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Analysis Of The Advantages And Strategy For Developing An Integrated System For Using Coffee Husks As Feed For Local Sheep

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Abstract

East Java has a sheep population of 1.40 million and is also a coffee production center. Coffee husk waste reaches approximately 60%, but has not been optimally utilized as animal feed. This study aims to analyze the comparative and competitive advantages of local sheep farming businesses integrated with the use of coffee husks through conventional patterns, identify internal and external factors that influence these integration patterns, and formulate priority development strategies. The quantitative descriptive study was conducted from April–October 2026 at two integrated farms (Kandang Sejahtera, Banyuwangi and Berkah Ternak, Jember) and one control farm (Jess Farm, Jember). Business advantages were analyzed using the Policy Analysis Matrix (PAM) with Private Cost Ratio (PCR) and Domestic Resource Cost Ratio (DRCR) indicators. Strategies were formulated through the IFE/EFE and SWOT matrices using 17 respondents, then prioritized using the Quantitative Strategic Planning Matrix (QSPM). The results showed that the three farms had competitive and comparative advantages (PCR and DRCR < 1), but the integration pattern was more efficient, with PCR 0.205 and 0.175 and DRCR 0.194 and 0.165, compared to the control farm with PCR 0.371 and DRCR 0.350. The strategic position was in Quadrant I (aggressive) with coordinates (1.170; 1.375). The QSPM results determined strengthening technical assistance and quality control of coffee husk feed (ST1; STAS 7.639) as the main priority, followed by strengthening multi-party partnerships for downstreaming and marketing (SO2; 7.610), standardization of fermentation technology and technology transfer (WO1; 7.582), development of group-based fermented feed processing centers (SO1; 7.530), and implementation of safe limits for giving through demonstration plots with trained livestock cadres (WT1; 7.338). The integration pattern of local sheep and superior coffee skin is economically viable and its development needs to begin with the establishment of feed safety standards and technical assistance.

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Keywords: Local Sheep, Coffee Skin, Policy Analysis Matrix, QSPM, Crop-Livestock Integration System, SWOT

INTRODUCTION

East Java is a province with geographically close livestock and plantation resources, but their utilization is still carried out independently. In terms of livestock, East Java is recorded as the province with the second-largest sheep population nationally after West Java, with 1.40 million head in 2025 (BPS, 2026). Furthermore, East Java is also the fifth-largest coffee producer in Indonesia, with a production area of 113,332 hectares spread across the regencies of Banyuwangi, Malang, Jember, Bondowoso, and Blitar, with a total production of 68,114 tons (East Java Provincial Department of Industry and Trade, 2023).

Coffee centers in East Java are generally also locations for smallholder livestock farming, including local sheep, as smallholder coffee plantations often directly adjoin livestock farming activities. Coffee bean processing leaves behind approximately 60% of the coffee husks from total production (Berlianti et al., 2025), and due to its high water content (75–80%), this waste is prone to environmental pollution if left to accumulate unmanaged. Nutritionally, dried coffee husks contain approximately 12% crude protein, 3.67% crude fat, and 28.26% crude fiber, making them a potential feed for ruminants (Aswanto, 2023). This waste has economic value as a feed substitute, considering that feed accounts for approximately 60–70% of total livestock production costs and its availability often fluctuates during the dry season.

Research on the use of coffee husks as feed has so far focused on beef cattle and goats outside East Java, such as a study of nutrient potential in West Lampung (Aswanto, 2023) and a rice bran substitution for Wonosobo sheep in Central Java (Susanti et al., 2026). Most previous studies have been partial, addressing nutritional content, fermentation techniques, or livestock performance testing, but have failed to quantify business advantages and develop a comprehensive integrated system development strategy that encompasses technical, institutional, and regional economic aspects.

Therefore, this study aims to analyze the comparative and competitive advantages of local sheep farming businesses integrated with the use of coffee skins compared to conventional business patterns, identify internal and external factors that influence the success of the integration pattern, and formulate appropriate development strategies to optimize the integration pattern of local sheep and coffee skins in East Java.

MATERIALS AND METHODS

Types and Design of Research

This research is a quantitative descriptive study with a multi-case study approach. Competitive and comparative advantages are analyzed quantitatively through private

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price components, social prices, and divergence effects. While development strategies are formulated based on socio-economic conditions, policies, and regional potential through SWOT and QSPM analyses.

Sample and Respondents

The sample was determined purposively with the criteria of local sheep farms with a population of at least 20 sheep, having adequate financial records, and making monthly sales during the study period. Two farms that use coffee husks as feed ingredients, namely Kandang Sejahtera (Songgon Village, Songgon District, Banyuwangi) and Berkah Ternak (Sumber Lesung Village, Ledokombo District, Jember), were compared with Jess Farm (Sidomulyo Village, Silo District, Jember) as a control that does not use coffee husks. The characteristics of the three farms are presented in Table 1.

The SWOT analysis involved 17 purposively selected respondents, consisting of livestock farmers, feed quality supervisors (field and laboratory), livestock seed supervisors, veterinarians/PPL, and officials and staff of Bakorwil V Jember. The QSPM analysis involved four respondents, namely the Head of the Breeding, Feed and Livestock Production Division of the East Java Provincial Livestock Service, two first-time expert feed quality supervisors, and an experienced livestock farmer.

Table 1. Characteristics of sample farms

Aspect	Prosperous Cage (integration)	Livestock Blessings (integration)	Jess Farm (control)
Location	Songgon, Banyuwangi	Ledokombo, Jember	Silo, Jember
Type of business	Fattening and buying and selling	Breeding and fattening	Order-based fattening, cycle ≤ 1 month
Population	30–40 tails	30 tails	–
Main rations	Long bean skin 75%, coffee skin 15%, concentrate 7.5%, ampok 2.5%	Corn husk 75%, coffee husk 12.5%, rice bran 12.4%, molasses 0.54%, EM4 0.06%	Ground corn cob 70%, concentrate 15%, tofu dregs 15%, molasses
Feed processing	Complete dry feed	Fermentation 21 days in ±60 kg barrel	Mixed with each feeding, plus green fodder ±35 kg/day

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Source of coffee skin	Own garden (3.8 ha; 2.3 tons of coffee/year)	Free from local coffee farmers	Do not use
Utilization of manure	Fertilizer for coffee plantations and rice fields	Garden and rice field fertilizer	For sale, ±20 sacks/month

Source: Primary data (2026).

Location and Time of Research

This research was conducted in Sumber Lesung Village (Ledokombo District) and Sidomulyo Village (Silo District), Jember Regency, and Songgon Village (Songgon District), Banyuwangi Regency. These locations were chosen because the majority of the residents are sheep breeders and coffee farmers. The research was conducted from April to October 2026.

Data Retrieval and Collection Procedures

The data collected consists of primary data and secondary data.

1. Primary data was obtained through direct observation of farm conditions, semi-structured interviews with farm owners regarding business descriptions, use of feed ingredients, production, finance, management, and business problems, open questionnaires to identify internal and external factors, and closed questionnaires on a Likert scale of 1–5 to assess these factors.
2. Secondary data is obtained from financial records, feed usage records, literature, and related agencies.

Data analysis

Business excellence was analyzed using the Policy Analysis Matrix (PAM) (Monke and Pearson, 1989), which plots revenues (A, E), tradable input costs (B, F), domestic factor costs (C, G), and profits (D, H) at private and social prices. Input costs were allocated to tradable and domestic components using the total and direct approaches (Pearson et al., 2005). Competitive advantage was measured using the PCR and comparative advantage using the DRCR:

$$\mathbf{PCR = C / (A - B)}$$
$$\mathbf{DRCR = G / (E - F)}$$

A PCR value < 1 indicates that the business is able to pay domestic factor costs at market prices and still leave a profit (competitive advantage), while a DRCR < 1

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indicates efficient use of domestic resources at social prices (comparative advantage) (Monke and Pearson, 1989).

The development strategy was formulated using the David and David (2017) framework. The rating for each factor is the average Likert score of 17 respondents, the weight is obtained by normalizing the rating against the sum of the ratings in the internal (S + W) or external (O + T) groups so that the total weight of each group is equal to 1, and the score is the result of multiplying the weight and rating. The SWOT quadrant coordinates are calculated as X = strength score − weakness score and Y = opportunity score − threat score (Rangkuti, 2016). Alternative strategies are compiled through the SWOT matrix, then prioritized using QSPM based on the attractiveness value (AS; 1 = not attractive to 4 = very attractive), the total attractiveness value (TAS = weight × AS), and the number of TAS (STAS).

RESULTS AND DISCUSSION

Competitive and Comparative Advantage

The results of the Policy Analysis Matrix for the three farms are presented in Table 2. All farms had PCR and DRCR values less than one, indicating that local sheep fattening businesses in all three locations have both competitive and comparative advantages. However, both integrated farms were significantly more efficient than the control farms.

Table 2. Policy Analysis Matrix (PAM) and indicators of sample farm excellence (Rp)

Component	Prosperous Cage	Blessing of Livestock	Jess Farm (control)
Private price			
Acceptance (A)	29,767,500	37,012,500	37,070,000
Tradable input costs (B)	20,085,000	26,312,726	27,059,333
Domestic factor costs (C)	1,970,167	1,877,921	3,719,590
Profit (D)	7,712,333	8,821,853	6,291,077
Social prices			
Acceptance (E)	29,841,919	37,105,031	37,162,675
Tradable input costs (F)	20,135,213	26,420,770	27,126,982

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Domestic factor costs (G)	1,885,707	1,761,238	3,514,762
Profit (H)	7,821,000	8,923,023	6,520,931
Indicator			
PCR = C/(A − B)	0.205	0.175	0.371
DRCR = G/(E − F)	0.194	0.165	0.350
Private profit margin (D/A)	25.9%	23.8%	17.0%
Domestic factor cost share (C/A)	6.6%	5.1%	10.0%

Social price values are rounded to the nearest rupiah. Profit margins and domestic factor cost shares are calculated from the PAM matrix. Source: Processed primary data (2026).

The PCR values of 0.205 for Kandang Sejahtera and 0.175 for Berkah Ternak indicate that to generate Rp1.00 of added value at private prices, integrated farms only require domestic factor costs of Rp0.175–0.205, while Jess Farm requires Rp0.371, or 1.8–2.1 times greater. The same pattern is seen in the DRCR (0.194 and 0.165 versus 0.350), indicating that the advantages of the integrated pattern apply to both market and social prices. The lower the PCR value, the greater the competitive advantage (Saptana, 2020). However, because the control farm also had a PCR <1, local sheep fattening businesses in the study area are already essentially efficient, and the contribution of the integrated pattern lies in increasing this efficiency.

The difference in PCR stems primarily from the domestic factor cost component, rather than from tradable inputs: the domestic factor cost share of integrated farms is only 5.1–6.6% of revenue compared to 10.0% in controls, with private profit margins of 23.8–25.9% compared to 17.0%. Coffee husks are obtained free of charge, either from the farm's own plantation (Kandang Sejahtera) or free from surrounding farmers (Berkah Ternak). This aligns with the principle of crop–livestock integration, where byproducts from one subsystem become inputs to another, reducing dependence on external inputs (Kochewad et al., 2017; Swastika et al., 2024).

Both integrated farms also implement batch feed processing, using complete dry feed at Kandang Sejahtera and 21-day fermentation at Berkah Ternak, so labor is concentrated on mixing. In contrast, Jess Farm mixes feed at each feeding and adds approximately 35 kg of forage per day, resulting in higher domestic factor costs. Dry-processed coffee husks have a low moisture content and can be stored for more than a year (Pandey et al., 2000), and sheep manure is returned to the coffee plantations and rice fields as fertilizer, forming a closed cycle within the framework of an integrated

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farming system (Idris, 2023; Dethan et al., 2024). At the farm scale, the integrated coffee-livestock farming system in Samosir Regency increased coffee farming income by 22.63% with a R/C ratio of 2.67 (Ginting et al., 2025). This study complements these findings from the perspective of efficient use of domestic resources.

Internal and External Factors

The identification results yielded six strengths, three weaknesses, six opportunities, and three threats (Table 3). The total strengths score was 2.720 and the weaknesses score 1.550, while the total opportunities score was 2.899 and the threats score 1.524.

Table 3. Internal (IFE) and external (EFE) factor evaluation matrix of local coffee-sheep skin integration pattern

Code	Factor	Rating	Weight	Score
Strength				
S1	The abundant availability of coffee skin waste as an alternative feed ingredient	4.12	0.107	0.442
S2	The nutritional content of coffee skin (crude fiber and crude protein) is sufficient as an alternative feed for sheep.	4.06	0.106	0.430
S3	The cost of providing feed is cheaper than commercial concentrate-based feed.	4.29	0.112	0.481
S4	Supporting the principles of a circular economy and zero waste in the coffee-livestock farming system	4.47	0.117	0.521
S5	Able to reduce the smell of ammonia in livestock feces and urine	4.00	0.104	0.417
S6	Long shelf life (inhibits lice infestation in feed ingredients)	4.06	0.106	0.430
Total power				**2,720**
Weakness				
W1	The tannin and caffeine content in coffee skin has the potential to be anti-nutritional for livestock.	4.35	0.113	0.494
W2	Additional processing/fermentation is required before coffee skin is given as feed.	4.59	0.120	0.549

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W3	Feed processing and storage facilities at the farmer level are still simple.	4.41	0.115	0.507
Total weakness				**1,550**
Opportunity				
O1	Coffee skin has not been used optimally as animal feed	4.47	0.112	0.503
O2	Regional government policy support for the circular economy and downstreaming of livestock	4.35	0.109	0.477
O3	Local sheep are easily adaptable to feed and environment	4.24	0.107	0.451
O4	Opportunities for cross-institutional partnerships (multi-party collaboration schemes) for the development of feed innovations	4.41	0.111	0.489
O5	Development of research and technology for processing fermented feed based on agro-industrial waste	4.47	0.112	0.503
O6	Market and consumer trends towards sustainable livestock products	4.35	0.109	0.477
Total chances				**2,899**
Threat				
T1	The mindset of the community still views coffee skin as waste that cannot be utilized.	4.29	0.108	0.464
T2	Risk of livestock health problems if coffee skin feed is not processed and given according to standards	4.76	0.120	0.571
T3	Limited number of extension workers/technical assistants in the field	4.41	0.111	0.489
Total threat				**1,524**

Rating = average Likert score 1–5 of 17 respondents; weight = rating normalized against internal (S + W) or external (O + T) groups; score = weight × rating. Source: Primary data (2026).

The highest-scoring strengths were support for the principles of a circular economy and zero waste (0.521) and lower feed costs (0.481). These respondents' perceptions are consistent with the PAM results, which show a low share of domestic factor costs in

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integrated farms. Strength S5 (reducing ammonia odor) has a physiological basis: tannins in feed bind proteins and slow their degradation in the rumen, shifting nitrogen excretion from urine to feces (Patra and Saxena, 2011), and natural phytochemical compounds have the potential to reduce nitrogen excretion in ruminants (Zhao et al., 2023). Compounds feared as antinutrients actually provide environmental benefits at controlled levels.

The weaknesses with the highest scores were the need for additional processing or fermentation (0.549), still rudimentary processing facilities (0.507), and tannin and caffeine content (0.494). The greatest threat and highest score across the EFE matrix was the risk of livestock health problems if coffee husks are not processed according to standards (0.571), followed by limited technical assistance (0.489). These main weaknesses and threats form a single issue: technical feed safety. Coffee husks contain caffeine, tannins, and polyphenols that can reduce protein consumption and digestibility if given in excess (Pandey et al., 2000), but solid fermentation and ensilage can reduce these levels (Brand et al., 2000; Murthy and Naidu, 2012). The dominance of respondents from the technical feed and livestock health groups (53%) likely contributed to the high score for this feed safety cluster.

The highest-scoring opportunities are underutilized coffee husks and the development of research into agro-industrial waste-based feed fermentation technology (0.503 each), followed by cross-institutional partnership opportunities (0.489). Fermentation technology is readily available but requires institutional channels to reach farmers; extension and mentoring are prerequisites for the success of integrated farming systems (Utami and Rangkuti, 2021), while low knowledge and weak institutional frameworks among farmers and livestock farmers hinder the adoption of integrated systems in Indonesia (Swastika et al., 2024).

Strategic Position and Alternative Strategies

The SWOT quadrant coordinates are X = 2,720 − 1,550 = 1,170 and Y = 2,899 − 1,524 = 1,375, so the integration pattern is in Quadrant I (aggressive). This position indicates that internal strengths are greater than weaknesses and external opportunities are greater than threats, so the strategy implemented needs to support an aggressive growth policy (Rangkuti, 2016; Pearce and Robinson, 2015). The SWOT matrix produces five alternative strategies (Table 4).

Table 4. SWOT matrix of the use of coffee skin as feed for local sheep

Strategy	Alternative strategies
S–O	SO1: Development of a coffee husk-based fermented feed processing center for livestock farmers (S1, S2, S3, O4, O5). SO2: Strengthening

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	multi-stakeholder partnerships for sustainable sheep downstreaming and marketing (S1, S2, S3, O2, O5).
W–O	WO1: Standardization of fermentation technology and technology transfer to livestock farmers (W1, O4)
S–T	ST1: Strengthening technical assistance and quality control of coffee skin feed (S1, T3)
W–T	WT1: Implementation of safe limits for providing coffee skin in rations and gradual socialization through demonstration plots of livestock farmer groups with trained livestock cadres (W1, T1)

Source: Processed primary data (2026).

The SO1 strategy is supported by evidence that solid fermentation of coffee husks with Pleurotus ostreatus increases crude protein from 10.36% to 12.14% and reduces tannin from 1.02% to 0.18% and caffeine from 1.39% to 0.20%, allowing fermented coffee husks to be incorporated into up to 20% of ruminant rations (Badarina et al., 2013). Pelibuey sheep fed up to 20% coffee pulp silage did not experience a decrease in consumption, daily weight gain, feed conversion, or carcass quality (Munguía-Ameca et al., 2023). The SO2 strategy leverages regional policy support, partnership opportunities, and market trends for sustainable products; consumers concerned about sustainability have shown the highest acceptance of meat from livestock fed agro-industrial by-products (Dias Vicuna et al., 2026).

Strategic Priorities

The QSPM results are presented in Table 5. Strategy ST1, namely strengthening technical assistance and quality control of coffee skin feed, occupies the first priority with STAS 7.639, followed by SO2 (7.610), WO1 (7.582), SO1 (7.530), and WT1 (7.338).

Table 5. Results of the Quantitative Strategic Planning Matrix (QSPM) alternative strategies

Priority	Code	Alternative strategies	Internal bag	External bag	STAS
1	ST1	Strengthening technical assistance and quality control of coffee skin feed	3,808	3,830	7,639
2	SO 2	Strengthening multi-party partnerships for sustainable sheep downstreaming and marketing	3,778	3,832	7,610

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3	WO 1	Standardization of fermentation technology and technology transfer to livestock breeders	3,750	3,832	7,582
4	SO 1	Development of a coffee skin fermented feed processing center based on farmer groups	3,754	3,776	7,530
5	WT 1	Implementation of safe limits for giving coffee skin through demonstration plots with trained livestock cadres	3,590	3,748	7,338

AS = attractiveness score (1 = not attractive to 4 = very attractive), rated by four respondents; TAS = weight × AS; STAS = sum of TAS internal and external factors. Source: Processed primary data (2026).

ST1 received a full attractiveness score (4.00) on eight factors, including W1 and W2 related to feed safety, so respondents considered technical assistance and quality control as the most appropriate response to the issue. These results should be read in conjunction with Quadrant I positions: the SWOT diagram points to the S–O strategy, while the QSPM places the S–T strategy first and SO2 second. The two can be combined, with an aggressive strategy (SO2) implemented with the support of technical assistance and quality control (ST1) as prerequisites for feed safety. The attractiveness assessment by those who understand implementation capacity also aligns with the decision stage in strategic management (David and David, 2017).

The STAS differences between the strategies are relatively small, so the five strategies are complementary. WO1 provides technical guidelines, ST1 ensures these guidelines are properly implemented at the farmer level, SO2 provides institutional and market channels, and WT1 is the operational instrument for WO1 and ST1. SO1 requires facility investment, which addresses the weaknesses of W3 and the limited capital of farmers, making it more realistic to place it at a later stage. Therefore, implementation can be carried out in stages: standard setting (WO1, WT1), mentoring and supervision (ST1, WT1), partnerships and downstreaming (SO2), and strengthening scale through group-based feed processing centers (SO1).

This study has limitations. The sample size was limited to three farms due to the small number of sheep farmers implementing an integrated approach to coffee husk farming. Therefore, the PAM results only reflect the conditions of these three farms and cannot be generalized. The IFE/EFE weights and ratings are subjective and influenced by the composition of the respondents, and the perspectives of coffee farmers and market participants are not represented.

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CONCLUSION

1. Local sheep farming integrated with coffee husk utilization has a higher competitive and comparative advantage compared to conventional methods. Kandang Sejahtera and Berkah Ternak achieved PCR of 0.205 and 0.175, and DRCR of 0.194 and 0.165, respectively, while Jess Farm, as the control, achieved PCR of 0.371 and DRCR of 0.350.
2. The main strengths of the integration pattern are support for a circular economy and zero waste (0.521) and lower feed costs (0.481), while the main weaknesses and threats focus on technical feed safety, namely the need for fermentation (0.549) and the risk of livestock health problems (0.571). The integration pattern is in Quadrant I (aggressive) with coordinates (1.170; 1.375).
3. Priority strategies are strengthening technical assistance and quality control of coffee skin feed (ST1; STAS 7.639), followed by strengthening multi-party partnerships (SO2; 7.610), standardization of fermentation technology (WO1; 7.582), development of group-based fermented feed processing centers (SO1; 7.530), and implementation of safe limits for feeding through demonstration plots (WT1; 7.338), which need to be implemented in stages starting from the determination of feed safety standards.

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