

THE PRIORITY OF BEEF CATTLE FARM DEVELOPMENT STRATEGY IN SEMARANG REGENCY USING AHP AND SWOT (A'WOT) METHOD

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Abstract: The development of a directed and sustainable beef cattle farm can be achieved if the development strategy plan is based on existing real problems. This study aims to determine the priority of beef cattle farm development strategies in Semarang Regency, Central Java Province, Indonesia. The A'WOT method was applied in this study, by integrating strengths, weaknesses, opportunities, and threats (SWOT) and the Analytical Hierarchy Process (AHP). After determining the strengths, weaknesses, opportunities, and threats found in beef cattle farm business, group weights and SWOT factors were calculated using the AHP method, the results of which were the three priority strategies with the highest scores. These strategies can be summarised as follows: (1) optimising the utilisation of forage through *silage* and *hay* making, (2) optimising the provision of suitable land and meeting the technical requirements of livestock, and (3) optimising farmers' ability to access capital. It was concluded that sustainable beef cattle farm business in Semarang Regency could be improved through the application of priority strategies focusing on feed technology, land suitability, and access to capital. Findings also demonstrated that the A'WOT method is useful and effective in determining livestock sector strategies.

Keywords: Beef cattle, AHP, SWOT, sustainability livestock sector.

Introduction

Food security is a very important issue for Indonesia, given the nation's large and growing population. Fulfilling food needs is absolute, including the livestock sector. Cattle-farming in Indonesia is faced with very complex problems with unsustainable status (Syarifuddin, 2009; Sutanto & Hendraningsih, 2011). Post 2000, the government has made various efforts to realise beef self-sufficiency. First, in 2000-2005 with a programme called the Beef Sufficiency Program, but it did not provide significant results. Secondly, in 2005-2010 with the Program to Accelerate Beef Self-Sufficiency Achievement, the results were also similar to the previous programme. Third, in 2010-2015 with the Independent Beef Support Program, it did not show maximum results (Paly *et al.*, 2013; Ariningsih, 2014; Nuhung, 2015). The government keeps striving to achieve self-sufficiency in beef up to now. It includes encouraging increased community participation

and investment in rural beef cattle farms (Suresti & Wati, 2013).

Beef products are a source of protein, fat and some functional compounds that are important as food intake for humans. Not only for food but beef also has a close relationship with health, economy and culture (Pighin *et al.*, 2016). Beef consumption is an effort to promote nutritional security in developing countries, such as in Indonesia. Demand for meat generally increases rapidly in developing countries (Thornton, 2010), along with the increasing welfare and lifestyle of the people. In Indonesia, it is estimated that in 2020 beef consumption will reach 3,36 kg per capita per year (Agus & Widi, 2018). The high public demand for beef is not accompanied by sufficient domestic production. There is a gap between demand and supply which is increasingly widening, where beef production only meets about 40% of the national demand for meat (Prasetiyono *et al.*, 2007; Agus & Widi, 2018). So far, most of the

beef production in Indonesia (78%) comes from traditional livestock. The shortfall is fulfilled by 22% of imports especially from Australia (Zakiah *et al.*, 2017).

The low performance of the development of beef cattle farms as mentioned above also occurs in Semarang Regency. Beef cattle population has declined for three consecutive years, as evidenced by data (BPS Kabupaten Semarang, 2018) that the number of beef cattle is 53.135 (2014), 49.172 (2015) and 46.238 (2016). The decline in livestock population is caused by various factors, both technical and non-technical, such as issues of policy, management, and coordination between stakeholders. Government policies that are less effective are the upstream of the low performance of the development of beef cattle farms (Nuhung, 2015). Effective policies must be preceded by comprehensive strategic planning. However, the beef cattle farm development strategy that has been compiled so far has in fact not provided optimal results, or in other words, the policies implemented have not been in line with expectations (Mulyo *et al.*, 2012).

Many studies reported that the low performance of livestock development in Indonesia is due to the lack of farmer involvement in the policy planning process (Iqbal, 2007), whereas beef cattle business is dominated by traditional farmers, most of whom are not accompanied by adequate capital and management (Malotes, 2016). Farmers only become the object or recipient not the subject of the programme and as a result the policies applied are less acceptable. Decision making regarding the right strategy for the development of beef cattle farming is indeed difficult due to various criteria or factors (such as environmental, economic, social) and multi-stakeholders.

Analysis of strengths, weaknesses, opportunities, and threats (SWOT) has been the main framework in the process of formulating development strategies in various sectors (Arslan & Er, 2008; Helms & Nixon, 2010; Akbulak & Cengiz, 2014). Integrating SWOT with the analytical hierarchy process (AHP) method

known as A'WOT makes it possible to achieve more analytical results, providing significant improvements in the process of decision making and public acceptance (Kajanus *et al.*, 2004; Huang *et al.*, 2011; Akbulak & Cengiz, 2014; Alitaneh & Golsheykhi, 2015). This study aims to determine the priority of beef cattle farm development strategies in Semarang Regency using the A'WOT method.

Materials and Methods

This study uses a combined method (qualitative-quantitative). The location of the study was in the area of Semarang Regency, Central Java Province, Indonesia. The maintenance pattern of beef cattle that is often found in the research area is an intensive maintenance. The majority of the population are traditional farmers with <10 head of beef cattle, while large-scale livestock (feedlot) with livestock raising >500 animals are only found in two sub-districts, namely: Getasan, and Ungaran Barat. Figure 1 shows the location of the study.

The integration of the SWOT and AHP methods known as A'WOT was used in this study. The factors that influence the development of beef cattle farms in Semarang Regency are described in detail through determining their current strengths and weaknesses, opportunities that arise, and possible threats. The preparation of each factor that is included in the internal and external groups in the SWOT method is the result of literature studies and preliminary interviews with the farmers, the results of which are then discussed. The assessment was made of the importance level of using the AHP method by policy makers as experts. Version 11 software *Expert Choice* was used to facilitate calculations in this analysis.

The purposive sampling technique, also called judgment sampling, is the deliberate choice of an informant due to the qualities the informant possesses. It is not a non-random technique that does not need underlying theories or a set number of informants (Tongco, 2007). Key informants became very important

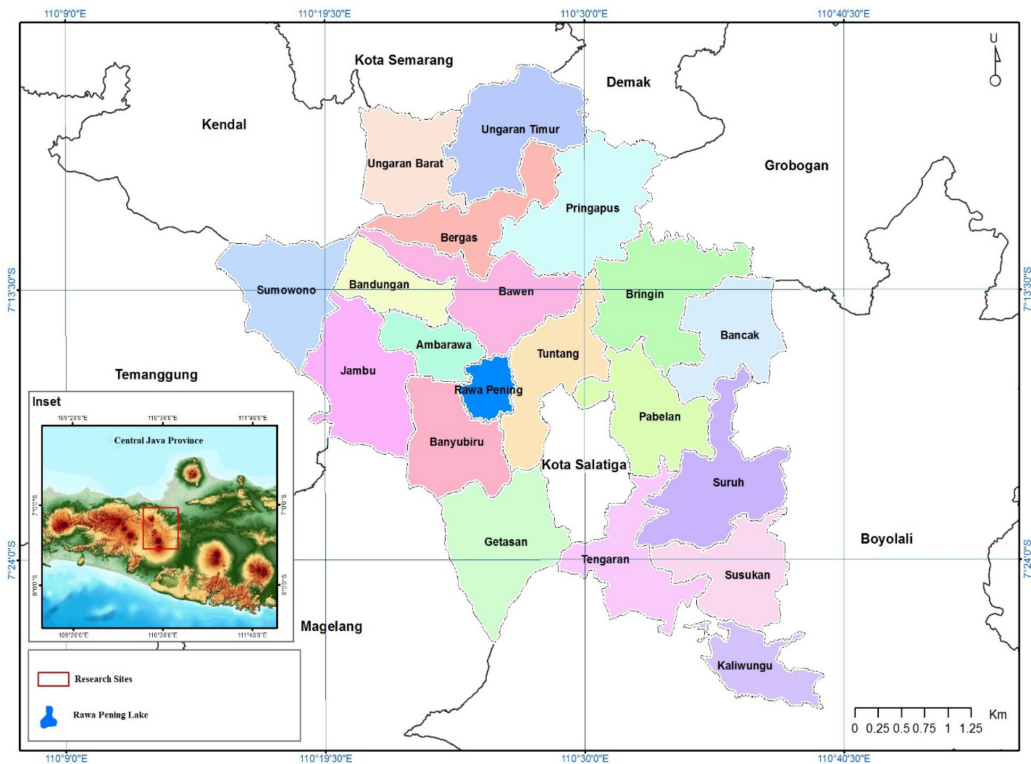


Figure 1: Study area in Semarang Regency, Central Java Province, Indonesia

guidelines as guides or providers of information needed by researchers (Claire Jarvis *et al.*, 2004; Lyon & Hardesty, 2005; Cruz García, 2006). The selected informants were policy makers (experts) because they were able to provide a better focus or understanding regarding the problems faced (Aydiner *et al.*, 2016) especially in developing beef cattle farms.

There are 4 informants, each of whom was from: (1) Animal Husbandry and Animal Health Service of Central Java Province, Indonesia (2) Regional Planning, Research and Development Agency of Semarang Regency, Indonesia (3) Agriculture, Fisheries and Food Agency of Semarang Regency, Indonesia and (4) Lecturer of Faculty Animal Husbandry and Agriculture, Diponegoro University, Indonesia. A detailed description of how the A'WOT method was applied is further described in the following section.

Weights Allocation of Group and SWOT Factors Using the AHP Method

Weights of group and SWOT factors were determined by considering the level of influence on the development of beef cattle farms. Weight reflects the relative importance of each factor and therefore must be chosen carefully (Mishra *et al.*, 2015). The weight of all SWOT factors was determined using the Analytic Hierarchy Process (AHP) method.

Application of the Analytic Hierarchy Process (AHP) Method

AHP method is based on hierarchy making to analyse complex and multi-criteria problems (Saaty, 1980; 2008). AHP analysis can be applied in various fields such as project management, strategy planning, and the selection of policy alternatives (Giri & Nejadhashemi, 2014), including in the beef cattle farming sector. AHP is considered to be able to provide effective

solutions for decision making by determining the relative priorities of the criteria or proposed factors (Ishizaka & Labib, 2011). Policy makers (experts) assess each factor using a pairwise comparison matrix, based on the scale shown on Table 1. The principle of AHP analysis is to use numerical techniques to obtain quantitative values from verbal comparisons conducted (Kurttila et al., 2000).

Table 1: AHP fundamental scale

Intensity of Interest	Definition
1	Equal
3	Moderate
5	Strong
7	Very strong
9	Extreme important
2, 4, 6, 8	Middle value between two adjacent values

Source: (Saaty, 1980; 2008).

Through pairwise comparison, AHP is able to calculate weights for each factor by taking the largest eigenvector of the order n matrix (Feizizadeh et al., 2014). The matrices are generally reciprocal, expressed mathematically as: $n(n-1) / 2$, comparisons are made for n number of elements in pairwise comparison matrices (Akinci et al., 2013). After pairwise comparison matrices are made, the eigenvectors or normalised weight factors (Saaty, 1980; 2008) are calculated. AHP is able to identify inconsistent perception given by experts. This is one of the advantages of the AHP method (García et al., 2014). Consistency ratio (CR) is a benchmark or the magnitude of acceptable values from expert perceptions (Chen et al., 2010; Park et al., 2011), shown in equation (1). The magnitude of the CR value depends on

the consistency index value (CI) and random inconsistency (RI), shown in equation (2).

$$CR = \frac{CI}{RI} \tag{1}$$

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{2}$$

Equation (2) represents the CI value, where λ_{max} is the maximum eigenvalue of the pairwise comparison matrix, and n is the number of factors found in each matrix. RI is an inconsistency ratio value, depending on the order of the matrix specified by Saaty (1980) shown in Table 2. If the CR value is >10% or 0.1 then the expert judgment must be repeated or improved. Conversely, if the CR value is <0.1, the assessment results are declared valid and consistent.

Priority Strategy for Developing Beef Cattle Farms in Semarang Regency

Each policy maker (expert) has quantitative values from the group and SWOT factors through the AHP method. Each perception from the expert is then combined using a geometric average (equation 3), resulting in a joint assessment. This combined assessment produces new weights for each group and SWOT factors (Saaty, 2008).

$$GM = \sqrt[n]{(X1)(X2)...(Xn)} \tag{3}$$

GM is a geometric average and X is the value of each factor in a pairwise comparison matrix (scale 1-9). Definition X1 is the first expert, X2 is the second expert, Xn is the nth expert, and n is the number of informants (experts) who carry out the assessment.

Determination of priority strategies is carried out by considering the results of a joint assessment of experts. The group weight is

Table 2: Random inconsistencies (RI)

Matrix Order (n)	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.46	1.49

Source: (Saaty, 1980; 2008)

multiplied by the weight of each SWOT factor resulting in global weights. The global weight with the highest value is used as the priority of the proposed development strategy to be applied.

Results

Based on the SWOT analysis, there are a total of sixteen factors that influenced the development

of beef cattle farms in Semarang Regency. Each group of strengths, weaknesses, opportunities, and threats was composed of 4 factors in it (Table 3). A joint assessment of policy makers (experts) who considered group weight and SWOT factors is shown in (Table 4).

The weight of the SWOT results from the perceptions of all experts combined with geometric averages (Table 4) show that the

Table 3: SWOT factors for development of beef cattle farming in Semarang Regency

Strengths	Weaknesses
Availability of forage (S1)	Low quality fodder (W1)
Availability of beef cattle land (S2)	Capital limitations (W2)
Potential marketing of livestock products (S3)	The spread of livestock officers is uneven (W3)
Availability of business development supporting facilities (S4)	The quality of farmers and farmer groups is limited (W4)
Opportunities	Threats
High demand for beef (O1)	Marketing and trading system (T1)
The trend of rising beef prices (O2)	Environmental pollution issues (T2)
The livestock industry infrastructure is quite adequate (O3)	The role of large farmers (feedloters) is limited (T3)
Beef self-sufficiency policy (O4)	Land conversion (T4)

Table 4: Group and SWOT factor weights

SWOT Group	Group Weight	SWOT Factor	Factor Weight	CR	Global Factor Weight
Strengths	0.4	Availability of forage	0.356	0.01	0.142
		Availability of beef cattle land	0.352		0.141
		Potential marketing of livestock products	0.092		0.037
		Availability of business development supporting facilities	0.2		0.08
Weaknesses	0.255	Low quality fodder	0.292	0.01	0.074
		Capital limitations	0.366		0.093
		The spread of livestock officers is uneven	0.101		0.026
		The quality of farmers and farmers groups is limited	0.241		0.061
Opportunities	0.107	High demand for beef	0.232	0.03	0.025
		The trend of rising beef prices	0.105		0.011
		The livestock industry infrastructure is quite adequate	0.267		0.028
		Beef self-sufficiency policy	0.396		0.042
Threats	0.238	Marketing and trading system	0.316	0.004	0.075
		Environmental pollution issues	0.127		0.03
		The role of large farmers (feedloters) is limited	0.358		0.085
		Land conversion	0.199		0.047

SWOT group with the highest priority is the strength group (40%) followed by the weakness group (25.5%), the threat group (23.8 %), and the opportunity groups (10.7%). Policy makers (experts) agreed to further optimise the strength of the Semarang Regency region in supporting the development of beef cattle farms.

Based on Table 4, it is known that the highest priority factor in the ‘strength’ group is the availability of forage (35.6%). The highest priority in the ‘weakness’ group is the factor of limited capital (36.6%). The government policy factor for self-sufficiency in beef is the highest priority (39.6%) in the ‘opportunity’ group. Meanwhile, the limited role of large-scale farms (feedloters) is the highest priority (35.8%) in the ‘threat’ group.

The strategy for developing beef cattle farm is determined based on the highest global weight. The global weight of the SWOT factor which occupies the top three (Table 4) includes: availability of forage (14.2%), availability of beef cattle land (14.1%), and capital limitation (9.3%). The proposed strategy and scope are summarised below and shown in Figure 2.

The first strategy was to optimise the natural resource potential of Semarang Regency. The most important potential of natural resources for beef cattle farming is the availability of forage as animal feed. Forage production in each sub-district must be calculated so that estimates of the beef cattle population that can be accommodated in the region are known. The fact is that the production of fiber (grass) feed is abundant during the rainy season, but is difficult for farmers to obtain during the dry season. Preserving fresh forages through the manufacture of *silage* or *hay* can be one solution to overcome the problem of lack of fresh forage in the dry season.

Silage is a forage preservation product through the effect of acidity by anaerobic fermentation process. The principle of making *silage* is forage fermentation by microbes that produce a lot of lactic acid. Lactic acid produced during the fermentation process will act as a preservative so it can suppress the growth of decomposing microorganisms (Naif *et al.*, 2016). Making *silage* is intended to optimise the preservation of nutrient content found in

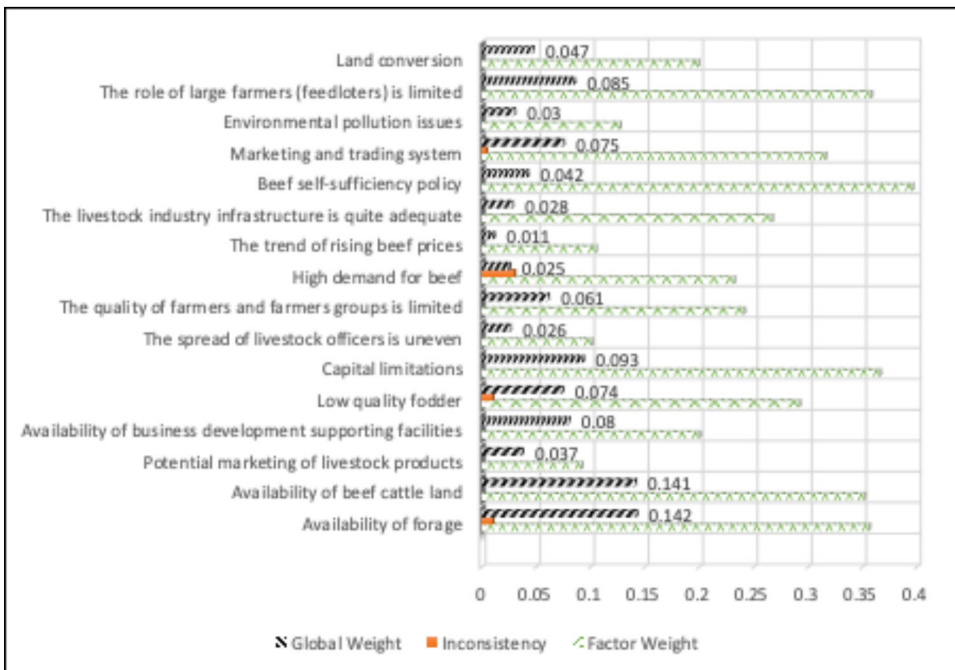


Figure 2: Priority strategy for the development of beef cattle farm in Semarang Regencyx

forages or even to improve its quality (Khan *et al.*, 2004). The advantages of making *silage* are longer shelf life, easier to digest livestock, and more carotene content in the forage. Carotene compounds are also known to increase animal fertility.

Hay is a forage preserved by drying, aiming to reduce the water content so that it reduces the activity of fungi, bacteria and enzymes which negatively affect the quality of forage. *Hay* production aims to minimise the loss of dry matter to provide fodder contains good nutrient. Making *hay* from grass is best and profitable to be applied in the tropics because the forage drying can be done naturally using sunlight (Sirait, 2017). *Hay* has even been very commonly used as animal feed in countries with four seasons, when fodder cannot be obtained during winter. *Hay* as forage has several forms such as *long hay*, *cubed hay*, *baled hay*, and *shredded hay*.

Research on alternative feed sources for beef cattle by utilising agricultural, plantation and food industry waste has been carried out by many universities and research institutions. The nutrition quality of agricultural and plantation waste can be improved through fermentation, supplementation, and manufacturing of complete feed. The results of these studies need to be socialized to farmers so that they are able to apply them in the field to increase the production and productivity of cultivated beef cattle.

The second strategy is to provide suitable land and meet the technical requirements of livestock. The government must ensure the availability of land for beef cattle farms, including land status that must be clear and have legality. One effort that can be made to realise this is the local government conducts a potential and appropriate land inventory for the development of beef cattle farms equipped with maps, the condition of available infrastructure, including the availability of water sources. These suitable and available lands are then offered to investors by a mechanism and system that guarantees the ease of investment.

The development of beef cattle farms should be directed to the development of medium to large scale farms (feedlot). Feedlot is a driver for the development of traditional livestock because it is able to meet the economy scale of cattle business. If the economy scale is fulfilled, then there will be efficiency and optimisation of resource use, so that the result will encourage the increase of domestic beef products competitiveness. Investment in the development of beef cattle farms can be carried out from upstream to downstream such as: in the field of nurseries (through the construction of breeding farms), in the field of livestock cultivation (building feedlot and slaughterhouses), as well as in the feed and pharmaceutical industries (development of fodder processing industry). Flexible government policies will determine the success of the development of beef cattle farming industry, especially if it involves the business world that requires business certainty and a conducive business climate (Nuhung, 2015).

The third strategy is to increase the ability of farmers to access capital or financing. Traditional farmers are small scale farmers with limited maintenance of beef cattle due to limited business capital. Farmers have low access to banks, both because of their ignorance and because of banking policies that have not fully aligned with these farmers. Traditional farmers need to be encouraged to become commercial farmers that are integrated with the market. One effort that can be done is through the application of a plasma core development pattern.

The plasma core philosophy is to integrate small businesses (traditional farmers) with big entrepreneurs (investors). Farmers have land, labour, experience in raising beef cattle, and can provide cattle cage, but on the other hand have limited capital, technology, market access, and access to information. While investors find it difficult to find land to meet the scale of business, and difficulties in providing labour, they have strengths in the aspects that are the limitations of traditional farmers. Through collaboration between the two, strong synergy

is formed. The plasma core pattern is able to encourage and motivate traditional farmers to develop their businesses so that production capacity becomes greater. The government functions as a facilitator, coach, and controller so that the pattern of cooperation can develop as planned. The development of beef cattle farms with plasma core patterns will form a cattle farm agribusiness area which is a regional development model (Muslim, 2006).

Discussion

Nowadays, the Indonesian government keeps striving to achieve self-sufficiency in beef considering that public consumption is increasing every year. The development of beef cattle farms in potential areas is being increasingly intensified. Semarang Regency is one of the areas in Central Java Province that has the potential to develop beef cattle farms because it has abundant natural resources in the form of land for livestock cultivation and land for growing forage. Determination of effective livestock development strategies is important so that the potential in the region can be utilised sustainably.

Analysis of strengths, weaknesses, opportunities, and threats (SWOT) is a method that can be used to determine accurate strategies, including in the beef cattle sector (Wasike *et al.*, 2011; Martín-Collado *et al.*, 2013) in Semarang Regency in particular, and in Indonesia in general. Substantially, SWOT does offer advantages in determining strategy, but there are some disadvantages in terms of a more comprehensive evaluation. SWOT cannot establish strategic weights for selected alternatives (Kangas *et al.*, 2003; Masozera *et al.*, 2006; Yüksel & Dağdeviren, 2007; Kajanus *et al.*, 2012; Abdel-Basset *et al.*, 2018), in addition to that, its measurement dimension is inadequate which results to arising of uncertainty (Shrestha *et al.*, 2004; Shinno *et al.*, 2006). SWOT assessment is better when the proposed factors are assessed comparatively, not judged separately.

Weaknesses in SWOT analysis can be minimised through integration with one type of multi-criteria decision analysis (MCDA), namely the analytical hierarchy process method (I. Linkov *et al.*, 2006; 2009). AHP is widely used in research because it is easily understood and applied for accurate decision making on a large scale. The AHP method is able to handle quantitative and qualitative criteria, factors in the SWOT analysis can be considered more accurate and detailed. The principle of the AHP method is to use numerical techniques to obtain quantitative values from verbal comparisons made (Kurttila *et al.*, 2000). AHP and SWOT integration, hereinafter referred to as A'WOT, enable policy makers (experts) to assess the factors proposed in greater depth through pairwise comparison techniques (Akbulak & Cengiz, 2014; Feizizadeh *et al.*, 2014; García *et al.*, 2014). With the A'WOT method, measurable and comparable characters are given to all SWOT factors so that a more logical evaluation of all alternative strategies can be achieved.

This study uses the A'WOT method to determine the priority of beef cattle farm development strategies in Semarang Regency. The condition of beef cattle farms in the study area is seen based on the strengths, weaknesses, opportunities, and threats that exist. Three priority livestock development strategies are produced, believed to be able to contribute to the sustainability of beef cattle farms. Furthermore, the AWOT method is a useful and effective method for multi-criteria decision making in various sectors, including the livestock sector.

Conclusion

The results of the study stated that the proposed priority of beef cattle farm strategies in Semarang Regency included: (1) optimising the utilisation of forage livestock through *silage* and *hay* making, (2) optimising the provision of suitable land and meeting livestock technical requirements, and (3) optimising the ability of farmers to access capital or financing. By considering the strategy produced, it is expected that the results of this study can help local

governments in planning a more sustainable beef cattle farming policy, especially in the Semarang Regency area.

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