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Sustainability Analysis of Beef Cattle Farming with a Revolving System in Gilireng District, Wajo Regency, Indonesia

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Abstract | Research on the sustainability of beef cattle farming with a rolling scheme involving synergy between the government, private sector and farmers is an interesting academic study to be explored and has not been widely reported. This study aims to analyze the index and sustainability status of cattle farming with a rolling system assessed from the ecological, economic, and social dimensions. The research was conducted using a quantitative approach. Respondents totaled 50 farmers who were beneficiaries of the revolving system beef cattle assistance selected by purposive sampling. The analysis method used was multidimensional scaling (MDS) with the Rap-BCRS approach to assess the index and status of sustainability in each dimension on a 0-100% sustainability index scale. Identification of attributes sensitive to sustainability and errors in index values with a 95% confidence interval for each aspect was carried out with Leverage and Monte Carlo analyses. The results of the sustainability index analysis resulted in a moderately sustainable ecological dimension (50.18%), an unsustainable economic dimension (23.23%), and a less sustainable social dimension 46.86%). Of the 48 attributes analyzed, 24 attributes are sensitive to the sustainability index and status. The dimensions that should be prioritized for improvement to increase the value of the sustainability index in the management of beef cattle farming in a rolling system are the economic and social dimensions. This can be improved by paying attention to each attribute and making efforts to improve the findings of sensitive aspects. Efforts that need to be made to improve the sustainability status are to strengthen the rolling system policy, establish an animal market and expand the market network for livestock products, increase the intensity of farmer counseling and training, optimize family participation and labor competence, and build livestock infrastructure.

Keywords | Sustainability, Revolving maintenance system, MDS, Rap-BCRS, Beef cattle farming, Policy

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INTRODUCTION

Large-scale farms have been shown to positively impact the sustainability level of beef cattle farming and the effective use of resources. In addition, these farms have been shown to offer more advantages in terms of economic sustainability (Başer and Bozoğlu, 2023). However, the sustainable development of beef cattle farming in Indo-

nesia still has obstacles, including beef cattle farming in Indonesia is still dominated by small-scale farms with low productivity levels, the role of cattle in society is not the main commodity (Indrayani *et al*., 2022) so that the scale of management of beef cattle farming is not matched by good capital and management (Khotimah and Isnaini, 2023), the maintenance system is generally still traditional (Salem *et al*., 2024), and limited infrastructure that supports the distribution of cattle products (Meidayanti and Annisa, 2023). Meanwhile, the increasing demand for food from livestock will continue to rise along with the increasing population (Aryani and Jember, 2019), increasing public income and awareness of the importance of nutrition, urbanization, and changes in diet (Ariani *et al*., 2018). Therefore, programs to increase livestock population and production must be prioritized to meet the needs of public meat consumption and support the sustainability of beef cattle farming in Indonesia (Rusdiana, 2019).

One of the efforts that can be taken to increase meat and calf production is to increase the number of beef cattle ownership and fattening bulls (Rusdiana and Praharani, 2019), and support strategic agribusiness policies (Mayulu and Daru, 2019), as well as involving synergy between the government, private sector, universities and beef cattle farmers that can encourage the potential of natural resources and human resources (Sirajuddin *et al*., 2020). The private company Energy Equity Epic Sengkang Pty.Ltd (EEES), located in Gilireng District, Wajo Regency, has several Corporate Social Responsibility (CSR) programs that aim to improve the standard of living of the community (Najeminur *et al*., 2021). In the economic sector program, EEES CSR in collaboration with the Regional Government of Wajo Regency implemented a poor community empowerment program with a cattle transfer scheme to the community starting in 2011 by providing capital in the form of feeder cows. In 2016, created a Household Biogas program and the use of organic fertilizer from pulp (biogas slurry) through the Organic Fertilizer Processing Unit (UPPO) by utilizing cow dung and in 2020, providing bull fattening assistance and forming a program assistance team to supervise livestock health services. According to research Amam (2022), farmer empowerment positively and significantly affects the sustainability of the ecological, social and cultural dimensions, while negatively affecting the institutional and technological dimensions.

Sustainability in the context of livestock farming is considered a multidimensional concept, namely the dimensions of ecological sustainability, namely environmental health, economic sustainability, which includes economic viability in the form of productivity sufficient to guarantee profits, and social sustainability, which includes the welfare of farmers and animals (Lebacq *et al*., 2013; Martin *et al*., 2020). Meanwhile, the concept of a sustainable livestock system is not a harmonious and certain state but has differences in each region and others, and the current sustainable system will not be sustainable in the future. This is due to changing environmental conditions and behavior (De Boer and Cornelissen, 2002). The sustainability index is very important for the livestock sector because it is a source of information on challenges and problems that must be prevented and corrected so that they have a positive economic, environmental, and social impact, both now and in the future (Labecq *et al*., 2013). The development of beef cattle farming needs to be done by managing the input and output factors of animal husbandry in a sustainable manner by taking into account ecological, social and economic aspects so that the availability of livestock commodities is maintained (Hardi and Soedarto, 2023; Suryanti *et al*., 2019; Wahyuni and Santoso, 2023). The revolving cattle program aims to increase the income of beneficiaries who are directed to improve the economic situation and welfare of the community whose main aspect in its development is sustainability for the continuity of livestock rotation so that the independence of farmers can be achieved and is expected to be able to reduce the impact of various main problems of sustainability of beef cattle farming faced by farmers. The problems of developing beef cattle farming with a rolling system are competition for land use between agricultural and livestock commodities, a criteria-based beneficiary mechanism so that farmers have not been able to raise livestock in groups, lack of public knowledge of the need for good feed according to cow weight, and still carrying out traditional maintenance using extensive patterns so that lack of supervision causes the death of calves in extreme conditions. For a revolving system beef cattle enterprise, the loss of a few cows has the potential to kill the scheme and slow it down. The death of a large number of cattle has an impact on economic losses for farmers and can threaten the continuity of the revolving beef cattle business system. Based on this, the hypothesis of this study is that there is an influence of sustainability aspects, namely ecological, social and economic aspects on the continuity of the revolving system beef cattle business, so this research was conducted to determine how the sustainability status index in each dimension and sensitive factors affecting the revolving system beef cattle farming business in Gilireng District, Wajo Regency. Previous research on the sustainability of livestock businesses has been carried out many times, such as reports (Hardi and Soedarto, 2023; Nurhasanah *et al*., 2023; Tommy *et al*., 2023), among these studies, no one has examined the sustainability of empowerment-based smallholder livestock businesses with a rolling system cattle assistance program. Therefore, to fill this gap, this study will provide specific and up-to-date information on the sustainability status of beef cat-

tle business development under the revolving system in Gilireng District, Wajo Regency, Indonesia. This analysis of the sustainability of the revolving system beef cattle enterprise needs to be conducted in the hope that it can provide an overview of the level of sustainability of the cattle enterprise and what intervention steps can be taken to improve the sustainability of the enterprise seen from the sustainable development framework which has three main dimensions, namely economic, social and environmental, which are the priorities of this research.

MATERIALS AND METHODS

Research Area and Period

This research was conducted from June to August 2024. The research location was in the Gilireng District, Wajo Regency, South Sulawesi, Indonesia. The selection of the research location was done purposively, the criteria for determining the research location were based on: the largest livestock population and distribution of respondent beef cattle farmers in the district, as well as the accessibility of the area with the consideration that the area is the operating area of Energy Equity Epic Sengkang Pty.Ltd (EEES) where the beef cattle business development program is implemented.

Data Collection

Farmers were selected through purposive sampling with the criteria that they have been rolling livestock for the last 3 years and have at least two cows under the beef cattle revolving system assistance program. The reason for selecting these criteria is because it is a rolling mechanism of the program assistance and has been declared in the category of independent farmers. Data collection methods were conducted through interviews, discussions, questionnaires, and field surveys with respondents in the study area consisting of various experts and stakeholders related to the topic of this research and validated with the results of the assessment of the goodness of fit model seen from the results of the magnitude of the *S-Stress* and R^2 values. Data were collected through individual interviews using questionnaires given to 50 farmer respondents. The population in this study are all farmers who are beneficiaries of cattle revolving assistance in Gilireng Subdistrict from 5 villages, namely Arajang, Alausalo, Poleonro, Lamata, and Polewali Villages where the sample selection is representative of the population on the object of research is farmers who meet the criteria in the mechanism of transfer and are considered capable and know the information needed by the research objectives. Determination of attributes for each dimension of sustainability In this study, there are 48 attributes consisting of 3 dimensions, namely 14 attributes in the economic dimension, 14 in the social dimension, and 20 in the ecological dimension. Determination of attributes was based on previous research (Ramadhan *et al*., 2014; Sriroso *et al*., 2013; Suyitman *et al*., 2012; Sutrisno *et al*., 2023) and adjusted based on commodities and conditions of the research site. Discussions were conducted separately with each expert or key informant. The focus of the interviews and discussions was directed at the sustainability aspects of the revolving system of the beef cattle business. The data obtained were analyzed descriptively by assessing the sustainability index and attributes sensitive to beef cattle development in Gilireng District, Wajo Regency.

Analysis Method

The analysis method used in this research is the Rapfish (Rapid Appraisal for Fisheries) ordination technique through the Rap-BCRS (Beef Cattle Revolving System) approach, which is a Multi Dimensional Scaling (MDS) method, this approach is modified from the Rapfish program. Rapfish analysis is a diagnostic analysis that will provide an overview of the degree of sustainability of a system (Fauzi, 2019) in this study for the beef cattle revolving system. This method is a statistical analysis technique for several cases that transforms all dimensions and multidimensions in the sustainability dimension and reduces the complexity of the sustainability dimension in simple measurements (Fauzi and Anna, 2005). This study's dimensions concern ecological, economic, and social sustainability. Each dimension has attributes or indicators related to sustainability. Rapfish ordination technique with the MDS method has stages (Kavanagh and Pitcher., 2004) among others: First, determining the attributes for each dimension of sustainability, Second, assessing the attributes and giving weight to each dimension (ecological, economic, and social) on an ordinal scale in the range of scores 0-4 which is interpreted from bad to good, Third, Rap-BCRS ordination analysis with MDS is used to obtain the index value and determine the position of the sustainability status of the beef cattle business revolving system in each dimension on the sustainability index scale, Fourth, assessing the index and sustainability status in each dimension, the sustainability index scale has a value of 0-100 percent, namely 0%-25% (Poor: Unsustainable), 25.1%-50% (Less: Less sustainable), 50.1%-75% (Fair: Moderately sustainable), and 75.1%-100% (Good: Very sustainable). Fifth, the sustainability index values in each dimension (economic, ecological, social) were visualized on a scatter diagram. Next, leverage analysis and Monte Carlo analysis were conducted. The analysis tool uses a software application called MDS Rapfish in which there is a sensitivity analysis namely, the attributes that play the most sensitive role in the sustainability of the rolling system beef cattle farming business can be known with Leverage Analysis, Monte Carlo Analysis to calculate the dimension of uncertainty, this analysis is used to evaluate the effect of errors in estimating the value of MDS ordination, and in the analysis, a process carried out at a confidence interval of 95%, The results of the Monte

Carlo analysis are then compared with the results of MDS if the value of the difference between the two analyses is < 5%, then the results of MDS analysis are adequate, then the MDS analysis results are adequate, and the assessment of good model accuracy (goodness of fit) in MDS can be seen from the magnitude of the *S*-Stress and R^2 values, a good model can be seen in the *S*-stress value which is smaller than 0.25 (S<0.25). In contrast, the R^2 value is close to 1. The analysis results are considered accurate and can be accounted for if the stress value is smaller than 0.25 or 25% and the coefficient of determination R^2 is close to 1.00 or 100% (Kavanagh and Pitcher, 2004).

RESULTS AND DISCUSSION

The results of the multidimensional Rap-BCRS analysis obtained the sustainability index value of each dimension, namely ecology (50.18%), economy (23.23%), and social (46.86%). This value is obtained based on assessing 48 attributes from the three dimensions of sustainability. The index values of each ecological, economic, and social dimension of the rolling system beef cattle farming business are positioned in the form of a flyer diagram, as presented in Figure 1. The results of the assessment of the sustainability status analysis of the rolling system beef cattle farming business in Gilireng District, Wajo Regency, generally show a level of sustainability that is still less sustainable, so there are attributes in the ecological, economic, and social dimensions that still need further attention and handling. Parameter statistics of the Rap-BCRS value, Monte Carlo value, the difference in value between Rap-BCRS and Monte Carlo, the stress value (S), and the coefficient of determination (R^2) in each dimension of the sustainability of the rolling system beef cattle farming business can be seen in Table 1.

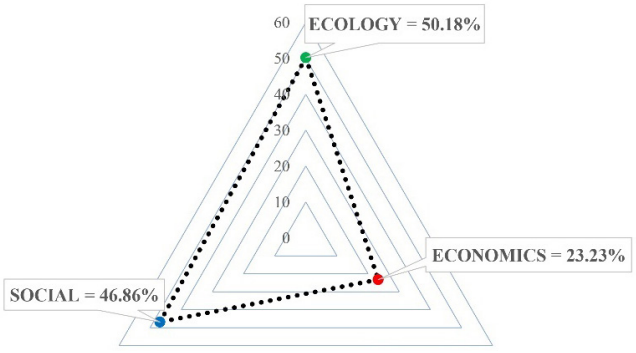

Figure 1: Kite diagram of the sustainability index value of beef cattle farming under the revolving system in Gilireng district, Wajo regency.

The results of the Monte Carlo analysis and the normalization test of model goodness of fit as presented in Table 1, show the low difference (<1) between the Rap-BCRS value and the Monte Carlo value in each dimension. Monte Carlo is used to evaluate the effect of errors in estimating Rap-BCRS values and in the analysis process carried out at a 95% confidence interval (Pitcher, 1999). The difference between the sustainability index value and the Monte Carlo value for each dimension can be said to have a relatively small error if it is not more than 5%. Based on Table 1, the comparison of the Rap-BCRS analysis results with Monte Carlo is very small, namely the ecological dimension of 0.63, the economic dimension of 0.28, and the social dimension of 0.15. The results of this statistical test also show that the Rap-BCRS method is good enough to be used as one of the tools to evaluate the sustainability of the rolling system beef cattle farming business. As for the normalization test goodness of fit model results using the stress value (S) and the coefficient of determination (R^2), the stress value in each dimension is smaller than the value of 0.25 or 25%. This can be seen from the stress, which only ranges from 11% to 20%, and the coefficient of determination (R^2) obtained ranges from 0.90 to 0.97, close to the value of 1, so it can be said that the data is normally distributed. This is reinforced by the statement Kavanagh and Pitcher (2004), which states that if the stress value is smaller than 0.25 and the coefficient of determination (R^2) is close to the value of 1, the results of the analysis carried out are declared quite accurate and can be accounted for. This indicates that the validity of the analysis results can be accounted for statistically. This also indicates that in the case studied, the addition of attributes is not necessary, and the aspects analyzed are accurately close to the actual conditions, where the attributes used can explain the sustainability conditions of the beef cattle farming revolving system in Gilireng District, Wajo Regency, and the results can be used for further analysis.

Table 1: Statistical parameters of sustainability dimensions in the beef cattle farming revolving system in gilireng district, wajo regency.

Dimensions	Rap-BCRS	Monte Carlo	The difference between Rap-BCRS and Monte Carlo	Stress (S)	Coefficient of Determination (R^2)
Ecology	50,18	49,55	0,63	0,15	0,93
Economics	23,23	22,95	0,28	0,11	0,97
Social	46,86	46,17	0,15	0,20	0,90

Sustainability Status of a Revolving System Beef Cattle Farm in Gilireng District, Wajo Regency

The results of the Rap-BCRS analysis show that there is only one dimension of the business, namely the ecological dimension, which shows an index value of 50.18% or is entirely sustainable on a scale of 50.01-75.00%, the or-

dination graph of the sustainability of the rolling system beef cattle farming business in the ecological dimension which shows the position of the point and the status of sustainability can be seen in Figure 2. Based on these results, the ecological dimension is the main advantage of the business run by farmers, including the support of land and water resource factors is an environmental aspect that affects the sustainability of rolling system cattle farming, although management of livestock waste released into the environment still needs to be improved according to the results of leverage analysis expressed in the form of Root Mean Square (RMS) values, There are 11 attributes of the ecological dimension which are sensitive attributes that become leverage attributes and require policy interventions so that sustainability in the ecological dimension can be maintained and getting better can be seen in Table 2.

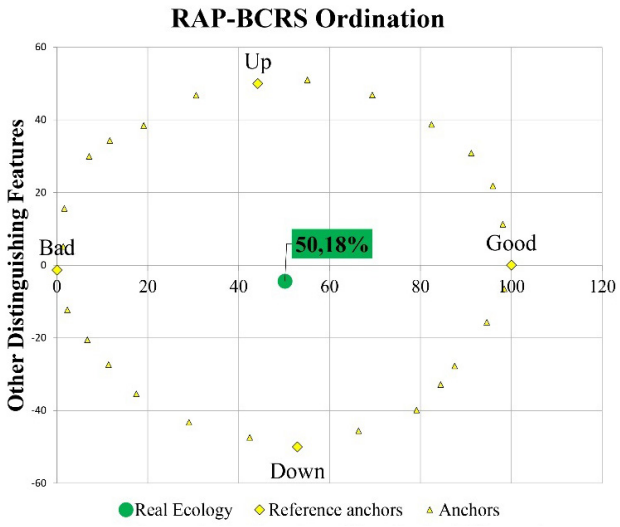

Figure 2: Ordination of ecological dimensions.

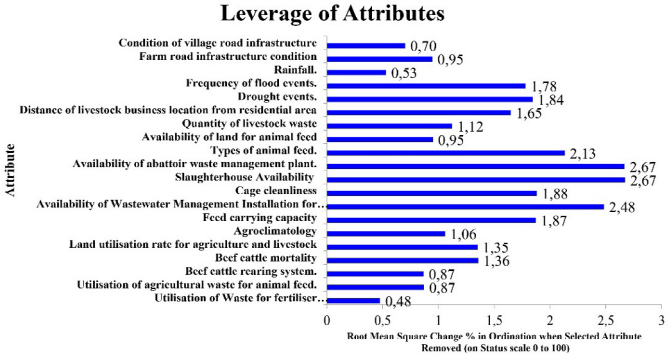

Figure 3: Results of leverage analysis of ecology dimension sustainability attributes.

From the results of the multidimensional analysis, it can be seen in Figure 3 that the most sensitive attribute affecting the sustainability of the ecological dimension is the availability of wastewater management installations (IPAL) in slaughterhouses (RPH) is still not available the disposal of livestock slaughter waste at this time is directly discharged into the nearest ditch and river around so that it will cause pollution and health problems for the surrounding community of river users. Meanwhile, slaughterhouses are not yet available in the research location. The location of slaughterhouses in Wajo Regency is quite far and limited from the research location and still includes type C. The IPAL and slaughterhouses are still unavailable, so they need intervention and are provided. According to research (Fianti and Hutwan, 2020), management of livestock waste released into the environment needs to be done to determine whether or not the activity or business in the slaughterhouse is feasible from the technical and environmental aspects which are the requirements and standards that have been determined in carrying out its activities and the availability of liquid waste treatment plants in slaughterhouses (Besse *et al*., 2021). The use of slaughterhouses (RPH) for animal slaughter is useful so that the meat from slaughter is Safe, Healthy, Whole, and Halal (ASUH). Slaughter can improve meat quality, minimise germ contamination with meat (maintained hygiene and sanitation), eliminate environmental contamination from blood and animal waste, and implementation becomes easy and fast and ensures the welfare of beef cattle. The availability of livestock IPAL for waste management is still not available at the location of the maintenance of beef cattle farmers in the revolving system, so the construction of a holding pond must be built to further treat waste with a wastewater treatment plant (IPAL) before the waste is discharged into the nearest ditch and river to prevent the emergence of air, water, soil pollution, and health problems. According to research (Zuroida and Azizah, 2018), the absorption of livestock waste close to the flow of water sources caused by improper disposal of livestock waste can cause the spread of disease and health problems for livestock and the community due to contamination. This ecological dimension emphasizes the support of land and water resources and the management of livestock waste released into the environment (Aziz *et al*., 2020). Therefore, the availability of infrastructure or public facilities and infrastructure such as slaughterhouses and wastewater management installations, provision of stalls, road access, provision of land and irrigation to produce adequate forage for livestock (HMT) is needed for more targeted management in the development of a revolving cattle farming business that is sustainable for the environment and can improve the welfare of farmers. With these efforts, sensitive attributes can be maintained and improved to determine the ecological dimension of the sustainability index. This is because these attributes have multiplier effects on other attributes that determine the sustainability of beef cattle business development.

The economic dimension shows an index value of 23.23% or categorized as unsustainable on a scale of 00.00-25.00%. The ordination graph of the sustainability of the rolling system beef cattle farming business in the economic dimension can be seen in Figure 4 Based on these results,

the economic dimension has the lowest sustainability index. This shows that the economic dimension still has less impact on the current status of sustainability of the rolling system cattle farms, the results of the leverage analysis expressed in the form of RMS values show that three attributes of the economic dimension are sensitive attributes that determine the sustainability of the economic dimension so that it can be improved so that its status is sustainable can be seen in Table 2.

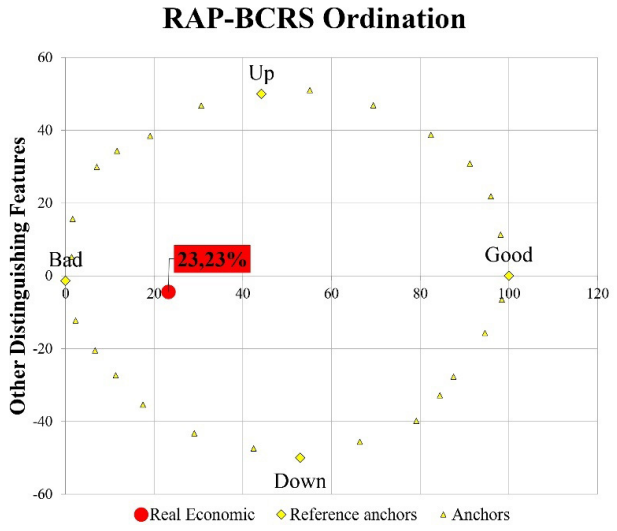

Figure 4: Ordination of economic dimension.

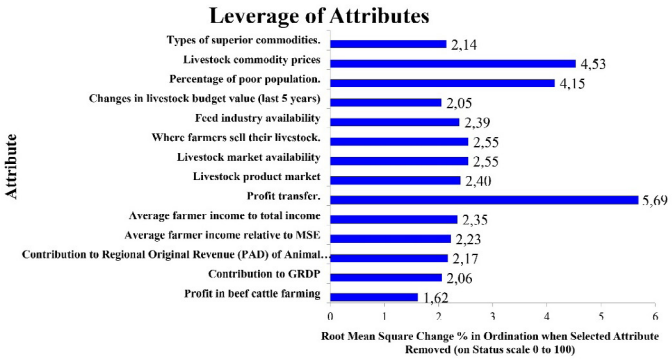

Figure 5: Results of leverage analysis of economic dimension sustainability attributes.

Based on the results of the leverage analysis shown in Figure 5, profit transfer is the sensitive attribute that affects the sustainability of the social dimension. Business actors in the revolving system of beef cattle farms are mostly carried out by local communities and involve local communities as breeders. This has an impact on the transfer of profits that are prioritized and enjoyed by local communities by involving local communities, starting from the determination of prospective recipients, maintenance and marketing, as well as monitoring of rolling cattle activities. According to research Bayu and Bahri (2022), the provision of a revolving system of beef cattle in the Gilireng District of Wajo Regency is considered effective in improving the quality of life of the community, especially the beneficiary cattle breeders with a significant increase in the level of community welfare. This is different from research Ramadhan *et al.* (2014) on business actors in dairy farming centers in Bogor Regency, which are mostly carried out by nonlocal communities. This has an impact on the transfer of profits that are not enjoyed by local people as labor farmers but rather by those with large capital who can employ local people.

The next influential sensitive attribute is the price of livestock commodities. Fluctuations in the price of cattle in the local market in Gilireng District of Wajo Regency are relatively stable due to the economic value of cattle sold live supplied and availability locally so that community consumption demand can be met, the social value of cattle sold live is relatively high. According to Sukastini *et al.* (2022), the income level of beef cattle farmers is generally influenced by the sale of live cattle. Thus, the effect of changes in the level of meat prices in the market does not significantly affect the income of farmers. The level of welfare of farmers in implementing beef cattle farming is directly influenced by the amount of production costs incurred and the sale of livestock, so the level of meat prices in the market is still indirect (Najihah *et al.*, 2022). The target of the revolving system beef cattle assistance program is the poor who still have the ability to raise livestock so that the results of the livestock business can increase the income and welfare of the beneficiaries. The relationship between the percentage of poor people and the rate of economic growth is negative, which means that high economic growth can reduce poverty and is expected to be able to improve the welfare of the community by favoring the poor, this is in accordance with research Padang and Murtala (2020), in the study indicated that an increased rate of economic growth can reduce the number of poor population and vice versa. According to research Mastuti *et al.* (2021), the sustainability of the beef cattle farming business as a whole is strongly influenced by the income received by farmers through the size of the scale of ownership of the number of cows owned by farmers, the provision of revolving cattle aid capital of 1 head/farmer and rolled over after the cattle have been raised for 3 years or have had two calves, has not been able to meet the needs of farmers' lives. If the distribution of relatively few aid packages has an impact on the development of livestock businesses, the increase in farmers' income will be relatively small, so farmers will make animal husbandry a side livelihood while their main job is farming. To increase the sustainability status index in the economic dimension, efforts to strengthen program policies by increasing the number of livestock distributed to farmers with intensive beef cattle rearing patterns establishing animal markets and expanding the market network for livestock products can be considered by related parties. This effort is to increase the income and profit transfer of cattle farmers so as to reduce the poverty rate of the population, and farmers can get a decent demand and determine

the price in accordance with market prices and the access of farmers to a wider market. This is in accordance with the opinion of (Simamora, 2020) that the ability of farmers to access the market and use livestock market facilities in selling livestock is relatively weak, so pricing tends to be powerless, the role of intermediaries in the cattle business in determining prices becomes dominant.

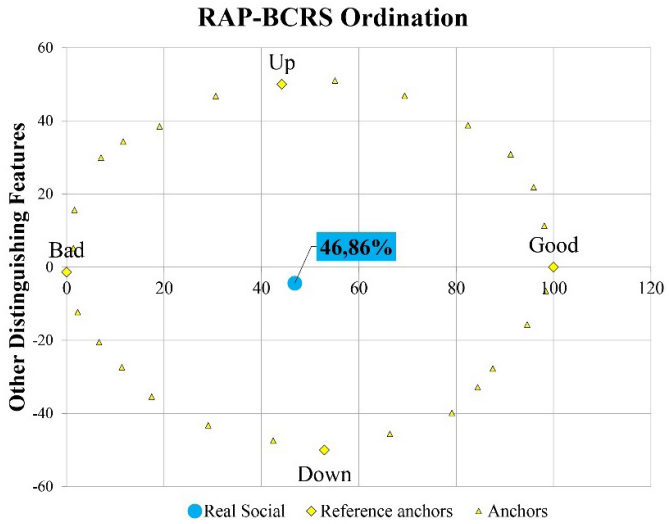

Figure 6: Ordination of the social dimension.

In addition, the social dimension shows an index value of 46.86% or less sustainable on a scale of 25.01-50.00%. The ordination graph of the sustainability of the rolling system beef cattle farming business in the economic dimension can be seen in Figure 6. This shows that the social dimension still provides less benefit to the sustainability status of the rolling system cattle farming. The low value of the social dimension sustainability index is influenced by 10 social dimension attributes, which are sensitive attributes that determine the sustainability of the social dimension so that it can be improved so that its status is sustainable, as seen in Table 2.

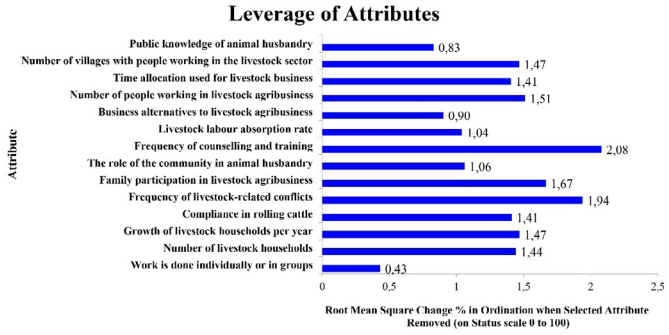

Figure 7: Results of leverage analysis of social dimension sustainability attributes.

From the analysis results shown in Figure 7, the most sensitive attribute based on RMS affecting the sustainability of the social dimension is the frequency of counseling and training. Counseling to beef cattle farmers in the rolling system has not been carried out in a planned and scheduled manner. The role of extension officers in organizing farmers has not been carried out so that farmers manage their businesses alone without groups, which has an impact on the traditional maintenance system and the low desire of farmers to improve business-oriented businesses. According to Djuraeva et al. (2023), the frequency of extension visits and the participatory approach of extension are very important in influencing productivity, technical efficiency, and agricultural sustainability, as well as the learning process of farmers through extension using methods that are easy to understand and low cost so that farmers can apply them (Sirajuddin *et al*., 2023).

Table 2: Sensitive attributes in the beef cattle farming revolving system in gilireng district, wajo regency.

Dimensions	Sensitive Attributes
Ecology	Slaughterhouse availability. Availability of Waste Water Management Installation (IPAL) for slaughterhouses. Availability of IPAL for livestock products. Type of animal feed Cage cleanliness Feed carrying capacity Drought events Frequency of flood events Distance of livestock business location from residential areas Beef cattle mortality Land utilisation rate for agriculture and livestock
Economics	Profit transfer Livestock commodity prices Percentage of populationpoor
Social	Frequency of counselling and training. Frequency of conflicts related Animal Husbandry Family participation in livestock agribusiness. Number of people working in the livestock agro-industry Growth of livestock households per year Number of villages with people working in the livestock sector Number of livestock households. Compliance in rolling cattle Time allocation used for livestock agribusiness. The role of the community in animal husbandry

The next sensitive attribute is the frequency of conflicts related to animal husbandry. Farmers, in running their businesses, must also understand the social impacts of livestock activities. Rolling cattle farmers in the Gilireng District understand that the existence of a livestock business can lead to social conflict within the community if cage management is not applied properly, such as building cages in residential areas. Grazing sites near agricultural land can result in competition and damage that results in economic

losses for both farmers and landowners. According to Baba *et al*. (2014), beef cattle farming is carried out by grazing on agricultural lands so that there is competition for land use between agricultural and livestock commodities. Family participation in the beef cattle business in this study location is still low. Apart from the lack of interest of family members in animal husbandry, the number of livestock raised is also not too much, so only the husband or wife is directly involved in handling livestock. Therefore, it is necessary to increase the number of livestock distributed to the community as well as educate the community on the importance of the role of women to reduce cultural barriers to gender equality in the rolling system beef cattle farming sector and awareness of the fair division of labor between men and women in farmer householdsand. The number of respondents of rolling cattle breeders of the male gender is more dominant, namely 40 people or 80%, while the number of respondents of female breeders is only 10 people or 20% of the total number of farmer respondents. This is in line with the opinion Wangi *et al*. (2022), who explain that gender affects the choice of business and work to be carried out, one of which is in the livestock sector, where in general, men will dominate because the livestock business requires considerable physical ability. According to Takasenserang *et al*. (2021), the role of family members is needed because household-scale animal husbandry requires a lot of labor, and the number of family members can affect business activities because they can provide labor that will help their business activities (Sirajuddin *et al*., 2017). Efforts that need to be made to improve the sustainability status of the social dimension based on sensitive attributes that emphasize the social impact of the existence of animal husbandry on the community are to increase the intensity of farmer counseling and training, which focuses more on increasing the capacity of farmers and their skills so as to increase the population and production of livestock raised. The involvement of extension workers influences the intensity of counseling, which not only provides information on agriculture but also information on animal husbandry in routine meetings. Extension intensity can change the perception and behavior of farmers when making decisions to develop beef cattle farming. Changes in farmer behavior take a long time, so extension programs and farmer coaching need to be improved. Farmer participation is required at every stage of activity in the rolling system beef cattle program. Active participation, participation in livestock organizations/groups, positive perceptions, and communication can influence the perspective of farmers so that efforts to find solutions to the obstacles faced in developing their business and minimizing the occurrence of conflicts related to the activities of the revolving system beef cattle farming. According to research Fadli *et al*. (2022), family participation in the livestock business is needed to ensure the sustainability of cattle business management. Therefore, by optimizing family participation, revolving cattle farmers can increase their interest and motivation to develop their businesses to be able to compete and increase their income. This is in accordance with research Rafiqah (2020), that shows that the income of farmer households comes from additional labor or working hours caused by increased output in the livestock sector.

CONCLUSION AND RECOMMENDATIONS

The results of the analysis of the sustainability status of the rolling system beef cattle farming business in the Gilireng District, Wajo Regency, based on the results of Rap-BCRS analysis in multidimensionally obtaining the sustainability index value of each dimension (ecological, economic, and social dimensions) are categorized as generally less sustainable. The dimensions that must be prioritized in the management of beef cattle farming in a rolling system are dimensions with less sustainable and unsustainable status, namely the economic and social dimensions. The results of the leverage analysis illustrate 24 sensitive attributes of the three dimensions of sustainability, namely 11 attributes in the ecological dimension, 3 attributes in the economic dimension, and there are 10 attributes in the social dimension that must get the right management priority. Therefore, support from related parties to the revolving cattle assistance program is needed to improve the sustainability index of the revolving system beef cattle farming business in Gilireng District, Wajo Regency. Efforts that need to be made to improve the sustainability status are strengthening the policy of the beef cattle rolling system, increasing the intensity of extension and training of farmers, optimizing family participation and the competence of the workforce to use land and process animal feed, and building livestock infrastructure. It is hoped that the findings of this research can be used as input in applying the concept of sustainability to realize the sustainability of the livestock business system in the research location and in other areas. There are some limitations of the research that need to be mentioned. This article only presents the findings of the business sustainability analysis at the Gilireng District level, so it is not possible to look at the smaller regional village level based on the distribution of respondents who are beneficiaries of revolving cattle. In addition, several models of rolling system programs have been implemented, namely breeding, fattening Balinese cattle, and artificially inseminated cattle. This study only focuses on beef cattle breeding, so future research can include these models to provide a more comprehensive understanding of the sustainability of the beef cattle revolving system.

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NOVELTY STATEMENT

There have been many academic studies on the sustainability of livestock enterprises. However, there has been no research on the sustainability of smallholder livestock enterprises based on a rolling cattle program from a sustainability perspective involving the integration of three ecological, economic, and social dimensions. This research will provide specific and up-to-date information on the sustainability status of beef cattle business development under the revolving system in Gilireng District, Wajo Regency, South Sulawesi Province, Indonesia, so that it can provide a sustainability index value and attributes that are sensitive to sustainability, then can be improved and maintained with appropriate management so that the sustainability index can be achieved.

AUTHOR'S CONTRIBUTIONS

Muhammad Irfhan: Conceptualisation, methodology, drafting, investigation, data analysis, and writing; Sitti Nurani Sirajuddin and Letty Fudjaja: Supervision, conceptualization, methodology validation, review, data curation, and draft editing; Lellah Rahim and Rahmadanih contributed data validation and manuscript review.

Ethical Approval

Since this research does not involve animals or humans, ethical approval was not required.

Conflict of Interest

The authors declare no conflicts of interest related to this research.

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