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Identification of Growth Patterns through Estimation of the Relationship Between Body Dimensions on Taro White Cattle

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ABSTRACT

This research evaluated the growth pattern of Taro white cattle by estimating the relationship between body dimensions by measuring 18 Taro white cattle periodically every two weeks for three months. Body dimensions measured were body weight (BW), body length (BL), chest circumference (CC), body height (BH), hip height (HH), and hip width (HW). The measured data were analyzed descriptively, and to estimate the relationship between body dimensions, Multiple Linear Regression analysis was used, followed by Step Wise. The results showed that the average body dimensions of Taro white cattle were: BW:183.61 ± 25.92 kg; BL: 113.36 ± 7.13 cm; CC: 143.93 ± 6.61 cm; BH: 109.79 ± 3.92 cm; HH: 108.68 ± 4.58 cm and HW: 32.96 ± 2.33 cm. Body weight (BW) as an indicator of the growth of Taro white cattle has genuine multiple linear relationships with BL, CC, BH, HH, and HW with the equation BW = 1.23BL + 2.29 CC - 0.24 BH + 0.11 HH + 1.97 HW – 336.63 with a coefficient of determination (R2) = 0.78. Then step-wise, a new regression equation is obtained: BW = 1.42 BL + 2.50 CC – 338.03 with a coefficient of determination (R^2) = 0.80. The conclusion is the estimation of body weight as an indication of Taro white cattle growth can be best carried out by utilizing body length and chest circumference as estimating variables.

Keywords: body dimensions, growth patterns, Taro cattle

INTRODUCTION

In Bali, apart from the well-known Bali cattle, there is also a group of cattle germplasm known as Taro white cattle. These cattle are only found in the forest of Taro Village, Tegalalang District, Gianyar Regency, Bali Province. The current population is in the critical category because there are only about 57 cattle. On the other hand, these cattle have a crucial position and is respected by the people of Taro Village. These cattle are cared for and treated correctly, have no nose pricks, are not employed to plough the fields, and are neither traded nor slaughtered. These cattle are mainly used to carry out religious ceremonies for the people of Taro Village and the Hindu community in Bali. Herewith a picture of a Taro cow with its calf (Figure 1).

In contrast to the Bali cattle, which have had much research on their characteristics and productivity, there is no adequate information on the Taro white cattle, especially regarding their genotypic and phenotypic characteristics. Phenotype is an essential factor in determining the characteristics of a population as a source of biodiversity to maintain the existence of that population (Noor, 2008). Given the population of Taro white cattle, which is classified as very small or lacking at this time, an inventory of phenotypic data is urgently needed as an alternative to the need to maintain the existence of the Taro white cattle population. Body size or dimensions are one of the phenotypic/quantitative traits that have an essential role in livestock productivity, and this body size is widely associated with body weight gain or animal growth. In Bali cattle, the body sizes found to have a strong relationship or correlation with body weight were chest circumference and body length (Djagra et al., 2002).

Figure 1. Taro cow with its calf

Growth is a change in body size, including changes in live weight and body dimensions. Overall body growth is generally measured by increasing body weight, and body weight gain can

be estimated by measuring body dimensions such as body height, body length, chest circumference, hip height, and hip width. The combination of body weight and size is generally used to measure growth. While in livestock, diversity can be seen from the characteristics that can be observed directly, where each trait expressed by an animal is called a phenotype (Noor, 2008). Body shape and size are classified as phenotypic traits that can be known by direct measurement, and body size is often used to evaluate the growth of livestock.

Research regarding the growth pattern of Taro white cattle based on measurements of body dimensions has not been widely carried out until now, including Taro cows, which are very important to maintain population stability. Data on growth patterns are helpful as references for implementing animal husbandry management in a conservation effort. Based on this, research on identifying the growth of Taro white cow based on the relationship between body dimensions was carried out to reveal the extent to which body measurements play a role in the growth of Taro white cow in conservation areas.

RESEARCH METHODS

The material used in this study was Taro white cows, aged I_3-I_4, who were physically healthy. The sample was selected by simple random sampling technique of 18 cattle from the Taro white cattle population in the Lembu Putih Foundation conservation area in Banjar Taro Kaja, Taro Village, Tegalalang District, Gianyar, Bali, Indonesia.

Variables Measured

The variables observed in this study were body dimensions such as body weight, body length, chest circumference, body height, hip height, and hip width obtained by weighing and measuring 18 Taro white cattle using a digital scale, measuring stick, and measuring tape. Weighing and measurements were carried out in a clamp cage (Fixation cage) every two weeks for three months of the study, so a total of 6 points or repeated measurements were obtained.

Weighing and measuring are carried out according to the method of Djagra et al. (2002) as follows:

1. Body weight (kg) is the body weight of the livestock when standing standard upright in a fixation cage and is measured with a 300kg digital cattle scale
2. Body length (cm) is the distance from the anterior part of the primum cervical vertebrae to the sacral tubers or the straight distance between the shoulder bumps to the sitting bones / sift bones (Tuber Ischii). Measurements are made with a measuring stick.
3. Chest Circumference (cm) is the distance measured around the chest just behind the shoulder joint (Os. scapula) perpendicular to the body axis using a tape measure (meter)
4. Body height (cm), the perpendicular distance from the highest point of the shoulder (gumba) to the ground or floor, measured with a measuring stick.
5. Hip height (cm), the height of the hips perpendicular to the ground, is measured with a measuring stick.
6. Hip width (cm) is measured from a distance between the two outer edges of the right and left hip joints (gluteus) and is measured with a measuring stick.

Data Analysis

The data obtained were analyzed descriptively to get an overview of growth patterns and to see the factors of body dimensions that affect body weight. The analysis was done using Multiple Regression and followed step-wise (Stell and Torrie, 1993). Body weight (BW) is defined as the dependent variable (Y) and other body dimensions as independent variables (Xi), namely body length (BL) as X1, chest circumference (CC) as X2, Body height (BH): X3, hip height (HH): X4 and hip-width (HW) as X5 with the linear model equation as follows:

$$Y = a + b1X1 + b2X2 + b3X3 + b4X4 + b5X5$$

Where :

Y = dependent variable
a = constant
b1.....5 = regression coefficient
X1.....5 = independent variable.

Data processing was carried out using the SPSS ver. 23

RESULTS AND DISCUSSION

Description of Body Weight, Body Length and Chest Circumference of Taro White Cattle

The description of the body size of Taro white cattle obtained in this study on averages was body weight (BW) of 183.61 ± 25.92 kg, body length (BL): 113.36 ± 7.13 cm, chest circumference (CC): 143.93 ± 6.61 cm (Table 1).

The growth of an animal is dependent on internal (genetic) factors and external factors such as rearing management, feed, environment, and disease. Fourie et al. (2002) stated that body size is an essential indicator of growth and that it can be used to evaluate the growth of the animal itself. The appearance of an animal is a continuous growth process, where each part of the body has a different growth and development rate and is a biological balance or is linear so that it can be used to predict the composition of the animal's body shape (Mulliadi, 1996). Meanwhile, according to Aberle et al. (2001), growth in young livestock can be seen from an increase in the height, length, body circumference, and body weight of this livestock kept under proper maintenance conditions.

The results showed that the average body weight and body dimensions of Taro white cattle were in the range of average body weight and body dimensions of Bali cattle in general, but higher than the study of Zurahmah and Enos (2015) whereas lower than the body weight and body dimensions of Bali cattle. Oka et al. (2016), primipara Bali cattle research results of Oka et al. (2018), and research results of Djagra et al. (2002).

Table 1. Description of body weight, body length, and chest circumference of Taro white cattle

Variable	Standard	Deviation Standard
Body Weight (kg)	183.61	25.92
Body Length (cm)	113.36	7.13
Circumference (cm)	143.93	6.61
Number of the sample (n)	18	

Compared with the results of research by Oka et al. (2020) on Taro cattle, the results of this study were lower due to the smaller number of cattle being measured, and the animals being measured in this study were also only genuinely white animals (not the whole population). Another reason for this study's lower average body weight was that the amount of feed given was less due to limited funds for providing forage.

Description of Body Dimensions of Taro White Cattle

The body size descriptions of Taro white cattle obtained in this study on average, were body height (BH): of 109.79 ± 3.92 cm, hip height (HH): 108.68 ± 4.58 cm and hip-width (HW) of 32.96 ± 2.33 cm (Table 2). Body size is a typical description of various body images and a comprehensive predictor of body shape.

Table 2. Description of body weight, body height, hip height, and hip width of Taro white cattle

Variable	Standard	Deviation Standard
Body weight (kg)	183.61	25.92
Body height (cm)	109.79	3.92
Hip height (cm)	108.68	4.58
Hip width (cm)	32.96	2.33
Number of the sample (n)	18	

The average body height and hip height results from this study were almost the same as the results obtained by Suryani et al. (2019) in Taro white cattle, namely 108.45 cm (with a range of 95 – 117 cm) for body height and 108.35 cm (with a range of 98 – 119 cm) for hip height. This result is supported by the statement of Djagra et al. (2002) that the growth of body height and hip height is determined by the growth of long bones, namely the forelimbs and hind limbs, which is a body size that includes early maturity and after adulthood body height is relatively the same as the hip height.

The pattern of Relationship between Body Weight and Body Size of Taro White Cow

The results showed that the body weight (BW) of Taro white cow had real multiple linear relationships with BL, CC, BH, HH, and HW with the equation BW = 1.23BL + 2.29 CC - 0.24 BH + 0.11 HH+ 1.97 HW– 336.63 with a coefficient of determination (R^2) = 0.78. This means that about 78% of changes in the dependent variable BW can be explained or related to the independent variables BL, CC, BH, HH, and HW together. From the other side, the coefficient of determination also shows that there is a reasonably

high variation related to the body weight gain of Taro white cow, namely around 78% comes from changes in body length, chest circumference, body height, hip height, and hip width together and 28% due to other factors. This means that the multiple linear regression equation obtained is quite good with a relatively high coefficient of determination (R^2), namely 0.78, where the coefficient of determination is to show how significant the role of the independent variable is on the dependent variable (Gaspersz, 1992).

The results of Kurnianto and Purbowati's (2013) study on Kacang goats found that the regression equation between body weight and the linear body size variable obtained can be used to estimate the body weight of the Kacang goats with a determination coefficient range of 81.4-97.8%. Research on the pattern of the relationship between body weight and body dimensions in Bali cattle has also been carried out by many animal husbandry experts, such as Djagra et al. (2002), Dhany et al. (2015), Hikmawaty et al. (2018) and Andilah et al. (2021).

Furthermore, by doing step-wise (the best level), namely to get a better regression equation by eliminating independent variables (X) that are not significant, a new regression equation is obtained, namely BW = 1.42 BL + 2.50 CC – 338.03 with a coefficient of determination (R2) = 0.80. These results are almost the same as the results of research by Hikmawaty et al. (2018) regarding the correlation of body weight and body size variables as the basis for selecting prospective Bali cows which obtain a regression equation with a very high degree of closeness, namely with a correlation coefficient (R) value between 0.91 – 0.98. A comparison of the estimated body weight value using the regression formula obtained with real (actual) body weight is presented in Table 3.

Table 3. Estimated body weight of Taro white cattle based on the regression equation BW = 1.42 BL + 2.50 CC – 338.03

No	Body Length (BL) (cm)	Chest Circumference (CC) (cm)	Estimated Body Weight (EBW) (kg)	Percentage of RBW - EBW (%)	Notation
1	113.33	150.17	198.32	8.47	+
2	106.16	151.17	190.64	-2.95	-
3	117.67	136.67	170.74	-2.87	-
4	117.83	142.00	184.29	-4.12	-
5	111.33	143.33	178.38	1.72	+
6	124.33	153.50	222.27	-8.16	-
7	121.83	147.67	204.14	7.75	+
8	121.50	153.50	218.25	5.86	+
9	103.67	136.33	150.01	6.24	+
10	107.50	143.67	173.80	-8.4	-
11	104.50	135.67	149.54	2.37	+
12	103.00	131,67	137.41	-2.41	-
13	104.83	138.50	157,08	6.22	+
14	116.67	150.33	203,47	-4.43	-
15	117.50	145.17	191,75	-5.75	-
16	121.50	138.00	179.50	0.28	+
17	117.67	146.50	195.31	6.78	+
18	109.67	147.00	185.20	-5.03	-

Explanation: EBW =Estimated Body Weight, RBW = Real BodyWeight
1) notation + when the estimated body weight < the real BW
2) notation – when the estimated Body weight > the real BW

The results showed a slight variation in the estimated body weight values from the actual body weights. The lowest difference value was 0.28%, and the highest was 8.47%. This indicates a slight difference between the estimated value and the weight of the measurement results. Body measurements greatly determine body weight estimation: chest circumference, body height, and body length. In this study, which had a close relationship with body weight were chest circumference and body length. The close relationship between body weight and body measurements can be used to determine good prospective Taro white cattle.

CONCLUSIONS

Several body dimensions, such as body length, chest circumference, body height, hip height, and hip width, are good enough to predict growth patterns (body weight) in Taro white cattle. The dimensions of body length and chest circumference are the best estimate of body weight in a white Taro cow. An estimate of body weight as an indicator of the growth of Taro white cow, multiple linear regression equations can be used using body length and chest circumference dimensions as estimating variables.

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