Open Access

Hasanuddin J. Anim. Sci.
Vol. 3, No. 2: 68-77 November 2021
pISSN 2621-9182 eISSN 2621-9190
Doi:10.20956/hajas.v3i2.18730

Development of Bali Cattle in Smallholder Farm Based on Population Structure in Maiwa Enrekang Regency

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Abstract

This study was conducted to determine the improvement of the Bali cattle population in smallholder farms based on the structure of population. This research was carried out from September to November 2019 at the Maiwa Breeding Center Partnership, Enrekang Regency. The type of research used was descriptive research, which we study that describes the variable condition, that are birth rates, mortality, sales, purchases, and population structure at the smallholder farm. The first stage was to collect data by direct observation in the field. The second stage was to carry out tabulation and data analysis. The results of the research were that the increased of Bali cattle at the Maiwa smallholder farm partnership in Maiwa Breeding Center in Enrekang Regency was influenced by calving rate of cows. The calving rate was founded was 23% in 2017, 32% in 2018, and 46% in 2019, respectively. The mortality rate and sales of cattle was 6%in 2017, 4% in 2018 and 17% in 2019, respectively. The population dynamics was affected by calving rate, mortality and sales livestock in a year. Prediction of population growth increased gradually (7% a year) from 2020 to 2025 based on the population structure of Smallholder Farm in 2019. It is expected that the calving rate is at least 60% in a year.

Keywords : Population dynamics, calving rate, mortality rate, birth rate, population growth.

INTRODUCTION

Bali cattle are native livestock originating from Indonesia, which are mostly maintained by farmers in South Sulawesi (Baco *et al.*, 2020a). These cattle have several advantages, among others, namely are not selective and able to consume utilize low quality feed, have a high level of adaptation to the environment and can even live and produce well on critical land compared to other cattle and they have a high carcass percentage, slightly fatty meat and the tenderness of the meat is not inferior to imported beef. Bali cattle can make an important contribution in

improving the welfare of the community, especially South Sulawesi's leading commodities in the field of animal husbandry (Baco *et al*., 2019).

As the population increases, the needs of people lives both quantitatively and qualitatively will increase along with the increase in beef consumption to fulfill community nutrition. The demand for beef in Indonesia has enormous potential with a population growth rate of around 1.5% per year, the increase in income and population growth will increase the amount of meat demand every year (Agus and Widi, 2018).

The demand for meat needs to be balanced with increasing cattle productivity and controlling the slaughter of productive females as well as overcoming reproductive disease disorders that can reduce livestock populations (Sudrajat, 2003). The decline in the performance of Bali cattle can be caused by inbreeding (Margawati *et al*., 2018), seed stock, and the absence of superior bulls in the livestock group, and the absence of supervision from breeder management. In addition, the management of the parent handling during the breeding or mating season also received poor attention. However, research on the genetic diversity of Bali cattle in South Sulawesi shows a high genetic diversity (Mansur *et al.*, 2016). This indicated that the possibility of improvements in the performance and productivity of Bali cattle can be improved through genetic and environmental or management improvement (Baco *et. al.*, 2020b).

The need for meat in Indonesia is not matched by an increase in domestic beef production, so that the national availability the need for meat is still not sufficient for national needs. Domestic beef production in 2018 was 403,668 tons. However, the estimated domestic demand for beef in 2018 is 663,290 tons (BPS, 2018). The need for livestock has increased along with the increase in income, nutritional needs and public education on the importance of consuming beef. Therefore, increasing the population and productivity of cattle need to be increased.

One of the efforts to meet the demand for meat is to become established the Maiwa Breeding Center (MBC) located in Bangkala Village, Maiwa District, Enrekang Regency (Syarif *et al*., 2019). MBC has a strategic role as a center for beef cattle breeding which was established on the basis of a cooperative relationship between Hasanuddin University and the Ministry of Research, Technology and Higher Education, the Enrekang Regency Government, the South Sulawesi Provincial Government, and small farmers. The breeding center of Animal Husbandry Livestock is one of the local cattle breeding centers developed with local farmer/livestock groups through community empowerment programs which are expected to produce superior seeds stock.

Therefore, it is expected to know the development of the dynamics and structure of the livestock population (Fioretti *et al*., 2020) and become the basis for policy making by related parties in the effort to develop Bali cattle in Indonesia.

MATERIALS AND METHODS

Material

This study uses the population of Bali cattle in the Smallholder Farm, Maiwa Breeding Center (MBC). Location was at around areas of the MBC in Maiwa sub-Distric, Enrekang District. The data used was data that has been collected by farmers and direct interviews and with questionnaires. This data collection was carried out from September to November 2019 at the at Smallholder Farms of Maiwa Breeding Center partnership in Enrekang Regency.

Methods

This research was a field research using survey method. The data were collected through direct interviews with farmers and questionnaires. The measured parameters was calving rate, mortality rate, sale rate, population dynamic, and growth percentage and population structure in the Smallholder Farms.Based on the population structure on smallholder farms, an estimation of population development was carried out for the next 5 years.

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Data Analysis

The data obtained were tabulated and analyzed.

1. The data analysis used for the population structure was descriptive statistical analysis by calculating the percentage Description:

$$\mathrm{Pi} = \frac{\mathrm{Xi}}{\sum \mathrm{X}} \mathrm{X}\ 100\%$$

Pi = Percentage of population structure (male calf, female calf, young bull, heifer, sire and dam-cows)
Xi = Number of beef cattle to-1st (male calf), 2nd (female calf), 3rd (young bull), 4th (heifers) etc.
$\sum X$ = Total population of beef cattle.

2. The data analysis used for population dynamics was as follows

$$\mathrm{N} = \frac{(\mathrm{Bi} + \mathrm{E}) - (\mathrm{Di} + \mathrm{G})}{\mathrm{N(the\ end)}} \mathrm{X}\ 100\%$$

Description: N = total population, Bi = number of calving to a year's population (heads), E = total purchase for a year (heads), Di = number of mortality to a year's population (heads), G = total sales for a year (heads).

3. The data analysis used for population dynamics is as follows:
   a. Livestock input in population
   - Calving Rate

$$Birth\ Rate\ based\ cows(\%) = \frac{Calving\ per\ year}{exposed\ cows\ per\ year} \mathrm{X}\ 100\%$$

$$Birth\ Rate\ by\ population\ (\%) = \frac{Calving\ per\ year}{Population\ per\ year} \mathrm{X}\ 100\%$$

   - Purchase Rate

$$Purchase\ Rate\ (\%) = \frac{Purchase\ per\ year}{Total\ population} \mathrm{X}\ 100\%$$

b. Expense livestock include:
- Mortality Rate

$$Mortality\ Rate\ (\%) = \frac{Death\ per\ year}{Total\ population} \text{X } 100\%$$

- Sale Rate

$$Sale\ Rate\ (\%) = \frac{Sale\ per\ year}{Total\ population} \text{X } 100\%$$

c. Growth in Percentage

$$Growth\ in\ Percentage(\%) = \frac{\text{Growth}}{Total\ population} \text{X } 100\%$$

4. Estimated Population Growth Based on Population Structure

Estimated population growth of Bali cattle at Smallholder Farm partnership Maiwa Breeding Center, Enrekang Regency based on the population structure in 2017-2019, it can be estimated population growth provided that 5 bulls are used as sired for five years, the rate of addition of calves is based on the final population structure (2019) by 24% consisting of 12% females 12% males, and assigned a mortality rate of 1% at each biological level in the population structure.

RESULTS AND DISCUSSION

Population Dynamics

The income (birth and purchase) and expenditure (mortality and sale rate) figures for Beef Cattle in Smallholder Farm, Maiwa District are presented in Table 1. It is known that the percentage of births to the number of calving percentage cows and calving percentage Population at Partnership Farm Maiwa, Enrekang District, indicated an increase in the percentage of the population due to an increase in the birth rate for three years (2017–2019). This shows that the percentage of births is influenced by the ability of the dam cow to give birth, the number of dam cow, and the total population. This is corroborated by Labatar and Aswandi (2017) stated that the number of births of Bali cattle in Manokwari Regency was 107 heads or (91.46%) to parents with 165 cows.

The high and low birth rates somewhere are influenced by the availability of superior bull as a sire. Another thing that supports the high birth rate of beef cattle is the availability of Artificial Insemination Centers, so that managers can easily get good livestock breeds. However, the birth rate of Beef Cattle in Partnership, Maiwa District was actually still relatively low due to the lack of management and government supervision of programs related to livestock pregnancy.

In addition, the availability of feed and environmental conditions greatly affects the situation of livestock.

Table 1. Partnership Cattle Population Dynamics in Smallholder Farm Maiwa, Enrekang Regency in 2017 - 2019

Parameters	Years		
	2017	2018	2019
Livestock Income:			
1. Birth (heads)			
a. Male Calf	1	8	8
b. Female Calf	5	2	13
Total (heads)	6	10	21
Calving Percentage from Dam-cows (%)	23	32	46
Calving percentage from Population (%)	18	21	24
2. Purchase (heads)			
a. Male	0	0	0
b. Female	0	0	0
Livestock Expenditure:			
3. Mortality (heads)			
a. Male	1	0	0
b. Female	0	0	1
4. Sale Rate (heads)			
a. Male	1	2	14
b. Female	0	0	0
% (Mortality and Sale rate) by population	6	4	17
5. Growth (head)	4	8	6
Growth (%)	12	17	7
Total Population (heads)	34	48	88

The percentage of livestock expenditure (mortality and sales rate) for cattle was 6% in 2017, 4% in 2018, and 17% in 2019, respectively.Utami's research (2015) found that the mortality rate of cattle on Kisar Island, West Southeast Maluku Regency was 21.30% and Susanti *et al*. (2015) reported that the average percentage of mortality in Beef Cattle was 1.44%. Most of the cattle deaths were dominated by calves and adult female cattle (mothering ability), this was because the pattern of livestock rearing was still traditional, with animal health management and feeding that were still very limited as a result, calves, and cows that had just given birth were not given good feed standards. Labatar and Aswandi (2017) state that cattle mortality in calves is caused by a pattern of rearing that uses an extensive system, lack of control of livestock health in cattle and calves, feed that is not in accordance with production needs, and lack of technical knowledge of farmers about good Bali cattle maintenance.

Livestock mortality are caused by three factors; there are sick cattle, giving birth, and food poisoning (Hernandez-Cortez *et al*., 2017; Terry *et al*., 2021). This is due to the lack of skills of the breeders to handle their livestock which is still traditional so that the livestock are

easily infected with the disease (Arif, 2015). The high mortality rate is generally caused by the lack of supervision of farmers and the condition of weak calf at birth as well as the lack of special handling from breeders for pregnant cow before birth and newborn calf (Tatipikalawan and Hehanussa, 2006).

The dynamics of population of Bali cattle on the Smallholders Farm Partnership in 2017-2019 (Table 1.) was fluctuated. This indicates that the mortality rate of calf and livestock sales sometimes were higher than the birth rate. High and low population growth of cattle was caused by maintenance management, feed availability, and environmental conditions (Sere *et al*., 1995). So that it affects the physiological condition of livestock, furthermore has an impact on performance. The results of this study was lower than the livestock population growth at the Smallholder Farm Maiwa Breeding Center partnership in Barru Regency where the percentage of Bali cattle population growth in 2018-2019 was 17%, 28% and 15% (Hasman *et al*., 2021).

The increase in livestock population growth was caused by the amount of livestock income being greater than spending, where the number of cattle born was more than the number of dead cattle and livestock sold in every year. The increase or decrease of livestock populations was largely determined by the birth, mortality, buying and selling of livestock. High birth rates will affect the composition of calf and yearling and then, it will become potential replacements for parents so that the expenditure of adult cattle increases (Putra, 2017).

The difference in the recording is due to inaccuracies of data and the recording is still lacking, for will becomes an obstacle to making decisions for the next program related to this recording program efforts to increase the population in order to achieve national meat self-sufficiency. According to Nuhung (2015), problems in the development of cattle farming are due to the level of validity and reliability of the missing data, which often difficult in the preparation of planning.

According to Purwantiningsih and Kia (2018), in general, breeder farmers in Indonesia do not understand the importance of identification and recording in the livestock maintenance management, especially the pattern of raising livestock; many are still kept in free-release grazing fields, without going through supervision and recording. Meanwhile, if the recording (mating, birth, mortality) are carried out properly and correctly. The recording can be used to analyze to solve the problems where can impact on increasing livestock in accordance by naturally increase (Pari, 2018).

Population Structure

The structure of the livestock population is a herd of livestock or a group of livestock (Thornton, 2010), in this case, are beef cattle. The structure of the livestock population can be grouped by sex and age, where the age of the livestock is divided into adults (beef cattle are generally two years old or more), heifers (calves between one and two years old and not yet breeding), and calves (calf aged 0 months to one year or calves that are still suckling from their mothers).

Table 2 is presented the population structure of Bali cattle in Smallholder Farm. That was dominated by adult cattle in population in 2017-2019. in a row as many as 2, 6, and 13 heads with a percentage of 11.17%. While the population of adult female cows was also increased from 2017-2019, there was 26, 31, and 45 heads with a percentage of 64.06%. In contrast to the population of heifer cows in Partnership in 2017, there were 0 heads, 2018 were1 head, 2019 were 2 heads with a percentage of 1.45%. While the calf bulls in 2019 at Partnership were 7

cows. The male calf population in Partnership in 2017 was 1 head, 2018 were 8 heads, and 2019 were 8 heads with a percentage of 9.57%. While the population of female calves at Partnership in 2017 was 5 heads, 2018 was 2 heads, 2019 was 13 heads with a percentage of 11.21%. The decline in population is due to the low birth rate which is not proportional to the death rate and also the expenditure of adult livestock (culling), the population structure at Smallholder Farm is dominated by adult livestock

Comparison of the number of bulls and cows in each year was based on age group. Starting from the adult age group, the ratio of the number of bulls is lower than cow females. The differences occur because the purpose of rearing is to get seeds or calves, so that more breeders have adult female cows. Then in the calf age group, the ratio between calf bulls is lower than that of calf female cows. This is intended as a preparation for prospective parents in the following year so that they can increase the birth rate.

Table 2. Beef Cattle Population Structure in Smallholder Farm partnership in Maiwa Breeding Center 2017-2019

No	Cattles	Year					
		2017		2018		2019	
		(n)	(%)	(n)	(%)	(n)	(%)
1	Sires	2	(5.88)	6	(12.50)	13	(14.77)
2	Dam-cows	26	(76.47)	31	(64.58)	45	(51.14)
3	Young Bull (>1 Year)	-	-	-	(2.08)	7	(2.27)
4	Heifer (>1 Year)	-	-	1	-	2	(7.95)
5	Male Calves (<1 Year)	1	(2.94)	8	(16.67)	8	(9.10)
6	Female Calves (<1 Year)	5	(14.71)	2	(4.17)	13	(14.77)
Total Population		**34**	**(100.00)**	**48**	**(100.00)**	**88**	**(100.00)**

n = Number of Cattle

The population structure of beef cattle in the smallholder Farm at the Maiwa Partnership Livestock Center, Enrekang Regency, can be seen in Table 2. The percentage of adult bull (sire) cattle from 2017 - 2019 is 5 - 14.7%, while the female parent (dam-cows) has a percentage of 51.14 - 76.47, that was the highest in the population structure. The young animal (heifer and young bull) and calves have 10% and 17 - 24%, respectively. This is because the partnership in Maiwa Regency it was focused on raising beef cattle for reaches produce offspring to produce broods, while males are generally sold during the Feast of Sacrifice. Breeder maintenance management prioritizes adult females to serve as superior parents to produce offspring for the purpose of increasing the population.

In the time, when compared with Tanari *et al.* research (2011) the structure of the cattle population in North Pamona District consists of 533 (34.88%) bull and 995 (65.12%) cows.

Population Growth Estimate

Estimation of the population growth of the Bali cattle at Smallholder Farm of Maiwa Breeding Center partnership in Enrekang Regency based on the population structure in 2019, that can be estimated population growth provided that 5 head of sire-bulls for five years. Growth rate

of calf was based on the 2019 population structure consisting of 12% female, 12% males, with a mortality rate of 1%. The estimated population for the years 2020-2025 is presented in Table 3.

The estimated Bali cattle at Smallholder Farm Maiwa Breeding Center in Enrekang Regency will be increased from the basic population in 2019 of 88 heads to108 heads in 2025 (Table 3). Population growth was increased gradually 7% a year. The dynamics and structure of the population are strongly influenced by several factors such as the birth rate, mortality rate, and sales for culling rate. Effort for increase the number of livestock populations, are necessary attention related to the determining policies and improving maintenance management by farmers, and increasing the number of calving rate at least 60% each year.

Table 3 Estimated of Population Growth of Bali Cattle in Smallholders Farm 2020–2025

Cattle	Based Population Structure	Total (Head)											
		2020	Sale	2021	Sale	2022	Sale	2023	Sale	2024	Sale	2025	Sale
Sires	13	5	14	5	7	5	4	5	4	5	6	5	6
Dam-cows	45	46		57		60		63		68		73	
Young Bull	7	7		4		4		6		6		7	
Heifer	2	12		4		4		6		6		7	
Male Calves (<1 Year)	8	5		5		7		7		8		8	
Female Calves (<1 Year)	13	5		5		7		7		8		8	
Total Population	**88**	**80**	**14**	**80**	**7**	**87**	**4**	**94**	**4**	**103**	**6**	**108**	**6**

CONCLUSION

The increased of Bali cattle at the Maiwa smallholder farm partnership in Maiwa Breeding Center in Enrekang Regency was influenced by calving rate cows. The calving rate was founded 23% in 2017, 32% in 2018, and 46% in 2019. The mortality rate and sales of cattle was 6% in 2017, 4% in 2018 and 17% in 2019, respectively. The population dynamics was affected by calving rate, mortality and sales livestock in a year. Prediction of Population growth increased gradually (7% a year) from 2020 to 2025 based on the population structure of Smallholder Farm in 2019.

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