



Genetic and Phenotypic Correlation of Weaning and Yearling Weight of Female Saburai Goats in Sumberejo District, Tanggamus Regency, Lampung Province, Indonesia

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Abstract | Lampung Province is currently developing one type of goat family, namely Saburai goat. The Saburai goat is a meat goat type from = *grading up* between male Boer goat female Etawa Grade (PE) goat. The objectives of this research were to find out the value of genetic and phenotypic correlation between weaning weight and one yearling weight of female Saburai goats in Sumberejo District, Tanggamus Regency. A total of 100 female of Saburai goats aged one year were used in this study. This research data uses primary and secondary data taken from direct observations in the field and livestock recording data from Sumberejo District. The method used is a survey method, the research sample was determined by purposive sampling. The data were analyzed using the paternal half-sib correlation method. The observed variables included weaning weight and yearling weight. The results of this study showed that the average weaning weight of female Saburai goats in Sumberejo District was 16.4 ± 2.0 kg, and the average weight for one year was 36.9 ± 2.5 kg. The weaning weight and yearling weight of female Saburai goat has a genetic correlation value of 0.30 which is categorized as medium positive, a phenotypic correlation of 0.27 which is a low positive value, and an environmental correlation of 0.47 which is a high positive value. The results of this study indicate that environmental factors have a major influence on goat performance. Based on the results of research, it can be concluded that selection of female Saburai goat based on weaning weight would improve yearling weight, and also improvement of environmental factors such as feeding would be beneficial to the performance of the goat.

Keywords | Saburai goat, Weaning weight, One year weight, Genetic correlation, Phenotypic correlation

Received | October 31, 2021; **Accepted** | December 06, 2021; **Published** | January 10, 2022

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Citation | Adhianto K, Lenanto SI, Dakhlán A, Hamdani MDI (2022). Genetic and phenotypic correlation of weaning and yearling weight of female Saburai goats in Sumberejo District, Tanggamus Regency, Lampung Province, Indonesia. *Adv. Anim. Vet. Sci.* 10(2): 421-426.

DOI | <http://dx.doi.org/10.17582/journal.aavs/2022/10.2.421.426>

ISSN (Online) | 2307-8316

INTRODUCTION

The livestock sector is one sector that has high potential to continue to be developed in Indonesia. The livestock sector can produce various kinds of products such as meat, eggs and milk to meet the needs of the community, especially as a provider of animal protein. In the livestock sector, there are several commodities that can be developed and one commodity that has high potential is goat. The commodity of goats is one type of livestock that is in

great demand among the people of Indonesia because of its high economic value. In addition, goats also have other advantages, namely the land required for maintenance is not too large, the labor required is small and has the ability to adapt quickly to the environment.

In 2018 the goat population in Indonesia reached 18,720,706 heads. The largest goat population in Indonesia is on the island of Java as much as 53.76%, and the rest are spread outside Java, one of which is Lampung Province.

Lampung Province is a province outside Java with the highest population of goats compared to other provinces. The recorded population of goats in Lampung Province reaches 1,297,872 heads (BPS, 2018).

Lampung Province is currently developing one type of goat family, namely Saburai goat. Saburai goat is a type of goat that has been designated as a local genetic resource in Lampung Province based on the Decree of the Minister of Agriculture of the Republic of Indonesia Number 359/Kpts/PK.040/6/2015. The Saburai goat is a meat type goat resulted from *grading up* between a male Boer goat with female Etawa Grade (PE) goat (Sulastri and Sukur, 2015; Adhianto et al., 2015).

Saburai goats in Indonesia have been designated as germplasm that must be maintained so that the population can continue to grow and its performance can be improved so that it can become one of the livestock commodities that can meet the needs of meat in Indonesia and provide many benefits for the breeder. The superiority of the Saburai goat itself is that in addition to a high level of adaptation to its environment, its maintenance is easier and its rate of growth is quite high (Adhianto et al., 2019, 2021; Sulastri et al., 2018).

The performance of an animal is influenced by several factors during its growth period. Therefore, selection of livestock is carried out to get superior goat. Selection is carried out on young livestock as a reference for the growth of an animal that will be reared to get more effective results. Weaning weight can be used as a selection criterion to get superior goat, because selection on weaning weight can be used to increase the weight of one year of goat. Weaning weights have a high heritability value and a high genetic correlation with a yearling weight (Dickerson et al., 1974).

Goat production performance is strongly influenced by two factors, namely genetic and environmental factors. Saburai goats in Sumberejo District have different or the same production performance, it really depends on genetic and environmental factors that influence whether there are similarities or differences. The genetic enhancement potential is highly dependent on the genetic variation of the trait and its relationship to other traits. Genetic correlation provides information that genes that affect one trait also affect other traits. Selection effectiveness and genetic progress can be evaluated when selection is made for more than one trait. Genetic correlation also helps in describing the relationship between the genes responsible for the genetic variation of the two traits (Falconer and Mackay, 1997; Sulastri et al., 2018). To evaluate the selection response on correlated traits, it is important to estimate the genetic correlation between the two traits. Therefore, this study was conducted with the aim to find out genetic,

phenotypic, and environmental correlations between weaning weight and yearling weight of female Saburai goats. It is hoped that later this research will assist in the development of a breeding plan for genetic improvement in female Saburai goats in Sumberejo District, Tanggamus Regency, Lampung Province, Indonesia.

MATERIALS AND METHODS

This research was conducted at the Saburai goat farm belonging at Pelita Karya III, Akur Nusa Jaya, and Mitra Usaha breeder farm group in Sumberejo District, Tanggamus Regency, Lampung Province, Indonesia.

Research materials consisted of primary and secondary data originating from a 100 female Saburai goats. Primary data includes weighing one year old female Saburai goats and conducting interviews with farmers. Secondary data in the form of weaning weight obtained from recording of female Saburai goats. The tools used in this study include writing instruments, digital cameras, weighing scales with a capacity of 120 kg with an accuracy of 0.1 kg, measuring tapes, and questionnaires.

METHODS

This study used a survey method using primary and secondary data. The research sample was determined by purposive sampling by observing female Saburai goat with 1 year age at the study site. Primary data was obtained by weighing the body of one year age of goat and conducting interviews with farmers. Secondary data was obtained from the results of measurements and weighing carried out by farmers on goats that were observed and recording card at the time of weaning.

After the data was tabulated and corrected for weaning weights and yearling weights, analysis of variance was then carried out to estimate the genetic, phenotypic, and environmental correlation values using paternal half-sib correlation method.

Estimated genetic correlation (r_G) is calculated by the formula:

$$r_G = \frac{4(\text{cov}_s)}{\sqrt{4\sigma_{s(x)}^2 4(\sigma_{s(y)}^2)}}$$

Description: cov_s = covariance between weaning weight and yearling weight among sires; $\sigma_{s(1)}^2$ = weaning weight variance; $\sigma_{s(2)}^2$ = yearling weight variance.

Estimated phenotypic correlation (r_p) is calculated by the formula:

$$r_p = \frac{cov_w + cov_s}{\sqrt{(\sigma_{w(x)}^2 + \sigma_{s(x)}^2)(\sigma_{w(y)}^2 + \sigma_{s(y)}^2)}}$$

Description: Cov_W = covariance between weaning weight (WW) and yearling weight (YW) within sires; $CovS$ = covariances between WW and YW among sires; $\sigma^2W(X)$ = WW variance within sires; $\sigma^2W(Y)$ = YW variance within sires; $\sigma^2S(X)$ = WW variance among sires; $\sigma^2S(Y)$ = YW variance among sires

Estimated environmental correlation (r_E) is calculated by the formula:

$$r_E = \frac{cov_w + 3cov_s}{\sqrt{(\sigma_{w(x)}^2 - 3\sigma_{s(x)}^2)(\sigma_{w(y)}^2 - 3\sigma_{s(y)}^2)}}$$

Description: $CovW$ = covariance between weaning weight (WW) and yearling weight (YW) within sires; $CovS$ = covariances between WW and YW among sires; $\sigma^2W(X)$ = WW variance within sires; $\sigma^2W(Y)$ = YW variance within sires; $\sigma^2S(X)$ = WW variance among sires; $\sigma^2S(Y)$ = YW variance among sires

RESULTS AND DISCUSSION

WEANING AND YEARLING WEIGHT

Weaning weight is the result of weighing the young goats when they are separated from the does. Weaning weight is influenced by the condition of the dam litter size and condition of goat kids (Sutama, 2007), while the yearling weight is greatly influenced during the growth period post-weaning starting from weaning (based on weaning weight) to the age of one year (based on the age of one year) (Edey, 1983).

According to Simon et al. (2004) age and body weight at the time of first puberty are factors that can affect livestock productivity, the faster the livestock reach the first oestrus cycle with good body weight, the livestock production will increase. In this study, there were 100 female Saburai goats consisting of 10 sires, each of which had 10 progeny of female Saburai goats. The female Saburai goat studied in Sumberejo District was the result of natural mating. The average weaning weight and yearling weight of female Saburai goats from several existing males can be seen in Table 1.

In Table 1 shows the results of the weaning weight of female Saburai goats that varies, this is presumably due to different environmental influences. Based on the results of this study, the average weaning and yearling weight of female Saburai goats were 16.4±2.0 kg and 36.9±2.5 kg, respectively. The results of the study on weaning weight and yearling weight of female Saburai goats higher than the results of

research by Adhianto et al. (2017), namely weaning weight 14.9±3.7 kg and yearling weight 34.7±5.2 kg, but lower than results of the study of Sulastri et al. (2014) with the weaning weight of Saburai goat was 19.67±1.54 and the yearling weight of Saburai goat was 42.27±2.12. The low result of this study compared to Sulastri et al. (2014) might be caused by the results obtained from this study are only data from female Saburai goats, when compared to the growth of male goat which is higher than that of female goat.

Table 1: Average weaning weight and yearling weight of female Saburai goat.

No.	Male	Weaning weight (kg)	Yearling weight (kg)
1	I	15.1±2.6	34.7±2.3
2	II	15.4±2.2	35.8±3.0
3	III	17.1± 2,3	37.0±2.1
4	IV	16.3±1.6	39.0±4.3
5	V	16.7±1.5	35.8±1.3
6	VI	15.8±2, 5	37.4±2.8
7	VII	16.8±2.2	37.4±2.4
8	VIII	16.1±2.2	38.8±3.5
9	IX	16.9±1.1	37,2±2.0
10	X	17.3±2.0	36.3±1.5
	Average	16.4±2.0	36.9±2.5

The difference in the results of this study may be due to apart from genetic factors, environmental factors also affect the growth of goats, especially feed. The availability of forage during the research period can affect growth, the feed consumed by the dams to produce milk and for the young goats greatly affects the growth of the young goats during the weaning period. This is in accordance with the opinion of Edey (1983) that weaning weight can be influenced by genetic factors, birth weight, dam's milk production, litter size, dam age, kid sex, feed, and parity.

The breeders in Sumberejo District provide feed to their livestock only by giving the type of leaves of legume without any concentrate. This is in accordance with the statement of Adhianto et al. (2017) in the Sumberejo and Gisting sub-districts, the breeders carried out treatment by providing forage feed without concentrate, as well as providing drinking water as needed. Concentrate is made and given to livestock when it is difficult to find forage, this usually only occurs during the long dry season. Animal feed consisting of a mixture of grasses and leaves with an equal ratio of 1: 1, from all the mixtures of forage materials it can meet and complete the nutritional needs needed by goats (Setiawan and Tanius, 2003; Adhianto et al., 2019).

Weaning weight is an indicator of the ability of the dam to produce milk and the ability of the kid to obtain milk and

grow. The size of the weaning weight obtained is influenced by the genetics of the mother and the productivity of the dam when breastfeeding. In the opinion of Subandriyo et al. (1998) that the weight of the goats when weaned is also influenced by the type of birth. This is due to the limited production of milk from the dam, so that if the dam has twin kids, the limited amount of dam's milk must be divided to the two kids.

Weaning weight is a reflection of the growth of an animal because it can determine the ability of livestock production at the age of one year, because weaning weight and yearling weight are correlated. If the weaning weight is high, the yearling weight will also be high, but if the weaning weight is low, the yearling weight will also be low. As according to Dakhlan and Sulastrri (2002) kids that have high weaning weights generally show rapid growth at post-weaning period. However, this cannot rule out the possibility that yearling weight does not match the weaning weight, this can be caused by environmental factors and different maintenance during the weaning and one year life span. This is in accordance with the statement of Tama et al. (2016) that the productivity of an animal is influenced by two main factors, namely genetics and the environment. Genetic factors determine the ability of production, while the environment is a supporter so that livestock are able to produce according to their abilities.

GENETIC CORRELATION, PHENOTYPE AND ENVIRONMENT

Correlation is a measure of the closeness of the relationship between two traits. The two traits are said to be correlated if changes in one trait will be followed by changes in the other traits regularly, in the same or opposite directions (Nugroho et al., 2008). The performance of female Saburai goats in Sumberejo sub-district is influenced by genetic, phenotype, and environmental factors. The results obtained from goat performance can be different or the same depending on the factors that influence it. Based on data analysis, the correlation of genetic, phenotypic and environmental between weaning weight and yearling weight of female Saburai goat in the District Sumberejo Tanggamus are presented in Table 2.

Table 2: Correlation of genetic, phenotypic and environmental between weaning weight and yearling weight.

No.	Parameter	Value
1	Genetic correlation	0.30
2	Phenotypic correlation	0.27
3	Environmental correlation	0.47

Genetic correlation is the relationship between single breeding values for two traits. The value of genetic

correlation shows the relationship between two traits that are passed down by parents to their offspring (Edey et al., 1981). The genetic correlation between weaning weight and yearling weight of female Saburai goats in Sumberejo District showed a positive result of 0.30. The results of the genetic correlation showed correlation value positive moderate, in accordance with the statement of Warwick et al. (1995) which states that the correlation value can be said to be moderately positive if the value is 0.1 to 0.3.

The genetic correlation shows a moderate positive direction so that it shows a close relationship between variables. This is in accordance with the statement of Zhang et al. (2008) which states that this is due to the fact that traits at the same age are controlled by the same genes at the same time, thereby reducing environmental variation and increasing additive genetic variance. According to Lasley (1978), correlations that have a positive value are very useful in genetic improvement programs through selection, with increasing the production of one trait through selection will increase other correlated traits. This means that selection on weaning weight will provide a selection response that is in line with yearling's weight and weaning growth rate, or in other words, an increase in weaning weight will be followed by an increase in yearling weight and also post-weaning growth rate.

According to Sulastrri et al. (2002) the positive correlation value between birth weight and weaning weight is included in the high category, which means that the higher the birth weight, the higher the goat weaning weight. In the results of this study, there was a moderate positive genetic correlation between weaning weight and yearling weight so that at the weaning age of female Saburai goats, it could be used as a reference for selection to be used as candidates for the next superior breed. This is in accordance with the statement of Beyleto et al. (2010) that the genetic correlation value between birth weight and weaning weight and weaning weight with yearling weight has a high correlation value where if the birth weight is high, the weaning weight will be high as well as the yearling weight.

The parameters needed to conduct selection on livestock at a certain age are genetic and phenotypic. According to Kurnianto(2010),the selection program requires knowledge of the value of genetic and phenotypic correlations to predict future livestock productivity. Phenotypic correlation consists of genetic and environmental correlation. Phenotypic correlation is the total correlation of all traits possessed by livestock. Phenotypic correlation values are useful for estimating the magnitude of changes in productivity in the same generation when used as selection criteria based on current productivity records (Warwick et al., 1995).

The phenotypic correlation in this study between weaning weight and yearling weight of female Saburai goats in Sumberejo sub-district showed a moderate positive result of 0.27. This is in accordance with the statement of Warwick et al. (1995) that if the value of a correlation is 0.1 to 0.3 then it is in the medium category. According to Jafari et al. (2012) that a positive phenotypic correlation value with a moderate to high category means that there is no genetic antagonism between the two traits and selection for one of the two traits can lead to changes in the other traits.

According to Tama et al. (2016) the productivity of an animal is influenced by two main factors, namely genetics and the environment. Genetic factors determine the ability of production, while the environment is a supporter so that livestock are able to produce according to their abilities. Environmental factors include feed, housing, maintenance, disease and climate. Genetics and the environment have an important role, because even though livestock have superior genetics, without the support of good maintenance and feeding, their production will not be optimal. On the other hand, even if the animal are given good feed, they do not have superior genetics, the production will not be maximized.

The environmental correlation value in the study between weaning weight and yearling weight of female Saburai goats in Sumberejo district showed a high positive value of 0.47. This result can be stated as high positive based on the statement of Warwick et al. (1995) if the correlation value is in the range of 0.3 to 1.0, it is included in the high category.

In the results of this study, the environmental correlation value has the highest value after the genetic and phenotypic correlation values. The result of the environmental correlation value is higher than the others because environmental factors have a big influence on growth performance in livestock. The influence of environmental factors on livestock has a percentage of 70% while from genetic factors it is only 30%. This shows that environmental improvements during weaning will also increase body weight at one year of age and the next period.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of research and discussion, it can be concluded that weaning weight and yearling weight of female Saburai goats in Sumberejo District, Tanggamus Regency, Lampung Province, Indonesia has a genetic correlation value of 0.30 (moderately positive), phenotype correlation value of 0.27 (moderately positive), and environmental correlation value of 0.47 (high positive).

SUGGESTION

Based on the results of this study, it is suggested that Saburai goat breeders in the Sumberejo sub-district need to conduct selection of weaning weight continuously because it can increase the yearling weight so that it can be used as a prospective parent stock candidate.

ACKNOWLEDGEMENTS

We would like to thank the Ministry of Research and Higher Education who financed this research through Penelitian Terapan Unggulan Perguruan Tinggi (PTUPT) Fund research scheme in 2020/2021.

AUTHOR'S CONTRIBUTION

All authors worked equally, KA designed research and drafted manuscript, SIL and MDIH collected, tabulated, and analysed data, and AD critically reviewed and revised final manuscript.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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