Estimation of Bali Cattle Population Dynamics in the South Konawe Regency, Southeast Sulawesi

Ahmat Endang Two Sulfiar[1], Alek Ibrahim[2], Bayu Andri Atmoko[2,3], Budi Guntoro[4],

I Gede Suparta Budisatria[2*]

[1] *Animal Science Study Program, Faculty of Agriculture and Animal Science, Universitas Muslim Buton, Jl. Betoambari No. 146, Bone-Bone, Batupoara, Kota Bau-Bau, Southeast Sulawesi Indonesia, 93721*
[2] *Department of Animal Production, Faculty of Animal Science, Universitas Gadjah Mada, Jl. Fauna No 3, Kampus UGM, Bulaksumur, Yogyakarta, Indonesia, 55281*
[3] *National Research and Innovation Agency, Jl. M.H. Thamrin No. 8, Jakarta Pusat 10340*
[4] *Deparment of Livestock Socio-Economics, Faculty of Animal Science, Universitas Gadjah Mada, Jl. Fauna No 3, Kampus UGM, Bulaksumur, Yogyakarta, Indonesia, 55281*
Corresponding author. Email: budisatria@ugm.ac.id

ABSTRACT

The central government determined South Konawe Regency as a national beef cattle development area and a source area for national Bali cattle breeds. This study aims to estimate the population dynamics of Bali cattle in South Konawe Regency in the coming year. This research was conducted in July-August 2019 in Konda and West Ranomeeto Districts. The research was conducted using interviews and census methods of cattle population to 105 farmers. Secondary data were obtained from the Department of Animal Husbandry and Health and The Central Bureau of Statistics of the South Konawe Regency. Population dynamics were calculated using a time series analysis. Population dynamics of Bali cattle in the period 2014 to 2018 increased by 4.02% per year. The estimated population development equation was $y = 2{,}332.63x + 61{,}921$. If the technical coefficient can be maintained, then the cattle population in 2025 was estimated to be 82,914 heads, with an average increase of 3.22% per year. The cattle ownership was 5.51 heads (4.20 animal units) per farmer. If Bali cattle's technical coefficient and composition were the same as in 2019, it was estimated that in 2025 will be 63,124 animal units of Bali Cattle available in the South Konawe Regency.

Keywords: Bali cattle, Cattle population, Population estimation, Time series analysis.

1. INTRODUCTION

The central government determined South Konawe Regency as a national beef cattle development area based on the Decree of the Minister of Agriculture Republic of Indonesia No. 43/2015 [1] and as a source area for national Bali cattle breeds based on the Decree of the Minister of Agriculture Republic of Indonesia No. 803/2016 [2]. The population of beef cattle in the Konawe Selatan District was the highest in Southeast Sulawesi Province. The current population in 2018 was 69,907 head with the average population increase in the last five years was 3.60% [3]. Bali cattle dominated the

population of beef cattle in the South Konawe Regency by 95%. [4], [5]. Generally, beef cattle farming in South Konawe Regency was traditionally carried out through grazing in grassland or extensively [6], [7].

The population increase impacts the increasing demand for beef, so an increase must follow it in the cattle population. The population of beef cattle in an area will have dynamics in the composition of the cattle breed and its structure. Population dynamics can be determined based on increasing or decreasing population size. Data on the development of the cattle population was essential to determine the number and breed of cattle in the area. Population maps were used to

determine the distribution of livestock population in an area based on the breed and population structure composition. The population structure consists of the age (adult, young, and calf) and sex (male and female). Population dynamics are changes in population size over time. Population size changes over time due to differences in population growth, which are influenced by birth and mortality rates [8]–[10].

The ability to describe a population makes it possible to know changes in a population [8]. The description of the population growth of beef cattle can be estimated based on time series analysis. Time series analysis describes the increase or decrease in population based on data from year to year [11]. The research related to population dynamics was needed to know the number of needs and know the potential of an area as a source of breeding stock, both as a replacement and feeder for fattening [9]. This study aims to estimate the population dynamics of Bali cattle in South Konawe Regency in the coming year. The data on population dynamics and maps can be used as a source of reference in programs and policies related to the development of beef cattle (Bali cattle) in South Konawe Regency, Southeast Sulawesi, given its status as one of the source areas for Bali cattle breeds in Indonesia which is established by the central government.

Konda and Ranomeeto Barat Districts, South Konawe Regency, Southeast Sulawesi, Indonesia. The research was conducted using interviews and census methods of cattle population to 105 farmers as primary data. The secondary data were obtained from and the Department of Animal Husbandry and Animal Health in South Konawe Regency and the Central Bureau of Statistics (BPS) of the Konawe Selatan Regency. The data observed included the structure and composition of cattle ownership and estimated the dynamics of the beef cattle population.

The data obtained from the study were then analyzed. The analysis used a time series analysis with the least-squares method. Data were analyzed using the time series least squares method with linear line equations based on the formula $y = ax + b$, where a is constant, b is an intercept, and x is time [11]. The population structure of beef cattle was grouped into each breed (calf, young, adult) and sex (male and female), if converted to animal units (AU) with the conversion of 1 adult = 1 AU, 1 young = 0.6 AU, and 1 calf = 0.25 AU [12]. The percentage structure and composition data were used to calculate the estimated number of livestock units by multiplying the percentage value of livestock structure and composition with the estimated value of population dynamics and converting it into animal units.

2. MATERIALS AND METHODS

This research was conducted in July-August 2019 in

Table 1. Bali cattle population dynamic in South Konawe Regency from 2014 – 2018

Years	Population		Population Increase of Bali cattle	
	Beef cattle*	Bali cattle*	heads	%
2014	60,195	57,185	-	-
2015	62,616	59,485	2,300	4.02
2016	65,434	62,162	2,677	4.50
2017	67,746	64,359	2,196	3.53
2018	69,907	66,412	2,053	4.02
Average	65,179	61,921	2,307	4.02

*based on the data from the Central Bureau of Statistics (BPS) of Konawe Selatan Regency [3]
** 95% of the total population [4,5]

Table 2. Estimation of Bali cattle population dynamic in South Konawe Regency from 2019-2025

Years	Population	Population increase (%)
2019	68,919	3.77
2020	71,251	3.38
2021	73,584	3.27
2022	75,916	3.17
2023	78,249	3.07
2024	80,582	2.98
2025	82,914	2.89
Average	75,916	3.22

3. RESULTS AND DISCUSSION

The beef cattle population dynamics will be influenced by births, mortality, mutations, and slaughter [9]. The beef cattle population dynamic data in the South Konawe Regency from 2014 – 2018 [3] showed in table 1. The data were used to calculate the Bali cattle population's estimation in South Konawe, which is 95% of the beef cattle population [4], [5]. During the 2014 – 2018, the calculations showed an increase of the Bali cattle population of 2.307 heads or 4.02% per year. The results different with the beef cattle population dynamic in the Bayang District, which has decreased by an average of 1.71% per year in 2012 – 2016 [13].

The regression equation was obtained from time series analysis, namely $y = 2,332.63x + 61,921$. If it was assumed that the technical coefficient is fixed, it could

be estimated that the Bali cattle population in South Konawe Regency was presented in table 2. Table 2 showed that the Bali cattle population's trend increases from 2019 to 2025, with an average of 3.22% per year. Although the population continues to increase and has a positive value, the number of percentage increases continues to decline every year. The condition requires the stakeholder attention to develop the population of Bali cattle in South Konawe, in terms of keeping the percentage increase in population to increase every year.

The composition, structure, and ownership of Bali cattle in the South Konawe Regency research area were presented in Table 3. Table 3 showed that the number of Bali cattle in the area was 5.51 head per farmer. If converted into animal units, the total cattle ownership was 4.20 AU per farmer. The result of this study was greater than the ownership of Bali cattle in Banyuasin

Table 3. The composition, structure, and ownership of Bali cattle in South Konawe Regency

Structure	Composition	Number (heads)	Percentage (%)	Animal Unit (AU)
Calves	Male	56	9.67	14.00
	Female	68	11.74	17.00
Young	Male	72	12.44	43.20
	Female	41	7.08	24.60
Adult	Male	157	27.12	157.00
	Female	185	31.95	185.00
Based on age	Calves	124	21.42	31.00
	Young	113	19.52	67.80
Based on sex	Adult	342	59.07	342.00
	Male	285	49.22	214.20
Total	Female	294	50.78	226.60
Number of farmers		579	100	440.80
Ownership/farmers		105		105

Table 4. Estimation of the animal unit (AU) number of Bali cattle in South Konawe Regency from 2019 – 2025

Structure	Composition	Years						
		2019	2020	2021	2022	2023	2024	2025
Calves	Male	1,666	1,723	1,779	1,836	1,892	1,948	2,005
	Female	2,044	2,093	2,160	2,229	2,297	2,366	2,434
Young	Male	5,142	5,316	5,490	5,664	5,838	6,012	6,186
	Female	2,928	3,027	3,126	3,225	3,325	3,424	3,523
Adult	Male	18,688	19,320	19,953	20,585	21,218	21,850	22,483
	Female	22,021	22,766	23,511	25,002	25,002	25,747	26,492
Based on age	Calves	3,690	3,815	3,940	4,065	4,189	4,314	4,439
	Young	8,070	8,343	8,617	8,890	9,163	9,436	9,709
	Adult	40,708	42,086	43,464	44,842	46,220	47,597	48,975
Based on sex	Male	25,496	26,359	27,222	28,085	28,948	29,811	30,674
	Female	26,972	27,885	28,798	29,711	30,624	31,537	32,450
Total		52,469	56,798	56,020	57,796	59,572	61,348	63,124

Regency, namely 3.62 head or 2.62 AU per farmer with a structure of calves, young, and adults were 24.19, 23.67, and 52.13% respectively [14] and in Bayang District, Pesisir Regency, namely 1.58 AU per farmer with population structure of calves, young and adults was 21.36, 24.78, and 53.84% respectively [13], and also when compared to Aceh cattle in North Aceh District, which was 2.57 heads or 1.78 AU per farmer with a population structure of calves, young, and adults were 27.58, 25.18, and 47.24% respectively [9], [10].

The results obtained in this study were used to calculate the estimated number of animal units of Bali cattle in South Konawe Regency, which was presented in Table 4. If the assumption that Bali cattle structure and composition each year was similar in 2018, then in 2025, 63,124 AU was available in South Konawe Regency. However, this estimate in real terms may not follow the estimation pattern based on the linear regression equation, so that there will be differences in results [11].

The livestock population dynamic analysis in an area was supported by the calculation of the natural increase, livestock mutation, and net replacement rate so that the livestock population's output can be predicted within one year. The livestock population dynamics were a reflection of the reproductive performance of livestock. The good of livestock reproduction will accelerate the population increase of the livestock. The livestock population dynamic was also useful for determining the amount of livestock mutation from the area and preventing the livestock population's depletion. In line with Indonesia's population growth, the number of livestock trade increased, and consumer demand for livestock products was higher, especially during religious and cultural festivities in society [15], [16].

4. CONCLUSION

The dynamics of the cattle population in the period 2014 to 2018 increased by 4.02% per year. The estimated population development equation was $y = 2,332.63x + 61,921$. If the technical coefficient can be maintained, then the cattle population in the South Konawe Regency in 2025 was estimated to be 82,914 heads, with an average population increase of 3.22% per year. The cattle ownership was 5.51 heads (4.20 AU) per farmer. If Bali cattle technical coefficient and composition are the same as in 2019, it was estimated that in 2025 will be 63,124 AU of Bali Cattle available in the South Konawe Regency.

AUTHORS' CONTRIBUTIONS

IGSB and BG designed and supervised the present study, AETS performed the field study, AETS, AI and BAA analysed the data and wrote the manuscript. The final manuscript has been read and developed in consultation with all authors, all authors read and approved the final manuscript.

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