Evaluation of Cow Morphometric Used for Selection of Proven Bull

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Abstract. This research aims to evaluate the morphometric characteristics of lactating cows with potential and proven bulls conducted in Malang Regency and Batu City, East Java. The morphometrics of dairy cows influence milk production, and traits such as stature, body depth, rump angle, and rump width have fairly high heritability, indicating a high probability that these traits will be inherited by their offspring. A total of 202 lactating cows were involved in this study, consisting of 110 participated cows and 92 comparison participated cows. The method used in this study was a survey method with data collection through purposive sampling, focusing on lactating cows based on specific criteria. The data were analyzed using descriptive analysis. The results showed that the morphometrics of the participated cows, including stature, body depth rump angle, and rump width, had scores of 4.1, 6.5, 5.1, and 5.4, while the morphometrics of the comparison participated cows, had scores of 4.1, 6.4, 5.3, and 5.1. It can be concluded that the morphometrics of the participated cows and comparison participated cows have almost the same scores and fall into the intermediate category.

Keywords: morphometrics, holstein cows, progeny test, participated cow, proven bull.

1 Introduction

Morphometrics is a study related to variations and changes in livestock body size and it is useful for knowing and describing livestock potential quantitatively. Morphometric characteristics can be measured through: height, body depth, rump angle and rump width. Morphometrics in dairy cows need to be evaluated to get calves with good phenotypic quality as a selection of proven bull.

Livestock productivity needs to be increased not only by modifying feed and environmental control but genetic factors also need to be considered. [7] revealed factors that influence milk production are genetics, environment, and interactions between both of them. Animal breeding is important functions and roles in increase genetics quality. Efforts that can be done in improvement genetics quality of cow is selection [1]. Improvement milk productivity can be implemented by selection cow and bull.

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Progeny test is method for test prospective milk production proven bull candidate (PBC) by daughter milk production (daughter cow; DC). For produce DC, the cow (participated cow; PC) is inseminated using sperm of the PBC being tested. In addition to DC, it is required contemporary comparison (CC) which is DC comparator. Contemporary Comparison is daughter from others cow (Non PC) that are inseminated using sperm from proven bull (PB). As comparator, then CC must same age and management with DC.

Many studies have shown positive correlation between stature of cow with milk production [5]. In general, exterior characteristics considered important in connection with production characteristic [9]. Body size known own correlation genetics with production and reproduction. Characteristic type like rump width ($r = 0.61$) correlated positive with milk production. Stature correlated positive and significant ($p < 0.001$) correlated ($r = 0.803$) with milk production. Meta-analysis study [4] showed that heritability of linear trait range between 0.07 to 0.49 which heritability of stature, rump width, rump angle and body depth are respectively 0,49; 0,40; 0,32 and 0,27. High heritability give indication the possibility superiority characteristic will passed on to his descendants.

Countries which joined in federation FH World Holstein Friesian Federation; (WHFF), shape and body size of cow is one of recommended properties for recorded and included in program of dairy cow quality genetics evaluation besides production milk characteristic. Because of genetics correlation, the recording morphometrics program in dairy cow become important for support the program selection. Morphometrics evaluation of PC and Non PC need be implemented for evaluate the breeding program. The information can made into as reference for organization, development and evaluation sustainable breeding programs.

2 Materials and Methods

2.1 Location and Duration

This study was conducted at Wagir District and Ngajum District, Malang Regency and Junrejo District, Batu City, over a period of five months from August to December 2023. Malang Regency and Batu City are central dairy-producing areas in East Java. The research in Malang Regency was conducted on smallholder farms that are part of the Kemitraan Sapi Perah Greenfields (KSG) partnership program. Meanwhile, in Batu City, the study was carried out at the Unit Pelaksana Teknis Pembibitan Ternak dan Hijauan Makanan Ternak Batu (UPT PT & HMT Batu).

2.2 Research Materials

A total of 202 mature cows of the Friesian Holstein (FH) breed were selected for the study based on lactation number (first to third lactation), has been vaccinated against foot and mouth disease (FMD) at least 2 times, and have a reproductive. The samples consist of 110 participated cows (PC) and 92 comparison participated cows (Non PC) in the progeny test program.

2.3 Research Methods

This study employed a survey method with purposive sampling for data collection. The data consisted of both primary and secondary sources. Primary data were obtained through direct observation and included measurements of specific morphometric traits: stature (STA), body depth (BD), rump angle (RA), and rump width (RW). Secondary data were gathered from supporting records and included information such as population size, individual cow identification, and number of lactations.

2.4 Observed Variables

The observed variables included stature (STA), body depth (BD), rump angle (RA), and rump width (RW) of parent cows (PC) used for the selection of proven bull candidates (PBC) and non-parent cows (Non-PC) inseminated with proven bulls (PB). These measurements (Table 1) were taken using the standard procedures recommended by the World Holstein Friesian Federation [17].

Table 1. Morphometric characteristics of lactating cows

Variable	Information	Picture
Stature (STA)	The distance measured from the upper surface of the spine bone between the thigh bones (hips) to the ground surface where the cow stands (cm) is measured using a measuring stick, then the value is converted to a scoring system.	
Body Depth (BD)	The distance from the top/end of the spine to the bottom end of the last rib to the deepest point, is measured using a measuring tape, then the value is converted to a scoring system.	
Rump Angle (RA)	Observing from the side to determine the triangular shape of the rump indicated by the hip bone and pin. The pin part is the part that is higher than the hip, this shape is a rump in a tilted condition, measured using a ruler, then the value is converted to a scoring system.	
Rump Width (RW)	the distance between the protrusions of the two pin bones seen from behind the cow, measured using a ruler, then the value is converted to a scoring system.	

2.5 Data Analysis

The collected data were analyzed descriptively by calculating the mean, minimum, maximum, and standard deviation for each of the two cow groups. The results were then compared with the recommendations provided by the World Holstein Friesian Federation (WHFF).

3 Results

3.1 General Conditions of the Research Area

Geography Conditions. Malang Regency is located in the south-central region of East Java and is characterized by a plateau surrounded by mountains and valleys. Ngajum and Wagir are two of the 33 districts in the regency. In Ngajum District, six villages are located on hilly slopes and three on plains, with an average elevation of 372 meters above sea level. Wagir District also has a mix of flat and hilly terrain, with an average elevation of 544 meters above sea level.

Batu City, geographically located at an altitude of approximately 921 meters above sea level, is surrounded by mountains such as Mount Panderman, Mount Arjuno, and Mount Wukir. The predominantly hilly topography contributes to its reputation as a cool-climate region. In 2023, the average temperature was 25°C, with the lowest recorded temperature of 14°C occurring in September.

The land areas of Ngajum, Wagir, and Junrejo districts are approximately 60.06 km², 61.29 km², and 30.68 km², respectively. In dairy farming, agricultural by-products from these regions are commonly utilized as alternative feed sources for livestock

Conditions of Cow Population. Data of Agriculture Census 2023 [3] shows that amount farmers that strives dairy cow in Malang Regency totaling 18,500 households (24.64 %) and in Batu City as 2,078 households (2.76%) of a total of 75,062 households that strives dairy cow in East Java. Farmers dairy cow in Ngajum, Wagir and Junrejo is small farmers with ownership of 1 – 10 animals. Data population of dairy cow shown in Table 2 below.

From the table 2, dairy cows population in East Java as 289,375 cows . The number female adult , female young and female child consecutive is 53.62 %; 22.41% and 12.29%. From these data , the composition cattle female good enough, female adult lots enough as producer children and milk production. Likewise in the population composition of dairy cow in Malang Regency is good, amount female adult as 51.13%. Female adults population in Batu City are only 38.60% of the total population in the area. This is not good, because can bother stability population in the next period. Management of female adult , female young and female child become very important its role, because productive female cow is bone back to increase population in *natural increase* (NI). Less female adult in a population will impact on the decline percentage birth and calf stock candidate replacement.

Table 2. Population Structure of Dairy Cattle in the Research Area.

Population Dairy Cow	East Java	Malang Regency	Batu City
Female	255,571	75,011	6,412
Mate (> 2 years)	155,164	42,460	3,281
Heifer (1 – 2 years)	64,853	20,550	1,170
Calf (< 1 year)	35,552	11,988	1,355
Male	33,804	8,039	2,088
Mate (> 2 years)	6,221	1,142	292
Heifer (1 – 2 years)	11,919	2,465	606
Calf (< 1 year)	15,664	4,432	1,190
Total Population	289,375	83,050	8,500

3.2 Morphometrics Analysis.

Based on the data analysis, it shows that stature of PC and Non PC groups get in intermediate category. Table 3 shows that the average stature for both of group almost the same which is 137 cm with score same 4.1. Ideal score recommended for stature is 7.

Table 3. Stature for dairy cow.

Dairy Cow	N (head)	$\bar{x}$ ST (cm)	Min (cm)	Max (cm)	Score	Category
Participated Cow (PC)	110	137.1 $\pm$ 5.8	120	152	4.1	Intermediate
Non Participating Cow (Non PC)	92	137.1 $\pm$ 5.1	121	147	4.1	Intermediate

Body Depth of the PC is of 80.4 $\pm$ 4.8 cm with score 6.5, has no different with Non PC which is 80.1 $\pm$ 5.4 cm with score 6.4 (Table 4). Body Depth both of PC and Non PC are in the intermediate category. The data of this study are a little higer from [12] research with body depth 78 $\pm$ 5.1 cm. Body Depth score both of group approach recommended ideal score 7.

Table 4. Data body depth (BD) of dairy cow.

Dairy Cow	N (head)	$\bar{x}$ BD (cm)	Min (cm)	Max (cm)	Score	Category
Participated Cow (PC)	110	80.4 $\pm$ 4.8	69	91	6.5	Intermediate
Non Participating Cow (Non PC)	92	80.1 $\pm$ 5.4	65	92	6.4	Intermediate

From Table 5 it show that rump angle of PC score 5.1 get in intermediate category. Rump angle of Non PC has score 5.3 also entered in intermediate category. Both of group have ideal score for rump angle recommended 5 – 7.

Table 5. Angle data cow rump angle lactation.

Dairy Cow	N (head)	$\bar{x}$ RA (cm)	Min (cm)	Max (cm)	Score	Category
Participated Cow (PC)	110	- 2.3 $\pm$ 2.5	- 7	6	5.1	Intermediate
Non Participating Cow (Non PC)	92	- 2.8 $\pm$ 2.3	- 7	2	5.3	Intermediate

Average rump width PC is 19.2 cm with score 5.4 (Table 6). The number is higher from Non PC which is 18,6 cm with score 5.1. However rump width both of group get in same category which is intermediate. The recommended score for rump width is 9.

Table 6. Data of rump width.

Dairy Cow	N (head)	$\bar{x}$ RW (cm)	Min (cm)	Max (cm)	Score	Category
Participated Cow (PC)	110	19.2 $\pm$ 1.9	15	25	5.4	Intermediate
Non Participating Cow (Non PC)	92	18.6 $\pm$ 1.6	14	23	5.1	Intermediate

4 Discussion

Stature and body depth show positive correlation with milk production. Stature and body depth were significant indicators, and many study has show positive correlation between body frame and milk production [5]. Acording to [11] A 1cm increase in the height stature will result in an extra 27.63 kg of milk produced per lactation. A 1 cm increase in the body depth results in a nearly 20 kg increase in lactational milk productivity.

It is important to note that selection pressure on a higher body frame plays a significant role in dairy cow. A large body frame is considered by breeders to be an impor tant parameter that is a prerequisite for high milk productivity. Stature has a very high heritability coefficient [13]; and because had high genetics correlation with milk production, then expected this characteristic can used as one of the selection factor.

Rump angle and rump width affect the birthing process [15]. A correlation birth with body dimensions frame and pelvis discussed in a study about Holstein, Brown Swiss, and Jersey cattle [16].

Rump width had positive correlation significant with milk production, especially during the early lactation period. In addition, this trait has high score of heritability and

correlation with longevity [8]. It is connected with the fertility level in dairy cows because it also affects the Feto-pelvic disproportion [6]. It could be resumed that rump width traits are closer to the body weight characteristics. The current findings indicated that these traits are notable as linear type trait in dairy cattle, and it has a significant positive relationship with the milk yield.

5 Conclusion

In conclusion, evaluation of dairy cow exterior characteristic is important, especially for milk production and heritability value that will passed on to their descendants. From the characteristics measured framework: stature, body depth, rump angle and rump width had positive correlation in milk production, heritability value and longevity. Both of PC and Non PC are approaching ideal score for recommended linear trait except characteristic rump width. The linear trait also get in same category, intermediate. The factors parent (PC and Non PC) which are in the same category can support in progeny test from daughter production (DC and CC).

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