



(RESEARCH ARTICLE)



Natural increase of balinese cattle in Tabongo sub-district, Gorontalo district

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Abstract

This study aims to analyze the projection of Natural Increase in Bali cattle in Tabongo District, Gorontalo Regency. This research is a quantitative research, where the data used in this research are primary data and secondary data. While data analysis uses descriptive statistical analysis and projections using a linear approach. The results showed that the Natural Increase of Bali cattle in Tabongo District, Gorontalo Regency in 2019-2023 amounted to 23.20% with an average growth of Natural Increase over the last 5 years of 11.00%. Then when compared to the value of Natural Increase between males and females, the results showed that the average Natural Increase for males between 2019-2023 was 10.25% and for females between 2019-2023 was 12.95%. Although from the average value of Natural Increase it is found that female Bali cows are better than male Bali cows, when compared to the average growth value, the value of Natural Increase growth of male Bali cows is 17.59% higher than female Bali cows by 7.20%.

Keywords: Bali Cattle; Natural Increase; Projection; Tabongo

1. Introduction

Bali cattle have the ability to reproduce at a young age and have a short *calving interval*. They are also known to have good growth with body weight that can reach the optimal weight for slaughter in a relatively short time. Bali cattle farming contributes significantly to the local economy, both as a source of income for farmers, providing employment and as an export commodity. As a source of animal protein, Bali cattle support local food security as beef is an important component in the diet of many communities in Indonesia (Duila, *et al.*, 2021).

Bali cattle are unique in the context of smallholder farming (Sudrajad, *et al.*, 2020), where they are known for their good adaptability to different environments, including areas with high temperatures and low feed quality. The potential of Bali cattle lies in their adaptability, good reproduction, and adequate meat quality. For smallholder farmers in Indonesia, Bali cattle are a valuable asset that contributes to a farmer's source of income and is able to achieve a region's target in terms of increasing the Bali cattle population. Gobel, *et al.* (2021) stated that the program to increase the population of local beef cattle is very important in achieving meat self-sufficiency, where one of the local beef cattle developed in Indonesia is Bali cattle.

Bali cattle rearing is often associated with smallholder farms, which tend to use extensive rearing systems. This system involves raising livestock by utilizing existing natural resources, such as natural pastures. Abdullah (2003); Hopwood, *et al.* (2011) stated that phenotypic flexibility is the variation in phenotypic expression of a genotype in response to certain environmental conditions and can increase the ability of individuals to survive and reproduce in these environmental conditions. Cahyadi, *et al.* (2022) stated that, phenotypic flexibility shows the degree to which the phenotypic expression of a genotype varies based on different environmental conditions.

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Natural increase in livestock refers to livestock population growth that occurs naturally without human intervention, such as through reproduction and biological growth. *Natural increase in Bali cattle* is the result of the animal's adaptation to its local environment (Yunus, *et al.*, 2022). The advantage lies in the fact that Bali cattle can cope with diverse environmental conditions, such as limited feed and a slightly extreme climate. The ability of Bali cattle to withstand difficult situations, such as a long dry season, makes them valuable to farmers (Asana, *et al.*, 2018). In addition, Dominanto, *et al.* (2016) stated that, good reproductive ability makes Bali cattle produce calves with high consistency, providing the potential for larger populations. Extensively reared Bali cattle can assist in land management and nutrient cycling, providing benefits to the ecosystem through seed dispersal and natural soil fertilization.

Natural Increase can have an impact on the phenotypic characteristics of Bali cattle. This can be seen in quantitative phenotype characteristics, such as body weight, shoulder height and body length. In addition, qualitative phenotype characteristics, such as coat color, horn shape, and eye type, can also change naturally. This is because the environment plays an important role in shaping the physical traits of animals. Iwanto, *et al.* (2023) stated that diversity has an important role in livestock because its value is very useful to see the potential diversity in a population that can be used as a basis for improving genetic quality with selection programs. The diversity of body size and other phenotypic aspects is caused by genetic and environmental factors.

The phenotypic characteristics of Balinese cattle vary widely, namely quantitatively, Balinese cattle have a variety of body sizes, body weights, and shoulder heights depending on environmental and husbandry factors. Qualitatively, the color of the head, neck, body, legs, and the presence of horns can vary between individuals (Rajab, 2021). However, these phenotypic characteristics often reflect the adaptation of Bali cattle to their local environment. Although Bali cattle have a number of advantages, there are some aspects of their phenotype that are not ideal, for example, in some cases, quantitative characteristics such as body weight have not reached the desired standard. Meanwhile, in some individuals, qualitative characteristics such as coat color do not match preferences or expected standards.

Based on the explanation above, a research has been conducted in Tabongo District, Gorontalo Regency with the title Phenotype Analysis and *Natural Increase* Projection of Bali cattle in Tabongo District, Gorontalo Regency. The selection of location is based on the existence of Bali cattle in Tabongo District, Gorontalo Regency has an increasing trend every year in the last 10 years, but recently the weight of Bali cattle tends to be less optimal than in previous years. Phenotypic characteristics of Bali cattle that include body size are an important issue, where initial observations found that some Bali cattle have smaller body sizes than expected. This smaller body size may reduce the potential of Bali cattle in terms of meat production. Inappropriate development can also affect the attractiveness to farmers of Bali cattle as livestock that have the potential to generate good income for farmers. This research is important, as there is still a lack of in-depth understanding from farmers in Tabongo District, Gorontalo Regency about the phenotypic variation of Bali cattle and its impact on growth and adaptation to the local environment. Other challenges include the lack of up-to-date and detailed data on Bali cattle population growth through *natural increase*, as well as the need for better husbandry strategies to ensure optimal livestock welfare and productivity.

2. Research methods

This research was conducted in Tabongo District, Gorontalo Regency, for 3 (three) months starting from October 2023 to January 2024. This research is a quantitative research, where the data used in this research are primary data and secondary data. While data analysis uses descriptive statistical analysis and projections using a linear approach.

3. Research results

Natural Increase has a number of significant benefits to the growth and health of Bali cattle populations, as it is a more environmentally friendly and sustainable way to develop Bali cattle populations than other genetic engineering or artificial breeding techniques. By utilizing natural processes, we can preserve the integrity of the environment and maintain the balance of the ecosystem in which Bali cattle live. Based on the results of secondary data, it was found that the fertility of Bali cattle in Tabongo District, Gorontalo Regency, which reached 83.20%, is an important indicator in understanding the natural growth and potential for increasing the productivity of Bali cattle populations naturally. Fertility is a key parameter that reflects the reproductive ability and success of conception or pregnancy in female cattle in a population. With such a high fertility rate, it can be concluded that the Balinese cattle population in Tabongo District, Gorontalo Regency has great potential to support natural growth and development without the need for reliance on artificial reproductive technologies.

High fertility rates also reflect the health and genetic quality of the Balinese cattle population in Tabongo sub-district, Gorontalo district. Cattle that are healthy and have good genetic quality tend to have high fertility rates, allowing conception or pregnancy to occur more easily and efficiently. This suggests that the environment and good farm management in Tabongo sub-district support optimal welfare and reproduction for Bali cattle. By knowing the high fertility rate, they can take steps to maintain or improve environmental conditions, feed quality, and reproductive management that support the health and fertility of the cows. In addition, information on good fertility can also serve as a reference in the selection of optimal parents for breeding in an effort to improve the productivity and genetic quality of the Bali cattle population in the future.

The fertility rate of Bali cattle in Tabongo District, Gorontalo Regency not only reflects the health and welfare of the cattle, but is also an important factor in ensuring the sustainability and productivity of Bali cattle farming naturally. Through proper monitoring and care, as well as good parent selection, it is expected that this high fertility rate can be maintained or even improved in the future to support sustainable and profitable livestock development for the local community.

Based on interviews with stakeholders and farmers in Tabongo District, Gorontalo Regency, related to Bali cattle rearing and its influence on the phenotypic characteristics of the cattle, it can be concluded that the *Natural Increase* phenomenon plays an important role in the development and quality improvement of Bali cattle in Tabongo District, Gorontalo Regency. *Natural Increase*, which reflects the natural increase of Bali cattle population through birth and decrease through death without excessive human intervention, contributes significantly to the phenotypic characteristics of Bali cattle. Farmers report that Bali cattle have unique traits, such as a compact, synthetic and hump-free appearance. Females and their calves or godlings tend to be brick red in color, while males are black. However, white can also be found on certain parts of the cow's body.

Natural environmental factors, such as climate, livestock behavior, disease causes, and husbandry management, have a significant influence on the phenotypic development of Bali cattle. Livestock environments that suit the needs of Bali cattle, such as large pastures for natural or extensive rearing systems, allow cattle to move freely and forage for natural foods necessary for optimal growth and reproduction. More intensive rearing patterns also provide advantages in terms of supervision, controlled feeding and protection from predators, but require greater investment in infrastructure and management.

In evaluating the phenotype of Bali cattle, farmers emphasize parameters such as weight, height, length, as well as uniform physical appearance and characteristics that indicate good adaptation to the environment. Natural improvements in the phenotype of Balinese cattle are observed through small changes from their ancestor, the Banteng, and occur along with a steady increase in population through births. Bali cattle rearing in Tabongo sub-district tends to favor the natural or extensive rearing system, as it facilitates livestock activities especially in terms of feed and provides advantages in terms of low production costs. However, challenges include lack of herd management and lack of understanding of animal health.

In the long term, farmers plan to continue to develop and refine the chosen rearing pattern, taking into account the physiological condition, age and sex of the Bali cattle. These efforts aim to ensure the welfare and productivity of Balinese cattle, while maintaining desirable phenotypic characteristics in the herd. Overall, *Natural Increase* has the potential to cause changes in the phenotypic characteristics of Bali cattle in Tabongo sub-district by affecting growth, reproduction, and adaptation to their natural environment.

The results of the *Natural Increase* analysis of Balinese cattle for farmer groups (recipients of Balinese cattle assistance), namely lestari, millennium, hope jaya, baharap and perkasa jaya groups in Tabongo District, Gorontalo Regency are presented in Table 1:

Based on Table 1, the results show that the Natural Increase value of farmer groups (recipients of grapefruit cattle assistance), namely the sustainable, millennium, hopeful, baharap and perkasa jaya groups in Tabongo District, Gorontalo Regency, tends to decrease, namely in 2021 by 26.73% which is in the medium category, in 2022 to 21.88% and in 2023 it decreased again with a natural increase value of 17.95%. This shows that a potential decrease in the quality of livestock health can lead to low reproduction rates and high calf mortality rates. A potential decrease in the quality or quantity of feed given to cattle can affect fertility and animal health. And the lack of good management in terms of care, maintenance and management of livestock can have a negative impact on the value of natural increase.

Table 1 Results of *Natural Increase* Analysis of Bali Cattle Farmer Groups (recipients of Bali cattle assistance) in Tabongo District, Gorontalo Regency

No.	Year	Year		
		2021	2022	2023
1	Adult Females to Population (%)	61.39	60.16	59.62
2	Mature females to total females (%)	80.52	77.00	76.86
3	Calves to Mature Females (%)	54.84	40.26	30.11
4	Calves to Population (%)	33.66	24.22	17.95
5	Mortality (%)	6.93	2.34	0.00
6	Natural Increase (%)	26.73	21.88	17.95
7	Natural Increase Males (%)	3.96	5.47	7.05
8	Natural Increase Females (%)	22.77	16.41	10.90

Source: Processed Data, 2024

The results of the *Natural Increase* analysis of Balinese cattle in Tabongo District, Gorontalo Regency are presented in Table 2:

Table 2 Results of *Natural Increase* Analysis of Balinese Cattle in Tabongo Subdistrict, Gorontalo Regency

No.	Year	Year				
		2019	2020	2021	2022	2023
1.	Adult Females to Population (%)	49.35	49.61	51.81	51.33	53.14
2.	Adult females to total females (%)	70.11	70.86	74.19	73.93	76.84
3.	Calves to Mature Females (%)	45.34	58.59	59.48	58.78	54.32
4.	Calves to Population (%)	22.38	29.07	30.82	30.17	28.87
5.	Mortality (%)	5.17	4.18	6.09	5.74	4.13
6.	<i>Natural Increase</i> (%)	17.21	24.89	24.73	24.43	24.74
7.	<i>Natural Increase</i> Males (%)	6.75	11.85	11.13	10.35	11.18
8.	<i>Natural Increase</i> Females (%)	10.46	13.04	13.61	14.08	13.55

Source: Processed Data, 2024

Based on Table 2, the results can be described as follows:

3.1. Adult Females to Population (%)

The results of the analysis of the percentage of mature female cattle to the population of Bali cattle in Tabongo District, Gorontalo Regency can be seen in Figure 1:

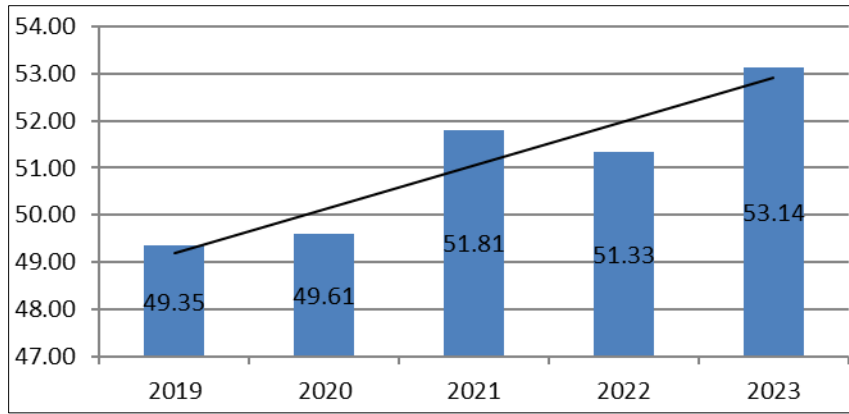


Figure 1 Adult females to population (%)

Based on Figure 1, it can be explained that in 2019, the percentage of mature female cattle to the total Balinese cattle population in Tabongo sub-district reached 49.35%. This indicates that almost half of the Balinese cattle population are mature females. Then, in 2020, this percentage experienced a slight increase to 49.61%, indicating a trend of growth in the mature female cattle population. This trend continued in 2021, where the percentage of mature females reached 51.81%, indicating more significant growth in the number of mature females in the Bali cattle population. However, in 2022, there was a small decrease in this percentage, to 51.33%. Although this decrease is not significant, it does indicate a fluctuation in the growth of the mature female cattle population in Tabongo sub-district.

Then, in 2023, the percentage of mature female cattle again experienced a sharp increase, reaching 53.14%. This shows a recovery from the decline in the previous year and confirms the positive growth trend of the adult female cattle population in Tabongo sub-district. These fluctuations are thought to be influenced by various factors, such as breeding management, environmental factors, and livestock policies implemented in the area. For example, the decline in 2022 was caused by factors such as bad weather, disease or changes in livestock policy. While the sharp increase in 2023 was the result of recovery efforts and improvements in farm management as well as more effective breeding programs.

3.2. Adult females to total females (%)

The results of the analysis of the percentage of mature females to total female Bali cattle in Tabongo sub-district, Gorontalo district can be seen in Figure 4.2:

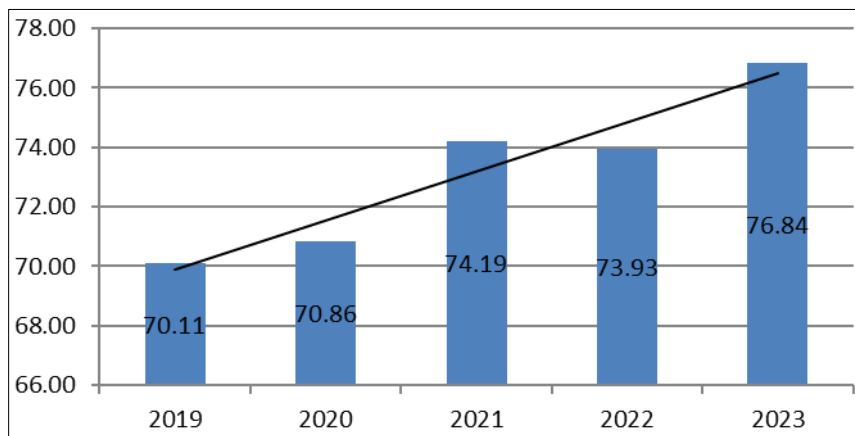


Figure 2 Adult females to total females (%)

Based on Figure 2, it can be explained that in 2019, the percentage of mature cows to total cows in Tabongo sub-district reached 70.11%. This indicates that the majority of the cattle population were mature females, which is a positive thing as mature females have a very important role in reproduction and breeding. This trend continued in 2020, where the percentage increased to 70.86%. This indicates a growing trend in the number of mature female cows in the overall female cattle population. This phenomenon can be interpreted as an indication that the breeding and farm management programs in the region are quite successful.

In 2021, the percentage of mature cows to total cows reached 74.19%, signaling a more significant growth in the number of mature cows in the cow population. This sizable increase could be due to several factors, such as farmers' increased awareness of the importance of breeding mature cows and the use of more advanced reproductive technologies. However, in 2022, there is a small decrease in this percentage, to 73.93%. Although this decrease is not significant, it indicates a fluctuation in the growth of the mature heifer population in this sub-district. This decline is influenced by factors such as unfavorable environmental conditions, disease or farm management issues. Then, in 2023, the percentage of mature female cattle again experienced a sharp increase, reaching 76.84%. This indicates a recovery from the previous year's decline and confirms the positive growth trend of the adult female cattle population in Tabongo sub-district.

Fluctuations in the percentage of mature cows to total cows in Tabongo sub-district are caused by a variety of factors, including farm management, environmental conditions and implemented livestock policies. This data analysis provides an important overview for stakeholders in planning more effective and sustainable breeding programs to increase the mature heifer population in the future.

3.3. Calves to Mature Females (%)

The results of the analysis of the percentage of calves to adult females in Tabongo Subdistrict, Gorontalo Regency can be seen in Figure 4.3:

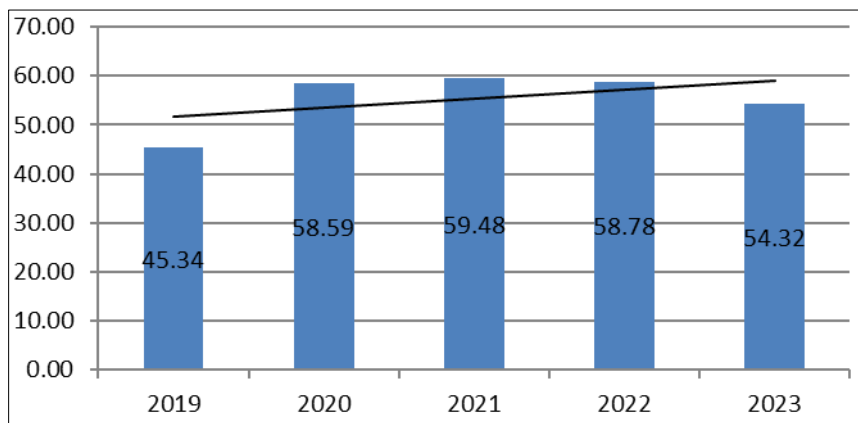


Figure 3 Calves to Mature Females (%)

Based on Figure 3, it can be explained that the percentage of Bali cattle calves to adult female Bali cows is 45.343%. This means that for every 100 mature female Bali cows in Tabongo Subdistrict, there are 45.34 Bali cattle calves. This indicates that the population of Bali cattle calves in Tabongo subdistrict in 2019 was moderate. The percentage of Bali cattle calves increased to 58.59%. This means that for every 100 mature female Bali cows, there were 58.59 Bali cow calves. This increase shows that the Bali cattle calf population experienced a significant increase compared to 2019. This can be caused by several factors, such as an increase in artificial insemination programs, increased awareness of farmers in maintaining the health of mother cows, and the availability of adequate feed.

The percentage of Bali cattle calves has increased again, reaching 59.48%. This means that for every 100 mature female Bali cows, there are 59.48 Bali cattle calves. This increase shows that the Bali cattle calf population continues to increase compared to 2020. This shows that farmers' efforts to increase the Bali cattle calf population are paying off. The percentage of Bali cattle calves decreased to 58.78%. This means that for every 100 mature female Bali cows, there are 58.78 Bali cattle calves. This decrease shows that there are obstacles in the effort to increase the Bali cattle calf population. This can be caused by several factors, such as livestock diseases, feed shortages, or other unknown factors. Then the percentage of Bali cattle calves continued to decline, reaching 54.32%. This means that for every 100 mature female Bali cows, there are 54.32 Bali cattle calves. This decline indicates that there is a serious problem that needs to be addressed immediately so that the Balinese calf population does not continue to decline. The government and farmers need to work together to identify the causes of the decline in Bali cattle calf population and find appropriate solutions.

The percentage of Bali cattle calves in Tabongo sub-district has fluctuated over the last 5 years. These fluctuations indicate that efforts are being made to increase the Bali cattle calf population, but there are still obstacles that need to

be overcome. Cooperation between the government and farmers is needed to ensure that the Bali calf population in Tabongo sub-district is maintained and continues to increase.

3.4. Calves to Population (%)

The results of the analysis of the percentage of calves to the population of Bali cattle in Tabongo District, Gorontalo Regency can be seen in Figure 4:

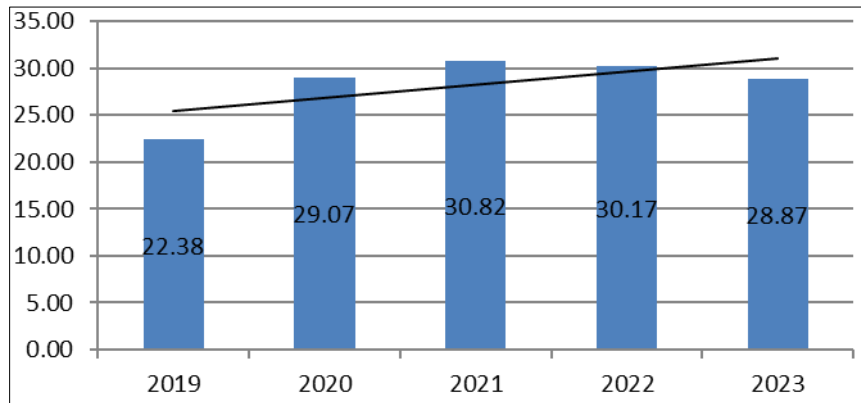


Figure 4 Calves to Population

Based on Figure 4, it can be explained that the percentage of Bali cattle calves to the Bali cattle population is 22.38%. This means that for every 100 Balinese cows in Tabongo Subdistrict, there are 22.38 Balinese calves. This indicates that the population of Bali cattle calves in Tabongo subdistrict in 2019 was low. The percentage of Bali cattle calves increased to 29.07%. This means that out of every 100 Bali cows, there were 29.07 Bali cow calves. This increase shows that the Bali cattle calf population experienced a significant increase compared to 2019. This can be caused by several factors, such as an increase in artificial insemination programs, increased awareness of farmers in maintaining the health of mother cows, and the availability of adequate feed.

The percentage of Bali cattle calves has increased again, reaching 30.82%. This means that for every 100 Bali cows, there are 30.82 Bali cattle calves. This increase shows that the Bali cattle calf population continues to increase compared to 2020. This shows that farmers' efforts to increase the Bali cattle calf population have paid off. The percentage of Bali cattle calves decreased to 30.17%. This means that out of every 100 Bali cows, there are 30.17 Bali cattle calves. This decrease shows that there are obstacles in the effort to increase the Bali cattle calf population. This can be caused by several factors, such as livestock diseases, feed shortages, or other unknown factors. The percentage of Bali cattle calves continues to decline, reaching 28.87%. This means that out of every 100 Bali cows, there are 28.87 Bali cattle calves. This decline indicates that there is a serious problem that needs to be addressed immediately so that the Balinese calf population does not continue to decline. The government and farmers need to work together to identify the causes of the decline in Bali cattle calf population and find appropriate solutions.

Fluctuations in the percentage of Bali calves to Bali cattle population have the same trend as fluctuations in the percentage of Bali calves to mature female Bali cows. This suggests that increases and decreases in the Bali calf population are influenced by the same factors. However, the percentage of Bali calves to Bali cattle population is always lower than the percentage of Bali calves to mature female Bali cows. This is because the Bali cattle population in Tabongo sub-district does not only consist of mature female Bali cattle, but also male Bali cattle, young Bali cattle, and other Bali cattle.

The percentage of Bali cattle calves in Tabongo sub-district has fluctuated over the last 5 years. These fluctuations indicate that efforts are being made to increase the Bali cattle calf population, but there are still obstacles that need to be overcome. Cooperation between the government and farmers is needed to ensure that the Bali calf population in Tabongo sub-district is maintained and continues to increase.

3.5. Mortality (%)

The results of the analysis of the percentage of Bali cattle mortality in Tabongo District, Gorontalo Regency can be seen in Figure 5:

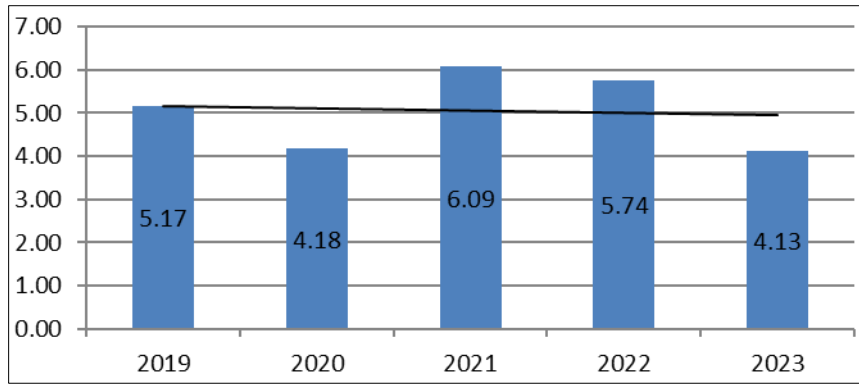


Figure 5 Bali cattle mortality (%)

Based on Figure 5, it can be explained that the percentage of Bali cattle mortality is 5.17%. This means that out of every 100 Bali cattle in Tabongo Subdistrict, 5.17 cattle died. This indicates that the mortality rate of Bali cattle in Tabongo Subdistrict in 2019 was moderate. The percentage of Bali cattle mortality decreased to 4.18%. This means that out of every 100 Bali cattle, 4.18 cattle died. This decrease shows that there are efforts being made to reduce the mortality rate of Bali cattle. This could be due to several factors, such as improved animal health programs, increased awareness of farmers in maintaining cattle health, and easier access to animal health services.

The percentage of Bali cattle mortality has increased again, reaching 6.09%. This means that out of every 100 Bali cattle, 6.09 cattle die. This increase shows that there are obstacles in the effort to reduce Bali cattle mortality rate. This can be caused by several factors, such as the emergence of new diseases, extreme weather changes, or other unknown factors. The percentage of Bali cattle deaths decreased to 5.74%. This means that out of every 100 Bali cattle, 5.74 cattle die. This decrease shows that efforts to reduce Bali cattle mortality are paying off. This shows that farmers and the government are working together to overcome the obstacles that arose in 2021.

The percentage of Bali cattle mortality continues to decline, reaching 4.13%. This means that out of every 100 Bali cattle, there are 4.13 cattle that die. This decrease shows that efforts to reduce Bali cattle mortality continue and are bearing fruit. This shows that farmers and the government continue to work together to improve the health of Bali cattle in Tabongo subdistrict. The percentage of Bali cattle mortality in Tabongo subdistrict has fluctuated over the last 5 years. This fluctuation shows that there are efforts made to reduce the mortality rate of Bali cattle, but there are still obstacles that need to be overcome. Cooperation between farmers and the government is needed to ensure the Bali cattle mortality rate remains low and continues to decline.

3.6. Natural Increase (%)

The results of the analysis of the percentage of *Natural Increase of* Bali cattle in Tabongo District, Gorontalo Regency can be seen in Figure 6:

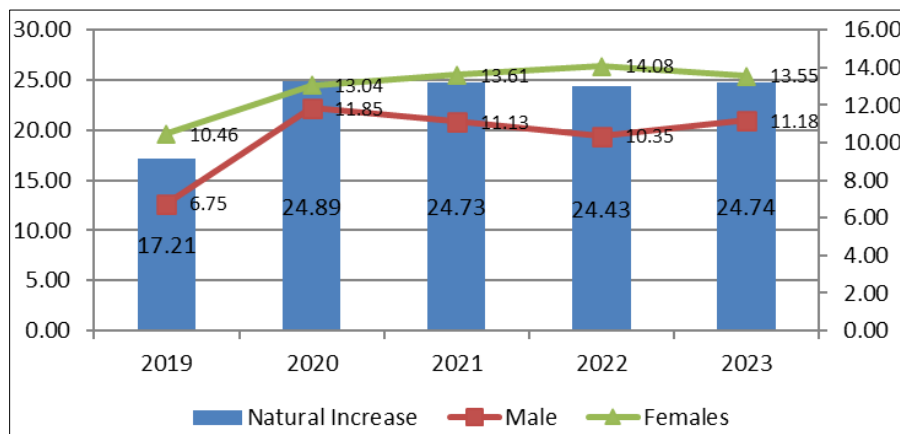


Figure 6 Natural Increase (%)

Based on Figure 6, it can be explained that the *Natural Increase of Balinese cattle* in Tabongo District, Gorontalo Regency in 2019 was 17.21%, which then increased in 2020. However, in 2021 and 2022 it decreased, and in 2023 it increased again. The average *Natural Increase of Balinese cattle* in Tabongo District, Gorontalo Regency in 2019-2023 was 23.20% with an average growth of *Natural Increase* over the last 5 years of 11.00%. The average value of *Natural Increase of 23.20%* is good because it is greater than some previous studies such as Putra's research (2022) of 19.44% and Duila *et al* (2021) of 19.00%. This 23.20% value is also good because it is in the medium category, as Putra *et al* (2017) argue that the range of natural increase values ranges from 0 - 45.90% which is divided into three categories, namely low (0 - 15.00%), medium (15.01 - 30.00%) and high (30.01 - 45.90%).

When comparing the *Natural Increase* value between males and females, it was found that the average *Natural Increase* for males between 2019-2023 was 10.25% and for females between 2019-2023 was 12.95%. Although from the average value of *Natural Increase* it was found that female Balinese cows were better than male Balinese cows, when compared to the average growth value, it was found that the growth value of *Natural Increase of male Balinese cows* was higher than female Balinese cows (17.59% male Balinese cows > 7.20% female Balinese cows). This illustrates that although the average value of *Natural Increase* gives an advantage to female cattle, in terms of actual growth, male cattle have higher growth potential. As a farmer, an in-depth understanding of these two aspects is essential to manage livestock populations efficiently and effectively.

The data on the *Natural Increase of Balinese cattle* in Tabongo District, Gorontalo Regency, together with the data on the percentage of mature females to the population can be used as existing data for *forecasting* to see the potential of *Natural Increase for the next 5 years*. The constant value of -40.630 means that if there is no growth of mature female cattle, there will be a decrease in the value of *Natural Increase of Balinese cattle* by 40.630%. Then the regression coefficient value of 1.250 means that every 1% increase in mature female Balinese cows will increase the *Natural Increase* value of Balinese cows by 1.250%. This shows that the negative constant value indicates that in a situation where there is no growth of mature female cows, the *Natural Increase* value of Bali cattle will decrease. This could be due to a variety of factors, such as an imbalance between birth and death rates, a decrease in fertility, or a decrease in livestock growth rates. A positive regression coefficient indicates a positive relationship between the growth of mature cows and the *Natural Increase* value of Bali cattle. This means that the more mature cows grow, the greater the increase in the *Natural Increase* value of Bali cattle. This could be due to an increase in the number of births of young cattle, increased fertility rates, or an increase in the overall growth rate of the herd. Thus, the constant value gives an idea of the *Natural Increase* value of Bali cattle in the initial condition with no mature heifer growth, while the regression coefficient value shows how much change is likely to occur in the *Natural Increase* value when there is a change in mature heifer growth. Both of these values are important in understanding the factors that influence the *Natural Increase* value of Bali cattle and provide a basis for effective farm planning and management.

Based on the linear equation formula, the values of the *Natural Increase of Bali Cattle* in Tabongo District, Gorontalo Regency for 2024-2028 can be seen in Figure 7:

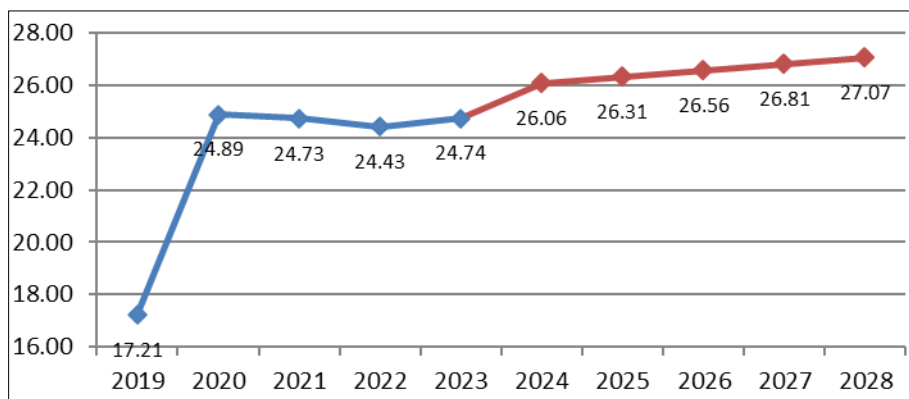


Figure 7 Forecasting *Natural Increase* 2024-2028 (%)

Based on Figure 7, it can be seen that the results of the *Natural Increase* projection for the next 5 years, namely 2024-2028, the value tends to increase, namely in 2024 by 26.06% which then increased to 26.31 in 2025. Then in 2026 and 2027 it was 26.56% and 26.81% respectively and in 2028 it became 27.07%. The projection of Bali cattle NI in Tabongo sub-district shows a positive increasing trend over the next 5 years. This indicates that there is great potential to

increase the population of Bali cattle in Tabongo sub-district. Sustained efforts from the government and farmers are needed to realize this potential.

Therefore, the Gorontalo District Government can implement various strategies to increase Bali cattle NI in Tabongo Sub-district, among others:

- Improved Cattle Health
 - Conduct routine vaccination and treatment programs for livestock.
 - Educate farmers on how to maintain cattle health.
 - Establish adequate animal health infrastructure.
- Feed Quality Improvement
 - Assist farmers in gaining access to quality feed.
 - Encourage the development of local feed crops.
 - Provide training to farmers on how to process feed.
- Improved Artificial Insemination Program
 - Provide artificial insemination services that are more accessible to farmers.
 - Improve the quality of cattle seedlings used for artificial insemination.
 - Provide training to farmers on how to artificially inseminate.
- Livestock Management Quality Improvement
 - Provide training to farmers on how to raise livestock properly.
 - Assist farmers in gaining access to capital.
 - Build adequate livestock infrastructure.
- Improved Institutional Role
 - Strengthen the role of farmer groups in improving Bali cattle NI.
 - Build cooperation between the government, breeders, and other related institutions.
 - Conduct research and development to improve the NI of Bali cattle.

The Gorontalo district government has an important role in increasing Bali cattle NI in Tabongo sub-district. By implementing the right strategies, it is hoped that the Balinese cattle population in Tabongo sub-district can continue to increase and provide economic benefits for farmers and the surrounding community. Although birth rates are predicted to increase, Bali cattle mortality rates also need to be monitored. If the mortality rate is high, then the increase in the Bali cattle population may be hampered. Increasing the Balinese cattle population will increase feed requirements. Farmers need to ensure adequate feed availability to support the growth of the Bali cattle population.

Bali cattle in Tabongo District, Gorontalo Regency have developed and adapted well to the existing natural conditions, allowing Bali cattle to live and breed naturally without the need for excessive human intervention. This phenomenon demonstrates the importance of environmental conservation and sustainability in livestock management, where Bali cattle can be an integral part of the local ecosystem and continue to contribute to biodiversity and the welfare of farming communities. Thus, the *Natural Increase of Bali cattle* in Tabongo District, Gorontalo Regency is a reflection of the successful adaptation and reproduction of cattle in their natural environment. This phenomenon highlights the importance of understanding and wisely managing local livestock populations, as well as strengthening the harmonious relationship between humans, animals and the environment. Thus, the *Natural Increase of Balinese cattle* serves as a motivating example for the preservation and development of sustainable livestock farming in Tabongo District, Gorontalo Regency.

This is in accordance with the opinion of Dominanto, *et al.* (2016) that good reproductive ability makes Bali cattle produce offspring with high consistency, providing the potential for a larger population. Extensively reared Bali cattle can assist in land management and nutrient cycling, providing benefits to the ecosystem through seed dispersal and natural soil fertilization. *Natural Increase* allows for greater genetic variation within the Bali cattle population. With more individuals being born, there are opportunities for different combinations of genes, which in turn can increase genetic strength and disease and environmental resistance. *Natural Increase* allows Bali cattle populations to naturally adapt to their local environment. Individuals born from this process tend to have higher levels of adaptation to environmental factors, such as climate, feed availability and general habitat conditions. By increasing the number of cattle through *natural increase*, the potential productivity of Bali cattle can also increase. More cattle born means more opportunities for increased production of milk, meat and other livestock products, which in turn can contribute to the local economy and the welfare of farmers.

4. Conclusion

The *Natural Increase* of Bali Cattle in Tabongo District, Gorontalo Regency in 2019-2023 amounted to 23.20% with an average *Natural Increase* growth over the last 5 years of 11.00%. Then when comparing the value of *natural Increase* between males and females, it was found that the average *natural increase* for males in 2019-2023 was 10.25% and for females in 2019-2023 was 12.95%. Although from the average value of *natural Increase* it is found that female Bali cattle are better than male Bali cattle, when compared to the average growth value, it is found that the value of *natural Increase* growth of male Bali cattle is higher than female Bali cattle (17.59% male Bali cattle > 7.20% female Bali cattle). *Natural Increase* projection for the next 5 years, 2024-2028, the value tends to increase in 2024 by 26.06% which then increases to 26.31 in 2025. Then in 2026 and 2027 it was 26.56% and 26.81% respectively and in 2028 it became 27.07%.

Advice

Based on the research results and conclusions described above, the suggestions for this research are as follows:

- It is recommended that the Gorontalo District Government (Livestock and Animal Health Service Office) implements a routine monitoring program of Bali cattle phenotypes to understand the impact of Natural Increase more deeply and conduct regular evaluations to measure the effectiveness of policies and programs that have been implemented. Provide training and counseling to farmers on sustainable husbandry management to improve the welfare and productivity of Bali cattle.
- It is recommended that farmers in Tabongo District, Gorontalo Regency, conduct regular livestock health monitoring and pay attention to the condition of the rearing environment to minimize risks to the welfare of Bali cattle. Then implement best livestock management practices that pay attention to the needs of Balinese cattle according to local environmental conditions. As well as improve understanding of the effect of Natural Increase on the phenotypic characteristics of Bali cattle and the adaptations required in livestock management.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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