Buffalo Selection in Bali Province, Indonesia: Performance and Quantitative Trait Analysis

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Abstract: *Background*: The selection program is one of the efforts that can be made to select livestock as superior breed stock. The selection program can be carried out by looking at the performance of quantitative traits in buffalo by measuring several economically valuable traits referring to the Indonesian National Standard (SNI 7706.1: 2011) regarding superior young bull buffalo breeds.

Methods: The research was carried out by directly measuring the performance of quantitative characteristics of buffalo in three regencies out of nine regencies in Bali Province, Indonesia, namely: Jembrana Regency, Tabanan Regency, and Buleleng Regency. Data analysis was carried out descriptively to obtain average quantitative characteristics and calculate the magnitude of population diversity.

Results: The results obtained were that the performance of quantitative traits in male and female buffalo in Bali Province, Indonesia, was higher than the Indonesian National Standard (SNI 7706.1: 2011) regarding superior young bull buffalo breeds. The population diversity of quantitative characteristics of male buffalo aged 2-3 years old in Bali province is categorized as diverse (varied). On the other hand, male buffalo aged >3 years are in the uniform (homogeneous) category, as are female buffalo aged 2-3 years and >3 years.

Conclusion: The buffalo in the province of Bali, Indonesia, were suitable for use as a breed, and effective selection was carried out on the male buffalo population aged 2-3 years. Suggestions require efforts to increase public interest in keeping buffaloes by providing protection and appreciation to breeders who want to keep buffaloes, especially female buffaloes.

Keywords: Buffalo, population, selection, performance, quantitative trait, superior breed.

INTRODUCTION

Buffalo livestock are domesticated animals used for agriculture, food, trade, industry, traditional agility sports, and as a means of Hindu religious ceremonies. People in Bali Province use buffalo for food, trade, competitions, or "Makepung" tourist attractions, and they complete Hindu religious ceremonies at both the secondary and primary levels.

Makepung is a competition that uses buffalo to pull vehicles called "cikar". The buffalo is decorated with a very attractive headdress in golden color. The length of the track is around 4 km. This makepung competition is a group competition, where participants are divided into the West Group and the East Group. As a barrier between the West and East groups is a river that runs through the middle of Negara city called the Ijo Gading River (https://jembranakab.go.id/?module=event).

The buffalo population in Bali Province in 2020 is 1390 heads. Of the 9 regencies in Bali Province, three have the largest buffalo population: Jembrana Regency with 1155 heads (83.09%), Buleleng District with 123 heads (8.85%), and Tabanan District with 81 heads (5.83%). The male-to-female ratio is 65%: 35% [1].

However, in recent years, the buffalo population has tended to decline. Based on data from the Bali Province Agriculture and Food Security Service (2021) shows that the buffalo population in Bali Province over the last 5 years (2016-2020) has decreased by 25.47% [1].

The quality of buffalo in Indonesia is generally experiencing a decline as a result of a decline in genetic quality and other factors, such as inappropriate rearing management. The decline in buffalo productivity, apart from being reflected in a decrease in body weight as a result of a decrease in the linear dimensions of the buffalo's body surface, is also caused by genetic factors due to undirected breeding efforts. If there is a decline in the population and quality of buffalo, and if it continues over a long period, it is feared that its sustainability will not be maintained. For this reason, efforts are needed to increase the population and genetic quality of buffalo.

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The Bali provincial government, especially the Jembrana Regency Government, has taken steps to protect and preserve buffalo's survival by taking legal action, namely by issuing Jembrana Regency Regional Regulation No. 4 of 2020 concerning the Protection and Preservation of Buffalo. With this regional regulation, it is hoped that the buffalo population can be maintained and increased.

Improving the genetic quality of buffalo can be done with a breeding program through selection. The selection program must be carried out in a directed, continuous manner. Selection programs can be conducted by looking at the performance of quantitative traits with economic value, such as chest circumference, shoulder height, body length, and hip height. Furthermore, these results were compared with Indonesian national standards (SNI 7706.1.2011; regarding young bull of mud buffalo breeds) [2]. Male/female livestock performing above SNI standards can be selected as the standard and then mated with good male/female livestock to produce superior offspring.

The selection program will be effective if the population of livestock to be selected has quantitative trait performance with a high level of variation. The amount of variation in quantitative traits in a population can be measured by calculating the coefficient of variation (CV). This variation determines the selection process that will be carried out. If the variation of quantitative traits is high, then within-breed selection will be effective and efficient. On the other hand, if the variation of quantitative traits is low, it is necessary to consider bringing in livestock from outside the population to increase the variation of quantitative traits in the population. The magnitude of a population's phenotypic variation can be measured by calculating its coefficient of variation. A population is considered diverse if the coefficient of variation value is >15%. Warmadewi (2022) found that buffalo in the Jembrana district are very good as seeds regarding their breeding value [3]. However, the performance and variation of quantitative characteristics of the buffalo population in Bali province as a source of seeds is not yet known.

MATERIALS AND METHODS

Study Area

The research was carried out in Bali Province, Indonesia in 3 (three) districts with the largest populations, namely: Jembrana, Buleleng and Tabanan Districts. The research lasted for 5 months, from research preparation to research implementation.

Determining the research location was carried out purposively. Jembrana Regency, Tabanan Regency, and Buleleng Regency have the largest buffalo populations in Bali Province, with respective populations of 1.125 buffaloes, 37 buffaloes, and 31 buffaloes. The sample was determined using purposive sampling, namely, taking samples with certain considerations [4].

Experimental Design, Animals

The research was carried out by directly measuring quantitative traits including: chest circumference,

Figure 1: Buffalo care for the traditional "makepung" competition in Manistutu Village, Melaya District, Jembrana Regency, Bali (https://www.detik.com/bali/budaya/d-6245441/persiapan-tradisi-makepung-jembrana-kerbau-dapat-perawatan-khusus).

shoulder height, body length and hip height of male and female buffalo in Bali Province. Next, data on male and female buffalo are grouped based on age and gender.

Variable Measurement

The independent variable used in this research was the age of the livestock as seen through its teeth. The dependent variable is quantitative traits, including chest circumference, shoulder height, body length, and hip height in male and female buffalo in Bali Province, while the control variable is livestock rearing management (the feed given is assumed to be the same).

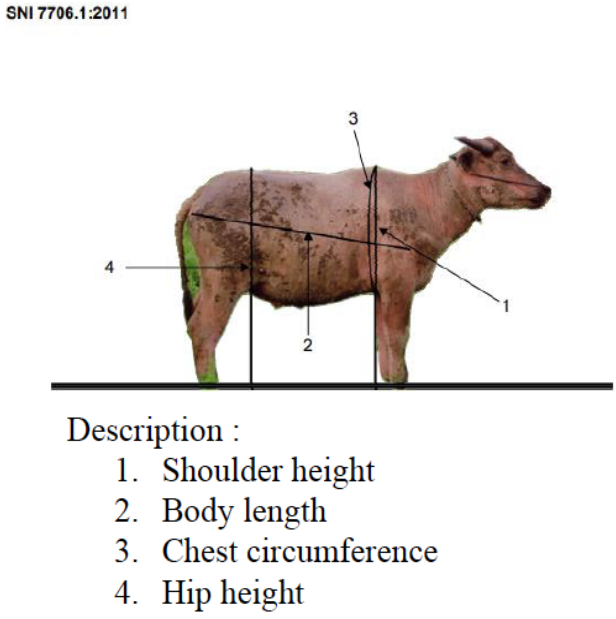

Figure 2: Visualization of body dimension measurement.

The buffalo being measured are put in a fixation cage to make the measurements easier. Next, quantitative trait measurements were carried out on male and female buffalo. The number of livestock used in this research was male buffaloes in age groups I1 and I2, each with 154 and 86. The number of livestock used in this research was female buffaloes in age groups I1 and I2, each with 32 and 26. All the data obtained was recorded, and then the data was grouped based on age and gender. Then, the performance and quantitative traits were calculated for each age and gender group. The results of quantitative trait performance calculations were compared with the Indonesian National Standard (SNI) 7706.1.2011 regarding young bull of mud buffalo breeds [2]. If the results obtained are in accordance with SNI, then the livestock measured are suitable for use as seeds. The results of the coefficient of variation will be used to consider whether selection will be carried out within the breed or will bring in livestock from outside the population to improve the genetic quality of existing livestock.

Data Analysis

The data obtained was analyzed descriptively. The performance of the quantitative characteristics of male and female buffalo is calculated by adding up the total values obtained and dividing them by the total number of livestock measured.

Analysis of the coefficient of variation (CV) of quantitative characteristics was carried out descriptively using the formula CV = Sd/X x 100% (Lasley, 1978), where CV = coefficient of variation; Sd = standard deviation of the population mean and X = population mean.

RESULT

Table **1** presents the performance and coefficient of variation (CV) of quantitative characteristics of male buffalo in age groups I1 and I2.

The results of research on male buffalo aged I1 showed that the quantitative characteristics of chest circumference, shoulder height, body length, and hip height were 187.12 ± 28.47 cm; 113.21±25.02 cm; 119.70±25.68 cm; and 110.64 ± 25.15 cm. Meanwhile, for male buffalo, the ages of I2 were 211.83 ± 6.63 cm, 138.17±8.18 cm, 157.00±7.92 cm, and 136.17 ± 7.83 cm.

Table **1** also shows the coefficient of variation values for the quantitative characteristics of chest circumference, shoulder height, body length, and hip height of male buffalo in age group I1, namely 15.22%, 22.10%, 21.45%, and 22.73%, while in age group I2 it is: 3.13%; 5.92%; 5.04%; and 5.75%. The performance and coefficient of variation of quantitative traits of female buffalo in age groups I1 and I2 are presented in Table **2**.

The results showed that the performance of quantitative traits including chest circumference, shoulder height, body length, and hip height in female buffalo of age group I1 were respectively: 170.25 ± 8.49 cm; 115.69±8.75 cm; 119.31±9.50 cm; and 113.06 ± 8.73 cm. Meanwhile, the performance of quantitative traits in female buffalo of age group I2 were

Table 1: Performance and Coefficient of Variation in Quantitative Characteristics of male Buffaloes in Age Groups 23-years and age > years

Characteristics (cm)	Age Groups			
	Age 2-3 years		Age >3 years	
	X	CV (%)	X	CV (%)
Chest size (cm)	187.12±28.47	15.22	211.83±6.63	3.13
Shoulder height (cm)	113.21±25.02	22.10	138.17±8.18	5.92
Body length (cm)	119.70±25.68	21.45	157.00±7.92	5.04
Hip height (cm)	110.64±25.15	22.73	136.17±7.83	5.75

Note: CV = Coefficient of variation; n = Number (head); X = Mean; ± = Standard deviation.

Table 2: Performance and Coefficient of Variation (CV) of Quantitative Characteristics of Female Buffaloes in Age Groups I1 and I2

Characteristics (cm)	Age Groups			
	Age 2-3 years		Age >3 years	
	X	CV	X	CV
Chest size (cm)	170.25±8.49	4.99	184.31±18.10	9.82
Shoulder height (cm)	115.69±8.75	7.59	126.46±17.46	13.80
Body length (cm)	119.31±9.50	7.96	132.46±17.81	13.45
Hip height (cm)	113.06±8.73	7.72	124.00±17.08	13.78

Note: CV = Coefficient of Variation; n = Number (head); X = Mean; ± = Standard Deviation.

respectively: 184.31 ± 18.10cm; 126.46±17.46cm; 132.46±17.81cm; and 124.00±17.08cm.

Table **2** also shows the coefficient of variation values for the quantitative characteristics of chest circumference, shoulder height, body length, and hip height of female buffalo at age I1: 4.99%, 7.59%, 7.96%, and 7.72%, while in age group I2, respectively, they were 9.82%, 13.89%, 13.45%, and 13.78%.

DISCUSSION

Quantitative Trait Performance

Quantitative trait requirements include chest circumference, shoulder height, body length, and hip height. Male mud buffalo seeds at the age of 30 - <36 months (I1) based on SNI 7706.1: 2011, respectively, are 180 cm, 110cm, 110cm, and 108 cm [2]. Compared with the results of this research, it can be said that the quantitative characteristics of male buffalo at age I1 in Bali Province are higher than the standard for male mud buffalo in the Indonesian National Standards. Furthermore, the quantitative characteristic requirements (chest circumference, shoulder height, body length and hip height) for male mud buffalo seeds at age I2 are respectively: 190 cm; 120cm; 125cm; and 118cm. Based on this, it can be said that the performance of the quantitative characteristics of male buffalo at age I1 in Bali Province is above the standards set in SNI 7706.1: 2011 concerning mud buffalo seeds [2].

Chest circumference has a positive correlation or is closely related to body weight compared to body length and shoulder height [5]. The higher the chest circumference, the higher the animal's body weight. This statement is supported by research [6]. Body size, especially chest circumference, can be a sign that the animal is growing well and quickly. Therefore, selection to improve the genetic quality of mud buffalo is more effective on chest circumference compared to selection on body length and shoulder height. Reported that the average body length of the Nili Ravi buffalo in Pakistan was 139.56±6.29cm [7].

Furthermore, Nur *et al*. (2018) found that the chest circumference of male swamp buffalo I2 in the Jepara region was 194.38cm with a body length of 125.75cm [8]. Also reported by Warmadewi *et al*. (2022) that the chest circumference of male buffalo I1 is 181.44±17.54cm; shoulder height is 125.36±6.52cm [3]. The results obtained are shorter than the body dimensions of mud buffalo in Bali Province, Indonesia. One of the causes is differences in breeds and methods of measuring body length [7].

The Indonesian National Standard (SNI 7706.1: 2011 concerning mud buffalo breeds) also includes requirements for the quantitative characteristics of chest circumference, shoulder height, body length, and hip height for female mud buffalo breeds at the age of 24 to <36 months (I1) respectively, 160 cm, 105cm, 105cm, and 103cm [2]. Meanwhile, at age >36 months (I2), respectively, 170cm, 115cm, 120cm, and 113cm. Based on this, it can be said that the performance of quantitative characteristics of female buffalo at ages I1 and I2 in Bali Province is higher than the standard female mud buffalo in the Indonesian National Standard.

Based on the research results obtained, the male and female mud buffalo in Bali Province are categorized as superior mud buffalo seeds. Suppose a male buffalo is mated with a superior female through natural mating or artificial insemination. In that case, the genetic quality of mud buffalo is expected to improve in Indonesia, especially in Bali Province.

The performance of the quantitative characteristics of male and female buffalo in the I0 age group cannot yet be shown because they are not listed in the minimum requirements for quantitative characteristics according to SNI 7706.1: 2011 [2]. This is possible because the performance of individuals in the I0 age group cannot yet be used as a selection reference. Parental influence is still visible in individuals of age group I0. Meanwhile, at age I1, large livestock, especially buffalo, are able to meet their own nutritional needs and can adapt to their own environment without any influence from the mother. The performance displayed starting in age group I1 is absolutely the performance of that individual.

Coefficient of Variation

The coefficient of variation describes the variation of a trait being measured, usually used to compare the variation of traits measured in different units, and it is convenient if the standard deviation is expressed as a percentage [5]. Hanafiah (1991) states that the coefficient of variation is high if the value is more than 15% [9]. On the other hand, the coefficient of variation is low if the value is less than 15%. If the coefficient of variation value is high, the population is considered diverse (varied). Conversely, the population is considered uniform (homogeneous) if the coefficient of variation value is low.

Population diversity will determine the alternative breeding techniques that will be used. The selection program will be effective if the population is diverse (varied). The higher the variation, the faster the selection response will be. If the population is diverse (heterogeneous), then crossbreeding will be effective in improving the genetic quality of livestock. However, if the population is uniform (homogeneous), it is necessary to introduce new livestock from other areas (outside the population) so that the population becomes diverse (varied).

Based on the research results, it can be said that the population of male buffalo at age I1 is diverse, so within-breed selection can be carried out. In contrast, the male buffalo population at age I2 is uniform (homogeneous). Likewise, the female buffalo population at ages I1 and I2 is in the uniform (homogeneous) category. In uniform populations, selection to improve genetic quality is less effective. Efforts that can be implemented to increase diversity in the population include including new populations from other areas (outside the population) into the existing population.

CONCLUSION

It was concluded that the performance of quantitative traits in male and female buffalo in Bali Province is higher than SNI 7706.1, so they are categorized as superior young bulls of mud buffalo breeds. The coefficient of variation value of quantitative trait diversity in male buffalo aged I1 in Bali province is in the diverse (varied) category. On the other hand, the coefficient of variation of quantitative traits for male buffalo aged I2 is uniform (homogeneous), as is the case for female buffalo aged I1 and I2.

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REFERENCES

[1] Dinas Pertanian dan Ketahanan Pangan Propinsi Bali. Cacah Jiwa Ternak. Denpasar 2021.

[2] SNI 7706.1: Bibit Kerbau Lumpur, Jakarta, Indonesia, 2011.

[3] Warmadewi,DA, IGNG Bidura, IN Ardika and IM Suasta. Performance and breeding value of male buffalo production traits as a basis for selection in Jembrana Regency, Bali Province, Indonesia. International Journal of Life Science Research Archive 2022; 03(02): 151-158. https://doi.org/10.53771/ijlsra.2022.3.2.0143

[4] Sudjana. Metode Statistik (6th ed.). Jakarta: Tarsito 1996.

[5] Tama WA, Nasich M, Wahyuningsih S. Hubungan antara lingkar dada, panjang dan tinggi badan dengan bobot badan kambing Senduro jantan di Kecamatan Senduro, Kabupaten Lumajang. Jurnal Ilmu-Ilmu Peternakan 2016; 26(1): 37-42. https://doi.org/10.21776/ub.jiip.2016.026.01.6

[6] Warmadewi DA, Oka IGL, dan Ardika IN. Efektivitas Seleksi Dimensi Tubuh Sapi Bali Induk. Majalah Ilmiah Peternakan 2017; 20(1): 16-19. https://doi.org/10.24843/MIP.2017.v20.i01.p04

[7] Mirza RH, Khan MA, Waheed A, Akhtar M, Raihandilshad SM, Faraz A, Ishaq HM, Kuthu ZH. Heritability estimates of somebody measurements in Nili Ravi buffaloes. The Journal of Animal & Plant Sciences 2020; 30(3): 537-544. https://doi.org/10.36899/JAPS.2020.3.0063

[8] Nur EA, Nugroho dan Kuswati H. Karakteristik Fenotip Kerbau Rawa (*B. Bubalis Carabenesis*) di Wilayah Sentra Pengembangan Kerbau Desa Guosobokerto Kecamatan Welahan Kabupaten Jepara. Journal of Tropical Animal Production 2018; 19(2): 156-166. https://doi.org/10.21776/ub.jtapro.2018.019.02.10

[9] Hanafiah KA. Rancangan Percobaan: Teori dan Aplikasi. Cetakan ke-5. PT. Raja Grafindo Persada. Jakarta Utara 1991.

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