Evaluation of Birth Weight and Body Measurements of Madura Cattle based on Year of Birth and Breeding System in Madura Breeding Centre, Indonesia

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Abstract. This research was conducted to evaluate the birth weight and body measurement of Madura cattle based on year of birth and different breeding systems. The research was conducted in Technical Unit for Animal Breeding and Veterinary in Madura. A total of 137 Madura cattle born in 2014 to 2019 were observed for its birth weight (BW), chest girth (CG), body length (BL) and wither height (WH). The data were analyzed by using one-way ANOVA to understand the effect of year of birth on birth weight and t-test to analyze the effect of sex and breeding system on birth weight. The results showed that the mean BW, CG, BL and WH were 16.25 ± 2.37 kg, 58.23 ± 4.9 cm, 50.59 ± 7.68 cm, 60.75 ± 4.92 cm for Madura heifer and 17.08 ± 2.4 kg, 59.12 ± 4.04, 51.09 ± 4.75, 63.78 ± 4.07 kg for Madura bull calf, respectively. Birth weight of bull calf was significantly higher than the heifer (P=0.02). Moreover, the practiced natural mating in Madura cattle were higher (62.04%) compared to artificial insemination (37.96%). Birth weight of Madura cattle in 2014, 2015, 2016, 2017, 2018 and 2019 were 17.07 ± 3.02 kg, 17.13 ± 2.56 kg, 17.91 ± 2.58 kg, 16.75 ± 2.09 kg, 16.40 ± 1.84 kg, and 18.01 ± 2.38 kg, respectively. The research concludes that the BW, CG, BL and WH of Madura calves at birth were not significantly different between year of birth and showed uncertain patern.

1. Introduction
Madura cattle are native cattle breed of Indonesia which originated on the island of Madura, East Java province, Indonesia. Madura cattle is a Bali-Ongole-Java native cross breed, developed from Bali (Bibos banteng), Java-native (Bos javanicus) and Ongole (Bos-indicus) breeds. Its specific color is reddish brick-brown with a non-specific white pattern on the back-bottom. The superiorities of Madura cattle compared to other breeds are it has high genetic resistance to hot climate and high adaptability to low quality feed. Madura cattle are kept by the farmer in Madura Island for three different purposes, which are for bull racing (Karapan), cattle dancing (Sonok) and beef cattle. Karapan and Sonok are two strong traditions of Madura farmer, which play an important role to prevent the Madura cattle from extinction.

Birth weight and body measurement of calves is of critical importance in the beef breeding program. Calves that are too small at birth tend to be lack of vigor, tolerance to cold stress, resistance to pathological agents. On the other hand, calves that are too large at birth may cause dystocia and increased susceptibility to disease. Birth weight plays an important role as the initial reference point with regard to the development of an individual animal. Hartatik, Volkandari and Sumadi [1] reported that the birth...
weight of Madura cattle was 20.55 kg, while other reported the mean value for birth weight of Madura cattle was 18.63±0.87 kg [2]. Karnaen [3] and Kutsiya [4] reported the birth weight of Madura cattle were 14.51 kg and 19.78±1.224 kg, respectively. The different data pattern on birth weight within 15 years and the tendency of reduced birth weight value indicates that there is still no breeding program to increase the birth weight of Madura cattle.

Breeding program which considers the birth performance should be applied to improve the genetic potency and performance of Madura cattle in the existing condition and specially to prevent the extinction of Madura cattle as local genetic resources of Indonesia. This research was conducted to evaluate the birth weight and body measurement based on year of birth and breeding system in Madura cattle, which can be used as consideration in Madura cattle breeding strategy.

2. Materials and Methods

The materials used in this research were 137 Madura calves reared in Technical Unit of Madura Cattle and Forage for Animal Feed (TUMC), Pamekasan, Madura, which calved in 2014 to 2019. The birth performances of Madura calves which consisted of birth weight (BW), chest girth (CG), body length (BL) and wither height (WH) were measured and recorded. The obtained data were analyzed by using one-way ANOVA with the help of GENSTAT software to determine the effect of year of birth on calves’ performance. The effect of sex and breeding system on performance of Madura cattle were analysed using T test, and the statistical model is as follows:

\[ Y_{ij} = \mu + \tau_i + E_{ij}; \]

where:

- \( Y_{ij} \) = Performance (body weight, chest girth, body length or wither height) of j individual;
- \( \mu \) = Mean population;
- \( \tau_i \) = Effect of year of birth; and
- \( E_{ij} \) = Error.

3. Results and discussion

The results showed that natural mating (62.04%) was more practiced compared to artificial insemination (37.96%). The higher percentage of natural mating seems to be due to the sire availability in the TUMC. Statistical results showed that breeding system gave no significant effect on performance of Madura calves for all traits under study. Table 1 showed the effect of breeding system on Madura cattle performance.

**Table 1.** Mean of birth performances of Madura cattle from natural mating and artificial insemination.

| Birth Performances | Natural Mating (n = 85) | Artificial Insemination (n = 52) |
|--------------------|-------------------------|---------------------------------|
| BW (kg)            | 17.22±2.53              | 17.11±2.34                      |
| CG (cm)            | 59.44±4.45              | 58.88±4.54                      |
| BL (cm)            | 51.47±5.60              | 50.98±7.26                      |
| WH (cm)            | 64.03±4.33              | 63.62±4.98                      |

Means of BW, CG, BL and WH for female and male Madura cattle were shown in Table 2. Statistical analysis showed that birth weight of male was significantly higher than female (\( P = 0.04 \)) and wither height of male was highly significant higher compared to female (\( P = 0.0001 \)).

**Table 2.** Mean of birth performances of Madura heifer and bull calf.

| Traits    | Heifer (n = 60) | Bull calf (n = 77) | P value |
|-----------|-----------------|-------------------|---------|
| BW (kg)   | 16.25±2.37\(^a\) | 17.08±2.40\(^b\)  | 0.04    |
| CG (cm)   | 58.23±4.90\(^a\) | 59.12±4.04\(^a\)  | 0.24    |
| BL (cm)   | 50.59±7.68\(^a\) | 51.09±4.75\(^a\)  | 0.64    |
| WH (cm)   | 60.75±4.92\(^a\) | 63.78±4.07\(^b\)  | 0.0001  |
The following Table 3 showed the mean of BW, CG, BL and WH of Madura cattle at birth in year of 2014, 2015, 2016, 2017, 2018 and 2019.

**Table 3. Birth performances of Madura calves in 2014 to 2019**

| Year of Birth | N  | BW (kg)         | CG (cm)       | BL (cm)       | WH (cm)       |
|--------------|----|----------------|---------------|---------------|---------------|
| 2014         | 19 | 17.07±3.02     | 58.24±3.61    | 49.34±4.00    | 63.61±3.42    |
| 2015         | 28 | 17.13±2.56     | 58.37±4.70    | 50.83±7.39    | 64.06±4.55    |
| 2016         | 26 | 17.91±2.58     | 60.99±4.48    | 54.28±9.36    | 64.67±5.62    |
| 2017         | 30 | 16.75±2.09     | 59.16±4.84    | 51.35±4.92    | 63.55±4.68    |
| 2018         | 19 | 16.40±1.84     | 59.06±3.94    | 50.12±2.81    | 63.04±4.21    |
| 2019         | 15 | 18.01±2.38     | 59.37±4.69    | 50.72±3.71    | 64.18±4.56    |

The performance of Madura calves at birth were not significantly different between year of birth. Rate of birth weight gain for the 2014 to 2019 period ranged from negative 0.35 kg to positive 1.61 kg. The highest gain was from 16.40 kg in 2018 improved to 18.01 kg in 2019. There were negative gains for all traits for the 2016 to 2018, which ranged from -0.35 to -1.16 for birth weight and 0.10 to -2.93 cm for body measurements (chest girth, body length and wither height). The low performance in year 2017 and 2018 was due to the extreme environment, where the rainy season was shorter than others. The improvement of performance from 2014 to 2016 could not compensate the loss of performance due to extreme environment. Birth weight of Madura calves in this research were lower compared to those reported [5], which were 18±2.16 and 19±1.75 kg for 2015 and 2016, respectively. The difference might be due to the different area of sample used.

4. Conclusions
Breeding system using natural mating and artificial insemination showed not different value in performance at birth of Madura cattle. Performance of Madura cattle at birth during 2014 to 2019 showed no improvement with uncertain patern. The high genetic potency of Madura cattle could be improved by applying selection program on performance at birth, which will increase surviveability and enhance growth.

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References
[1] Hartatik, T S D Volkandari and Sumadi 2012 Relatedness between polymorphism growth hormone gene and growth traits of Limousin Cross Madura cattle *Proceedings of the 15th AAAP Animal Science Congress*.
[2] Tribudi Y A, Prihandini P W 2019 Repeatability estimates for birth, weaning and yearling weight in Madura cattle *International Research Journal of Advanced Engineering and Science* 4(1) 207-208.
[3] Karnaen 2004 Model kurva pertumbuhan sapi Madura betina dan jantan dari lahir sampai umur enam bulan *Jurnal Ilmu Ternak* 7(1) 48-51.
[4] Kutsiya F 2002 *Analisis Performans Reproduksi pada Crossbreed (Sapi Madura x Limousin) dan Purebreed (Sapi Madura) dan Performans Produksi Hasil Keturunannya* Master Thesis Universitas Brawijaya, Malang.
[5] Sulistiyoningtiyas I, Nurgiartiningingsih V M A, Ciptadi G 2017 Evaluasi performa bobot badan dan statistik vital sapi Madura berdasarkan tahun kelahiran *Jurnal Ilmiah Peternakan Terpadu* 5(2) 40-43.