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Sustainability Analysis of Bali Cattle Farming (Bos Javanicus) in Tebo District

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ABSTRACT

Tebo Regency is known as one of the centers for beef cattle farming in Jambi Province. Raising Balinese cattle on people's farms is dominated by local cattle, especially Bali cattle (*Bos javanicus*). The study aims to stop the business index for Bali cattle farming integrated with oil palm plantations in Tebo Regency on intensive and extensive rearing patterns. This research uses a survey method, a longing index using a Multidimensional Scaling (MDS) approach called Rap-CP (Cattle Palm), a modified approach from the rapfish program. Multidimensional scaling (MDS) RAP-CP method (palm cattle). The results of the analysis of the inventory index values for the economic, legal-institutional, technological-infrastructural, socio-cultural and ecological dimensions of intensive and widespread maintenance patterns, respectively in the categories entirely sustainable (68.72) and very sustainable (88.44), entirely sustainable (67.05) and less sustainable (40.67), entirely sustainable (55.34) and less sustainable (32.87), less sustainable (39.94) and less sustainable (37.04), quite sustainable (52.46) and entirely (74.41). The results of sustainability index analysis indicate that Tebo Regency has sustainable potential for establishing a Bali cattle farming enterprise using an extensive rearing system.

Keyword: Bali cattle, integrated, sustainability index

ABSTRAK

Kabupaten Tebo dikenal sebagai salah satu sentra peternakan sapi potong di Provinsi Jambi. Pemeliharaan ternak sapi bali pada peternakan rakyat didominasi oleh sapi lokal, khusunya sapi bali (*Bos javanicus*). Tujuan dari penelitian adalah untuk mengevaluasi indeks keberlanjutan usaha peternakan sapi bali terintegrasi perkebunan kelapa sawit di Kabupaten Tebo pada pola pemeliharaan intensif dan ekstensif. Penilitian ini menggunakan metode survey, indeks keberlanjutan dianalisis menggunakan pendekatan Multidemensional Scaling (MDS) yang disebut dengan Rap-CP (Cattle Palm) yang merupakan pendekatan yang dimodifikasi dari program rapfish. metode Multidimensional scalling (MDS) RAP-CP (cattle palm). Hasil analisis nilai indeks keberlanjutan dimensi ekonomi, hukum-kelembagaan, teknologi-infrastruktur, sosial-budaya dan ekologi pada pola pemeliharaan intensif dan ekstensif berturut-turut pada kategori cukup berlanjut (68.72) dan sangat berkelanjutan (88.44), cukup berlanjut (67.05) dan kurang berkelanjutan (40.67), cukup berlanjut (55.34) dan kurang berkelanjutan (32.87), kurang berkelanjutan (39.94) dan kurang berkelanjutan (37.04), cukup berkelanjutan (52.46) dan cukup berkelanjutan (74.41). Hasil analisis indeks keberlanjutan tersebut menunjukkan bahwa Kabupeten Tebo memiliki potensi yang berkelanjutan untuk dijadikan usaha peternakan sapi bali dengan sistem pemeliharaan secara ekstensif.

Kata kunci : Sapi bali, terintegrasi, indeks keberlanjutan.

INTRODUCTION

Indonesia is the world's largest producer of palm oil. According to the Ministry of Agriculture estimates, the total area of palm oil plantations in Indonesia in 2023 was 16.83 million hectares. Palm oil plantations can serve as a source of cattle feed derived from palm fronds, leaves, and grass growing around the plantation area (Gunawan and Talib 2014; Helviani *et al.* 2021). Tebo Regency is one of the regions where Bali cattle farming is integrated with palm oil plantations. In Tebo Regency, the palm oil plantation area was 60.985 hectares in 2021 and 61.130 hectares in 2022 (BPS 2022). Bali cattle in Tebo Regency supply meat commodities to Jambi City (BPS 2021).

The palm-cattle integration system has been established to optimize land use and develop Bali cattle farming in regions with palm oil plantations as part of the effort to achieve meat self-sufficiency and meet the demand for animal protein (Permentan No. 105 of 2014) concerning the integration of palm oil plantations with Bali cattle farming. The integration of palm oil cultivation with Bali cattle farming is conducted to utilize by-products from palm oil plantations and cattle manure as fertilizer, bio-urine, biogas, and other benefits such as soil enrichment, reduction of waste, and increased biodiversity.

The strategy involves conducting a sustainability analysis that evaluates the long-term viability and impact of a palm-cattle business or project based on the current conditions. A sustainability analysis can determine effective and efficient strategies to achieve optimal outcomes. Tebo Regency holds significant potential for integrating palm oil cultivation with Bali cattle farming. The Bali cattle farming system in Tebo Regency, where cattle are released into oil palm plantations, reduces labor requirements in cultivation, allowing the Bali cattle to roam freely in search of feed. However, the management of extensive Bali cattle farming in Tebo Regency remains underdeveloped, as evidenced by the high incidence of livestock diseases, weak security measures in livestock management, lack of quarantine facilities for cattle migrating into Tebo Regency, inadequate monitoring of Bali cattle entering and leaving the area, an unfenced system of cattle release into oil palm plantations, and insufficient health monitoring of the livestock.

The Bali cattle population in Tebo Regency was 18.256 heads in 2018, 19.004 heads in 2019, 20.909 heads in 2020, 21.445 heads in 2021, and 21.660 heads in 2022 (BPS 2022). The dynamics of the Bali cattle population drive the growth of the Bali cattle population in Tebo Regency. According to Swatland (1984), cattle population dynamics are determined by the balance between mortality, slaughtering, cattle imports, exports, and births within a given area. According to Kusuma *et al*. (2017), the cattle population dynamics in a region are influenced by cattle births, mortality, migration, and slaughtering. The cattle population dynamics are calculated based on cattle population data over several recent years.

The potential for palm-cattle integration needs to be explored by developing policy strategies to mitigate the existing threats and weaknesses in the development of cattle farming in palm oil plantation areas (Diwyanto *et al.* 2004; Fagi *et al.* 2004). Therefore, for development purposes, it is necessary to analyze the dynamics and required attributes to ensure the sustainability of Bali cattle farming in Tebo Regency, as well as identify feasible and important measures to be implemented. The results of the analysis are expected to provide solutions for the sustainability of Bali cattle farming in Tebo Regency.

MATERIAL AND METHODS

The study was conducted from July to September 2023 in Tebo Regency, Jambi Province, with the location selected intentionally (purposive sampling) based on factors such as accessibility, livestock potential, cattle-palm integration patterns, livestock numbers, and the significance of livestock farming as a primary livelihood in the local community. Both primary and secondary data were utilized, with primary data obtained through field observations and interviews using a structured questionnaire. In contrast, secondary data were collected from previous research, literature reviews, and documents from relevant institutions, such as data from the Indonesian Central Bureau of Statistics (BPS).

Respondents comprised 30 farmers, and the study observed 802 Bali cattle owned by these farmers. The research location was selected using purposive sampling, with sub-districts chosen based on the highest number of livestock farmers. Thirty cattle farmers participated in the study, consisting of 15 farmers who own more than 30 Bali cattle and apply an extensive farming system, and 15 farmers who own more than 5 Bali cattle and apply an intensive farming system. The sample size was determined based on recommendations from Gay *et al*. (2011), who suggested that a minimum of 10% of the population is required for descriptive methods, and Borg *et al*. (2007), who advised that 15-30 respondents per group are necessary for smaller populations.

Data collection methods included interviews, discussions, questionnaires, field surveys, expert perception analysis, and literature reviews. Observations were conducted through direct interviews with respondents, assisted by enumerators using a questionnaire guide. The sustainability of Bali cattle farming in Tebo Regency was analyzed using a Multidimensional Scaling (MDS) approach called Rap-CP (Cattle Palm), a method modified from the Rapfish program developed by the University of British Columbia to evaluate the sustainability of fisheries from a multidisciplinary perspective (Kavanagh 2001). The sustainability index scaled from 0-25 (poor or unsustainable), 26-50 (less sustainable), 51-75 (moderately sustainable), and 76-100 (good or highly sustainable).

Leverage analysis was employed to identify sensitive attributes or interventions based on the priority order from the analysis results, focusing on changes in the root mean square (RMS) ordination on the x-axis. The greater the RMS change value, the more significant the attribute's role in improving sustainability status, indicating that the attribute requires attention or improvement.

RESULTS AND DISCUSSION

Farmer Profile

The summary of the farmer profile indicates that the farmers' ages in both intensive and extensive farming systems fall within the productive age category. Non-productive age ranges from 0-14 years, productive age from 15-55 years, and older age from 55 years and above (Kasim and Sirajuddin 2008). Therefore, farmers in intensive and extensive farming systems still possess high enthusiasm and motivation to develop sustainable livestock farming. The farmers' considerable farming experience indicates that they possess knowledge and experience related to livestock farming. On average, farmers in the intensive farming system own 6.07±2.23 palm plantations, while those in the extensive farming system own 12.27±4.29 hectares. The large area of palm plantations owned by farmers in the extensive farming system presents the potential for developing sustainable integration between Bali cattle and palm plantations. The average number of livestock owned by farmers in the intensive farming system is 17.00±1.41 cattle per farmer, while in the extensive farming system, it is 37.00±0.82 cattle per farmer. The significant number of livestock and long-standing experience indicate that livestock farming is promising for increasing farmers' income. The average income for farmers in the intensive farming system is IDR 22.88 million per month, while in the extensive farming system, it is IDR 46.00 million per month. The income derived from livestock farming constitutes 3.84% of the total income in the intensive system and 4.34% in the extensive system. The additional income from livestock farming motivates farmers to maintain their Bali cattle farming businesses. However, whether intensive or extensive, most Bali cattle farms in Tebo Regency are side businesses, leading farmers to sell their livestock only when necessary. This is evidenced in Table 1, which shows that the average sales in the intensive farming system are 1.00±1.77 cattle per year, while in the extensive farming system, it is 2.00±1.23 cattle per year.

Sustainability Analysis

In Tebo Regency, particularly in several sub-districts (Tebo Ilir, Muara Tabir, Tebo Tengah, Sumay Tengah Ilir, Rimbo Bujang, Rimbo Ulu, Rimbo Ilir, Tebo Ulu, VII Koto, Serai Serumpun, VII Koto Ilir) used as research locations, only one slaughterhouse is in the Rimbo Bujang Sub-district. In addition to being far away, the slaughterhouse is in an empty condition. It needs to function optimally regarding scheduling, inadequate facilities, cleanliness, and the number of slaughters.

Ecological Dimension. The presence of slaughterhouses is a sensitive attribute that has the most significant influence on the sustainability index of the ecological dimension in both extensive and intensive farming systems.

In Tebo Regency, particularly in the sub-districts chosen as research locations, there is only one slaughterhouse in Rimbo Bujang Sub-district. Besides being located far away, the slaughterhouse needs to be more utilized, with suboptimal scheduling, inadequate facilities, poor cleanliness, and limited slaughter capacity. Feed also emerges as a sensitive attribute affecting the sustainability of the ecological dimension in the extensive farming system. The feed consumed by livestock consists only of natural grasses or weeds found in palm plantation areas.

Additionally, during the dry season, farmers face a shortage of green fodder in the plantation area. One of the supporting factors for cattle breeding is the availability of feed (Muktiani 2011). Land ownership for cattle pens is an issue that needs attention from farmers in the intensive farming system. It relates to costs and the freedom of farmers to develop their livestock businesses. During the study, all cattle shed areas used by farmers under the intensive farming system were privately owned. This ownership allowed farmers

Table 1. Profile of livestock farmers in Bali cattle farming in Tebo Regency

Description	Total		Average±STD	
	Intensive	Extensive	Intensive	Extensive
Age (of individuals)				
a. Productive (15-55 years old)(%)	13	10	88.10±15.79	67.75±27.44
b. Elderly (>55 years old)(%)	2	5	11.91±15.79	32.25±27.44
Experience in livestock farming (individuals)				
a. 1-5 years old (%)	5	3	30.95±23.49	20.24±16.20
b. 6-10 years old (%)	7	8	60.72±29.71	55.95±31.44
c. >10 years old (%)	3	4	8.33±16.67	23.81±16.03
Oil palm land ownership (ha)	91	184	6.07±2.23	12.27±4.29
Livestock ownership (head)	252	550	17.00±1.41	37.00±0.82
Livestock sales (head/year)	13	32	1.00±1.77	2.00±1.23
Income/month				
a. Oil palm land (million.)	328	662	22.00±8.02	44.00±15.44
b. Livestock farming (million.)	11	28	0.88±0.35	2.00±0.41
c. Total (million.)	339	690	22.88	46.00

Note: Palm oil price: Rp. 1,800/kg; livestock price: Rp. 10,500

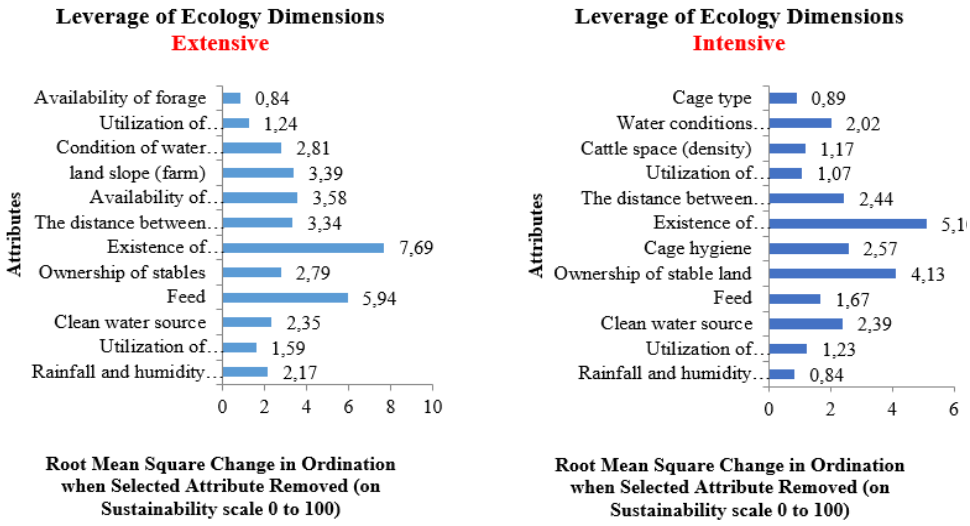

Figure 1. Analysis leverage of ecology dimensions extensive and intensive

the freedom to manage the land and eliminated the need for additional expenses for land rental. In contrast, farmers with leased land faced limitations in land management and incurred additional costs for rental fees. However, guidance or assistance is still needed to help farmers manage their land effectively and develop their livestock businesses further.

Technological Dimension. The suboptimal use of farming equipment in the extensive farming system hinders the development of livestock businesses. This is also related to another sensitive attribute, livestock technology.

One piece of equipment found in the extensive farming system is a chopper. However, this tool is not used optimally because farmers have yet to show interest in producing processed feeds such as fermented or ammoniated. The lack of knowledge about the use of livestock technology among farmers in the extensive farming system is one reason they are not interested in producing processed feed. Adrial and Mohtar (2013) suggested that implementing feed processing and preservation technology, where feed is stored for extended periods in warehouses as a reserve for the dry season, presents an opportunity for farmers, especially those with more than five cattle. The lack of interest among farmers in the extensive farming system in following government recommendations and programs is a significant issue in the development of livestock businesses. This is evident in their reluctance to produce and provide supplementary feed and inadequate management practices, such as continued inbreeding. Feed availability for Bali cattle farming is of green fodder and concentrates. One of the obstacles to developing livestock businesses is the availability of green fodder and concentrates. This is due to the diminishing availability of green fodder around the farming area, resulting from competition with other farmers, land use changes, and the dry season. Therefore, establishing feed storage facilities and alternative feed sources is necessary to ensure sufficient feed availability for livestock.

Law and Institutional Dimension. Collaborative agreements between farmers and farmers, farmers and traders,

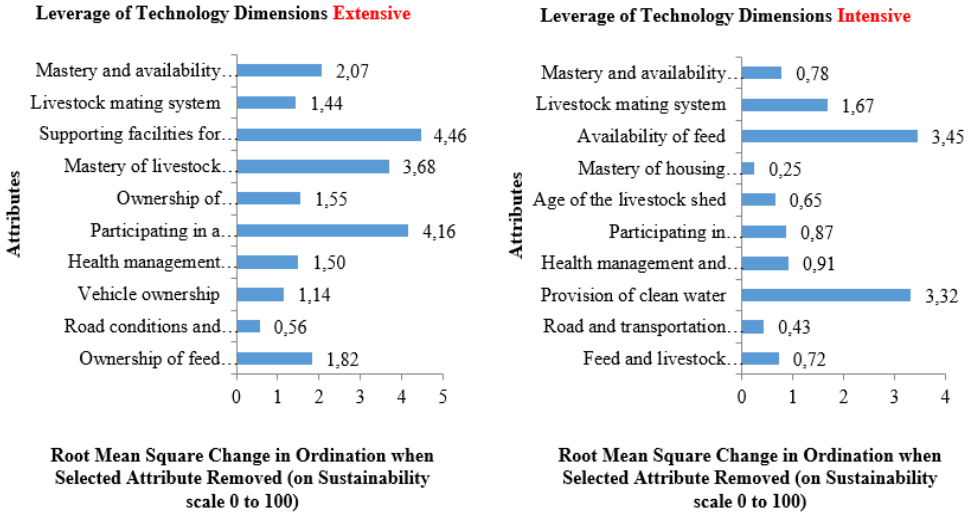

Figure 2. Analysis leverage of technology dimensions extensive and intensive

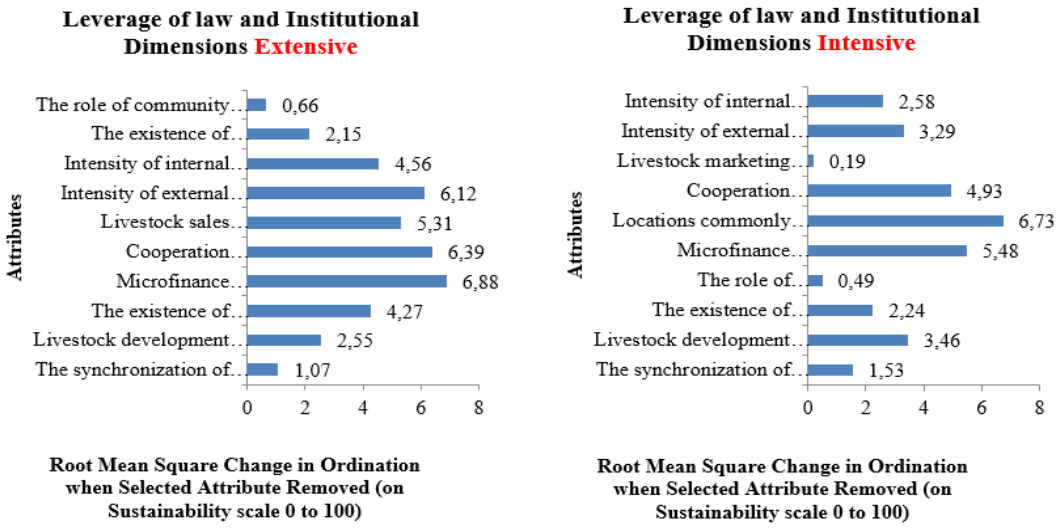

Figure 3. Analysis leverage of law and institutional dimensions extensive and intensive

farmers and livestock institutions were important efforts for advancing livestock farming enterprises.

Most farmers in the extensive farming system still need agreements to develop their livestock businesses. The existence of cooperatives in the extensive farming system is linked to microfinance institutions that can provide credit. The absence of cooperatives in the extensive livestock farming areas is a concern, as they are crucial in facilitating credit. Banking institutions also need attention, as they function similarly to cooperatives as credit providers. Farmers need capital credit in the intensive farming system to develop their businesses. The extensive farming system, has cooperation networks between farmers and slaughterhouses and farmers and livestock market providers. However, this cooperation could run optimally due to the underutilization of slaughterhouses and farmers rarely selling their livestock. Additionally, the livestock market often needs more buyers, sometimes discouraging farmers from selling their livestock.

Economic Dimension. Leverage analysis results in the extensive farming system show that the government's role in determining livestock selling prices is a sensitive to the economic dimension's sustainability index.

The government is a critical stakeholder in determining livestock selling prices (Muktiani 2011). Besides setting livestock prices, the government also assists in improving livestock quality. However, farmers have yet to improve livestock quality as recommended by extension officers, as evidenced by the fact that the feed provided is only the green fodder available in palm plantation areas, and cases of inbreeding are still prevalent. In the intensive farming system, the average income farmers earn from livestock farming per month is an attribute that affects the sustainability index. The average income from livestock farming per month is still low. This is due to the low average number of livestock owned in the intensive farming system, resulting in an annual sale rate of only one cattle (Table 1). Profitability is another aspect that

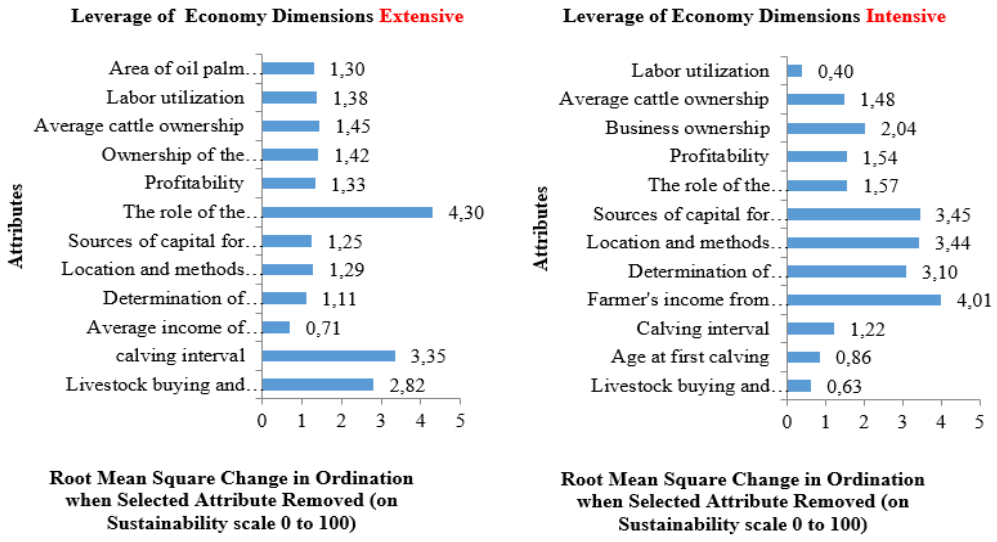

Figure 4. Analysis leverage of economy dimensions extensive and intensive

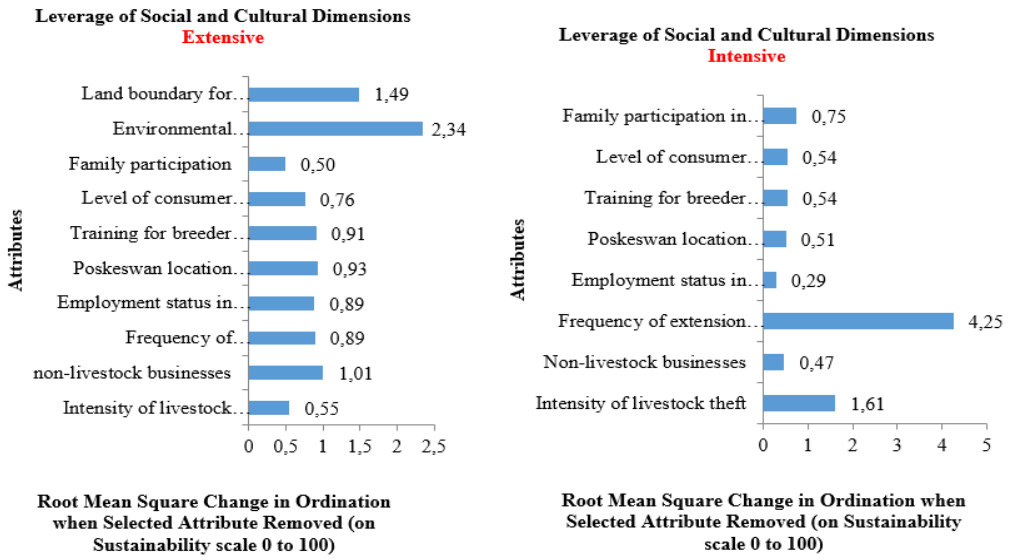

Figure 5. Analysis leverage of social and cultural dimensions extensive and intensive

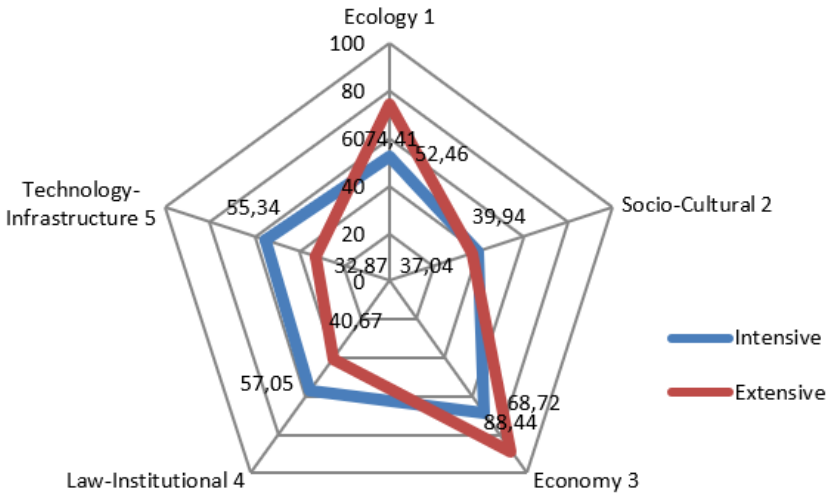

Figure 6. Diagram of a multi-indicator sustainability kite chart for Bali cattle farming in Tebo Regency under intensive and extensive rearing systems

needs attention in Bali cattle farming. The extensive farming system yields higher profits compared to the intensive system. The extensive farming system in Tebo Regency has no additional costs because the cattle are free-grazed in palm plantations. Extensive livestock farming is low-cost, even when farming large cattle (Yulianti *et al*. 2021). However, there are some drawbacks to the extensive system, such as difficulties in health management and nutritional deficiencies. These drawbacks contribute to a high mortality rate in the extensive system, leading to a declining livestock population. Therefore, improvements in management practices in the extensive farming system, such as better health management, provision of supplemental feed, and enhanced management, are necessary.

Socio-Cultural Dimension. The sustainability index analysis shows that the sustainability status of the intensive and extensive farming systems falls into the less sustainable category.

A sensitive attribute affecting the socio-cultural sustainability dimension in the intensive farming system is the frequency of extension activities and training for farmers. The frequency of extension activities involving social interaction between extension officers and farmers still needs to be higher, with only three sessions per year. In contrast, farmers who attend extension activities more than seven times a month gain more knowledge (Pakpahan 2021). The low intensity of extension activities results in low knowledge and skills among farmers. Knowledge and skills are evident from the limited alternative uses or by-product utilization from livestock farming. If farmers had adequate knowledge and skills, they could explore alternative business opportunities, such as using livestock manure and urine for organic fertilizer production, cultivating high-quality grasses, and more. Environmental management around livestock farms, particularly regarding damage caused by livestock farming activities, still needs to be improved among farmers

in the extensive farming system. An issue that farmers rarely address is the condition of drainage ditches. The condition of ditches often matches the road surface due to uncontrolled livestock movement, which causes water flow problems during floods.

Additionally, during the rainy season, roads used by farmers can be damaged by livestock, and scattered livestock waste on roads can lead to conflicts between farmers and other road users. However, sometimes farmers and their families repair roads damaged by their livestock. It is essential for livestock farming to create a positive perception within the community, as this is closely related to the sustainability of livestock business development. Livestock farming should meet the criteria of Good Farming Practices (GFP) and avoid creating negative perceptions among the public (FAO 2011).

Sustainability Index Kite Diagram

In the intensive farming system, the socio-cultural dimension demonstrates the most minor sustainability compared to other dimensions. Similarly, in the extensive farming system, the socio-cultural, law-institutional, and technology-infrastructure dimensions in cattle breeding exhibit the lowest sustainability status. Analysis using the Index Kite Diagram reveals a shared need for improvement in the socio-cultural aspect of both farming systems. It is also essential to address the other dimensions, particularly the sensitive attributes, which can evolve over time and with changes in local leadership. Continuous enhancements across all dimensions are crucial to elevate the sustainability index, positioning it within sound and highly sustainable categories.

CONCLUSION

The aspects of farmer profiles that support the sustainability of livestock farming in Tebo Regency include age, farming experience, oil palm land ownership, livestock ownership, and livestock income. Tebo Regency has sustainable potential for Bali cattle farming with an extensive management system. However, improvements in management practices are needed, such as reducing calf mortality rates, enhancing health management, providing and administering high-quality supplementary feed while utilizing existing natural resources, and implementing recording and selection of breeding males to avoid inbreeding. Additionally, support and guidance for farmers are necessary to develop a better and more sustainable extensive farming system.

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