

Repeatability Estimates for Birth, Weaning and Yearling Weight in Madura Cattle

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Abstract—This study was aimed to estimate the repeatability value for body weight. Data on body weights of 186 offsprings of Madura cattle were taken at birth, weaning and yearling. All animals were reared under similar production system by breeders in Pamekasan regency, Madura. The repeatability values were estimated by HGLM-REML (Hierarchical Generalized Linear Model-Restricted Maximum Likelihood) using Genstat software. The result showed high repeatability value for birth weight (0.46 ± 0.15), weaning weight (0.38 ± 0.11) and yearling weight (0.33 ± 0.07). The high estimates indicated that selection on the basis of first record will be effective to improve body weight at birth, weaning and yearling.

Keywords— Body Weight, Cattle, Repeatability, Selection.

I. INTRODUCTION

Animal breeding strategy has a vital role and function in livestock genetic improvement since it can improve the individual genetic potency for a better performance in the future. Each animal has different production capabilities. Birth weight, weaning weight and yearling weight are among economic traits, which are controlled by many genes. Animal performance is an expression of the effect of genetic and environmental factors, as well as their interaction. Genetic factor is important and has many attentions in livestock breeding programs since it consists of genetic materials inherited from parents to offsprings [1].

Animal breeding includes two programs, including selection and crossing. Selection is an important way for the animal genetic improvement. Kurnianto *et al.* [2] reported that selection is conducted with the aim at maintaining the number of cows, which will be mated to superior bulls to obtain offsprings with higher performance. Moreover, the superior offsprings are used as replacement stocks in the breeding flocks. Selection is carried out to evaluate the individual performance within a population and to produce the animals with high productivity.

Repeatability is one of the genetic parameters that can be used to determine the most probable producing ability (MPPA) in animals for a particular trait. It is also used to evaluate the magnitude of a particular trait to be inherited from parents to offspring. It can be used to predict the upper limits of heritability for a particular trait. In addition, the repeatability is one of the important genetic parameters utilized by livestock keepers for designing selection programs.

II. MATERIALS AND METHODS

A. Data Collection

This study was conducted in Pamekasan, Madura. Samples were determined by using purposive sampling. The materials used were 93 cows of Madura cattle with 186 offsprings.

B. Repeatability Estimates

Repeatability was estimated based on the following formula:

$$r = \frac{(\sigma_s^2 + \sigma_{Ep}^2)}{(\sigma_s^2 + \sigma_{Ep}^2) + \sigma_{Et}^2}$$

where σ_s^2 : Bulls variance, σ_{Ep}^2 : permanent environmental variance, σ_{Et}^2 : temporary environmental variance.

The value which are variance between performance within bulls was obtained from *antilog of estimate lambda Madura cattle*, while σ_{Et}^2 which is the individual variance between animals was obtained from the value of *antilog of estimate phi* by HGLM-REML (Hierarchical Generalized Linear Model-Restricted Maximum Likelihood) using Genstat 14th edition [3].

III. RESULTS AND DISCUSSION

Birth weight is the weight of calves obtained by weighing the calves with maximum at 3 days since they are born [4]. Table I showed that the mean value for birth weight of Madura cattle was 18.63 ± 0.87 kg, which was higher than 14.51 kg reported by Karnaen's [5] and lower than 19.78 ± 1.224 kg reported by Kutsiya [6] in Madura cattle. This difference might be due to several factors, including genetic and environment (calf sex, pregnancy length, parent age, body weight of cows and feed). Falconer and Mackay [1] stated that genetic factors are the genes of both parents. Parents inherit their genes, but they do not inherit genotypes to their offsprings. Therefore, the combination effect between the genes from their parents determines the average genotypic value of the offsprings. The high value of birth weight resulted in this study because there has been a positive selection for this trait in Madura cattle population resulting increased birth weight. Also, environmental factors, such as different location and population investigated might be a possible reason.

The mean value for body weight and repeatability estimates for body weight at birth, weaning and yearling in Madura cattle are presented in Table I.

TABLE I. The mean value for body weight of Madura cattle.

Parameter	Mean (kg)	Repeatability
Birth weight	18.63±0.87	0.46±0.15
Weaning weight	90.32±3.42	0.38±0.11
Yearling weight	122.17±6.15	0.33±0.07

The mean values for weaning and yearling weight in Madura cattle were 90.32±3.42 kg and 122.17±6.15 kg, respectively. The weaning weight of Madura cattle resulted in this study was higher than 46.22 kg reported by Karnaen and Arifin [5] in the same breed. Meanwhile, the yearling weight result was quite similar with the findings of Sulistiyoningtyas *et al.* [8] with the mean value of 120.00±10.86 kg. This difference in body weight might be attributed to the different quality and quantity of feed given to the animals. Moreover, the body weight is also influenced by genetic factor, maintenance management and mothering ability. Calf growth is strongly influenced by milk production of the cows. A low milk production of the cows affects on the growth delay of calves. Gunawan *et al.* [9] reported that sex has a significant effect on weaning weight and growth rate, especially after the animals reach puberty. Praharani and Juarini [10] stated that sex affects on differences in growth rates, which will be increased along with age. The body weight in male calves is higher due to the presence of male hormones. The testosterone hormone is one of the androgen steroids produced by the testes involved in growth regulation and is primarily responsible for differences in body composition between male and female sexes [11].

Repeatability estimates for birth weight, weaning weight and yearling weight were 0.46±0.15, 0.38±0.11 and 0.33±0.09, respectively. The repeatability estimates for the tested traits were high ($r > 0.30$). High repeatability indicates that the cows of Madura cattle had great ability to repeat their present performance in the future. Generally, high repeatability estimates indicate large influence of additive genes [12]. The repeatability value for a particular trait is determined by the variances of additive, dominant and epistasis genes, as well as environmental component (permanent and temporary). The high repeatability estimates for the observed traits indicate that the use of the traits as selection criteria in the population investigated will result in development for higher genetic response. The repeatability estimates for body weight resulted in this study were higher than those reported by several studies in different cattle breeds [13-15].

Repeatability is used to estimate the most probable producing ability (MPPA) of cows during the production period. Also, it is used to increase the accuracy of selection and determine the upper limits of heritability [16]. Warwick

and Legates [17] stated that estimates of repeatability for a particular trait are useful for predicting the future production performance of each animal. The results of this study were considered to be very useful for the genetic selection of Madura cows for the characteristics of birth weight, weaning weight and yearling weight.

IV. CONCLUSION

The repeatability estimates for birth weight, weaning weight and yearling weight in Madura cattle were all high.

REFERENCES

- [1] D. S. Falconer and T. F. C. Mackay, "Introduction to Quantitative Genetics". Longman, 1997.
- [2] E. I. Kurnianto, Sumeidina, and P. P. Astuti, "Evaluasi keunggulan genetik sapi perah betina untuk program seleksi," *Journal of the Indonesian Tropical Agriculture*, vol. 33, issue 3, pages 186-190, 2008.
- [3] P. W. Goedhart, and T. N. M. Thissen, *Biometris GenStat Procedure Library Manual*. 16th ed. Biometris, Wageningen, 1992.
- [4] Ditjenak, "Petunjuk Teknis Uji Performans Sapi Potong Nasional". Kementerian Pertanian, Jakarta, Indonesia, 2007.
- [5] Karnaen and J. Arifin, "Kajian Produktivitas Sapi Madura" Fakultas Peternakan Universitas Padjajaran. Bandung, pages 1-10, 2004.
- [6] F. Kutsiya, "Analisis Performans Reproduksi pada Crossbreed (Sapi Madura x Limousin) dan Purebreed (Sapi Madura) dan Performans Produksi Hasil Keturunannya," M.S. Thesis. Universitas Brawijaya, Malang, 2002.
- [7] Karnaen, "Korelasi Genetik dan Fenotipik antara Bobot Lahir dan Bobot Sapih pada Sapi Madura," Fakultas Peternakan, Universitas Padjajaran, Bandung, 2004.
- [8] I. Sulistiyoningtyas, V. M. A. Nurgartiningstih, and G. Ciptadi, "Evaluasi performa bobot badan dan statistik vital sapi Madura berdasarkan tahun kelahiran," *Jurnal Ilmiah Peternakan Terpadu*, vol. 5, issue 2, pages 40-43, 2017.
- [9] A. Gunawan, R. Sari, Y. Parwoto, and M. J. Uddin, "Non genetic factors effect on reproductive performance and preweaning mortality from artificially and naturally bred in Bali cattle," *Journal of the Indonesian Tropical Agriculture*, vol. 36, issue 2, pages 83-90, 2011.
- [10] L. Praharani and E. Juarini, "Evaluasi Keragaan Berat Badan Sapi Bali Umur 190 Hari dan 350 Hari," in *Lokakarya Nasional Pengelolaan dan Perlindungan Sumber Daya Genetik di Indonesia*, Indonesia.
- [11] T. L. J. Lawrence, V. R. Fowler, and J. E. Novakofski, "Growth of Farm Animal," 3rd edition. CABI, USA, 2012.
- [12] W. P. B. Putra, Sumadi, and T. Hartatik, "Estimasi nilai pemuliaan dan *most probable producing ability* sifat produksi sapi aceh di kecamatan Indrapuri provinsi Aceh," *Buletin Peternakan*, vol. 38, issue 1, pages 1-7, 2014.
- [13] F. K. Euclides, P. R. C. Nobre, and A. N. Rosa, "Age of Cow and its Interaction with Herd, Sire and Sex of Calf" *Rev Bras Zootecn*, vol. 20, pages 40-46, 1991.
- [14] H. O. K. Ulsan, "The change of calf growth according to birth season and repeatability of birth weight in Brown Swiss cattle raised in elaziğ sugar factory farm. *Uludağ Univ. Vet. Fak. Derg.*, vol.11, pages 57-67, 1992.
- [15] G. Bakır, A. Kaygısız, and H. Ulker, "Estimation of Genetic and Phenotypic Parameters for Birth Weight in Holstein Friesian Cattle," *Pakistan Journal of Biological Science*, vol. 7, pages 1221-1224, 2004.
- [16] R. M. Bourdon, "Understanding Animal Breeding," 2nd ed. Prentice-Hall, Inc, New Jersey, USA, 2014.
- [17] E. J. Warwick and J. E. Legates, "Breeding and Improvement of Farm Animal" 8th ed. Mc Graw-hill Education, London, UK, 1990.