses. At the same time, development opportunities remain through local market demand, sociocultural demand for pigs, local feed resources, village government support, and village economic empowerment programs. Therefore, future development should be progressive but realistic, by strengthening what farmers already have while expanding opportunities from the surrounding rural environment.

The development of sustainable smallholder pig farming should therefore begin from the existing strengths of farming households. These characteristics are in line with findings that smallholder pig farming in rural areas generally relies on household-based business systems, family labor, and local experience passed down across generations, while pigs also have strong economic and sociocultural value in rural communities (Elly et al., 2024; Manese et al., 2021; Santa et al., 2018; Tembei et al., 2019). At the farmer level, this strategy can be implemented by improving family-based business efficiency through clearer role division among household members in livestock management, feed preparation, pen sanitation, and simple business record-keeping. The experience of senior farmers should also be used as a source of local learning through experience sharing, farmer-to-farmer mentoring, and practice-based training, so that local knowledge is not lost and can be transferred to the next generation.

To take advantage of available opportunities, farmers need to be encouraged to use local village resources, especially feed ingredients available in their farming areas, so that dependence on commercial feed can be gradually reduced. This can be done through training in simple feed formulation, demonstrations on the use of local feed ingredients such as

maize and rice bran (Bunok et al., 2022), and the development of household- or group-based forage plots. Using locally available feed resources can improve efficiency and strengthen the sustainability of smallholder pig production (Makkar, 2018; Raja et al., 2022; Thanapongtharm et al., 2016). In addition, sociocultural demand for pigs can be used to strengthen local markets, for example by building more direct marketing networks to consumers, meeting customary needs, and organizing community social events, so that farmers do not rely entirely on collectors.

The role of stakeholders, particularly village governments, is crucial in supporting the implementation of this strategy. Village governments need to position smallholder pig farming as part of local economic potential that is explicitly included in village development planning documents, both in policy directions, community empowerment programs, and support for smallholder production. In this way, the development of smallholder pig farming is not implemented in isolation but is directly linked to the village development agenda. Village governments can also facilitate the establishment or strengthening of farmer groups as platforms for learning, business collaboration, and access to information and support programs. At the same time, relevant agencies and livestock extension officers need to play a role in improving farmers' capacity, particularly in business management, animal health, biosecurity, and feed processing using local resources. This approach is consistent with studies on village governance, which show that village governments play an important role in enhancing community participation, coordinating village development, and strengthening social welfare functions, so that institutional support at the village level can serve as a key driver for local economic development (Purnomo et al., 2017). In addition, the development of smallholder pig farming can be aligned with national programs through the strengthening of Village-Owned Enterprises (BUMDes) and Koperasi Merah Putih, for example, in the provision of production inputs, marketing management, access to capital, and the development of collective village-based enterprises. Thus, this strategy does not merely rely on the utilization of farmers' internal

strengths but evolves into a collaborative effort among farm households, farmer groups, village governments, and other supporting stakeholders to strengthen the sustainability of smallholder pig farming in Sonder District, North Sulawesi.

CONCLUSION

Smallholder pig farming in Sonder District retains potential for revitalization despite the predominance of inactive households. Farming experience, retained housing assets, and potentially available household resources may support revitalization, although their current suitability and economic value require further assessment. Potential support for active farmers includes improvements in feed management, animal health, biosecurity, and market access. For inactive households, assistance should begin with an assessment of readiness and resource requirements before financing or restocking is considered. The small number of active farmers and the absence of epidemiological measurements of ASF limit group-specific and disease-level inference. Revitalization should build on remaining household capacity and differing farmer readiness.

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