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The Development Potential of Bali Cattle Breedling Areas in Smallholder Farms in Tinanggea Sub-District, South Konawe Regency

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ABSTRACT

The development of Bali cattle faces challenges, including increasingly limited land for both livestock farming and forage crops. This research aims to assess the potential of Tinanggea District, South Konawe Regency, as a development area for Bali cattle breeding. The field study was conducted from February to March 2023. The research location was selected through purposive sampling, specifically in Tinanggea District, which serves as one of the central regions for Bali cattle seed sources. Respondents were determined using a census method, involving a total of 716 livestock farmers. To analyze the collected data, several analytical approaches were employed, including economic density, farm density, area density, and the Capacity for Increasing Bali Cattle Population (CIBCP). The analysis results revealed that economic density falls into the moderate category with a value of 86.09 Livestock Units (LU) per 1.000 people. Farm density is also categorized as moderate, with a value of 0.27 LU per hectare, while area density is considered low, with a value of 6.27 LU per square kilometer. The combination of livestock density identified as a Development Area (DA) was found in the economic–farm density combination, while the Distribution and Development Area (DDA) was identified in both the economic–area and farm–area combinations. The effective CIBCP value in Tinanggea District still shows potential for an increase of up to 293 LU. At the village level, the effective CIBCP values in Tinanggea District can be grouped into three development categories: high (4 villages), moderate (3 villages), and low (17 villages). Roraya Village has the highest effective CIBCP value, amounting to 116 LU, whereas the village with the lowest value is Telutu Jaya, which has an effective CIBCP of -193 LU.

Keywords: Bali cattle, bali cattle breeding source area, carrying capacity, livestock density, smallholder livestock farming

ABSTRAK

Pengembangan sapi Bali menghadapi tantangan diantaranya semakin terbatasnya lahan baik untuk usaha ternak maupun untuk lahan hijauan pakan ternak. Penelitian bertujuan mengkaji potensi wilayah Kecamatan Tinanggea Kabupaten Konawe Selatan untuk pengembangan wilayah sebagai sumber bibit sapi Bali. Penelitian lapangan dilakukan dari bulan Februari sampai dengan Maret Tahun 2023. Lokasi penelitian yang ditentukan dengan *purposive sampling* yaitu di Kecamatan Tinanggea sebagai salah satu wilayah sentra sumber bibit sapi Bali. Penentuan responden ditentukan secara sensus sebanyak 716 peternak. Pendekatan analisis kepadatan ekonomi, kepadatan usahatani, kepadatan wilayah, dan kapasitas pengembangan populasi ternak sapi Bali (KPPTR) digunakan untuk mengkaji data yang dikumpulkan. Hasil analisis mengungkapkan bahwa kepadatan ekonomi memiliki kriteria sedang dengan nilai 86,09 ST/1.000 jiwa, kepadatan usahatani juga berkriteria sedang dengan nilai 0,27 ST/ha, dan kepadatan wilayah termasuk kategori jarang dengan nilai 6,27 ST/km2. Kombinasi kepadatan ternak yang dianggap sebagai Wilayah Pengembangan (WP) ditemukan pada kombinasi ekonomi-usahatani, sementara Wilayah Penyebaran dan Pengembangan (WPP) teridentifikasi pada kombinasi ekonomi-wilayah dan usahatani-wilayah. Nilai KPPTR efektif Kecamatan Tinanggea masih berpotensi untuk dinaikkan hingga mencapai 293 ST. Nilai KPPTR yang efektif per desa di Kecamatan Tinanggea dapat dikelompokkan ke dalam tiga kategori wilayah pengembangan, yaitu tingkat tinggi (4 desa), tingkat sedang (3 desa), dan tingkat rendah (17 desa). Desa Roraya memiliki nilai KPPTR efektif tertinggi sebesar 116 ST, sementara desa dengan nilai KPPTR efektif terendah adalah Desa Telutu Jaya, yang memiliki nilai -193 ST.

Kata kunci: Daya dukung, kepadatan ternak, peternakan rakyat, sapi bali, wilsumbit sapi bali

INTRODUCTION

Indonesia is currently unable to meet the domestic demand for beef due to continuously increasing demand that is not balanced with the national beef production capacity, resulting in a shortfall of 45.80%, equivalent to 374.10 thousand tons. Efforts to reduce dependence on beef imports and achieve national beef self-sufficiency face several challenges. According to Stephanie *et al.* (2020), strategies to improve beef cattle efficiency should focus on operational management and breeding, genetics, functional efficiency of the rumen microbiome and respiration, as well as feed structure and composition. These strategies must also consider the health and developmental needs of beef cattle in response to environmental changes (Fatimah and Rahim 2019).

The Directorate General of Livestock and Animal Health (2016) states that livestock development is inseparable from livestock infrastructure development. According to BPS (2024), the population of beef cattle in South Konawe Regency amounts to 53.900 heads, indicating a significant potential for cattle farming development in the region, making it one of the leading commodities. The central government has designated South Konawe Regency as a national beef cattle development area as well as a national Bali cattle breeding source region (Sulfiar *et al.* 2022; Abadi *et al.* 2024). Bali cattle population is also projected to increase by 82,914 heads, with an average growth rate of 3.22% in 2025, provided that the technical coefficients can be maintained.

Livestock population can influence the high growth rate of livestock in a region, thereby having the potential to become a leading sector (Khair *et al.* 2023). Furthermore, Lestari *et al.* (2017) and Harianto *et al.* (2023) stated that supporting factors in the development of Bali cattle farming are driven by meat prices and land availability. According to Abadi *et al.* (2023), equally important is the sustainability of the Bali cattle breeding system itself. The development of beef cattle farming needs to consider the availability of resources at the location as well as the extent to which the potential of beef cattle can be utilized as a source of food and animal protein (Untung 2020; Hajirin *et al.* 2020; Abadi *et al.* 2021; Solikin and Linawati 2022).

The development of Bali cattle faces challenges, namely the increasingly limited land available both for livestock farming and forage crops due to competition for land use with the agricultural sector (Abadi *et al.* 2019; Rusman *et al.* 2020; Doni *et al.* 2023). Therefore, the development of cattle farming is closely related to the carrying capacity of a region and the carrying capacity of forage crops, both in terms of quality and quantity (Doni *et al.* 2023). The carrying capacity for livestock business development in a region can be assessed from three aspects: economic carrying capacity, farm carrying capacity, and area carrying capacity (Sugiarti 2020; Budiari 2020; Suindari 2020). Therefore, research on livestock density and the carrying capacity of livestock business development in the Bali cattle breeding center, specifically in Tinanggea District, is very important to determine the sustainable condition of the Bali cattle breeding area.

MATERIALS AND METHODS

This study was conducted in Tinanggea District, South Konawe Regency, during February to March 2023. The respondents were determined by a census approach, involving a total of 716 livestock farmers. The census method used in this study is based on previous research conducted in the Bali cattle breeding center area of South Konawe Regency (Abadi *et al.* 2025). Data analysis was performed through livestock density analysis, criteria for livestock development areas, and analysis of forage carrying capacity.

Livestock Density Analysis

Economic density, agricultural density, and regional density were all included in the livestock density analysis, calculated using the formula by Ashari *et al.* (1995) presented in Table 1. The criteria for livestock development areas are shown in Table 2.

Capacity for Increasing Bali Cattle Population (CIBCP)

The CIBCP calculation is used to determine the results of the livestock feed carrying capacity analysis (Fariani 2008) as follows:

a. Maximum Potential Based on Natural Resources (MPBNR) / Carrying Capacity of the Region, calculated using the formula:
   MPBNR = Agricultural Land Carrying Capacity + Food Crop Carrying Capacity

Explanation:

- Agricultural Land Carrying Capacity = Agricultural Land Contribution × 3,75. Both grassland and non-grassland areas (dry land, plantations, rice fields, and forests) contribute to the agricultural land carrying capacity.
- Agricultural Land Contribution = Land Area × Land Contribution Coefficient.
- The coefficient of 3,75 represents the contribution of agricultural land to livestock farming units.
- Food Crop Carrying Capacity = Agricultural Waste Production / 2,3. This is determined by considering the contribution of agricultural waste from food crops (e.g., rice, corn, peanuts, mung beans, cassava, sweet potatoes, and soybeans).
- Agricultural Waste Production = Harvested Area × Harvested Area Contribution Coefficient.
- A coefficient of 2,3 is used to determine the dry matter (ton/year) required per livestock unit.

b. Maximum Potential Based on Farmer Households (MPBFH), calculated using the formula:
   MPBFH =c×FH

Explanation:

- c: The coefficient is 2,33 LU/HF, based on the number of livestock units (LU) allowed per farming household.
- FH: Farmer family head.

c. CIBCPValue Calculation:
   CIBCPNR = MPBNR – Popril
   CIBCPFH = MPBFH – Popril

Table 1. Livestock Density Analysis Formula*

No	Description	Formula	Criteria
1	Economic Density	$\frac{\sum beef cattle\ population(lu)}{\sum total\ population\ (people)} \times 1000$	· VH > 300 · H (100-300) · M 50-100 · L < 50
2	Farm Density	$\frac{\sum eef cattle\ population(lu)}{area\ of cultivated\ land\ (ha)}$	· VH > 2 · H 1-2 · M 0,25-1 · L < 0,25
3	Area Density	$\frac{\sum eef cattle\ population(lu)}{total\ area\ (km^2)}$	· VH > 50 · H 20-50 · M 10-20 · L < 10

*Source: Ashari *et al.* (1995)

Legend:

· L (Low)
· M (Moderate)
· H (High)
· VH (Very High)

Table 2. Criteria for Livestock Development Areas*

Economic Density of Livestock	Density Combination			
(Lu/1000 Inhabitants)	L	M	H	VH
L	DDA	DDA	DA	SA
M	DDA	DA	SA	SA
H	DA	DA	CA	CA
VH	DA	SA	CA	CA

*Source: Rahaeni (2014)

Legend:

· DDA (Distribution and Development Area): Score 4
· DA (Development Area): Score 3
· SA (Stabilisation Area): Score 2
· CA (Consumer Area): Score 1

Explanation:

- CIBCPNR: Capacity for increasing ruminant livestock population (LU) using natural resources.
- CIBCPFH: Capacity for increasing ruminant livestock population (LU) based on farmer households.
- Popril: Actual livestock population (number of cattle in the survey location).

d. Effective CIBCP:
CIBCPNR is used ifCIBCPNR <CIBCPFH
CIBCPFH is used ifCIBCPFH <CIBCPNR

e. Effective CIBCP: Effectiveness is assessed based on the ability to increase the ruminant livestock population in the research area, particularly the lower value between CIBCP NR and CIBCP FH. The CIBCP calculation follows Nell and Rollinson (1974).

Livestock Unit Conversion (Soekardono 2009)

- 1 ST = 1 adult cow (>2 years old)
- 0,5 ST = 1 heifer (1–2 years old)
- 0,25 ST = 1 calf (<1 year old)

Land Requirements for Forage Cultivation

Types of Land & Contribution (ha):

- 100% of the land consists of grassland.
- 5% of the land consists of homogeneous forests.
- 3% of the land is covered by secondary forests.
- Plantations (5% of the total land area).
- 2% of the land consists of rice fields.
- Rice field embankments (2.5% of the total land area).
- Dry fields (1% of the total land area).

Harvest Area for Green Feed Production (Straw Yield Production)

- 0,23 tons of dry matter (DM) of rice straw per hectare per year.
- 10,9 tons of DM of corn straw per hectare per year.
- 1,44 tons of DM of peanut straw per hectare per year.

- 1,07 tons of DM of soybean straw per hectare per year.
- 5,05 tons of DM of cassava straw per hectare per year.
- 1,2 tons of DM of sweet potato straw per hectare per year.

RESULTS AND DISCUSSION

Livestock Density

Livestock density is a measure used to optimize land use by determining the number of animals that can be raised for productivity, cost reduction, disease spread mitigation, and increased profit for farmers based on economic density, farm density, and area density criteria. The calculation results of Bali cattle density in Tinanggea District, as shown in Table 3, indicate that the economic density has a value of 86.09 LU (Livestock Units) per 1.000 people, which falls into the moderate category. Farm density is also categorized as moderate with a value of 0.27 LU per hectare, while area density falls into the sparse category with a value of 6.27 LU per square kilometer. The distribution of density criteria and values varies across villages or sub-districts, depending on land conditions, livestock population, and management practices applied by the farmers. For more details, see Table 3.

Table 3 shows that the analysis of economic density in Tinanggea District yields a value of 86.09 LU per 1.000 people, categorized as Moderate. This economic density value indicates that the development of the Bali cattle breeding center area in Tinanggea District is still feasible, with varying economic density levels across villages. Specifically, eight (8) villages fall into the sparse category, six (6) villages are classified as moderate, ten (10) villages are dense, and no villages fall into the very dense category. This suggests that the area still holds potential for further development based on economic density criteria. Meanwhile, farm density in Tinanggea District, as shown in Table 3, falls into the Moderate category with a value of 0,27 LU per hectare. At the village level, twenty-two (22)

Table 3. Values and Criteria of Livestock Density in Bali Cattle Breeding Source Areas in Tinanggea District. South Konawe Regency

Village/Sub-District	Economic Density (Lu/1000 Inhabitants)		Farming Density (Lu/ha)		Area Density (Lu/km^2)	
	Value	Criteria	Value	Criteria	Value	Criteria
Lanowulu	10.29	L	0.04	L	0.79	L
Tatangge	259.01	H	0.78	M	1.50	L
Roraya	66.60	M	0.38	M	3.74	L
Wundumbolo	12.28	L	0.04	L	1.19	L
Telutu Jaya	117.61	H	0.53	M	41.32	H
Panggosi	0.00	L	0.00	L	0.00	L
Lapoa	66.72	M	0.25	L	9.26	L
Bomba-Bomba	82.21	M	0.16	L	9.34	L
Asingi	116.74	H	0.91	M	24.25	H
Ngapaaha	103.17	H	0.34	L	8.99	L
Tinanggea	20.32	L	0.00	L	2.96	L
Akuni	174.53	H	6.94	VH	35.43	H
Bungin Permai	0.00	L	0.00	L	0.00	L
Torokeku	0.00	L	0.00	L	0.00	L
Lapulu	155.45	H	0.32	M	4.50	L
Lasuai	230.19	H	1.50	H	20.46	H
Wadonggo	69.00	M	0.19	L	3.23	L
Matambawi	81.13	M	0.10	L	7.25	L
Watumelewe	110.49	H	0.12	L	19.80	M
Moolo Indah	160.76	L	0.27	L	9.25	L
Matandahi	29.31	L	0.04	L	3.55	L
Lalonggasu	225.36	H	8.42	VH	8.56	L
Palotawo	88.47	M	0.06	L	4.22	L
Lalowatu	136.41	H	0.06	L	7.70	L
District Tinanggea	86.09	M	0.27	M	6.27	L

Explanation:

- L (Low)
- M (Moderate)
- H (High)
- VH (Very High)

villages have potential for development based on their farm density.

Area density in Tinanggea District is classified as Sparse, with a value of 6.27 LU per square kilometer. This indicates that there is still considerable potential to accelerate the growth of the Bali cattle population in the area. The analysis reveals that, from the perspective of livestock density, the region generally still applies a traditional livestock farming system. There are four (4) villages classified as dense, one (1) village with moderate area density, and nineteen (19) villages categorized as sparse. Therefore, it is possible to develop Bali cattle farming in Tinanggea District based on area density criteria.

Livestock Density Combination

The combination of livestock density is a strategy to optimize livestock farming efforts to increase production and efficiency, reduce business risks, optimize the use of resources such as land, feed, and water, and increase profits for farmers. Therefore, analyzing livestock density combinations can help farmers make better decisions in managing their farms, improving both efficiency and profitability. The analysis of livestock density combinations is divided into three types: the combination of economic density and farm density, economic density and area density, and farm density and area density. There are four assessment criteria used: DDA (Distribution and Development Area, score 4), DA (Development Area, score 3), SA (Stabilisation Area, score 2), and CA (Consumer Area, score 1). For more details, see Table 4.

Table 4. Livestock Density Combinations in the Development of Cattle Farming in Tinanggea District, South Konawe Regency

Village/Sub-District	Density Combination			Total Value	Priority
	EF	ER	FR		
Lanowulu	DDA	DDA	DDA	12	1
Tatangge	DA	DA	DDA	10	2
Roraya	DA	DDA	DDA	11	1
Wundumbolo	DDA	DDA	DDA	12	1
Telutu Jaya	DA	CA	SA	6	3
Panggosi	DDA	DDA	DDA	12	1
Lapoa	DDA	DDA	DDA	12	1
Bomba-Bomba	DDA	DDA	DDA	12	1
Asingi	DA	CA	SA	6	3
Ngapaaha	D	DA	DDA	10	2
Tinanggea	DDA	DDA	DDA	12	1
Akuni	CA	CA	CA	3	4
Bungin Permai	DDA	DDA	DDA	12	1
Torokeku	DDA	DDA	DDA	12	1
Lapulu	DA	DA	DDA	10	2
Lasuai	CA	CA	CA	3	4
Wadonggo	DDA	DDA	DDA	12	1
Matambawi	DDA	DDA	DDA	12	1
Watumelewe	DA	DA	DDA	10	2
Moolo Indah	DDA	DDA	DDA	12	1
Matandahi	DDA	DDA	DDA	12	1
Lalonggasu	CA	DA	DA	7	3
Palotawo	DDA	DDA	DDA	12	1
Lalowatu	DA	DA	DDA	10	2
District Tinanggea	DA	DDA	DDA	11	1

Explanation:

- EF = Economic density >< Farming density
- ER = Economic density >< Regional density
- FR= Farming density >< Regional density
- DDA (Distribution and Development Area)
- DA (Development Area)
- SA (Stabilisation Area)
- CA (Consumer Area)

Table 4 shows that the analysis of livestock density combinations and the development of Bali cattle in Tinanggea District ranks as the first priority for overall development. The combination of economic density and farm density falls into the DA (Development Area) category, indicating its potential as a growth center for the livestock subsector. The combination of economic density and area density is categorized as DDA (Distribution and Development Area), which signifies its potential as an economic distribution hub across the region. Similarly, the combination of farm density and area density is also categorized as DDA, representing potential for the distribution of livestock activities throughout the area.

The villages in Tinanggea District identified as first priority include Lanowulu, Roraya, Wundumbolo, Panggosi, Lapoa, Bomba-Bomba, Tinanggea, Bungin Permai, Torokeku, Wadonggo, Matambawi, Moolo Indah, Matandahi, and Palatawo. The second priority villages are Tatangge, Ngapaha, Lapulu, Watumelewe, and Lalowatu. The third priority villages include Telutu Jaya, Asingi, and Lalonggasu, while Akuni and Lasuai are in the fourth priority group.

The livestock density combinations presented in Table 4 indicate that Tinanggea District is primarily a development area within the economic-farm density combination. Meanwhile, the economic-area and farm-area combinations reflect aspects of dissemination and livestock development. Martanto (2019) specifically states that livestock development can be implemented through various approaches such as zonal production, breeding source areas, development of system patterns, infrastructure, farmer empowerment, and feed development. In the development of Bali cattle, the key factors include sustainable natural resources, feed availability, and human resources. The Directorate General of Livestock and Animal Health (2016) also emphasizes that livestock development is inseparable from livestock infrastructure development.

Capacity for Increasing the Bali Cattle Population

The capacity for increasing the Bali cattle population refers to the ability of a region or livestock system to sustainably and effectively increase the number of Bali cattle, taking into account the availability of resources, quality of breeding stock, farm management, infrastructure capacity, and supportive policies. For more details, see Table 5.

Table 5 shows that the capacity to increase the Bali cattle population in Tinanggea District is distributed across several villages, including Lanowulu, Roraya, Wundumbolo, Bomba-Bomba, Wadonggo, Matambawi, and Palatawo,

Table 5. Capacity for Increasing the Bali Cattle Population in Tinanggea District

Village/Sub-District	POPULATION (LU)	MPBNR (LU)	MPBFH (LU)	CIBCPNR (LU)	CIBCPFH (LU)	CIBCPEfektif (LU)
Lanowulu	9	328	9	319	1	1
Tatangge	137	45	149	-91	13	-91
Roraya	126	349	242	223	116	116
Wundumbolo	4	85	14	81	10	10
Telutu Jaya	291	97	592	-193	301	-193
Panggosi	0	0	0	0	0	0
Lapoa	79	58	149	-21	70	-21
Bomba-Bomba	67	80	205	13	138	13
Asingi	226	98	336	-128	109	-128
Ngapaaha	254	323	200	69	-54	-54
Tinanggea	49	2	28	-47	-21	-47
Akuni	83	2	84	-81	1	-81
Bungin Permai	0	0	0	0	0	0
Torokeku	0	0	0	0	0	0
Lapulu	86	57	135	-29	50	-29
Lasuai	131	18	182	-113	51	-113
Wadonggo	67	239	140	172	73	73
Matambawi	52	375	93	322	41	41
Watumelewe	94	65	186	-29	92	-29
Moolo Indah	127	123	191	-4	64	-4
Matandahi	34	523	28	489	-6	-6
Lalonggasu	185	179	168	-6	-17	-17
Palotawo	39	78	89	39	50	39
Lalowatu	70	8574	117	-52	46	-52
Total	1,54	1,541	2,325	1	785	-617

with a total potential increase of 293 Livestock Units (LU). However, the overall Capacity for Increasing Bali Cattle Population (CIBCP) in Tinanggea District is considered sufficient, as the total CIBCP is only 1 LU. Meanwhile, the effective CIBCP values indicate that each village in Tinanggea District has a different level of development potential. These values are categorized into three levels of development areas: high (4 villages), medium (3 villages), and low (17 villages). For more details, see Table 6.

Table 6. Priority Levels for the Development of Bali Cattle Population in Tinanggea District

Village/Sub-District	CIBCPEfektif (LU)	Development Level
Lanowulu	1	Medium
Tatangge	-91	Low
Roraya	116	High
Wundumbolo	10	Medium
Telutu Jaya	-193	Low
Panggosi	0	Low
Lapoa	-21	Low
Bomba-Bomba	13	Medium
Asingi	-128	Low
Ngapaaha	-54	Low
Tinanggea	-47	Low
Akuni	-81	Low
Bungin Permai	0	Low
Torokeku	0	Low
Lapulu	-29	Low
Lasuai	-113	Low
Wadonggo	73	High
Matambawi	41	High
Watumelewe	-29	Low
Moolo Indah	-4	Low
Matandahi	-6	Low
Lalonggasu	-17	Low
Palotawo	39	High
Lalowatu	-52	Low

Table 6 shows that the highest effective Capacity for Increasing Bali Cattle Population (CIBCP) value reaches 116 LU in Roraya Village, followed by 73 LU in Wadonggo Village. On the other hand, the lowest effective CIBCP value is -193 LU, found in Telutu Jaya Village. The fact that Roraya Village has 104 households involved in livestock farming is another contributing factor to the increase in ruminant livestock numbers, indicating strong potential for improved livestock management. This village also has agricultural land consisting of 300 hectares of rice fields, 10 hectares of dry fields, 20 hectares of plantations, and 55 hectares of grazing land. With a total land capacity capable of supporting 126 LU, the village still has the potential to accommodate an additional 116 LU, supporting sustainable growth in ruminant livestock populations. According to Untung (2020) and Hajirin *et al.* (2020), the development of beef cattle farming must consider the available local resources and the extent to which these resources can be utilized as sources of food and animal protein. Furthermore, Abadi *et al.* (2021) emphasize that livestock sector development is also significantly influenced by regional development and the forage carrying capacity both in terms of quality and quantity.

CONCLUSION

The density of Bali cattle in Tinanggea District falls into the moderate category for economic (86.09 LU/1.000 people) and farming (0.27 LU/ha) densities, while regional density (6.27 LU/km²) is considered sparse. The combination of these density types indicates potential for livestock development, particularly in the economic-farming, economic-regional, and farming-regional dimensions. The effective CIBCP in Tinanggea District still has the potential to increase by up to 293 LU. Based on village-level effective CIBCP values, development areas are classified into three levels: high (4 villages), medium (3 villages), and low (17 villages). The highest effective CIBCP is in Roraya Village (116 LU), while the lowest is in Telutu Jaya Village (-193 LU).

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