Cici Nuraeni et al./Animal Production. 27 (1): 46-58, 2025
Accredited by Kemendikbudristek Dirjendiktiristek No 225/E/KPT/2022. E-ISSN 2541-5875

Livestock Business Development Strategies of Beef Cattle in Pangandaran District

Cici Nuraeni, Akhmad Sodiq, Novie Andri Setianto*, Agustinah Setyaningrum, and Rahayu Widiyanti

Faculty of Animal Science, Jenderal Soedirman University, Purwokerto, Indonesia
***Corresponding author's email: novie.setianto@unsoed.ac.id**

Abstract. The Pangandaran Regency in West Java has shown an increasing trend of beef cattle population over the past three years, reaching its peak of 18,938 in 2021, which indicates a potential opportunity for the development of beef cattle farming businesses. It is crucial to understand the key factors and strategies for this development. The study utilized a participatory survey method and the Harry King Nomogram technique to sample beef cattle farmers, collecting and analyzing the primary and secondary with descriptive, SWOT, and qualitative modeling analyses. The results showed that farmers in both lowland and highland areas were predominantly productive-aged. Performance metrics such as average service per conception and calving interval were observed at 14.48 and 2.37 in lowland areas, and 16.68 and 2.25 in highland areas, respectively. Key factors influencing the development of beef cattle farming in Pangandaran Regency included the availability of agricultural land, a supportive community environment, and effective breeding management. The SWOT analysis positioned both lowland and highland areas in quadrant I, suggesting that an aggressive growth-oriented strategy would be the most appropriate. Proposed strategies include increasing beef cattle population by optimizing agricultural land use, introducing technologies for processing forage feed and agricultural waste, aligning production with market demands through integrated farming practices, and implementing effective livestock waste management systems.

Keywords: Pangandaran regency, Beef cattle, Farm performance, Development strategy, Qualitative modeling

Abstrak. Kabupaten Pangandaran di Jawa Barat telah menunjukkan tren peningkatan populasi sapi potong selama tiga tahun terakhir, mencapai puncaknya sebesar 18.938 pada tahun 2021, yang menunjukkan peluang potensial untuk pengembangan usaha peternakan sapi potong. Sangat penting untuk memahami faktor-faktor kunci dan strategi untuk pengembangan ini. Penelitian ini menggunakan metode survei partisipatif dan teknik Nomogram Harry King untuk mengambil sampel peternak sapi potong, mengumpulkan dan menganalisis data primer dan sekunder dengan analisis pemodelan deskriptif, SWOT, dan kualitatif. Hasil penelitian menunjukkan bahwa peternak di daerah dataran rendah dan dataran tinggi sebagian besar berusia produktif. Metrik kinerja seperti rata-rata layanan per konsepsi dan interval beranak diamati masing-masing sebesar 14,48 dan 2,37 di daerah dataran rendah, dan 16,68 dan 2,25 di daerah dataran tinggi. Faktor-faktor kunci yang memengaruhi pengembangan peternakan sapi potong di Kabupaten Pangandaran meliputi ketersediaan lahan pertanian, lingkungan masyarakat yang mendukung, dan manajemen pembibitan yang efektif. Analisis SWOT menempatkan daerah dataran rendah dan dataran tinggi pada kuadran I, sehingga strategi yang paling tepat adalah strategi yang berorientasi pada pertumbuhan agresif. Strategi yang diusulkan meliputi peningkatan populasi sapi potong dengan mengoptimalkan pemanfaatan lahan pertanian, pengenalan teknologi pengolahan pakan hijauan dan limbah pertanian, penyelarasan produksi dengan permintaan pasar melalui praktik pertanian terpadu, dan penerapan sistem pengelolaan limbah ternak yang efektif.

Kata kunci: Kabupaten Pangandaran, Sapi potong, Kinerja usaha tani, Strategi pembangunan, Pemodelan kualitatif

Introduction

The demand for beef increases annually with population growth, rising incomes, and greater awareness of nutrition. According to Central Bureau of Statistics (2022), Indonesia's population increased consistently from 2020 to 2022, reaching 270.2, 272.7, and 275.8 million, respectively.. This growing population and, by extension, meat consumption, was unmatched with the declining domestic beef production (Prakoso et al., 2022). Indonesia relies on both domestic and imports production to meet this demand; the country imported 170,304.96 tons of beef in 2020 (Directorate General of Livestock and Animal Health Services, 2021). Over 90% of local beef production originates from small-scale farms (Widiati, 2014).

Cattle farming is a common activity among rural communities in West Java. Beef cattle farming is a key sector in Pangandaran Regency, with an LQ index >1, bearing significant development potential (Trisman et al. 2022) for its largest beef cattle populations, amounting to 18,938 head (Central Bureau of Statistics, 2021). These beef cattle are predominantly raised by small-scale farmers, often as a side business to agriculture farming. Data from the Pangandaran Regency Agriculture Office in 2021 show that 11,662 farmers were engaged in beef cattle breeding in typically traditional management with limited infrastructure, technology, and resources, resulting in low productivity. Therefore, it is necessary to identify alternative development models for small-scale farms for economic gains and sufficient contribution to family income. In a wider context, development of livestock subsectors, particularly beef cattle, plays an important role in the regional economy. In consideration of promising prospects for livestock development strategies in the future, this study aims to identify the influencing factors of the beef cattle farming development in Pangandaran Regency, and to develop relevant strategies of development.

Materials and Methods

This study employed a participatory survey with phased sampling. In the first phase, we purposely selected districts based on elevation, namely highland and lowland areas. The selected highland district was Langkaplancar (400-1000 masl), where three villages with the most farmers were situated: Cimanggu, Karangkamiri, and Sukamulya. The selected lowland district was Pangandaran (3-500 masl) with two villages with most farmers at the lowest elevation in the district (Wonoharjo and Sidomulyo). The total population for the study was 1,653 farmers, including 782 from Langkaplancar and 871 from Pangandaran, considering a 10% margin of error and 90% confidence level which results in a multiplier factor of 1.195. The sample size was calculated using the Harry King Nomogram: 0.04 x 1653 x 1.195 = 79.01, rounded to 79 individuals. The observed variables were beef cattle performance and factors related to development strategies. Primary data were derived from participatory surveys through interviews and Focus Group Discussions (FGDs) with farmers, and secondary data were obtained from agricultural departments, official government websites, and literature reviews. The collected data were subjected to descriptive, SWOT and dynamic modeling analysis.

Results and Discussion

Characteristics of Farmers

Understanding farmers' characteristics is fundamental to the initial development of beef cattle farming. Farmers' characteristics such as age, education level, farming experience, and cattle size, are crucial factors of farm managers which significantly influence the success of livestock farming endeavors. Efforts to foster farm development would require the first step of understanding farmers' capabilities and backgrounds related to livestock management (Nurdiansyah et al., 2020). The characteristics of beef cattle farmers in Pangandaran Regency are presented in Table 1

Based on Table 1, the highest proportion of farmers' age is 51-60 years old group, followed by 41-50 years old and under 30 years old. These age groups are considered productive age (Central Bureau of Statistics, 2023). Productive-aged group made up 91.1% of farmers in lowland areas and 100% of farmers in highland areas, providing healthy, capable manpower to support the development of beef cattle farming. According to Ibrahim, education and technology adoption is more effective when introduced to productive-aged farmers to enhance their skills and knowledge (Ibrahim, 2020).

Table 1. Characteristics of Beef Cattle Farmers in Pangandaran Regency

No	Characteristics of farmers	Lowland	Highland
1	Age		
	15-30 years	2.22%	0%
	31-40 years	11.11%	22.50%
	31-50 years	33.33%	35%
	51-60 years	44.44%	42.50%
	>60 years	8.90%	0%
2	Education		
	No formal education	0%	0%
	Elementary school equivalent	53.33%	57.50%
	Junior high school	22.22%	27.50%
	Senior high school	15.56%	15%
	College	8.89%	0%
3	Farming Experience		
	1-5 years	20%	27.50%
	6-10 years	46.67%	42.50%
	>10 years	33.33%	30%
4	Livestock Ownership		
	1-3 heads	58%	95%
	4-10 heads	38%	5%
	>10 heads	4%	0%

Note: Processed Primary Data (2023)

In terms of education, the majority of farmers in lowland and highland areas completed elementary school (SD), Indicating their basic reading ability to support knowledge acquisition.

Regarding farming experience, most farmers had 6–10 years in the field. Experience is a key factor in their success, as it enhances knowledge through daily routines and activities.

Performance level of beef cattle

The performance level of beef cattle is one of the influencing factors of beef cattle productivity. Beef cattle productivity is the combination of production and reproductive traits over a specific period, influenced by genetics, environment, and their interaction (Susanti et al., 2015). Reproductive performance can be measured by Service per Conception (S/C), the ratio of successful matings to conceptions, and calving interval (CI), the time between successive calvings. The performance level of beef cattle farming in the lowland areas of Pangandaran Regency is presented in Table 2.

Table 2 showed that the average CI was 14.48 months, indicating that beef cattle in the lowland area (Pangandaran District) produced calves within approximately 15 months. Yulyanto et al. (2014) suggest that the ideal CI is 12 months, including 9 months of gestation and 3 months of lactation. CI in this study is slightly higher than that of Sodiq et al. (2014), namely 13.7 months due to delays by breeders in remating their cows. Yuniarti et al. (2022) stated that European red cattle breeds that are not compatible to the local environmental conditions may result in lower S/C rates and, by extension, lower reproductive productivity.

The average S/C ratio in the lowland area was 2.37 and the highest was 3.0. The average S/C value in Pangandaran District was higher than that reported by Sodiq et al. (2014) in Sidareja District, Cilacap Regency, with an average of 2.4 and a maximum of 3. The normal range of S/C value according to Laurestabo et al. (2022) is 1.6-2.0.

Table 2. Performance Level of Beef Cattle Breeding in Lowland Areas

Beef Cattle Nation	Number of livestock	Min	Max	Average
Calving interval **(months)**	**32**	**12**	**24**	**14.48**
Brahman	3	14	16	15.33
Limousine	13	12	18	14,15
Ongole Crossbreed	10	14	24	15.90
Simmental	5	13	18	15.00
Pasundan	1	12	12	12.00
Service Per Conception **(S/C)**	**32**	**1**	**3**	**2.37**
Brahman	3	2	3	2.67
Limousine	13	1	3	2.00
Ongole Crossbreed	10	2	3	2.40
Simmental	5	2	3	2.40
Pasundan	1	2	2	2.00

Note: Primary Data Processed (2023)

The higher S/C ratio in Pangandaran District can be attributed to breeder-related factors, such as errors in heat detection and delays in reporting to inseminators. Limited availability of inseminators in Pangandaran District also affected the success of insemination.

Table 3 shows that the average CI (Calving Interval) and S/C values differed between the lowland area (Pangandaran District) and the highland area (Langkaplancar District). The average CI of cattle in the highland area was longer than in the lowland area due to lower success rate of artificial insemination (AI) in the highlands. Highlands have more challenging access to facilities and infrastructure, and fewer inseminators than in lowlands. There is a vast distance between highland farmers to the nearest inseminator, thus taking much longer time to reach the farmers' locations.

In Table 3, the average CI in the highland area (Langkaplancar District) is 16.18, indicating a 16-month interval before the next calving. Kustanti (2022) stated that the normal CI is 367 days or 12.2 months. The CI figure in Langkaplancar District is relatively long, probably due to inaccurate estrus detection which causes missed heats, and farmers' habit to breed their cows after weaning which results in a prolonged empty period. Another factor is cost considerations; lacking funds encouraged farmers to delay artificial insemination on their cattle.

Table 3. Performance Level of Highland Beef Cattle Breeding

Beef Cattle Nation	Number of livestock	Min	Max	Average
Calving interval (CI) **(months)**	**26**	**12**	**24**	**16,18**
Brahman	1	16	16	16.00
Limousine	15	12	16	13.40
Ongole Crossbreed	1	24	24	24.00
Simmental	6	12	16	14.00
Pasundan	3	12	14	13.33
Service Per Conception **(S/C)**	**26**	**1**	**3**	**2.25**
Brahman	1	3	3	3.00
Limousine	15	1	3	1.73
Ongole Crossbreed	1	3	3	3.00
Simmental	6	1	3	1.83
Pasundan	3	1	2	1.67

Note: Primary data processed (2023)

The average S/C rate in Langkaplancar District was 2.25, The normal S/C range according to Laurestabo et al. (2022) is 1.6-2.0. The S/C rate in Langkaplancar District is relatively high because farmers lacked both knowledge of estrus cycles and accuracy in detecting heats. Combined, these factors lead to late reporting to inseminators after the estrus period ends. Additionally, there is a huge distance between Langkaplancar District and the inseminator/agricultural office, which further creates a significant delay from reporting to insemination.

Development Strategy

Identification of Internal Factors

Internal environmental analysis was performed to identify the strengths and weaknesses in developing beef cattle in Pangandaran Regency (see Table 4). Through this analysis, it is expected that relevant stakeholders, including local government and farmers, utilize the identified strengths while mitigating the weaknesses (Hidayah et al., 2018).

Table 4 shows that the most significant strength in the lowland area of Pangandaran Regency is the supportive community environment, with a score of 0.889. The supportive community environment, referring to a platform of active farmer groups, has empowered farmers in their livestock operations. Pratama (2016) stated that the groups functioned as a cooperation body and a place to network for business.

The primary weakness in beef cattle development in the lowland area of Pangandaran Regency is unstable selling price, scoring 1.209. This issue highlights a significant challenge among farmers. According to Harsita et al. (2020), unstable prices of live cattle is a major problem affecting more than 10% of farmers, prompting them to seek assistance from middlemen known as *blantik*.

The analysis of internal variable factors subtracted the total strength (S) score by the total weakness (W), namely 3.360 - 2.947 = 0.414. This value served as the X-axis value (horizontal axis) in the SWOT diagram, demonstrating that the strength factor value was greater than the weakness factor value.

Table 4. Identification of Internal Factors (Strengths) in the Lowland Area

No	Strength	Weight	Ratings	Score
1	Availability of agricultural land	0.14	3.29	0.470
2	Abundant green fodder	0.11	3.24	0.348
3	High farmer motivation	0.07	3.04	0.217
4	Continuity with work	0.18	3.31	0.591
5	Supportive community environment	0.25	3.56	0.889
6	Abundant agricultural waste	0.21	3.47	0.743
7	Demand for organic fertilizer	0.04	2.87	0.102
	Score	**1.00**		**3,360**

Note: Primary data processed (2023)

Table 5. Identification of Internal Factors (Weaknesses) in the Lowlands

No	Weakness	Weight	Ratings	Score
1	Limited marketing access	0.10	2.80	0.280
2	Unstable selling prices	0.40	3.02	1. 209
3	The slaughterhouse was not yet available	0.30	2.93	0.880
4	The lack of livestock health services and artificial insemination	0.20	2.89	0.578
	Score	**1.00**		**2,947**

Note: Processed Primary Data (2023)

Table 6. Identification of Internal Factors (Strengths) in the Highlands

No	Strength	Weight	Ratings	Score
1	Availability of agricultural land	0.25	3.30	0.825
2	Abundant green fodder	0.18	3.13	0.558
3	High farmer motivation	0.14	3.10	0.443
4	Continuity with work	0.11	3.03	0.324
5	Supportive community environment	0.07	2.95	0.211
6	Abundant agricultural waste	0.21	3.15	0.675
7	Demand for organic fertilizer	0.04	2.45	0.088
	Score	Total		**3,123**

Note: Primary data processed (2023)

Table 7. Identification of Internal Factors (Weaknesses) in the Lowlands

No	Weakness	Weight	Ratings	Score
1	Limited marketing access	0.40	3.15	1,260
2	Unstable selling prices	0.30	3.00	0.900
3	The slaughterhouse was not yet available	0.20	2.75	0.550
4	The lack of livestock health services and artificial insemination	0.10	2.73	0.273
	Score	Total		**2,983**

Note: Primary data processed (2023)

Table 6 shows that the highest strength of beef cattle development in the highland area of Pangandaran Regency is the availability of agricultural land, scoring 0.825. Private land was utilized for feed production, maximizing agricultural waste from fields, orchards, and rice fields for potential alternative of cattle feed sources. Unused land was also considered potential for new agricultural and livestock purposes, particularly beef cattle (Kodoati et al., 2014).

Based on Table 7, the main weakness in beef cattle development in the highland area of Pangandaran Regency is limited marketing access, scoring 1.260. This issue was a major concern among farmers, as restricted road access and the distance to urban areas limited their ability to sell their cattle. Moreover, technological use, such as social media for marketing, was limited, as most highland farmers lacked proficiency or access to such technologies. This situation directly impacted cattle pricing, as limited marketing access prevented farmers from setting accurate selling prices (Oktavia et al., 2017).

Based on the analysis of internal environmental factors (strengths and weaknesses), a value of 0.141 was obtained, calculated as 3.123 - 2.983 = 0.141. The SWOT diagram used This value as the X-axis value (horizontal axis). Therefore, the strength factor value exceeded the weakness factor value.

External factors

External factor analysis is expected to identify opportunities (Table 8) and threats (Table 9) in determining the prospects for developing beef cattle in Pangandaran Regency.

Table 8. Identification of External Factors (opportunities) in the Lowlands

No	Opportunities	Weight	Ratings	Score
1	Demand for beef cattle peaks on certain days	0.33	3.24	1,081
2	Workforce is available	0.50	3.27	1,633
3	Facilities and infrastructure support are available	0.17	2.64	0.441
	Score	**1.00**		**3,156**

Note : Processed Primary Data (2023)

Table 9. Identification of External Factors (threats) in the Lowlands

No	Threats	Weight	Ratings	Score
1	Disease outbreak	0.67	2.98	1.99
2	Agricultural land use alteration	0.33	2.27	0.76
	Score	**1.00**		**2,743**

Note: Primary data processed (2023)

Table 8 shows that the biggest opportunities in developing beef cattle in the lowlands of Pangandaran Regency is labor availability, 1.633. Otoluwa (2016) mentioned that the number of family members reflected the availability of labor in local livestock farming. The biggest threat is disease outbreak, scoring 1.99. Disease outbreaks could impose losses to beef cattle breeders. Once symptoms appear on cattle, breeders tend to quickly sell the infected animal at a low price before the animals die. Disease outbreaks, such as Foot and Mouth Disease (FMD) in various regions had drastically reduced cattle prices (Rohma et al., 2022). The calculated weighted value of external environmental factors (opportunities and threats) was calculated as 3.156 - 2.741 = 0.415, demonstrating that the value of opportunity factors outweighed the threat factors. The strategy used was the S-O strategy, formulating efforts to utilize and develop existing strengths to optimize the use of open opportunities (Nursan and Sukarne, 2021).

The SWOT diagram in Figure 1 shows that the internal value was 0.414 and the external value was 0.415.

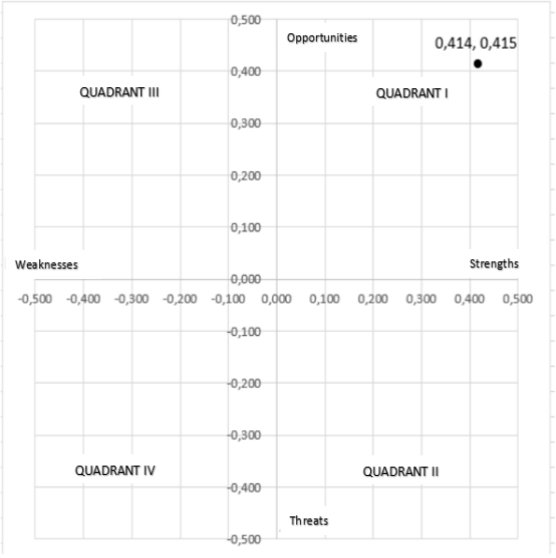

Figure 1. SWOT Diagram of Lowland Areas

The strategic formulation in the highland areas located in Quadrant I was most suitable using an aggressive strategy (growth-oriented strategy), advancing beef cattle farming efforts by leveraging existing strengths to capitalize on available opportunities. According to Rangkuti (2015), Quadrant I represents a highly favorable situation where businesses have both opportunities and strengths to exploit.

Table 10. Identification of External Factors (Opportunities) in Highland Areas

No	Opportunities	Weight	Ratings	Score
1	Demand for beef cattle peaks on certain days	0.50	3.30	1,650
2	Availability of workforce	0.33	2.88	0.958
3	Availability of facilities and infrastructure support	0.17	2.70	0.450
	Score	**1.00**		**3,058**

Note: Primary data processed (2023)

Table 11. Identification of External Factors (threats) in the Highlands

No	Threats	Weight	Ratings	Score
1	Disease outbreak	0.67	3.23	2.15
2	Agricultural land use alteration	0.33	2.38	0.79
	Score	**1.00**		**2,942**

Note: Processed Primary Data (2023)

Results of the identification of opportunities in the highland areas of Pangandaran Regency, which had the highest weight, indicated high demand for beef cattle on specific days, scoring 1.650. High demand for cattle at high prices on certain days, such as Eid al-Adha, presents an opportunity in running livestock farming. Permatasari (2015) mentioned that there is an increase in livestock sales during certain months, such as during Eid al-Adha. Sales are made to individuals and other livestock farming businesses. The threat factor in the development of beef cattle in the highland areas of Pangandaran Regency, which had the highest weight, is disease outbreaks, scoring 2.15. Disease outbreaks pose a threat to both highland and lowland beef cattle farmers. Diseases can cause livestock deaths if not promptly and properly managed. Additionally, access to animal health posts in the highlands is not yet available, making disease outbreaks the biggest threat to highland farmers. The weighted value of the external environmental factors (opportunities and threats) calculation yields a value of 0.117, from the calculation of 3.058 – 2.942 = 0.117.

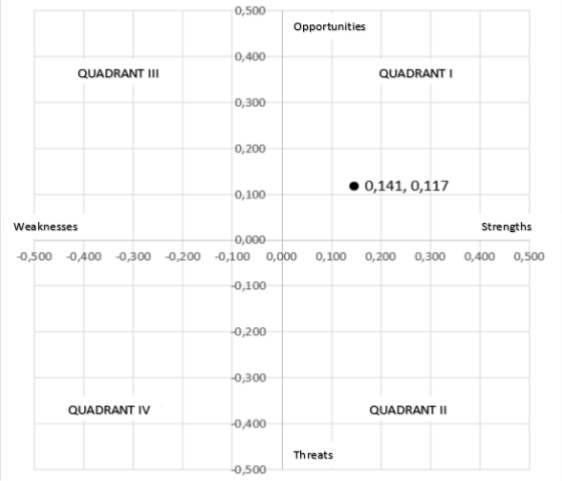

Figure 2. SWOT Analysis of Highland Areas

Development Strategy

Strategies are formulated based on the thought process of developing beef cattle farming, utilizing all strengths to maximize opportunities. Putritamara et al. (2018) stated that the analysis is grounded in logic aimed at maximizing strengths and opportunities, while simultaneously minimizing weaknesses and threats. The SWOT Matrix analysis result is presented in Table 12.

Based on the SWOT matrix, alternative strategies have been formulated. One recommended alternative strategy is the S-O strategy (Strength-Opportunity), which utilizes internal strengths to capitalize on existing opportunities (Rusman et al., 2020). The S-O strategy involves:

a) Increasing the population of beef cattle by using agricultural land for grazing and planting high-quality green fodder (S1, S2, O1, O2). This strategy is particularly applicable in highland areas where farmers own agricultural land, ensuring sufficient feed for cattle and reducing labor for foraging.
b) Introducing green fodder and agricultural waste processing (S2, S6, O3). This strategy aims to enhance feed utilization, including preservation for feed storage during dry seasons and processing to improve nutritional content from agricultural waste. Field extension officers can introduce this initiative in farming communities.
c) Adapting production to market demand by integrating farming patterns with agricultural land (S1, S3, S4, S5, O1, O2). This strategy aligns with rice and maize farming efforts, utilizing agricultural waste from these crops as feed. Utilizing agricultural waste as feed can enhance continuous feed supply.
d) Introducing livestock waste management (S4, S7, O2, O3). This strategy is essential for farmers to increase income through organic fertilizer sales. Additionally, organic fertilizer can be used to fertilize agricultural land, reducing the cost of purchasing chemical fertilizers. This effort can be facilitated by field extension officers in collaboration with farmer groups

Table 12. SWOT Matrix Analysis Results

Internal / External	Strengths	Weaknesses
	1. Availability of agricultural land 2. Abundant green fodder 3. High motivation of farmers 4. Continuity with occupation 5. Supportive community environment 6. Abundance of agricultural waste 7. Demand for organic fertilizers 8. Weaknesses	1. Limited marketing access 2. Unstable selling prices 3. Lack of Slaughterhouses (RPH) 4. Insufficient access to health services and AI (Artificial Insemination)
Opportunities 1. High demand for beef cattle on specific days 2. Availability of labor 3. Availability of infrastructure support	**S-O Strategies (Strengths-Opportunities)** 1. Increase beef cattle population by maximizing the use of land for planting high-quality fodder. 2. Introduce agricultural waste feed technology. 3. Adjust production to market demand by integrating farming and livestock management practices. 4. Introduce fertilizer processing.	**W-O Strategies (Weaknesses-Opportunities)** 1. Build partnerships with local markets and retailers, and utilize social media to expand marketing reach. 2. Collaborate with local health authorities or animal health institutions to provide health services and AI to farmers.
Threats 1. Disease outbreaks 2. Agricultural land conversion	**S-T Strategies (Strengths-Threats)** 1. Conduct training and education with the community to improve understanding of animal health aspects. 2. Develop sustainable land management models through integration with agricultural land.	**W-T Strategies (Weaknesses-Threats)** 1. Enhance farmers' capacity in animal health aspects.

Qualitative Modeling

The development of beef cattle in a region is determined by genetic factors and environmental factors. Environmental factors include the geographical conditions and characteristics of the area, availability of facilities and infrastructure, socio-cultural aspects, and economic turnover rate (Syamsu et al., 2010). These factors are interconnected and mutually influence the development of beef cattle. The geographical conditions and characteristics of the area determine the availability of agricultural land, fodder, and waste produced. The available facilities and infrastructure support farmers. The socio-cultural aspects of the community are closely related to the methods and practices of farmers and the types of livestock they develop.

The productivity of beef cattle farming in Pangandaran Regency is still relatively low. This is evident from the high S/C values of Pangandaran District and Langkaplancar District of 2.37 and 2.25, respectively. Yuniarti et al. (2022) mentioned that the breeding cows in the Sukahayu farmer group, Cijulang District, Pangandaran have suboptimal S/C values ranging from 2.5 to 3.0 on average, whereas a good S/C category falls within the range of 1.3-

1.6. Efforts to improve the productivity of beef cattle farming will need to involve various stakeholders and their interactions to foster mutual influence. These interactions form a causal relationship that identifies leverage or determining factors in enhancing the productivity of beef cattle farming (Sol'uf et al., 2021).

The Causal Loop Diagram (CLD) in this research depicts the relationships of various components for developing beef cattle farming in Pangandaran Regency. The findings from CLD show three influencing factors of beef cattle farming development in Pangandaran Regency: agricultural land availability, work suitability, and breeding management.

Loop R1 explains the component of agricultural land availability in relation to the development of beef cattle farming. Agricultural land availability in Pangandaran Regency includes vast areas of agricultural land which, according to the local government (Pangandaran Regency RKPD, 2022), consists mostly of community forest land (30,202.04 ha), followed by mixed gardens/crop fields/fallow land/forests (around 24,678.00 ha). The loop shows an evident influence of land availability on cattle farming development; the higher the agricultural land availability, the more abundant the green fodder and agricultural waste produced.

Increased green fodder and agricultural waste lead to abundant feed availability. Adequate feed availability results in the growing population of beef cattle and, by extension, optimal beef cattle development. However, the increasing population leads to a balance (B1) where feed availability decreases. This component serves as a crucial initial step in the development of beef cattle farming to achieve extensive and high-quality cattle development. Utilization of agricultural waste like straw as feed is also a crucial factor that can be improved to enhance sustainable beef cattle feed supply. Overall, based on the Loop 8 diagram, adequate availability of agricultural land plays a crucial role in providing green fodder and feed crops for beef cattle. The strategy that needs to be implemented is ensuring continuous adequate feed supply for beef cattle. This can be addressed by integrating these factors holistically, thus enabling farmers to design effective strategies to enhance beef cattle farming development and improve productivity sustainably. Lakitan and Nuni (2013) state that suboptimal land can increase its productivity through sustainable management using appropriate technology.

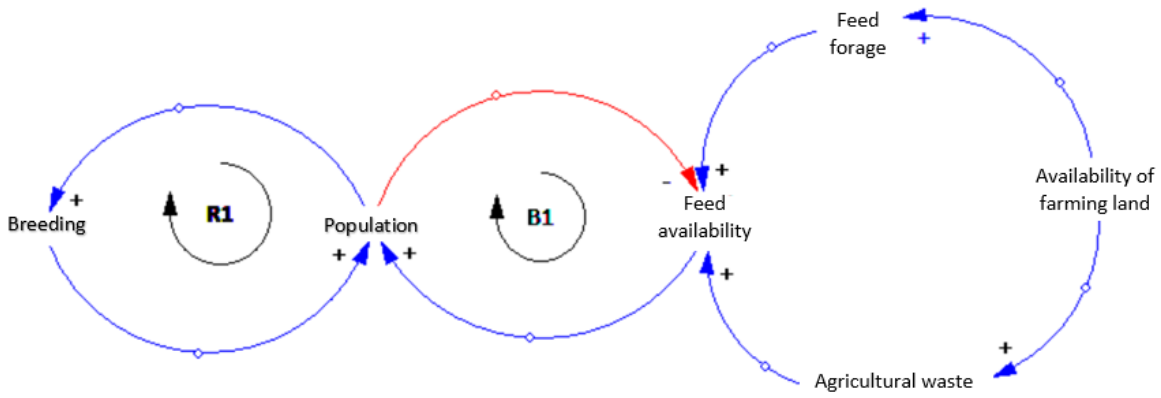

Figure 3. Availability of Agricultural Land Component in Developing Cattle Farming Business

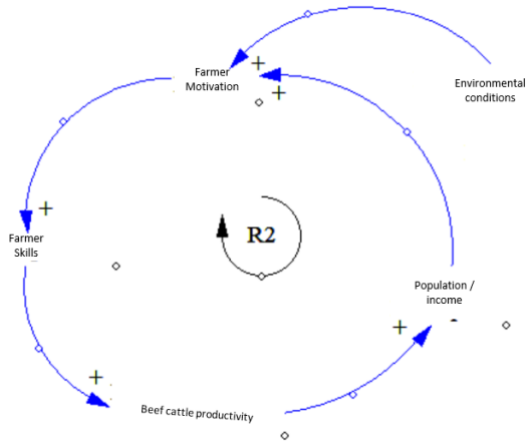

Figure 4. Component of Supportive Community Environment in Livestock Farming Development in Pangandaran Regency

Loop R2 explains the role of a supportive community environment in the development of beef cattle farming in Pangandaran Regency. In loop R2, the influence of the environmental conditions is evident. A supportive community environment enhances farmers' motivation in managing their livestock farming business. High motivation affects the farmers' skills in managing their farms. Farmers' proficiency in farm management influences livestock productivity. Improved livestock productivity increases the population size, thereby boosting farmers' income. In turn, farmers' income affects their motivation. Rusdiana et al. (2018) emphasize the significant opportunities for developing beef cattle farming, influenced by factors such as adequate farmer skills. Overall, based on figure loop 9, the strategy to focus on is ensuring farmers' high motivation. Government interventions, livestock extension services, and supportive facilities and infrastructure can enhance farmers' motivation (Alam et al., 2014).

Loop R3 elucidates the role of breeding management in the development of beef cattle farming in Pangandaran Regency. Breeding management plays a crucial role in enhancing the quality and quantity of offspring, thus positively impacting beef cattle productivity. Breeding management is closely related to the success rate of artificial insemination (AI).

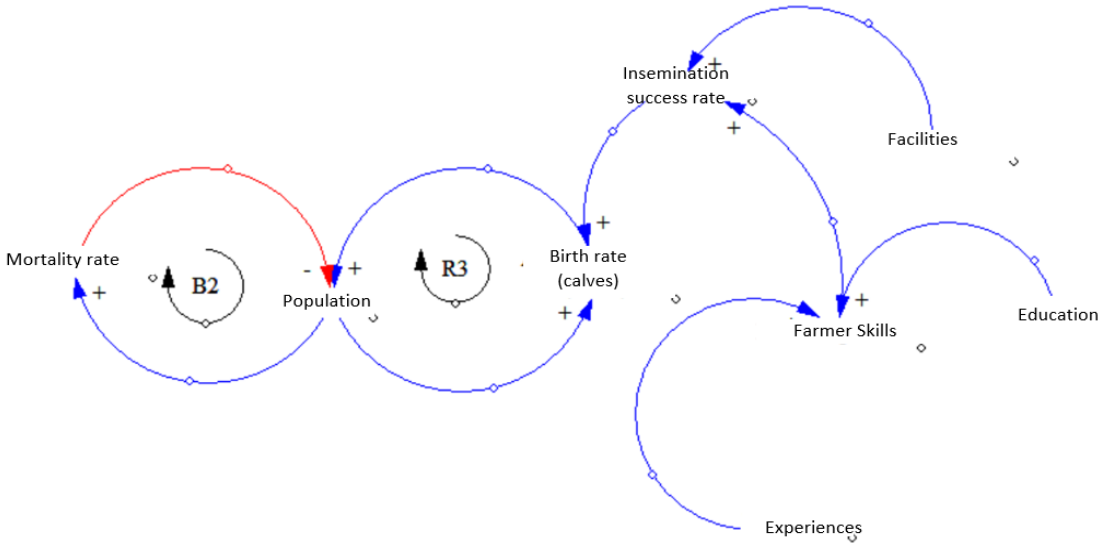

Figure 5. Breeding Management Component in Livestock Farming Development in Pangandaran Regency

Loop R3 shows an evident impact of AI success rate on the increase in beef cattle population. The success of AI is influenced by farmers' skills and the availability of facilities and infrastructure. Farmers with high levels of education and more experiences show different proficiency levels in farm management. The success of artificial insemination is significantly affected by proficiency in detecting estrus and availability of supportive facilities and infrastructure.

Success rate of AI success rate can increase the number of calf births, thus boosting the beef cattle population. However, there is a balancing effect (B2) where high population leads to increased mortality, resulting in a population decrease. The strategy to implement focuses on reducing mortality rates, which can be achieved through enhancing farmers' skills. Hanum et al. (2021) mention that farmers face risks such as AI failure and errors in detecting estrus, which can impact the success of pregnancy in cattle.

Conclusions

Breeding performance based on the average S/C values in Pangandaran Regency is relatively high, marking 2.37 in lowland areas and 2.25 in highland areas. The economic analysis indicated that beef cattle farming is profitable in Pangandaran Regency, with an R/C ratio of 1.95 in lowland areas and 1.77 in highland areas. The influencing factors of beef cattle farming development in Pangandaran Regency included the availability of agricultural land, supportive community environment, and breeding management. The interrelationship among these influencing factors includes the availability of agricultural land as a source of feed contributing to population growth. Environmental conditions enhance farmers' skills, thereby increasing livestock productivity. Breeding management, particularly the success rate of artificial insemination, significantly affects population growth. This study suggests that the most suitable intervention for beef cattle farming development in Pangandaran Regency is a set of aggressive growth-oriented strategies, which include 1) increasing beef cattle population integrated with agricultural land; 2) introducing technology processing of forage and agricultural waste; 3) adapting production to market demands and integrating beef cattle with agricultural land; and 4) introducing agricultural waste processing.

References

Alam, A., & Dwijatmiko, W. S. (2014). Motivation of farmers towards beef cattle farming activities in Buru District, Maluku Province. AGROMEDIA: Scientific Journal of Agricultural Sciences, 32(2), 75-89.

Badan Pusat Statistik. (2021). Population of Beef Cattle in Pangandaran Regency 2019-2022 (heads). Retrieved June 21, 2023, from https://jabar.bps.go.id/indicator/158/255/1/populasi-hewan-ternak-.html

Direktorat Jenderal Peternakan dan Kesehatan Hewan Kementerian Pertanian RI. (2023). Livestock and Animal Health Statistics. Retrieved August 5, 2023, from https://satudata.pertanian.go.id/assets/docs/publikasi/statistik_Peternakan_dan_Kesehatan_Hewan_2022_compressed.

Hanum, L., Nofianti, S., & Raflis, H. (2021). Risk analysis of beef cattle agribusiness production in Limapuluh Kota District. Proceedings of the National Seminar, 280-288.

Harsita, P. A., & Amam, A. (n.d.). Main problems in beef cattle farming at the farmer level using the Vilfredo Pareto Analysis approach. In Proceedings of the National Seminar on Livestock and Veterinary Technology (pp. 254-262).

Hidayah, N., Guntoro, B., Sulastri, E., & Suranindyah, Y. Y. (2018). Alternative development strategies for dairy cattle farming based on SWOT analysis in Boyolali District. Journal of Agricultural Extension Development, 15(27), 83-93.

Ibrahim, Supamri, & Zainal. (2020). Analysis of factors affecting the income of smallholder beef cattle farmers in Lampasio Subdistrict, Tolitoli Regency, Central Sulawesi. Journal of Social and Agricultural Economics, 13(3), 307-315.

Kodoati, G., Waleleng, P. O., Lainawa, J., & Mokoagouw, D. R. (2014). Analysis of natural resources potential, labor, agriculture, and plantation on the development of beef cattle farming in Eris District, Minahasa Regency. ZOOTEC, 34, 15-26.

Kustanti, N. O. A., & Panggah, P. (2022). Reproduction performance of beef cattle in Blitar City. Journal of Science Nusantara, 2(4), 143-146.

Lakitan, B., & Nuni, G. (2013). Policy of technological innovation for sustainable management of suboptimal land. In Proceedings of the National Seminar on Suboptimal Lands (pp. 1-11).

Laurestabo, A. S., Poli, Z., Lomboan, A., Bujung, J. R., & Paath, J. F. (2022). Evaluation of the application results of artificial insemination technology in beef cattle in Sangkub Subdistrict. ZOOTEC, 42(1), 220-228.

Nurdiyansah, I., Dadang, S., & Heri, D. P. (2020). Relationship between farmer characteristics and ownership scale of dairy cows in Kabawetan Subdistrict, Kepahiang Regency. Bulletin of Tropical Animal Science, 1(2), 64-74.

Nursan, M., & Sukarne, S. (2021). Development strategy of beef cattle agribusiness in West Sumbawa Regency. Journal of Cemara Agriculture, 18(2), 21-32.

Oktavia, H. C., Cahyadi, E. R., & Syamsun, M. (2017). Role of People's Livestock Schools in Increasing Added Value for Beef Cattle Farmers in Muara Enim Regency. Journal of Animal Production and Technology Results, 5(2), 71-77.

Otoluwa, M. A., Salendu, A. H., Rintjap, A. K., & Massie, M. T. (2016). Prospects for the development of beef cattle farming in Bolangitang Timur Subdistrict, North Bolaang Mongondow Regency. Zootec, 36(1), 191-197.

Permatasari, R. (2015). Feasibility study of cattle farming using oil palm waste at PT. Citra Borneo Indah, Central Kalimantan. JBTI: Journal of Business: Theory and Implementation, 6(1), 65-78.

Prakoso, L. D., Darmansah, D., Widia, T., & Hanifah, H. S. (2022). Implementation of the Moving Average method in the analysis of the beef supply chain in Indonesia. JURIKOM (Journal of Computer Research), 9(3), 623-628.

Pratama, B. P., Ery, S., & Ermy, T. (2016). Role of farmer groups in increasing the income of independent oil palm farmers in Bukit Lingkar Village, 84 Batang Cenaku Subdistrict, Indragiri Hulu Regency. (Doctoral dissertation, Riau University).

Rangkuti, F. (2015). SWOT Analysis. Gramedia Pustaka Utama. Jakarta.

RKPD Kabupaten Pangandaran. (2022). Topographic conditions of the region in Pangandaran Regency. Retrieved November 1, 2023, from https://bkad.pangandarankab.go.id/transparansi-keuangandaerah/rkpd/ rkpd tahun 2022/

Rohma, M. R., Ahmad, Z., Herlinda, P. U., Hani, A. K., & Desy, C. W. (2022). Cases of foot and mouth disease in Indonesia: epidemiology, disease diagnosis, incidence rates, disease impacts, and control. National Conference of Applied Animal Science, 15-22.

Rusdiana, S., & Praharani, L. (2018). Development of smallholder beef cattle farming: policy of beef self-sufficiency and feasibility of livestock farming. In Forum of Agro-Economic Research, 36(2), 97-116.

Rusman, R. F. Y., Hamdana, A., & Sanusi, A. (2020). Development strategy of beef cattle farming in Lau Subdistrict, Maros Regency. JBMI (Journal of Business, Management, and Informatics), 17(2), 120-129.

Sodiq, A., & Hidayat, N. (2014). Performance and improvement of beef cattle production systems based on groups in rural areas. Agripet Journal, 14(1), 56-64.

Sol'uf, M. M., Krova, M., & Nalle, A. A. (2021). Understanding farmer management in increasing the productivity of beef cattle farming in Kupang Regency, East Nusa Tenggara Province. Journal of Indonesian Animal Science, 16(2), 156-163.

Susanti, A. E., Ngadiyono, & Sumadi. (2015). Estimation of Beef Cattle Output in Banyuasin Regency, South Sumatra Province. Journal of Sriwijaya Livestock, 4(2), 17-28.

Syamsu, J. A., & Mawardi, A. A. (2011). Dynamic System Approach in Modeling the Utilization of Local Forage Resources for Beef Cattle Development. Proceedings of the National Livestock Seminar, 294-306.

Trisman, I., Sulaeman, M. M., & Sulistyati, M. (2022). Development potential of livestock-based livestock business based on population and institutional in West Java Province. Mimb. Agribusiness J. Thought. Soc. Sci. Sci. Agribusiness, 8(1), 490.

Yulyanto, C. A., Trinil, S., & Ihsan, M. N. (2014). Reproduction performance of Ongole Crossbred (PO) and Limousin Crossbred cattle in Sawoo Subdistrict, Ponorogo Regency and Tugu Subdistrict, Trenggalek Regency. Indonesian Journal of Animal Science, 24(2), 49-57.

Yuniarti, E., Ismiraj, M. R., Mutaqin, B. K., Mansyur, M., Indrijani, H., Heriyadi, D., & Pratama, A. (2022). Assistance to Sukahayu Livestock Groups in Kertayasa Village, Cijulang, Pangandaran as Efforts to Identify Livestock Productivity Issues. Farmers: Journal of Community Services, 3(2), 29-31.