

## The Forecasting of Beef Cattle Population in Sinjai Regency, South Sulawesi, Indonesia

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### ABSTRACT

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One of the weaknesses of the livestock sector management in Indonesia, particularly in Sinjai Regency, is the lack of population data. The available data so far mostly consists of general beef cattle population data without clear population structure details. To understand the development of the beef cattle population, a forecasting approach based on various beef cattle population data in Sinjai Regency is necessary. This study aims to analyze the structure and dynamics of the beef cattle population and calculate the predicted population development of beef cattle in Sinjai Regency. This research uses a case study method with purposive location selection. The beef cattle population dynamics data were processed using the time series forecasting method, specifically exponential smoothing with  $\alpha = 0.9$ , based on annual data over 10 years from 2015 to 2024. The results show that if the data behavior remains the same as the actual data from the past 10 years, the overall structure of the beef cattle population in Sinjai Regency consists of fewer male cattle compared to female cattle. The forecasted beef cattle population in Sinjai Regency for 2025–2034 varies and tends to increase year by year, except for a decline in population in 2033 due to technical constraints in the development of beef cattle by the community in the field.

**Keywords:** Forecasting, Population; Beef Cattle; Sinjai Regency.

## INTRODUCTION

Beef cattle are one of the most widely raised large ruminants by farmers and contribute significantly as a source of meat and fulfillment of food needs, especially animal protein [1]. The

types of beef cattle raised in Indonesia vary, including local cattle and imported breeds [2]. Generally, beef cattle can be categorized into three breeds: *Bos taurus* (originating from England and mainland Europe), *Bos indicus* (originating from Asia and Africa), and *Bos sondaicus* (found in the Malay Peninsula and Indonesia). Examples of *Bos sondaicus* include Bali cattle and Madura cattle, while *Bos indicus* includes Ongole Crossbred (OC) and Brahman cattle, and *Bos taurus* breeds include Simmental, Limousin, Angus, and Brangus cattle [3].

South Sulawesi has great potential in developing beef cattle farming because this business has been hereditary [4]. South Sulawesi is one of the regions producing beef cattle, and its livestock sector is dominated by beef cattle at 43.70% [5]. Cattle farming in South Sulawesi is spread across all regencies/cities [4]. Sinjai Regency ranks second in terms of beef cattle population in South Sulawesi in 2024. The highest beef cattle population in South Sulawesi in 2024 is in Bone Regency, with 247,415 heads [6], followed by Sinjai Regency with 71,239 heads [7], and Bulukumba Regency with 67,967 heads [6].

A population is a group of organisms of the same species (a specific taxon) living in a particular area at a specific time [8]. Livestock population refers to the number of livestock living in a region during a certain period, usually expressed annually [9]. The population structure in a region greatly determines its population growth [10]. The structure of livestock populations is very important to know as the basis for policy enforcement, implementation of maintenance management, mating system, and knowing the number of livestock populations [11]. The population structure of animals is closely related to population dynamics. Population dynamics of livestock are the ups and downs or changes in the number of livestock populations in a region [12]. The structure of the population can give information on how productive females and young females are by the ratio between the females and the young females with the males [13]. Livestock population structure can be differentiated by sex and age, where cattle age groups are divided into adults (productive cattle, generally two years or older), young (weaned cattle aged between one and two years that are not yet productive), and calves (calves aged 0 to 12 months or still nursing) [14]. Factors influencing livestock population dynamics include births, deaths, and livestock movement between regions (migration) [15].

Livestock output from a region is determined by its population structure and development or population growth plans. Determining output requires consideration of replacement livestock needs for breeding to prevent overexploitation of the population [16]. The livestock population can be increased if there are births and incoming livestock. Conversely, it decreases if there are deaths, slaughtering, and outgoing livestock [17]. One weakness in livestock sector management in Indonesia, particularly in Sinjai Regency, is the lack of population data. The available data mostly consists of general beef cattle population data without clear structural details. To understand the development of the beef cattle population in Sinjai Regency, a forecasting approach based on various beef cattle population data is necessary.

Forecasting involves predicting the future, but can only be done based on past information, raising the issue of selecting the most appropriate information and models to predict the future [18]. Generally, forecasting is useful as a tool for effective and efficient planning, determining future resource needs, and making informed decisions. The quality of research results depends heavily on the accuracy of forecasts. However, it is important to note that forecasts always contain errors, so efforts must be made to minimize them [19]. There is no single forecasting

method that is always best for predicting various types of data. Each method has advantages and disadvantages, so it is necessary to compare several forecasting methods [20].

One of the challenges in forecasting is selecting the best forecasting model that can identify and respond to historical data patterns. Forecasting models can generally be grouped into two main categories: qualitative and quantitative methods [21]. Qualitative methods are intuitive and are usually carried out when there is no past or historical data, so that mathematical forecasting cannot be done. However, if past data is available, forecasting can be done using quantitative methods [22].

Quantitative methods are further divided into intrinsic and extrinsic models [21]. Intrinsic quantitative models, often called time series models, involve quantitative forecasting methods based on past data collected regularly. Time series forecasting can be performed by detecting patterns and trends in time series data and formulating them into a model [23].

The exponential smoothing method is a widely used forecasting technique for time series analysis due to its simplicity and ease of automated forecasting procedures. Exponential smoothing is a repetitive calculation procedure that continuously uses the latest data. Each data point is weighted, with the weight represented by alpha ( $\alpha$ ). The value of the smoothing constant,  $\alpha$ , can be chosen between 0 and 1, where  $0 < \alpha < 1$  [24].

## MATERIALS AND METHODS

This study uses descriptive quantitative research with secondary time series data collected annually over 10 years from 2015 to 2024. The research method employs a case study with purposive location selection, as Sinjai Regency is highly potential for beef cattle development. This is evidenced by its ranking as the second-highest beef cattle population among all regencies/cities in South Sulawesi in 2024 [6]. Data analysis uses the exponential smoothing forecasting method with  $\alpha = 0.9$ , calculated using the following formula [25]:

$$F_t = F_{t-1} + \alpha (A_{t-1} - F_{t-1})$$

Where:

$F_t$  = forecast for the period to be predicted.

$F_{t-1}$  = forecast for the previous period.

$\alpha$  = smoothing constant ( $0 < \alpha < 1$ ).

$A_{t-1}$  = actual data for the previous period.

The forecast accuracy was tested using the Mean Absolute Deviation (MAD), where a smaller MAD indicates higher forecast accuracy. If actual data is denoted as  $A_t$  and forecast data as  $F_t$ , the forecast error is expressed as  $e_t = A_t - F_t$ . Thus, Error = Actual Data – Forecast. To measure forecast accuracy, the tracking signal is used, calculated as the Running Sum of Forecast Errors (RSFE) divided by MAD, as follows [21]:

$$\begin{aligned} \text{Tracking Signal} &= \text{RSFE} / \text{MAD} \\ &= \Sigma (\text{Actual Data for Period } i - \text{Forecast Data for Period } i) / \text{MAD} \end{aligned}$$

Where:

$\text{MAD} = \Sigma (\text{Absolute Forecast Errors}) / n$

$n$  = number of data periods.

A positive tracking signal indicates that actual data is greater than the forecast, while a negative tracking signal means actual data is smaller than the forecast. A "good" tracking signal

has a low RSFE and balanced positive and negative errors, centering the tracking signal near zero. Experts in forecasting systems suggest using a maximum tracking signal of  $\pm 4$  as control limits [21].

The beef cattle population dynamics data forecasted using the time series method include deaths, slaughter, outgoing, and incoming cattle. Birth data is calculated separately based on the reproductive efficiency of beef cattle in Sinjai Regency, following existing patterns using data on the number of adult females, mating percentage, pregnancy, births, and calf mortality.

The next step calculates the year-end population using the formula [26]:

End Population = Initial Population + Births – Deaths – Slaughter – Expenditures + Incoming.

After determining the year-end population, the beef cattle population structure is organized by sex and age group, assuming a 50% male and 50% female birth rate. Newborn calves become the calf population for that year. The following year, the calf population becomes the young population, and the year after, the young population becomes the adult population.

## RESULTS AND DISCUSSIONS

### General Condition of the Research Area

Astronomically, Sinjai Regency is located between  $5^{\circ}2'56''$ – $5^{\circ}21'16''$  South Latitude and  $119^{\circ}56'30''$ – $120^{\circ}25'33''$  East Longitude. Geographically, Sinjai Regency is bordered by: North: Bone Regency, South: Bulukumba Regency, Bantaeng Regency, West: Gowa Regency, East: Bone Gulf. Sinjai consists of 9 sub-districts: West Sinjai, Sinjai Borong, South Sinjai, Tellulimpoe, East Sinjai, Central Sinjai, North Sinjai, Bulupoddo, and Pulau Sembilan.

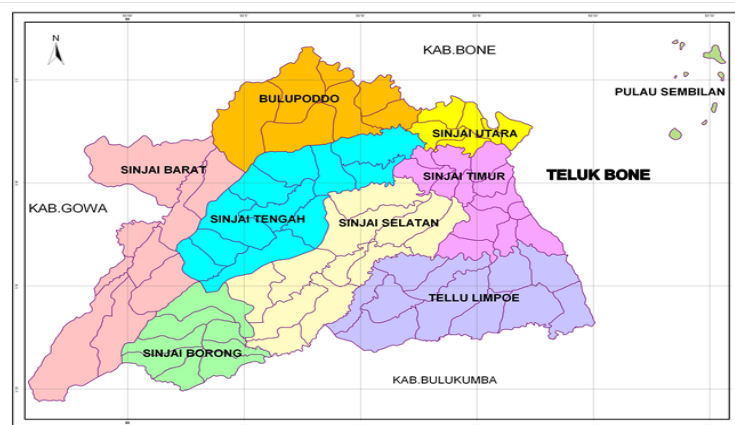


Figure 1. Map of Sinjai Regency [7]

The total area of Sinjai Regency is 819.96 km<sup>2</sup>, located 223 km from the provincial capital of South Sulawesi. Tellulimpoe is the largest sub-district, covering 147.30 km<sup>2</sup> or 18% of Sinjai Regency's total area.

Sinjai Regency has a population of 276,269 people, with an annual growth rate of 1.70% from 2020 to 2024. The population density in 2024 is approximately 337 people/km<sup>2</sup>. The highest population density is in North Sinjai (1,803 people/km<sup>2</sup>), while the lowest is in Bulupoddo (188 people/km<sup>2</sup>). The sex ratio in Sinjai Regency is 98.28% (98 males per 100 females).

Sinjai Regency has three geographical dimensions: coastal/marine, lowland, and highland areas. Morphologically, the topography varies from flat to mountainous. About 38.26% (31,370

ha) is flat to gently sloping land (0–15% gradient), while hilly to mountainous areas (>40% gradient) cover approximately 25,625 ha (31.25%).

The region is dominated by hills and mountains, though there are no active volcanoes. Mountainous areas are primarily located in West Sinjai, Central Sinjai, Sinjai Borong, and Bulupoddo. Due to this topography, regional development in Sinjai is limited.

Sub-districts with relatively flat terrain include East Sinjai, North Sinjai, and Pulau Sembilan. Flat areas with sufficient water resources are used by the community as rice fields. The elevation of Sinjai Regency ranges from 0 to 1,000 meters above sea level (MASL).

Sinjai experiences a subtropical climate with two seasons: the rainy season (April–October) and the dry season (October–April). Annual rainfall ranges between 2,000 and 4,000 mm, with 100–160 rainy days per year. Average humidity ranges from 64–87%, and temperatures range between 21.1°C - 32.4°C.

Livestock farming in Sinjai is categorized into large livestock (cattle, horses, buffalo, and goats) and poultry (layers, broilers, native chickens, and ducks). Beef cattle are primarily raised in Sinjai Borong, South Sinjai, East Sinjai, and Tellulimpoe, while dairy cattle are developed in West Sinjai. Goats are raised in Bulupoddo, Tellulimpoe, South Sinjai, and Central Sinjai. Native chickens are predominantly raised in Central Sinjai and North Sinjai, layers in Tellulimpoe, South Sinjai, and North Sinjai, and broilers in Bulupoddo, East Sinjai, South Sinjai, and Tellulimpoe [7].

### **Beef Cattle Population Structure in Sinjai Regency**

The beef cattle population structure data for Sinjai Regency were obtained from the Department of Animal Husbandry and Animal Health of Sinjai Regency. The data includes the beef cattle population structure in 2024. Overall, the beef cattle population in Sinjai Regency consists of fewer males (20,509 heads) compared to females (50,730 heads).

In 2024, the total beef cattle population in Sinjai Regency was 71,239 heads, consisting of: Male calves: 6,946 heads, Male young: 6,931 heads, Male adults: 6,632 heads, Female calves: 7,209 heads, Female young: 8,378 heads, Female adults: 35,143 heads. In percentage terms, the population structure is: Male calves: 9.75%, Male young: 9.73%, Male adults: 9.31%, Total males: 28.79%, Female calves: 10.12%, Female young: 11.76%, Female adults: 49.33%, Total females: 71.21% [27].

This is because the female sex will be used as a parent, and the male, when it is a young male or adult male will be sold for the needs of the farmer's household such as for school fees or education costs, medical expenses if someone suddenly gets sick, party costs if someone gets married, costs to buy a vehicle and other costs. The results of this study are in accordance with the results of research conducted by Tanari et al. [28] which stated that the structure of the beef cattle population in North Pamona District consists of; adult males (22%), adult females (48%), young males (6-7%), young females (8-9%), or it can be calculated from the total population obtained the composition of male cattle (34.7%) and females (65.3%).

### **Beef Cattle Population Dynamics in Sinjai Regency**

The beef cattle population dynamics data for Sinjai Regency were obtained from the Service of livestock and animal health, Sinjai Regency, covering 10 years (2015–2024). The data is presented in Table 1.

**Table 1. Beef Cattle Population Dynamics in Sinjai Regency (2015–2024)**

Year	Initial Population (Heads)	Births (Heads)	Slaughter (Heads)	Deaths (Heads)	Outgoing (Heads)	Incoming (Heads)	Year-End Population (Heads)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2015	92,355	15,506	5,779	155	4,386	97	97,638
2016	97,638	16,598	6,707	249	5,817	270	101,734
2017	101,734	14,861	6,922	158	3,883	85	105,718
2018	105,718	15,488	6,897	164	3,443	59	110,761
2019	110,761	13,659	6,890	273	3,316	200	114,141
2020	114,141	13,377	4,825	241	1,391	25	121,086
2021	121,086	11,685	5,381	421	2,847	25	124,147
2022	124,147	11,944	5,918	669	2,488	0	127,016
2023	127,016	6,772	17,238	6,093	40,684	0	69,773
2024	69,773	15,385	6,236	53	7,631	-	71,239

Source: Service of livestock and animal health, Sinjai Regency, 2025

The population dynamics data of beef cattle in Sinjai Regency, 10 years ago from 2015-2024, is also presented in the form of images to facilitate the identification of actual data patterns and behavior. The data can be seen in Figure 2.

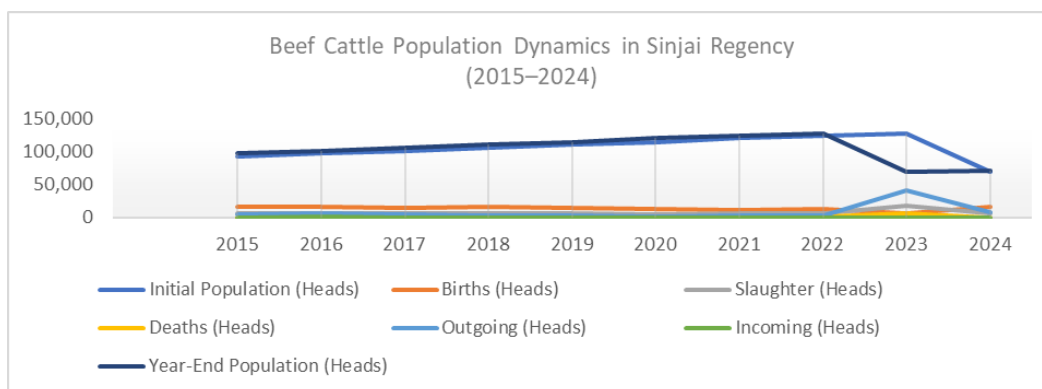


Figure 2. Beef Cattle Population Dynamics in Sinjai Regency (2015–2024) [27]

The development of beef cattle births in Sinjai Regency has fluctuated every year since 2015. 2016 was the highest number of births during a 10-year period, namely 16,598 heads, and 2023 was the lowest number of births during a 10-year period, namely 6,772 heads.

The development of beef cattle slaughter in Sinjai Regency has fluctuated every year since 2015. In 2023, the highest number of slaughters during 10 years, namely 17,238 heads, and 2020 was the lowest number of slaughters during a 10-year period, namely 4,825 heads.

The development of beef cattle deaths in Sinjai Regency has fluctuated every year since 2015. In 2023, the highest number of deaths during a 10-year period was 6,093, and in 2024, the lowest number of deaths during a 10-year period was 53.

The development of beef cattle expenditure in Sinjai Regency has fluctuated every year since 2015. In 2023, the highest number of beef cattle expenditure during 10 years was 40,684, and in 2020, the lowest number of beef cattle expenditure during a 10-year period was 1,391.

The development of beef cattle imports in Sinjai Regency has fluctuated every year since 2015. 2016 was the highest number of beef cattle imports during 10 years, namely 270 heads,

and 2022-2024 was the lowest number of beef cattle imports during a 10-year period, namely 0 heads each.

The development of the beef cattle population in Sinjai Regency tends to increase every year except in 2023, when the population decreased but increased again in 2024. In 2022 was the highest beef cattle population during a period of 10 years was 127,016 head, and in 2023 was the lowest beef cattle population during a period of 10 years was 69,773 head.

Overall, the actual data on the dynamics of the beef cattle population in Sinjai Regency in 2023 is very fluctuating, namely the birth of beef cattle is low, slaughter, death, and expenditure of beef cattle are high, and there is no income from beef cattle. This happened because at the end of 2022, beef cattle in Sinjai Regency were infected with disease outbreaks such as Jembrana Disease, Bovine Viral Diarrhea, Thrypanosomiasis, and Foot and Mouth Disease, which disrupted the productivity and reproduction of beef cattle, causing the birth of beef cattle to decrease in 2023. The slaughter of beef cattle increased because one of the government's efforts to stop the spread of the Foot and Mouth Disease virus was by forced slaughter. The death of beef cattle increased because Jembrana Disease, Bovine Viral Diarrhea, and Trypanosomiasis had high mortality rates. The expenditure on beef cattle increased because the price of beef cattle was getting cheaper and dropping drastically. There was no income from beef cattle because the Sinjai Regency government closed access to the traffic of beef cattle from outside the region to overcome the disease outbreak, so that it would not spread further.

The situation of strategic disease/cases in beef cattle in Sinjai Regency, recorded in the Service of Livestock and Animal Health, Sinjai Regency [29] shows that in 2022, 16 beef cattle in Sinjai Regency were infected with Bovine Viral Diarrhea, 22 Jembrana disease, 598 Foot and Mouth Disease, and 14 Thrypanosomiasis. This is in accordance with the opinion of Gunawan et al. [30], which states that proper and correct handling of diseases in livestock needs to be carried out because livestock health greatly affects livestock productivity. Proper and correct handling of diseases is a key factor in achieving optimum productivity and reproductivity of cattle. Comprehensive prevention, control, and eradication of strategic infectious animal diseases are determinants of securing healthy and productive livestock in the development of community cattle farming businesses.

### **Predicted Beef Cattle Population Development in Sinjai Regency**

Prediction data on the development of the beef cattle population in Sinjai Regency in 2025-2034 was obtained from the results of forecasting data on beef cattle population dynamics in Sinjai Regency 10 years ago, namely, from 2015-2024. This can be seen in Table 2. The prediction of the development of the birth of beef cattle in Sinjai Regency is predicted to increase every year. The highest predicted number of births of beef cattle during 10 years is in 2034, which is 23,107 heads, and the lowest predicted number of births of beef cattle during a 10-year period is in 2025, which is 14,022 heads. Of the several existing forecasting methods, the best forecasting method whose prediction accuracy results can be relied on to predict data on the development of the beef cattle population in Sinjai Regency is the Exponential Smoothing method,  $\alpha = 0.9$ . Because the prediction results are not much different from the actual data available, and most of the prediction results are within the tracking signal control limits (maximum  $\pm 4$ ). This is in accordance with the opinion of Gaspersz [21], who said that several experts in forecasting systems, such as George Plossl and Oliver Wight, suggest using a maximum

tracking signal value of  $\pm 4$  as the tracking signal control limits. A positive tracking signal indicates that the actual value of the data is greater than the forecast, while a negative tracking signal means that the actual value of the data is less than the forecast.

**Table 2. Predicted Beef Cattle Population in Sinjai Regency (2025–2034)**

Year	Initial Population (Heads)	Births (Heads)	Slaughter (Heads)	Deaths (Heads)	Outgoing (Heads)	Incoming (Heads)	Year-End Population (Heads)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2025	71,238	14,022	848	7,279	7,589	76	69,620
2026	69,620	14,245	224	5,929	4,706	95	73,101
2027	73,101	14,974	247	6,629	5,706	252	75,745
2028	75,745	15,311	167	6,893	4,065	102	80,033
2029	80,033	15,954	164	6,897	3,505	63	85,484
2030	85,484	16,846	262	6,891	3,335	186	92,029
2031	92,029	17,846	243	5,032	1,586	41	103,054
2032	103,054	19,668	403	5,346	2,721	27	114,279
2033	114,279	21,345	642	5,861	2,511	3	126,613
2034	126,613	23,107	5,548	16,100	36,867	0	91,205

Source: Processed Data, 2025

Birth predictions were calculated based on reproductive efficiency, using data on adult females, mating rate (70%), pregnancy (80%), birth rate (75%), and calf mortality (5%). This can be seen in Table 3.

**Table 3. Calculation of Beef Cattle Births in Sinjai Regency 2025-2034**

Year	Initial Population (Heads)	Adult Female (Head)	Mating 70% (Head)	Pregnant 80% (Head)	Giving Birth 75% (Head)	Child Dead 5% (Head)	Birth (Head)	Male/Female (Head)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2025	71,238	35,143	24,600	19,680	14,760	738	14,022	7,011
2026	69,620	35,701	24,991	19,993	14,994	750	14,245	7,122
2027	73,101	37,528	26,270	21,016	15,762	788	14,974	7,487
2028	75,745	38,374	26,862	21,490	16,117	806	15,311	7,656
2029	80,033	39,986	27,990	22,392	16,794	840	15,954	7,977
2030	85,484	42,222	29,555	23,644	17,733	887	16,846	8,423
2031	92,029	44,726	31,308	25,047	18,785	939	17,846	8,923
2032	103,054	49,293	34,505	27,604	20,703	1,035	19,668	9,834
2033	114,279	53,496	37,447	29,957	22,468	1,123	21,345	10,672
2034	126,613	57,913	40,539	32,431	24,324	1,216	23,107	11,554

Source: Processed Data, 2025

The prediction of the development of beef cattle mortality in Sinjai Regency fluctuates every year. The tracking signal results of the prediction of beef cattle mortality in Sinjai Regency in 2025-2034 that can be accepted are 8 periods, namely the prediction of 2025-2032, because it is within the limits of tracking signal control (maximum  $\pm 4$ ). So it can be said that the prediction of the highest number of beef cattle deaths during the 8 years is in 2025, as many as 848 heads, and the prediction of the lowest number of beef cattle deaths during the 8 years is in 2029, as many as 164 heads.

The prediction of the development of beef cattle slaughter in Sinjai Regency fluctuates every year. The tracking signal results of the prediction of beef cattle slaughter in Sinjai Regency in 2025-2034 that can be accepted are 8 periods, namely the prediction of 2025-2032, because it is within the limits of tracking signal control (maximum  $\pm 4$ ). So it can be said that the highest

predicted number of slaughters during the 8 years is in 2025, which is 7,279 heads, and the lowest predicted number of slaughters during the 8-year period is in 2031, which is 5,032 heads.

The prediction of the development of beef cattle expenditure in Sinjai Regency fluctuates every year. The tracking signal results of the forecast of beef cattle expenditure in Sinjai Regency in 2025-2034 that can be accepted are 7 periods, namely the forecast for 2025-2029 and the forecast for 2031-2032, because they are within the limits of tracking signal control (maximum  $\pm 4$ ). So it can be said that the prediction of the highest number of beef cattle expenditure during a period of 7 years is in 2025, as many as 7,279 heads, and the prediction of the lowest number of beef cattle expenditure during a period of 7 years is in 2031, as many as 5,032 heads.

The prediction of the development of beef cattle income in Sinjai Regency fluctuates every year. The tracking signal of the forecast results of beef cattle income in Sinjai Regency in 2025-2034 that can be accepted is 9 periods, namely the forecast for 2025-2033, because it is within the limits of tracking signal control (maximum  $\pm 4$ ). So it can be said that the highest predicted number of incomes during the 9 years is in 2027, as many as 252 heads, and the lowest predicted number of incomes during the 9 years is in 2033, as few as 3 heads.

Predictions of the development of the beef cattle population in Sinjai Regency in 2025-2034 are also presented in the form of images to make it easier to see the results of the forecast and calculations. Data on the predicted development of the beef cattle population in Sinjai Regency in 2025-2034 can be seen in Figure 3.

The prediction of the development of the final population of beef cattle in Sinjai Regency is calculated using the formula for the total population at the end of the year, namely the final population = initial population + births - deaths - slaughter - expenditure + income. Based on Figure 3 regarding the prediction of the development of the beef cattle population in Sinjai Regency in 2025-2034, it is known that the results of the calculation of the predicted final population of beef cattle in Sinjai Regency tend to increase every year from 2025-2033 except in 2033 to 2034 there was a decrease in the final population of beef cattle in Sinjai Regency. The highest predicted final population of beef cattle during 10 years was in 2033 with 126,613 heads, and the lowest predicted final population of beef cattle during 10 years was in 2025 with 69,620 heads.

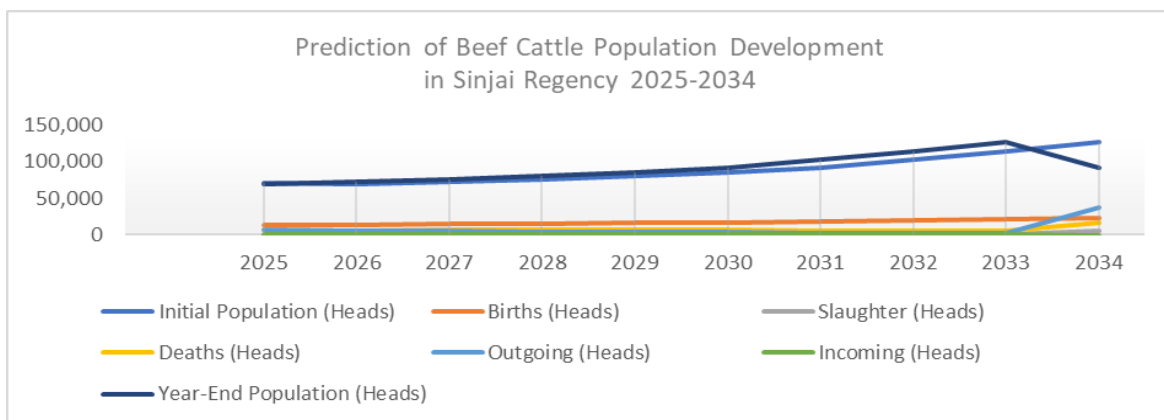


Figure 3. Prediction of Beef Cattle Population Development in Sinjai Regency 2025-2034 (Processed Data, 2025)

After the prediction of the development of the beef cattle population is known, the next step is to compile and calculate the prediction of the beef cattle population structure according to gender and age stage, with the assumption of 50% female and 50% male births. The number of births will be the child population in that year. The following year, the child population will become the young population. The following year, the young population will become the adult population. Data on the predicted structure of the beef cattle population in Sinjai Regency in 2025-2034 can be seen in Table 4.

Table 4. Predicted Beef Cattle Population Structure in Sinjai Regency (2025–2034)

Year	Total Population (Heads)	Male			Female				
		Male Calves (Heads)	Male Young (Heads)	Male Adults (Heads)	Total Males (Heads)	Female Calves (Heads)	Female Young (Heads)	Female Adults (Heads)	Total Females (Heads)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2025	69,620	7,011	6,945	5,743	19,699	7,011	7,209	35,701	49,921
2026	73,101	7,122	7,011	7,306	21,439	7,122	7,011	37,528	51,662
2027	75,745	7,487	7,122	8,152	22,761	7,487	7,122	38,374	52,984
2028	80,033	7,656	7,487	9,762	24,905	7,656	7,487	39,986	55,128
2029	85,484	7,977	7,656	11,997	27,630	7,977	7,656	42,222	57,854
2030	92,029	8,423	7,977	14,502	30,902	8,423	7,977	44,726	61,127
2031	103,054	8,923	8,423	19,069	36,415	8,923	8,423	49,293	66,639
2032	114,279	9,834	8,923	23,270	42,027	9,834	8,923	53,496	72,252
2033	126,613	10,672	9,834	27,687	48,193	10,672	9,834	57,913	78,420
2034	91,205	11,554	10,672	8,263	30,489	11,554	10,672	38,490	60,716

Source: Processed Data, 2025

The prediction of the structure of the beef cattle population in Sinjai Regency in 2025-2034 is also presented in the form of images to make it easier to identify the calculation results. Data on the predicted structure of the beef cattle population in Sinjai Regency in 2025-2034 can be seen in Figure 5.

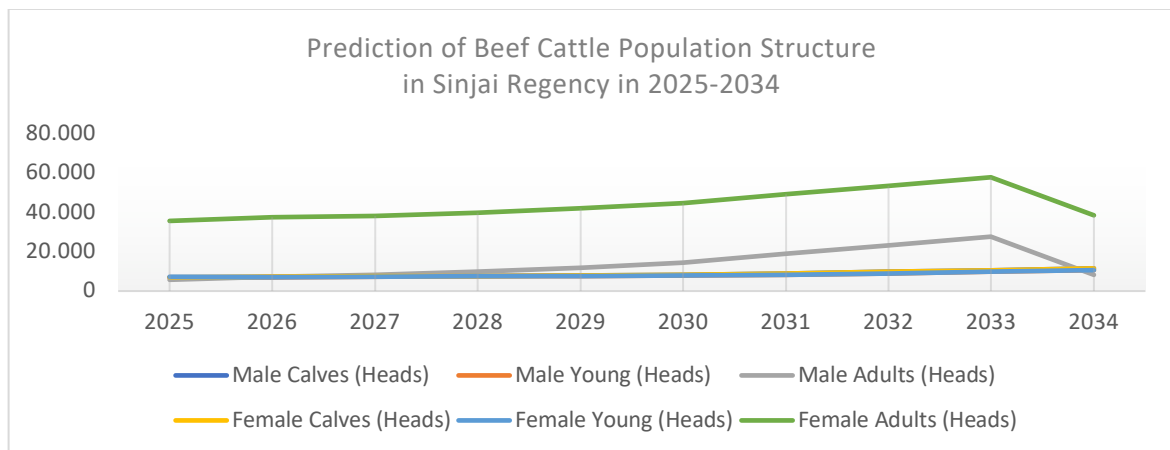


Figure 5. Prediction of Beef Cattle Population Structure in Sinjai Regency in 2025-2034 (Processed Data, 2025)

Based on Figure 5, it is clearly seen that the prediction of beef cattle population structure in Sinjai Regency in 2025-2034 is dominated by female adults, followed by male adults, with the remainder being male calves, male young, female calves, and female young.

## CONCLUSIONS

Based on this study, it is concluded that if data behavior remains consistent with the past 10 years, the beef cattle population structure in Sinjai Regency will continue to have fewer males than females. The forecasted population for 2025–2034 shows a general upward trend, except for a decline in 2033 to 2034 due to technical constraints in the development of beef cattle by the community in the field.

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## AUTHORS' CONTRIBUTIONS

N.R. Conceptualized the study, conducted experiments, analyzed data, drafted and revised the manuscript. M.R. and A.A. conducted experiments and analyzed data. All authors have read and approved the final manuscript.

## COMPETING INTERESTS

The authors declare that they have no competing interests.

## ETHICAL CLEARANCE

The research has no animal subjects.

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