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Sustainability of Smallholder Beef Cattle Farming Business in Dryland Areas: Enhancing Zero Hunger and Climate Action

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Abstract: Climate change is an environmental issue and a major concern for the global community, impacting various sectors, including the livestock sector. This study aims to assess the sustainability of smallholder beef cattle farming businesses in dryland areas affected by climate change in Tambakrejo District, Bojonegoro Regency. The research method is a quantitative descriptive, involving direct field surveys and interviews with smallholder farmers. A total of 100 respondents were purposively selected with the criteria active members of a farmers' group and having ≥ 1 cattle. The data analysis used was Rapfish with five dimensions, namely the ecological, economic, social, technological, and legal and institutional dimensions that are customized to the specific research area to provide an accurate representation of the present state. The results show that the ecological, economic, and technological dimensions are in quite sustainable category, and the social and legal and institutional dimensions are in highly sustainable category. Climate change affects forage and water availability, and drought frequency affects the sustainability score. Addressing these challenges requires enhanced ecological, financial support, and appropriate policy interventions. This study provides insights into resilience strategies for smallholder beef cattle farming aligned with SDG 2 (Zero Hunger) and SDG 13 (Climate Action) in Indonesia.

Keywords: Beef cattle; Business; Climate change; Sustainability

Introduction

Climate change leads to rising air temperatures, increased evapotranspiration, and lower soil moisture, thereby affecting crop water efficiency (Yuan et al., 2024). Climate change is expected to have a direct influence on agriculture, including livestock, crops, soils, and pestilence (Hatfield et al., 2020). In Beef Cattle, surface temperatures higher than the comfort zone (thermoneutral zone) will cause heat stress. Increases in temperature and humidity have been shown to have a serious effect on feed consumption and hormone levels in cattle, thereby impairing their reproductive capacity (Habeeb et al., 2023).

Livestock is one of key to various domains: economic development, employment generation, trade, food and nutritional security, and poverty reduction (Sterzer & Azizah, 2021). Based on Badan Pusat Statistik (2024), the demand for beef meat reached 819.47 tons, which significantly exceeded the domestic production of 478.85 tons. The rising global human population has resulted in increased demand for animal protein, particularly in meat (Herawati & Setianingrum, 2025). The demand for beef among Indonesian consumers has led to a trade deficit, characterized by higher import volumes compared to exports, resulting in a limited self-sufficiency in beef production (Nazaruddin et al., 2024).

East Java Province records the highest beef cattle population in Indonesia. Bojonegoro Regency is one of the main production centers of beef cattle in East Java. From 28 districts spread across the region, Tambakrejo District is one of beef cattle farming that is facing a declining trend in the beef cattle population relative to the previous year. Furthermore, Bojonegoro is one of the regions most severely impacted by drought, especially in the Tambakrejo District, which can occur annually

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throughout the dry season (Artikanur et al., 2022). Drought continues to threaten the livelihoods of farmers, and especially smallholders, because it leads to the depletion of water resources, pastures, and fodder (Bahta & Nyaki, 2024).

Dry climate livestock farms consist of agricultural enterprises operated by small-scale farmers in regions characterized by a dry season that extends for a period of seven to eight months annually (Burrow, 2019). Based on data from the National Meteorology, Climatology, and Geophysics Agency (2025), findings indicate that the dry season in Bojonegoro Regency is predicted to start from April to November and reach its peak in September. This climatic condition justifies its classification as a dryland area for the purpose of this study. In regions characterized by dry climates, the low levels of rainfall result in a constrained supply of water (Saidah et al., 2023), which is important for cattle and feed crops. Limited water availability constitutes a critical challenge, with significant implications for all aspects of livestock business activities (Halimani et al., 2021). Even with its considerable potential, the advance of beef cattle production systems in Bojonegoro faces various challenges to optimal productivity. Some of the main obstacles faced by farmers are feed and water availability, also feed quality (Sutaryono et al., 2023), Livestock marketing level, success rate, and constraints in the artificial insemination mating system (Sutrisno et al., 2023), waste is not managed optimally (Rasyid et al., 2024), and agricultural counseling availability. This discrepancy highlights the need to evaluate the sustainable aspects of beef cattle enterprises in the region. Environmental conditions have been indicated as a contributing factor in this regard.

While previous studies highlighted the most important aspects, the sustainability of beef cattle farming is feed resources in dry seasons (Yulianso et al., 2025), livestock market facilities and frequency of counselling and training (Irfhan et al., 2025), Success rate of artificial insemination and role of cooperatives and livestock groups (Sutrisno et al., 2023). Although numerous studies have assessed the sustainability of beef cattle farming using partial approaches, there remains a lack of integrative, multi-dimensional sustainability assessments explicitly contextualized for dryland ecosystems under climate change, particularly in Indonesia.

The analysis used to assess sustainability can be conducted using the Rapid Appraisal for Fisheries (RAPFISH) method. The RAPFISH method is a multi-dimensional scaling rapid assessment technique and has been widely used in evaluating spaces defined by relevant attributes (Pitcher & Preikshot, 2001). The RAPFISH approach was originally introduced by the University of British Columbia (UBC) Department of Fisheries Center in 1999 and has been widely applied in Indonesia since 2002. The RAPFISH analysis employs MDS approach is used to depict the comparative status of an analytical unit in relation to the ideal sustainability value. Multi-dimensional scaling has been applied to various dimensions, one of the most commonly used being to analyze the ecology, economic, social, institutional, and technological dimensions (Chaliluddin et al., 2023).

This study was conducted to address the need for a sustainable business model in beef cattle farming by evaluating current conditions based on five main sustainability dimensions. The research specifically assessed the current state of sustainability in Tambakrejo District and identified critical areas for improvement to inform the development of a more sustainable and adaptive beef cattle farming system.

Method

Research Location and Time

This research was conducted in 5 villages that serve as smallholder beef cattle farming in Tambakrejo District, Bojonegoro Regency. The research period was conducted during the peak dry season in September 2025 to capture extreme dryland conditions. The selection of research locations is based on several key considerations. Based on data from the National Meteorology, Climatology, and Geophysics Agency (2025), findings indicate that the predicted water availability for crops in the western part of Bojonegoro Regency is at a low/deficit level of 0-20%. The dry season is projected to begin in April and peak in September. Tambakrejo District is one of strategic development areas of cattle breeding in Indonesia (Hidayatulloh et al., 2024). Furthermore, Tambakrejo District has been designated as a breeding ground for Peranakan Ongole (PO) cattle since 2015, in accordance with an issuance of the Indonesian Minister of Agriculture.

Data Collection Method

The data collection method in this study will involve both primary and secondary data sources to ensure comprehensive findings. Primary data were collected from observations and viewing research objects directly, as well as interviewing respondents face-to-face by asking questions according to the list of questions on the questionnaire to capture the five sustainability dimensions. To complement these firsthand accounts, secondary data were methodically acquired from authoritative institutional sources, such as the BMKG (2025), and most notably the Bojonegoro Regency Livestock Agency, which provided population records and livestock farmer groups. The research was

methodically structured, commencing with the determination of the number of respondents.

A total of 100 respondents (N = 100) were selected using purposive sampling based on the following inclusion criteria: active member of a livestock farmer group and having ≥ 1 cattle. The sample was distributed across five villages and five livestock farmer groups. The next step was to identify key problems in beef cattle farming by visiting each farm pen, followed by in-depth interviews and a literature study.

Data Analysis

This research is classified as descriptive quantitative research to describe, examine, and explain something according to the facts, and draw conclusions from the phenomena during research process observed in the figures without the active manipulation or control of conditions. This study applies the MDS technique to evaluate sustainability data on beef cattle farming business. MDS refers to a group of analytical techniques designed to map highest-dimension data into a lowest-dimension space on minimal distortion of Euclidean distances among observation (Delicado & Pachón-García, 2024). The MDS is utilized in conjunction with the RAP-BC (Rapid Appraisal for Beef Cattle) method, which is an adaptation of RAPFISH.

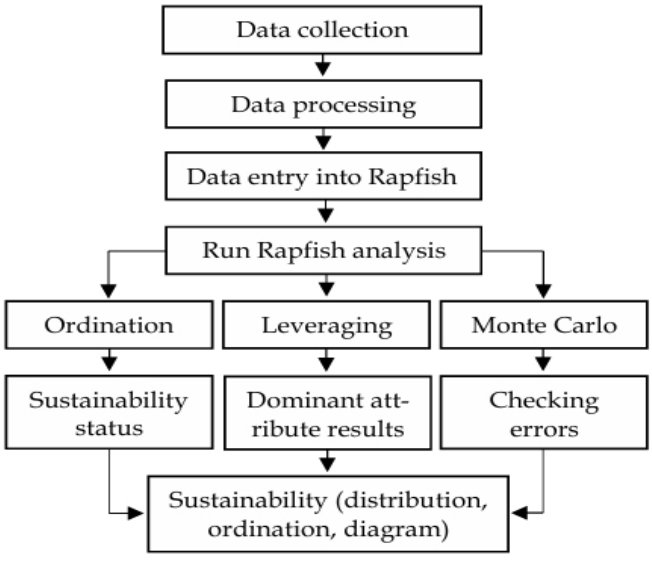

Figure 1. Analytical Flowchart

The RAPFISH analysis was employed due to its robustness in handling multi attribute sustainability assessments under limited data. The test comprises a variety of subjects, including ecological, economic, social, technological, and legal and institutional are evaluated through ordination techniques or the placement of elements in a sequence of measurable attributes. Based on the selected indicators, the scores were organized in a Rap Scores matrix within Excel worksheets. The sustainability status will be compared to a benchmark of (100%) is the best point, and for each attribute that influences the sustainability (0%) result is the worst.

Rapfish has been demonstrated to produce consistent findings compared with alternative multivariate analyses. The ordination technique depends on Euclidean distance formula in n-dimensional space, shown as follows:

$$d = \sqrt{|(x_1 - x_2|^2 + y_1 - y_2|^2 z_1 - z_2|^2 + ..)} \quad (1)$$

The position of an object or point is determined through regression along the Euclidean direction (dij) from point i to point j with the origin (δij) using regression analysis. The equation is shown as follows:

$$d_{ij} = \alpha + \beta\delta_{ij} + \varepsilon \quad (2)$$

To simplify, the least-squares method is applied iteratively based on squared distance minimization, known as the ALSCAL method. The ALSCAL approach focuses on optimizing the squared distance between points (represented as dij_klm) and the origin (denoted as (ij_klm) in a five-dimensional formula (ij_klm) known as S-stress, which is shown as follows:

$$S = \sqrt{\frac{1}{m}\Sigma_{k=i}^{m}\left[\frac{\Sigma_i\Sigma_j(d_{ijk}^2 - O_{ijk}^2)^2}{\Sigma_i\Sigma_j O_{ijk}^4}\right]} \quad (3)$$

The weighted squared distance is the Euclidean distance expressed as follows:

$$d_{ijk}^2 = \Sigma_{a=i}^{r} w_{ka}(x_{ia} - x_{ja})^2 \quad (4)$$

The goodness of-fit value reflects the magnitude of the S-Stress value of coefficient of determination (R^2). If the "stress" value is below 0.20, the analysis results are considered satisfactory, while the R^2 value is expected to be close to 1 (100%). The MDS analysis illustrates the placement of the sustainable point. The vertical and horizontal axes are determined by leverage and Monte Carlo analysis. A Monte Carlo simulation is used to assess the confidence level and potential scoring error of the MDS results, while Kite diagrams are used to visually compare sustainability status across all dimensions. The sustainability status index category levels are shown in Table 1.

Table 1. Sustainability status index category levels

Index Value (%)	Sustainability Status Category
0–25.99	Bad (Not Sustainable)
26.00–50.99	Less (Less Sustainable)
51.00–75.99	Quite (Sufficiently Sustainable)
76.00–100	Good (Highly Sustainable)

Result and Discussion

Result of The Research

RAP-BC is an adaptation of RAPFISH designed to examine the sustainability beef cattle farming in dryland areas of Bojonegoro Regency, particularly in Tambakrejo District, which is characterized by relatively less favorable natural and economic resources and limited technology implementation. Implementing sustainable management practices is very important to support cattle farming in this region. Ecological and economic sustainability assessments are needed, particularly in relation to production and marketing, to ensure that farmers have a reliable income and contribute to regional growth. Most farmers in the 5 villages in Tambakrejo District manage their cattle farms as a side business and use the income as family savings. A considerable number of smallholders face constrained options for increasing agricultural output under relatively challenging environmental conditions (Giger et al., 2022).

Ecological Sustainability Status

The Attributes in the ecological aspect are outlined through 9 characteristics, such as forage availability, water sources availability, utilization of livestock and agricultural waste, barn sanitation, livestock management system, preference for the types of livestock feed, frequency of droughts, and distance between the cage location and residential areas. These characteristics were chosen from the literature study and adapted to the research location conditions. The ecological aspect relates to the natural environment around the farm (Chandra et al., 2024). The result of the RAP-BC in the ecological sustainability dimension shows a number of (56.30), which is in the quite sustainable index (Figure 2).

The sensitivity analysis aimed to determine the impact on sustainability rating resources from an ecological perspective with 9 attributes. This analysis was conducted using the leverage analysis approach. Leverage ecological dimension (Figure 3) shows that there are 3 attributes that are most sensitive, namely the availability of forage (5.18), the availability of water (3.78), and the level of drought (3.76). Forage availability emerges main focus influencing beef cattle farming resilience in Tambakrejo District. These findings correspond to a study from Asminaya et al. (2018) The most sensitive attributes to ecological sustainability in smallholder livestock farming are the availability of forage and local feed sources.

The combination of land availability for green fodder and the selection of superior livestock has been identified as a pivotal element in the pursuit of maintaining the sustainability of beef cattle farming (Simmamora et al., 2024). Observations show that the level of drought in the soil in Tambakrejo District is due to minimal land cover, limited surface water sources, and poor land management. Climate change will cause drylands to become even drier or wetter, which will impact the water resources' sustainability in the surrounding area (Dewanti et al., 2024). Furthermore, farmers' abilities and knowledge in land cultivation and cattle farming techniques will contribute to the enhancement of the ecological sustainability dimension.

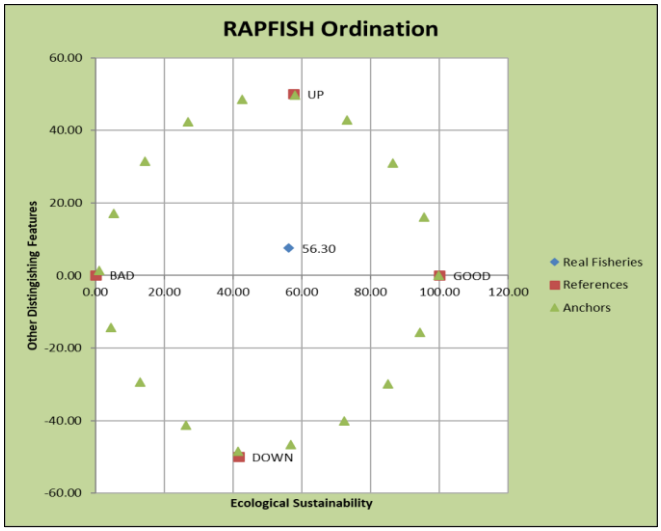

Figure 2. Sustainability position and index value in the ecological dimension

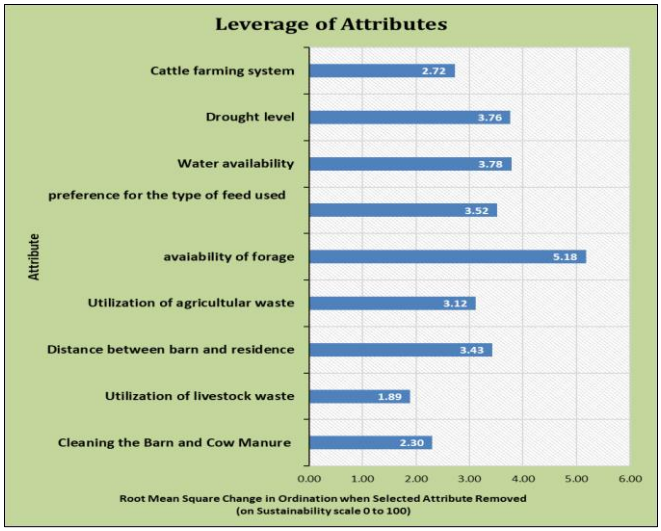

Figure 3. Leverage value and sensitive factors affecting the ecological dimension

Economic Sustainability Status

The economic sustainability dimension index indicates the total capacity in livestock enterprises to provide stable and reasonable profits for farmers in a long-term perspective. The attributes in economic dimension outlined through 9 characteristics to evaluate

economic beef cattle farming enterprises in the research areas. These attributes include number of livestock owned over time, business viability, business can support the family, livestock marketing, livestock sales scale in 1 year, provision of subsidy assistance, livestock product marketing, profits margin, and source of business capital. As illustrated in (Figure 4), the RAP-BC in the economic dimension results indicate (62.12), which is still in the quite sustainable index.

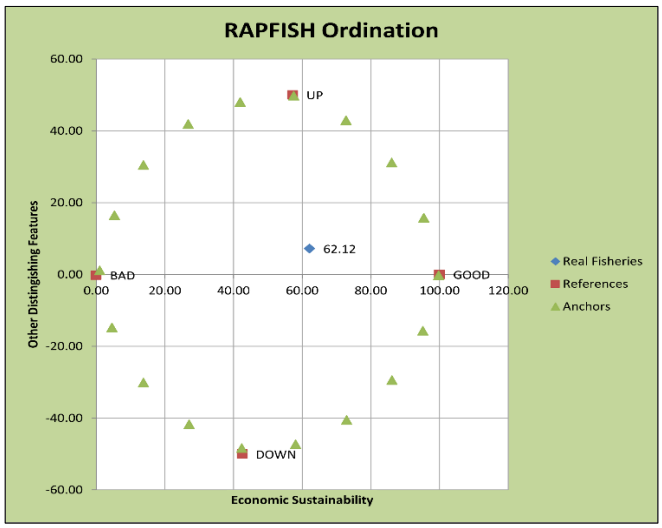

Figure 4. sustainability position and index value in the economic dimension

The economic sustainability sensitive factors identified 3 attributes as most sensitive among others. The sensitive attributes consist of livestock marketing RMS (3.35), subsequently followed by the number of livestock owned over time (2.18), and the source of business capital (1.82). Marketing patterns in various regions indicate that farmers tend to rely on intermediary agents due to the limited scale of their businesses and market access. The existence of supplementary intermediaries has been shown to result in augmented marketing margins and an impact on inefficiency cattle business (Dewi et al., 2021). Strengthening agricultural support can improve farmers' income (Parmawati et al., 2023).

The livestock population owned by farmers in the study area has declined noticeably over successive years. Based on Bojonegoro Regency Livestock Agency (2025), beef cattle population decreased by 4.821 heads from the previous year. Farmers in the two villages tended to switch to goat and sheep farming. All of the farmers' business capital comes from personal funds without assistance from credit institutions. Financial access to capital and financing is a critical component for the initiation and growth of livestock business enterprises (Rasyid et al., 2024). Farmers In overcoming financial constraints that hinder climate change adaptation, access to credit has emerged as a crucial solution (Nugroho et al., 2024). The involvement of local governments in providing financial assistance, credit access, and support to the agribusiness sector in promoting the sustainability of beef cattle farming enterprises also enhances community income.

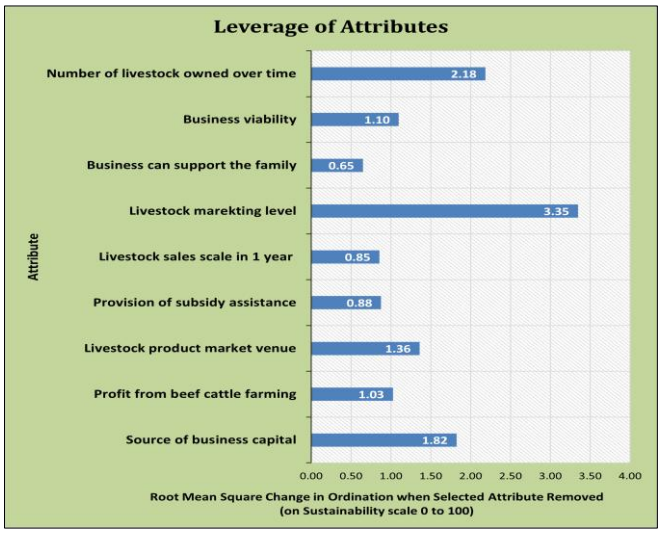

Figure 5. Leverage value and sensitive factors affecting the economic dimension

Social Sustainability Status

Social sustainability refers to an ethical principal that governs human development and survival in an inclusive and prudent manner is imperative (Denu et al., 2023). Social sustainability focuses on three issues: the welfare of farmers within a group, communication among farmers and the community, and farmers' ethical responsibility regarding production outcomes. The social element also examines institutional robustness and gender equity in decision-making and successful actions (Mushandono et al., 2025). The attributes in the social dimension are outlined through 8 characteristics. A closer look at the RAP-BC results indicates a sustainability index of (77.34), indicating that the social dimension is highly sustainable index.

The leverage analysis demonstrates that time allocation for livestock farming exhibits the most sensitivity, with a value of (3.61), mutual assistance among farmers (3.42), and family participation in running business (3.20). The farmers' time allocation to livestock farming in the study area showed that most of it is used as a side job and is adjusted to the main activities of the household. In Indonesia, most livestock breeders operate on a small scale, with livestock farming functioning as a supplementary economic activity in addition to their primary agricultural pursuits (Baharuddin et al., 2024).

Mutual assistance among farmers is a form of social capital that is very important contributes to the

sustainability of beef cattle farming enterprises. Informal cooperation particular importance for smallholder and family-operated farms. This means that farmers share equipment and information, and help each other when there is a lot of work to do (Lutz et al., 2017). Family participation in running the business shows a very significant role in supporting smooth business operations and reducing production costs. Furthermore, the social dimension is important in supporting efforts to prevent conflict and maintain good relations between farmers and the community.

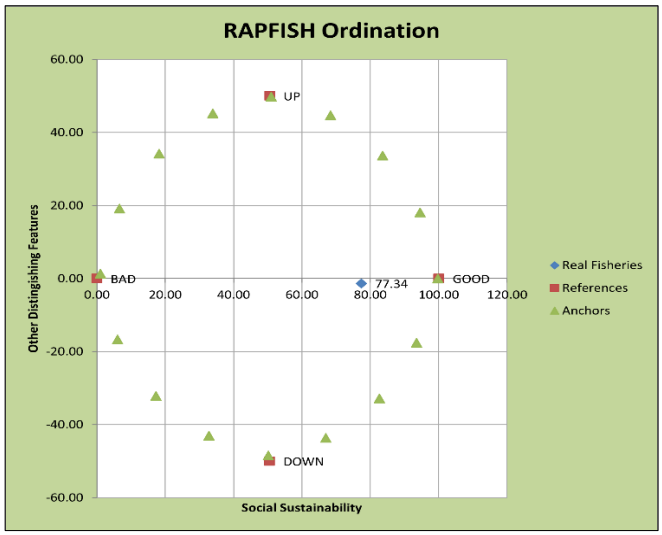

Figure 6. Sustainability position and index value in the social dimension

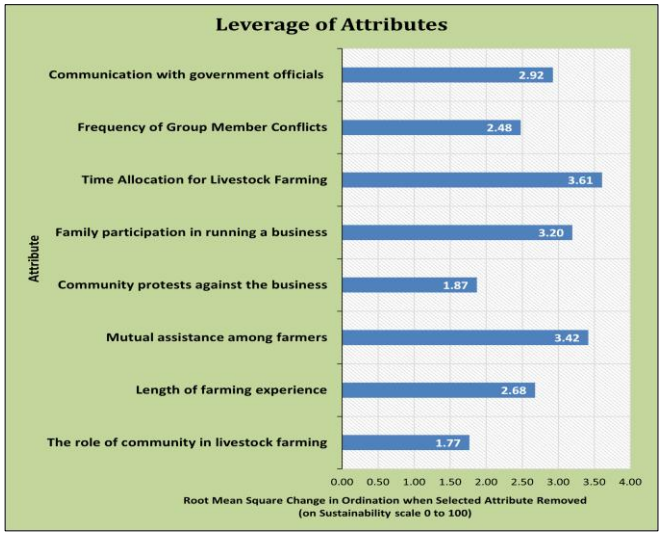

Figure 7. Leverage value and sensitive factors affecting the social dimension

Technological Sustainability Status

Technology in the livestock business is essential for enhancing production and improving product quality. To enhance beef cattle farms sustainability in Tambakrejo District, the technological dimension attributes consist of availability of agribusiness facilities and infrastructure, availability of information technology, cattle breeding handling technology, Artificial Insemination result, ability to process livestock waste, availability of Artificial Insemination, ability to use a chopper, and ability to use waste treatment and feed processing facilities.

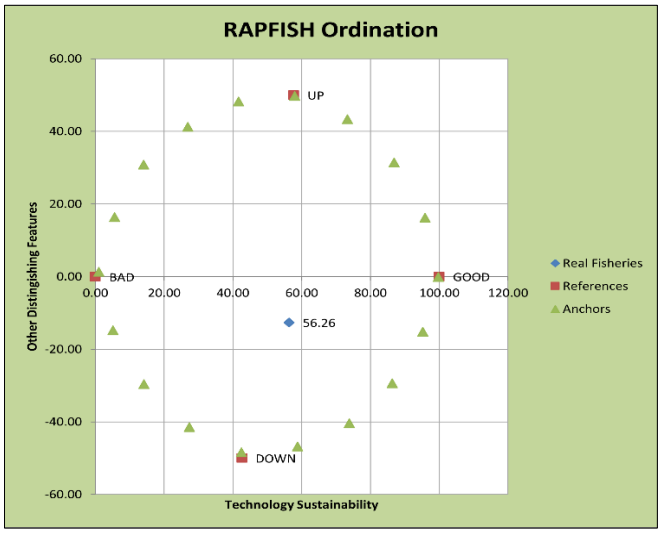

Figure 8. Sustainability position and index value in the technological dimension

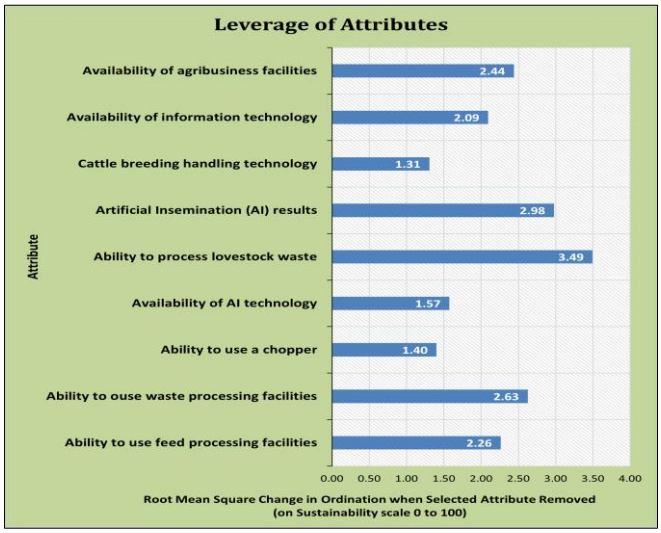

Figure 9. Leverage value and sensitive factors affecting the technological dimension

The result of the Rapfish software in technological sustainability dimension shows a number of (56.26), which is in the quite sustainable index (51.00–75.99). The leverage analysis (Figure 9) highlights the attribute of ability to process of livestock waste with RMS value (3.49) and artificial insemination result (2.98). The ability of farmers to process livestock waste shows poor

performance in operating facilities, whether in the form of biogas, compost fertilizer, or liquid waste storage systems. Livestock manure has a negative impact on the environment, including increased greenhouse gas emission, water pollution, and poses adverse human health effects (Lin et al., 2025). The prevalence breeders who are unaware of the proper methods for processing livestock waste can be attributed to a paucity of socialization from relevant parties, leading to low skill and knowledge among farmers in terms of handling livestock waste issues (Sholikin et al., 2024). The Result of the study indicated use of AI has been able to produce conception, but the process often requires several inseminations before the livestock actually conceives. Moreover, the utilization of AI has emerged as a pivotal technique to enhance the genetic potential of farm animals (Hamid et al., 2021).

Legal and Institutional Sustainability Status

Legal and Institutional sustainability is conducted in 9 attributes. The results in the legal and institutional dimension show RMS Value (76.37), which is in the highly sustainable index. A closer look at the leverage index (Figure 11) showed that the availability of credit institutions (4.23) and the availability of institutional support and extension services (4.16) became the most influential attributes. Institutional dimensions support farmers in collaborating with the government and credit providers to improve the marketing network for livestock commodities. Support from extension agencies will be more effective if they can provide technical assistance, introduce innovations, and help farmers manage their businesses more efficiently. Any small change in these leverage factors can have a big impact on improving the legal and institutional dimension of beef cattle farming business.

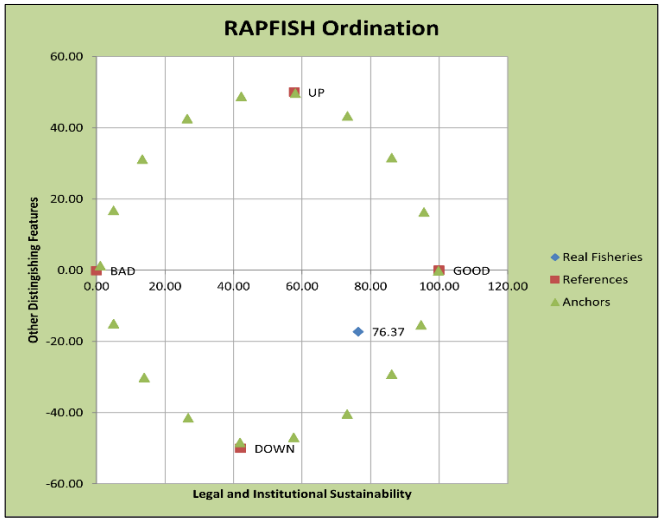

Figure 10. Sustainability position and index value in the legal and institutional dimension

The primary factor in the role of institutions in beef cattle farming is the structural component, which includes membership and leadership (Firmansyah & Sunyigono, 2020). Structured institutions can provide added value by facilitating long-term sustainability. The widespread presence of extension institutions is critical in improving farmers' competence and livestock management practices. Extension services are instrumental in strengthening farmers and stakeholders knowledge of sustainable farming practices and livestock waste management (Yanfika et al., 2024). Continuous guidance and knowledge transfer through these institutions can substantially enhance the overall quality of beef cattle farming. Innovation involves not just productivity enhancement but also risk mitigation, resilience improvement, and the fortification of agricultural market connections (Perdana et al., 2025).

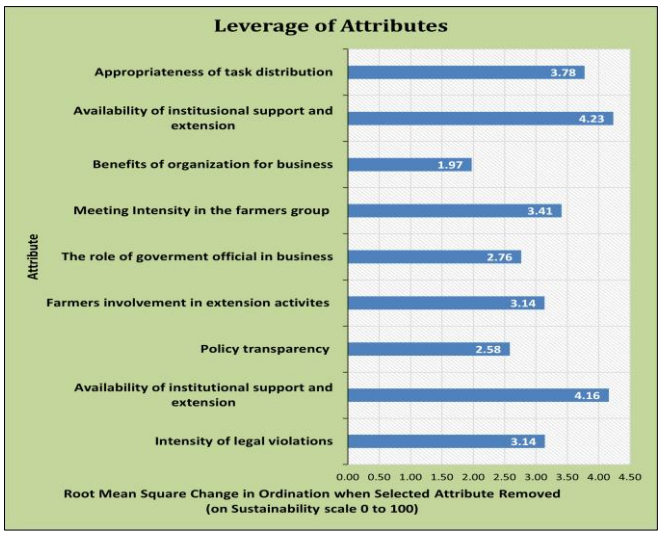

Figure 11. Leverage value and sensitive factors affecting the legal and institutional dimension

Multidimensional Sustainability Status

The results of the sustainability study using Rapfish modified into RAP-BC show several important factors, especially in the ecological and economic dimensions, at greater risk. However, other less important factors should not be ignored. MDS analysis values showed that the sustainability of smallholder beef cattle farming business is in the range of 50-100, which falls into a moderate level of sustainability.

To evaluate and manage smallholder beef cattle farming in Tambakrejo District, it's important to set standards for this type of farming. There are five main parts to how agribusinesses are sustainable. The ecological aspect is very important for keeping productivity and the environment sustainable. The economic dimension required an increase in farmers' income through the provision of credit institutions to increase business capital, as well as the role of the

government and academics in providing training and guidance in managing businesses to generate profits and further development. optimization of savings and loan units for the community, particularly emphasizing the potential for underprivileged communities, can be used to create a better community business for a better community economy (Ardiyanti et al., 2025). The social dimension of beef cattle farming resource management to time allocation for livestock farming and mutual assistance among farmers. Legal and institutional aspects describe how important institutional support and the availability of credit institutions are in the research area to develop a thriving and sustainable livestock business. Integration between economic, social, legal, and institutional is key to achieving the interests of farmers.

The technological dimension shows how important the process of livestock waste and estrus detection in cattle. Training and mentoring are important to improve farmers' skills to adapt to livestock waste technology and estrus detection. Otherwise, socioeconomic characteristics of farmers including age, educational level, and farming experience, are related to how management of beef cattle businesses and adaptation to new technologies (Rasyid et al., 2024).

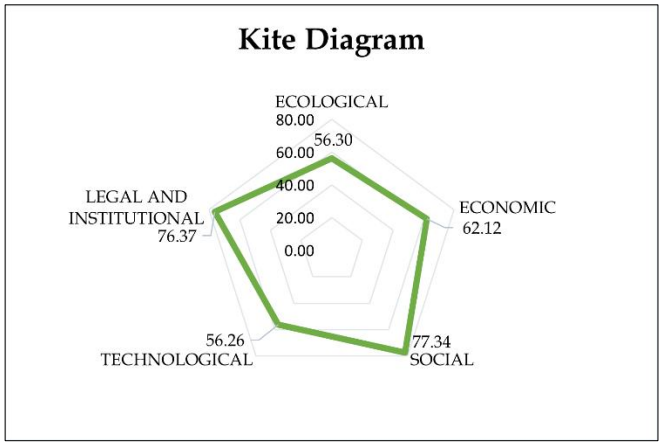

Figure 12. Kite diagram of multidimensional sustainability of smallholder beef cattle farming business

Feasibility Test of Sustainability Analysis Results

In this study, the RAP-BC method was applied as an adaptation of the RAPFISH (Rapid Appraisal for Fisheries) approach originally developed by Pitcher & Preikshot (2001). This adaptation involved modifying the variables and indicators of RAPFISH to better suit the context of beef cattle farming in Tambakrejo Regency. Accordingly, the term RAP-BC is consistently used throughout this manuscript to refer to this specific adaptation. Although, the RAP-BC approach is designed to reflect the unique characteristics of the beef cattle farming system under research areas.

After identifying the sensitive attributes of beef cattle farming sustainability in Tambakrejo District, a Monte Carlo simulation was conducted on the five dimensions. Monte Carlo Simulation is a statistical approach employed to evaluate the margin of variability of error in MDS. Controlled random variation was applied to the score matrix to evaluate the robustness and reliability of the sustainability index, with a total of 25 random simulation trials performed.

Table 2. Differences between MDS and Monte Carlo

Dimension	MDS	Monte Carlo	Differences
Ecological	56.30	57.34	1.04
Economic	62.12	62.47	0.35
Social	77.34	79.44	2.10
Technological	56.26	56.83	0.57
Legal and Institutional	76.37	78.62	2.25

A difference of under than 5% between the MDS and Monte Carlo results suggests that the MDS approach reliably estimates sustainability at a 95% confidence level (Sittadewi et al., 2025). The Monte Carlo results based on (Table 2) revealed an error rate of 0.35–2.25, suggesting that scoring errors had a minimal effect on the analysis. This shows how important it is to think about differences and possible problems when managing a beef cattle farming business, with particular emphasis on the implications of climate change and market volatility context. Therefore, the Monte Carlo results provide a secure perspective that pairs well with the RAP-BC findings and strengthens confidence in the sustainability analysis conducted. To see if the system was sustainable, we looked at the ability of each part of the system to explain and quantify improvement by analyzing the coefficient of determination (R^2) across the various factors. A stress value < 0.20 indicates a good model fit, whereas a coefficient of determination (R^2) near 100% reflects the proportion of variance explained and examine a dimension is sufficiently accurate (Nasir et al., 2025).

Table 3. RAP-BC stress value and coefficient of determination (R^2) results

Dimension	S-Stress	R^2	Description
Ecological	0.16	0.93	Accurate
Economic	0.17	0.93	Accurate
Social	0.16	0.94	Accurate
Technological	0.15	0.94	Accurate
Legal and Institutional	0.14	0.95	Accurate

The data on the (Table 3) indicates that the sustainable of beef cattle farming enterprise index are acceptable and model is in good consider. Stress (S) and Coefficient of determination (R^2) value demonstrate the effectiveness of these dimensions in enhancing sustainability. These findings indicate that the research

variables appropriately represent the actual data and their alignment in MDS provides insights into the sustainability and long-term viability of beef cattle farming in Tambakrejo District.

The results of this study align with previous research showing in climate change impacts in dryland areas affect the sustainability and performance of beef cattle farming production and improvement that needs to be considered is the availability of green fodder, in economic perspective, farmers in dry regions making beef cattle business as a side business and in technology dimension is affected by availability of beef cattle waste processing (Simmamora et al., 2024). Social dimension sustainability is closely associated with optimizing family participation, as well as the competence of the workforce in livestock agribusiness (Irfhan et al., 2025). Moreover, within the institutional dimension, the role of financial institutions is identified as the most sensitive attribute, as the continuity of farming activities, requires substantial capital that can be provided through institutional financial support (Suardi et al., 2022).

Conclusion

Beef cattle farming business in Bojonegoro Regency, particularly in Tambakrejo District, has demonstrated favorable development and indications of sustainability, as reflected by sustainability index scores across five dimensions: ecological, economic, and technological are in quite sustainable, social, and legal and institutional are in highly sustainable index category. Overall, the beef cattle farming sector exhibits a moderate level of sustainability performance, with adequate index values across these key dimensions. These results suggest that beef cattle management practices in the study area are generally positive, although certain aspects still require improvement. Accordingly, sustaining and enhancing future performance will require integrated efforts, including optimization of local feed resources, improved water availability and drought mitigation strategies, strengthened access to credit service institutions, maintenance of harmonious relationships between farmers and local communities, enhancement of waste management systems, technological modernization, institutional strengthening, and the provision of adequate supporting infrastructure. With an integrated management strategy, smallholder beef cattle farming in Tambakrejo District has the potential to become a sustainable model for dryland areas in Indonesia, while contributing to the Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger) through the strengthening of sustainable livestock production and farmer livelihoods, as well as SDG 13 (Climate Action) through climate-resilient farming, improved resource efficiency, and adaptive management practices.

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Author Contributions

N.F. and B.H.; Developing ideas, methodology, overseeing data collection, conceptualization, and reviewing, A.F.A. and A.P.A.Y.; data collection, writing, editing, visualization, and draft preparation, E.N.; analyzing data development, reviewing scripts, and writing. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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