Assessment of cattle BCS performance in participatory-based breeding programs, South Sulawesi Indonesia

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Abstract. Body Condition Score (BCS) in Bali cattle has an effect on the calves performance. The BCS value correlated with the morphometrics of the calves. The BCS value is used as a parameter for improving the quality of cows in the breeding program. This study was aimed at calculating the development of the BCS value of cows and measuring its correlation with birth weight and withers height of the calves. The material used in this study was 200 heads Bali cattle divided into 100 cows and 100 calves. Cattle owned by the farmer partners of PT. Hasanuddin Agrivisi Internusa, located in Tanete Riaja and Barru District, Barru Regency, South Sulawesi, Indonesia. The parameters observed in this study were Body Condition Score (BCS) of the cows, withers height (WH), and birth weight (BW) of calves. The BCS on a scale of 3 to 5. The data obtained were analysed using ANOVA comparative test, correlation test and linear regression analysis using the SPSS program. Research showed that there was an increase in BCS scores from 2019 to 2020 and 2021 (*p<0.05*). The correlation value between BCS of cows and BW of calves was a positive correlation of 0.347. The relationship between WH of cows and BW of calves was positively correlated at 0.188. The correlation between BCS and WH of cows to BW of calves was positively correlated at 0.350. Even though there is a positive correlation, the correlation value is still low, so there are other factors that influence the BW of the calves.

1 Introduction

Body Condition Score (BCS) defines as a subjective evaluation method by sighting and palpating a cattle's body to estimate body fat reserves. Assessment of BCS in Bali cattle with the provisions of score 1 means very thin; score 2 means thin; score 3 means medium; score 4 means fat, and score 5 means very fat. Cows with good body condition can produce calves with good birth weight too. BCS can be applied to evaluate feeding management and assess health status of cattle individually. The ability of a cattle to reach certain BCS criteria are strongly influenced by the level of energy and body fat reserve which is highly dependent on

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management feed and control disease, and both aspects also become the reasons of reproductive disorders that results in affected cattle with reproduction's problem often accompanied by poor BCS or otherwise [1]. In smallholder farming conditions, the lack of feed nutrition in female cattle causes a decrease in BCS which in turn impact on cows' disruptive reproduction activity characterised by the incident of *silent heat*, oestrus postpartum (OPP), days open (DO), service per conception (S/C) and long calving intervals (CI). Lack of nutritional intake in cows during pregnancy has also led to low birth weight and even deaths of newborns.

Performance of newborn calves can be seen and measured through the appearance of body dimension such as body length, withers height, chest circumference and calf body weight [2]. Phenotypic diversity of Bali Cattle calves can be observed through observation and measurement of quantitative traits through morphometric analysis (body size). The morphometric approach can be used to study genetic relationships through measurements of body dimensions. Research conducted by Saputra et al. [3] showed the morphometric size of female Bali cattle calves with a height of 69.66 ± 9.09 cm, body length 63.66 ± 13.18 cm, chest circumference 77.16± 16.80 cm, while male calves had a height of 83.00 ± 10.81, body length 81.88 ± 13.71, and chest circumference 91.55 ± 13.32 cm. Birth weight is an important factor in calf growth. Cattle with high birth weights and born normally will be better able to sustain their lives [4].

Body size and body weight of Bali cow can have a significant influence on calf performance such as birth weight and body weight. Based on the research of Tainmeta et al. [5] showed that there is a very significant correlation between cows body weight and calf birth weight with r = 0.575, meaning that whenever there is 1 kg of a cow's body weight, there is an increase in calf birth weight of 0.575 kg. Physiologically there is a significant relationship because cows with high body weight is manifestation of relatively better body condition and or have larger frames. Cow with higher body condition scores and body weight may produce better or more milk so that their calves will grow faster and reach a relatively higher body weight at one month of age.

In general, the management of Bali cattle rearing in the community is still traditional and as a result, cattle productivity is low. With traditional rearing system, cattle have not been able to reach their potential even though genetically they have potential high productivity. Based on field observations, in general, cows that display good body condition and body weight will produce offspring with good birth weight as well. The objective of this study was to determine the development BCS of cows and its relationship with the dimension of the withers height to calf birth weight in beef cattle breeding with a Participatory-Based Breeding Program.

2 Materials and methods

This research was conducted in February - June 2022, at the farmer partners of PT. Hasanuddin Agrivisi Internusa, Tanete Riaja District and Barru District, Barru Regency, South Sulawesi. The material used in this study was 200 heads Bali cattle divided into 100 cows and 100 calves. The age of the cow was 5-6 years old. The parameters observed in this study were Body Condition Score (BCS) of the cows, withers height (WH), and birth weight (BW) of calves. The BCS on a scale of 3 to 5. The BCS on a scale of 3 to 5.

The data obtained were analysed using ANOVA comparative test, correlation test and linear regression analysis using the SPSS program, between cow performance and calf performance at birth using the formula:

$$R^2_{yx_{1x_2}} = \sqrt{\frac{r^2_{yx_1} + r^2_{yx_2} - 2r^2_{yx_1}\, r^2_{yx_2}\, r_{x_{1x_2}}}{1 - r_{x_{1x_2}}}} \quad (1)$$

Description:
$R^2_{yx_{1x_2}}$: Correlation
X_1 : Withers height
X_2 : BCS
Y : Birth weight of the calf
$r^2_{yx_1}$: correlation between X_1 and Y
$r^2_{yx_2}$: correlation between X_2 and Y
$r_{x_{1x_2}}$: correlation between X_1 and X_2

3 Results and discussion

3.1 Improvement of body condition score

The BCS value was observed by visual method observation. The development of BCS values of Bali breeding cows in Barru Regency can be seen in Table 1.

Table 1. Comparison of cows BCS values in the Barru District.

Year	N	Mean ± standard deviation	BCS changes
2019	50	$3.30^a \pm 0.46$	-
2020	50	$5.02^b \pm 0.86$	52,1
2021	50	$5.10^b \pm 0.83$	1.60

Notes: ^{a,b} Different superscripts in the same column indicate significant differences ($p<0.05$)
N: sample quantity

Table 1 shows the results of the comparison of BCS values of Bali breeding cows in Barru Regency, where the average BCS value of cows in 2019 is 3.30 ± 0.46 which means it is on BCS scale 3, in 2020 reaches 5.02 ± 0.86 which means it is on BCS scale 5 and in 2021 it is 5.10 ± 0.83 which means it is on BCS scale 5. It can be seen that the comparison of BCS values between 2019 and 2020 has a change in value of 52.1 which shows the difference ($p<0.05$). While the comparison of BCS values between 2020 and 2021 has a change in value of 1.60 which means no difference ($p>0.05$).

The results showed that throughout 2019 to 2021 there were changes in the BCS value of Bali breeding cows in Barru Regency, especially the comparison of BCS values between 2019 and 2020 and between 2019 and 2021, there was a significant difference from BCS scale 3 to scale 5, the development of these values indicates that the participatory breeding model in Barru Regency is getting better every year because it is able to meet the BCS standard for breeding cows, that is BCS on scale 5. In accordance with the opinion of Tyler and Ensminger [6]; Netika et al. [7] which states that BCS values of 5-7 in cows is in ideal conditions, which has a good overall appearance. Generally, cattle with BCS scale 5 have the characteristics of the 2nd or 3rd last rib still visible, transversus processus spinosus can only be felt with strong pressure (palpation) and cannot be seen by the eye and there is fatty in the area around the base of the tail.

Krishna et al. [8] stated that on a body condition score scale of 1-9, cows that have a score of 5-6 or with a moderate level of fatness, considers quite good. Herd and Sprott [9] emphasised that a BCS score of 5-7 at calving is the capital to achieve good reproductive performance of breeding cows in the next cycle. A decrease in the BCS value of a cattle or cow is a contributing factor to the decline in reproductive performance of Bali cattle [10, 11]. Changes in the body condition of the lactating cow affect the development of the calf so that it will have an impact on the growth of the next calf. Good cow condition will greatly support calf development until 60 days of age as the peak of milk production and will affect a better growth rate after weaning [5, 12].

The BCS value in 2020 and 2021 did not have a difference ($p>0.05$), indicating a fairly good response to maintaining the ideal BCS value for breeding cows. Generally, breeding cow must have ideal weight and fatness, meaning that they are not too fat and not too thin because cattle with body conditions that are too fat will experience difficulties when giving birth or there are other reproductive disorders and vice versa. Meanwhile, cattle with body conditions that are too thin will be vulnerable to disease. In accordance with the opinion of Masir et al. [11] which states that BCS observations are carried out to assist farmers in obtaining an overview of the level of muscly and fatty reserves in the livestock body. Excess fat content tends to cover the reproductive tract which results in impaired function of the reproductive organs. Conversely, cattle with low BCS can reduce the body's ability to synthesise reproductive hormones and disrupt the ovulation process.

3.2 Cows and calves morphometrics

The mean of correlation value between BCS and WH cows with BW calves can be seen in Table 2 below:

Table 2. Morphometrics parameters of cows and calves.

Variables	Mean ± standard deviation
Body Condition Score	5,10± 0,83
Withers height of cows (cm)	107,73 ± 3,37
Birth weight of calves (Kg)	15,19 ± 1,61

The mean value of BCS of Bali cows was 5.10 ± 0.83. It can be said that the BCS of Bali cows is in the medium group with interval values of 4-6. This is in accordance with that the moderate group with BCS values of 4-6 still shows bone protrusions in some parts. According to Krishna et al. [8] BCS can predict cattle energy reserves and herd energy balance. He added that in the broiler industry, BCS is generally used on a scale of 1-9, with cows scoring 5-6 or with a moderate level of fatness.

The average withers height (WH) of Bali cows is 107.73 ± 3.37 cm. The average WH in this study is still lower when compared to the research of Pikan et al. [13] which states that the WH of cattle at the age of 4.5 years is a minimum of 100 cm and a maximum of 118 cm with an average of 109.18 cm, and at the age of 5.5 years a minimum of 97 cm and a maximum of 115 cm with an average of 109.83 cm. Estepanus [14] stated that the performance of breeding cattle quantitatively can be determined by indicators of vital statistics, especially body length (BL), withers height (WH), and chest circumference (CC). The greater the value of these vital statistics, the better the performance/quality, in addition to qualitative indicators shown by exterior conditions including health and specific characteristics of a breed/type/race of cattle.

The average birth weight (BW) of Bali cattle calves was 15.19 ± 1.61 kg. The BW of calves in this study is still in normal condition in accordance with the statement of Tainmeta et al. [5] that the range of BW is still within the range of normal at Bali cattle, which is 12-13 kg. Fallo et al. [15] stated that the BW of Bali calves is 18.4 ± 1.6 kg. The BW between male calves and female calves varies greatly. The range of BW of male calves is between 10.5-22 kg with an average of 18.9 ± 1.4 kg. Meanwhile, female calves had a range of BW between 13-26 kg with an average of 17.9 ± 6 kg. The BW is also inseparable from the influence of the cow where only qualified cows can produce high BW. The decrease in livestock productivity is thought to be caused by the lower pregnancy rate and birth rate (birth weight). Calves born with weights less than the minimum standard will experience poor growth compared to calves born with normal weights, even some calves born with weights below the standard can be declared as culling animal candidate.

Table 2 shows the mean values of BCS, WH of cow and calf BW. It can be said that the higher the BCS value and the height of the cow WH, the higher the value of calf BW. Tainmeta et al. [5] stated that in general, cows who display good body condition and body weight will produce children with good BW as well. Cows with lower body weight caused by BCS which is also lower, this indicates lower milk production so that the weight gain of calves from birth to one month of age is smaller, which is an average of 5.8 kg compared to cows who have a score of 4 and 5 whose calf weight gain is 6.41 kg and 7.14 kg respectively. Birth weight is determined by prenatal growth conditions, which are supported by the supply of nutrients from the cow and the cow's ability to use them Saptayanti et al. [16]. Thin cows generally give birth to weak calves with low birth weight, low milk production, predators, feed and disease [17].

3.3 Correlation on morphometrics parameters

Biologically there are several factors that can affect the calf, this could be influenced by the cow factor itself and the environment or genetic and non-genetic factors of the livestock. In this study, the cow factors studied, that is BCS and WH on calf BW can be seen in Table 3 below.

Table 3. Correlation between BCS and WH cows on BW calves.

Connection	r value	t count	t table	Regression Equation
BCS (X) of cows on BW calves	0.347	3.665	1.985	Y : 11.829 + 0.691 X
WH cows to BW calves	0.188	1.897	1.985	Y : 5.524 + 0.09 X
WH and BCS cows on BW calves	0.350	0.449 3.100	1.985	Y : $9.593+0.023X^1 +0.651X^2$

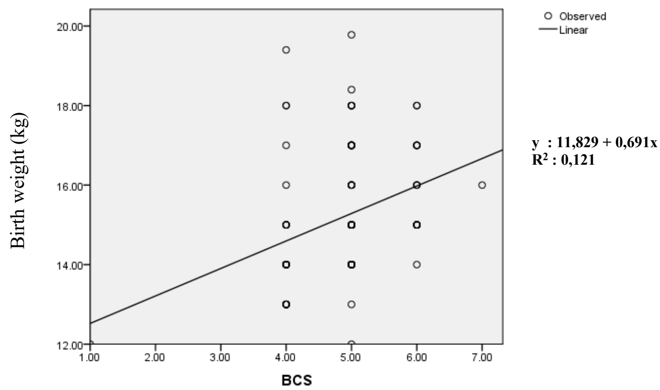
The data in Table 3 above shows that the correlation value between BCS and BW calves is a positive correlation of 0.347, which means that the relationship between these variables is a weak correlation. This indicates that BCS is not the only factor affecting of BW calves. Given sig $0.000 \leq 0.05$ or t count $3.665 \geq$ t table 1.985, it can be said that there is an effect of BCS on BW calves.

The relationship between WH and BW calves is positively correlated at 0.188 which means that there is a relationship between the variable of WH and BW calves. This indicates that the WH of the cow is not the only factor affecting calf BW. Given sig $0.61 \geq 0.05$ or t count $1.897 \leq$ t table 1.985 then there is no effect of WH on BW calves.

The correlation between BCS and WH to BW calves is positively correlated at 0.350 which means that the relationship between BCS and WH variables is weakly correlated to calf BW. This indicates that BCS and WH are not the only factors that influence calf BW. Given sig $0.654 \geq 0.05$ or t count $0.449 \leq$ t table 1.985, it can be said that there is no effect of WH on BW calves. Whereas BCS and BW calves are given sig $0.003 \leq 0.05$ or t count $3.100 \geq$ t table 1.985, it can be said that there is an influence of BCS on BW calves.

3.4 Graph analysis of the relationship between morphometrics parameters

Linear analysis graph that shows the statement of BCS can affect the BW of calves while the WH cows does not affect the BW of calves, can be seen in Figure 1:



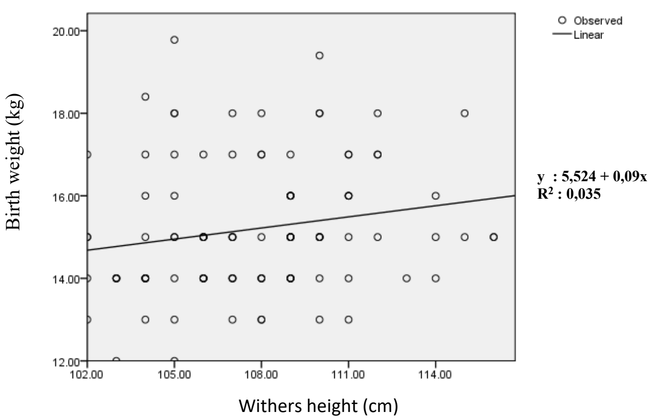


Fig. 1. Linear analysis chart. [(a)]Relationship of Cow's body condition score (BCS) to calf birth weight; [(b)]Relationship between cow's withers height and calf birth weight.

The linear analysis graph of the relationship between BCS and BW calves obtained y: 11.829 + 0.691x and R^2 : 0,121. This shows that the effect of BCS simultaneously to BW calves is 12.1% and 87.9% is influenced by other factors. While the linear analysis graph of the relationship between WH cows and BW calves obtained y: 5.524 + 0.09x and R^2: 0,035.

This shows that the effect of the WH cows simultaneously to the BW calves is 3.5% and 96.5% is influenced by other factors.

4 Conclusion

Based on the results of the research conducted, it can be concluded that WH and BCS cows are positively correlated with BW calves. The BCS value of Bali breeding cows in the Participatory-based breeding program in Barru regency showed a significant increase from 2019 to 2021 with BCS values on a scale of 3 to 5, the increase was a manifestation of improvement towards the ideal cows.

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