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LOCAL SHEEP BODY WEIGHT SELECTION RESPONSE ON VARIOUS SELECTION INTENSITY IN PURWAKARTA, WEST JAVA, INDONESIA

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Abstract

Research about the local sheep body weight selection response on various selection intensities has been held in Purwakarta, West Java, Indonesia, on November 2017. The aim of the research is to know the heritability and body weight selection response of local sheep as the genetic parameters. The purpose sampling data from 144 sheep (75 male and 69 female derived from six sires), are birth weight (January 2016 until December 2016) and corrected weaning weight on 100 days of age. The variety components and the heritability value were used variance analysis pattern of half-sib correlation. Fixed effect were used sex (male and female) and type of birth (single and twins) the average of birth weight was 2.73 Kg; weaning weight were 6.43 Kg and corrected weaning weight on 100 days of age were 9.32 Kg. Results of analysis data were shown the heritability value of birth weight was 0.32 is high category and the heritability value of corrected weaning weight on 100 days of age was 0.36 also is high category. The highest value of selection response body weight by heritability corrected weaning weight on 100 days (of one sire and eight ewes) with selection intensity 2.03 was 4.22 Kg.

Key words: *local sheep, selection response, body weight, heritability, selection intensity*

INTRODUCTION

The development of sheep farming in Indonesia has never been detached from people's lives, because some people raise sheep for consumption needs while some other people maintain sheep for hobbies. Sheep spreads almost in all parts of Indonesia. Sheep is one of the genetic resources that need to be developed especially for consumption of red meat other than other ruminant animals. Indonesian local sheep are named according to their regions and characteristics, such as *Donggala* sheep, *Garut* sheep, *Kisar* sheep, Fat Tailed Sheep, *Java* Thin Tailed Sheep, *Sumatra* Thin Tailed Sheep, and others.

Seedlings are livestock that have superior properties and bequeath superior properties and meet certain requirements for breeding [12]. Sheep seeds for livestock businesses have an important meaning in supporting the success of the business carried out. Selection of sheep depends on the tastes of consumers and the purpose of the farm business, and these factors are related to the type of sheep that are commonly maintained and also marketing. Selection of sheep that will be selected as seed or going in principle based on age, shape outside the body, the power of growth and behavior of livestock. Selection is used in nursery programs to select or replace elders in the next generation. Selection aims to produce sheep seeds of good quality, and improve the genetic quality of sheep populations. One type of sheep that has the potential to be developed is Local sheep. Local sheep breeding sites at *Kampung Nenggeng, Purwakarta,* West Java, Indonesia was established to preserve the purity of local sheep. For this reason, an effort to improve genetic quality is better. The correlated selection response is basically a comparison between the average phenotype of children and the average phenotype of parents. This response illustrates the genetic progress obtained from the selection results. Estimating correlated nature selection responses is very important for breeders, because it can predict genetic progress earlier, saving time, effort and costs. The use of selection intensity to determine the correlated selection response between birth weight and weaning weight is not yet known, especially in the local sheep breeding site. Therefore, it is necessary to estimate the body weight selection response at various local sheep selection intensities. The problem is, how much is the heritability value (h^2) of local sheep body weight in the local sheep breeding site, based on birth weight and corrected weaning weight at 100 days of age and also how much is the value of the local sheep's body weight selection response in the local sheep breeding site at various selection intensities.

Individual appearance is determined by genetic factors and environmental factors. Genetic factors are determined by the composition of genes and chromosomes that these individuals have. Environmental factors consist of a temporary and permanent environment. Mathematically, the influence of genetic factors and environmental factors can be written as follows:

Performance = Genetic + Environmental [7].

Generally sheep that are raised in Indonesia are used for meat production, then the target of breeding is the number of lambs born and the body weight of lambs to increase meat production. The theory of grouping sheep based on the shape of the tail, among others: groups of thin-tailed sheep (thin tail), groups of thick-tailed sheep (fat tail) and groups of triangular tailed sheep (*Garut* sheep) [8]. One measure of whether or not a lamb is raised is to know the birth weight and weaning weight.

Birth weight is the weight of the lamb weighed within 24 hours after birth. Weaning weight is an indicator of the ability of the parent to produce milk and the ability of lamb to produce milk and grow. The speed of growth greatly determines the efficiency and profitability of the farm business because it is closely related to efficiency and conversion of feed use.

Selection is usually interpreted as an activity to get rid of livestock that have low production quality and maintain livestock that have high production quality for breeding. Selection will be effective if the genetic parameters of the characteristics used in the selection criteria are known, including: heritability (h^2), intensity of selection (i) and various phenotypes (σ_P). The selection intensity is a selection differential expressed in standard deviation. The size of the selection intensity depends on the proportion of livestock that will be selected to become elders in the next generation. The accuracy of selection for each trait is the same as the correlation between genotypes and phenotypes. The accuracy of selection is the root of the heritability value, so the size of the selection accuracy will depend on the value of the heritability obtained. The accuracy of selection will increase with increasing heritability and vice versa [14].

The influence of the selection program that will be implemented can be known by estimating one of the genetic advances, namely the selection response. Selection responses are simple quantitative predictions for change. The usefulness of the correlated selection response is if the second trait is too long to wait or has a very small value of heritability, so selection is better based on other properties that have a correlation.

After the superior sheep seeds are obtained, the next step is to increase sheep breeding. This can be realized with the support in the field of breeding. Considering the importance of breeding programs for the development of superior sheep seeds, a study was conducted on estimating the value of body weight selection response on various local sheep selection intensities.

MATERIALS AND METHODS

The breeding objective were birth weights and weaning weights of local lambs that has complete production records, including: sex, type of birth, time of birth, time of weaning, birth weight, weaning weight, parent identity, and sire identity. The data used are birth weight and weaning weight from January 2016 to February 2017, of 144 local sheep, consisting of 75 rams and 69 females from 6 sires; type of birth single and twins. The data is then compiled, coded, and processed, then entered into tables using Microsoft Office Excel software; starts from the male identity number, parent, child, sex, type of birth, birth weight, date of birth, weaning date, and weaning weight, then the data is sorted from top to bottom based on weaning date.

Data encoding consists of fixed effects that are given a code based on their respective criteria, namely: (a) sex, the code number 1 for male and 2 for female, (b) type of birth, code number 1 single, and 2 for twin births.

Data Processing, after collecting and coding data, then tabulated on the table using Microsoft office excel software which consists of original data, the original data that has been multiplied by the correction factor into corrected data, and continued with the analysis of corrected data to obtain genetic parameter values.

Variables observed, were birth weight and weaning weight. The methods for measuring these two variables are as follows: (a) birth weight, is obtained from the results of weighing when the lamb is born or within 24 hours after birth. (b) weaning weight, are obtained from the results of weighing when the lamb is weaned, then corrected in corrected weaning weights at the age of 100 days.

Statistical Analysis

The variance component is assumed by the various patterns of Paternal Half-Sib Correlation Analysis, using Microsoft excel to estimate the variance component and the heritability value.

Weaning weights at the age of 100 days:

$$WW_{100} = \left(BW + \frac{WW\ when\ Weight - BW}{Age\ when\ weight}\ X\ 100 \right) X\ FCTBXFCF$$

Notes:

BS_{100} : weaning weights at the age of 100 days

BW : birth weight

WW : weaning weight

TBCF: type of birth correction factor

SCF: sex correction factor [7]

Selection intensity:

$$i = \frac{z}{p}$$

Notes:

i is selection intensity

z: phenotype coordinate curve function

p: sheep proportion for stock. [7].

Selection response:

$$R = i\ x\ h^2\ x\ \sigma_p$$

Notes:

R : selection response

i : selection intensity

h^2 : Heritability

σ_p : phenotype standard of deviation . [7]

RESULTS AND DISCUSSIONS

Birth weight and Weaning weight

In Table 1, can be seen the birth weight and weaning weight of the local sheep

Table 1. Birth weight and Weaning weight

Data	n	Mean	SD	Min	Max	CV
		-----	Kg	-----		%
BW	144	2.73	0.61	1.50	4.70	22.40
WW	144	9.43	1.15	8.00	19.20	12.20

Notes :
BW = birth weight
WW = weaning weight
n = sum of the sheep (population)
SD = standard deviation
Min = minimum weight
Max = maximum weight
CV = coefficient of variation
Source : own calculation

The average local lamb birth weight is 2.73 kilograms and the weaning weight is 9.43 kilograms. Livestock populations are considered effective for selection if the coefficient of variation is more than 10% [13]. Coefficients of Variation were analyzed to find out the diversity of a measured characteristic, to compare the diversity with other population groups, and determine whether or not the selection was effective. The coefficient of variation in local sheep birth weight was 22.4% and local sheep weaning weight was 12.2%.

Weighing weights in the Nenggeng Village Local Sheep Nursery is not yet fully carried out at the same time. The weaning age used in this study is 100 days. Weaning weights at the age of 100 days were obtained using a correction factor. The use of correction factors

in this study was carried out to homogenize local sheep weaning age at age 100 days, the condition was based on weaning time which was not entirely same at the age of 100 days.
The correction factor in this study was based on sex and type of birth at the local sheep breeding center *Margawati Garut*. The correction factor for birth type is standardized to the second type of birth and is presented in Table 2. The standardization is needed to compare the performance of individuals with different types of births [3].

Table 2. Correction factor for birth type

birth type	correction factor
1	0.77
2	1.00
3	1.23
4	1.44

Source: [3]

The sex correction factor is standardized to male sex. These conditions are needed to compare the performance of individuals of different sexes and are presented in Table 3 and Table 4.

Table 3. Standardized Sex Correction Factor (Single Birth Types)

Sex	Characters (corrected)	Age (day)	CF
Male	The weight of 100 days	100	1.00
Female	The weight of 100 days	100	1.074

Source: [3]

Table 4. Standardized Sex Correction Factor Twins Birth Types

Sex	Characters (corrected)	age day	CF
Male	The weight of 100 days	100	1.00
Female	The weight of 100 days	100	1.074

Source: [3].

Corrected weaning weights at 100 days of age, are presented in Table 5.

Table 5. Corrected weaning weight at 100 days of age, based on sex correction factor and type of birth

Data	N	Mean ------	SD Kg	Min ----	Max	KV %
BW	144	2.73	0.61	1.50	4.70	22.44
WW	144	9.32	2.17	6.25	25.10	23. 30

Notes: BW = birth weight
WW = weaning weight
n = sum of the sheep (population)
Source : own calculation

The average local lamb birth weight is 2.73 kilograms and the corrected weaning weight at 100 days is 9.32 kilograms, more heavier than the sheep at *Margawati Garut* breeding center from 1994 – 2001; the average is 1.93 Kg (birth weight) and 8.39 Kg (weaning weight) [5]. The coefficient of variation of local lamb birth weight was 22.4% and the corrected weaning weight at 100 days was 23.3%. These results indicate that the conditions in this local sheep breeding center are still diverse, so the selection is still effective and the selection value of the local sheep body weight will be heavier.
Birth weight is a determining factor for the survival of sheep breeding businesses, because the birth weight is positively correlated to livestock survival and development after birth. Sheep with high birth weight will have better resistance and adaptation to the environment, faster weaning time and higher post weaning body weight gain [6]. Weaning weights have a close relationship with birth weight, both are positively correlated so birth weight can be emphasized in the indirect selection program, namely the response to selection of weaning weights based on birth weight [14]. Local sheep body weight is influenced by several factors, namely sex, type of birth, parity, and season. All of these factors are then used as a fixed effect in the analysis of genetic parameters [1]. Type of birth is a description of the number of children born to a mother sheep. The number of children born with one baby is called single birth and if more than one is called twin births. Based on the number of lamb born to a sheep, the sheep population in the breeding center can be grouped into two types of birth, namely single and twins. Distribution of birth types is presented in Table 6.

Table 6. Distribution of birth types

Birth type	n	Percentage
	head	------%--------
Single	94	65.28
Twins	50	34.72

Source: own calculation

Table 6 shows that the percentage of single birth types was 65.28%, and twins were

34.72%. When compared with the results at *Margawati Garut*, from 2011 – 2012, the proportion of single births was 44.02%, the birth of twins was 46.82%, triplets is 8.65%, and quadruplets are 0.51%. [3]. The parents originating from multiple births will reduce twins more than parent from a single birth. Likewise, males from twin births will lose more twins than males from single births [4].

Based on several studies conducted in various livestock companies in Indonesia that the factors of season, rainfall, rainy days, temperature and humidity have less influence on the diversity of livestock body weight. This can happen even though in Indonesia there are only two seasons (rainy and dry seasons), but the difference in seasons is relatively not as extreme as in the subtropical regions [9].

Value of Heritability

Data analysis with various patterns analysis of Paternal Half-Sib Correlation, using Microsoft Excel to predict the value of heritability and variance components. The estimation the heritability of local sheep body weight including birth weight and weaning weight of 100 days is presented in Table 7.

Table 7. Heritability (h^2) Estimation Pattern of Paternal Half – Sib Correlation on Local Sheep for Breeding

Character	h2
birth weight	0.32
weaning weight of 100 days	0.36

Notes : h^2 : heritability
Source : own calculation

The estimated heritability value with the paternal half-sib correlation pattern on local lamb birth weight is 0.32 and the corrected weaning weight at 100 days of local sheep is 0.36. Heritability value of birth weight is included in the high category ($h^2 > 0.3$), and the heritability value of weaning weight corrected at 100 days also in the high category ($h^2 > 0.3$) [15]. This heritability value can be influenced by the shared environmental and genetic influences of the parent. The influence of the parent is higher on the weaning weight than the birth weight, can be caused by the breastfeeding factor of the mother and the parent's age when giving birth to a child. Based on the heritability value of birth weight and corrected weaning weight at 100 days, it can be assumed that the selection response will produce good value.

Selection intensity

Because of the different numbers of male and female, will make selection intensity different between the male and female. The magnitude of the average selection intensity is the number of male selection intensities and the female selection intensity is divided into two [7]. The selection intensity in various proportions of selected male and female sheep is presented in Table 8.

Tabel 8. Selection intensity in various proportions

	%♂	1.33	2.67	4.00	5.33
%♀	head	1	2	3	4
11.59	8	2.03	1.93	1.87	1.82
23.19	16	1.85	1.76	1.69	1.64
34.78	24	1.73	1.63	1.57	1.51
46.38	32	1.62	1.53	1.47	1.41
57.97	40	1.53	1.44	1.37	1.32
69.57	48	1.45	1.36	1.29	1.24
81.16	56	1.36	1.27	1.21	1.15
92.75	64	1.27	1.18	1.11	1.06

Source: own calculation

Tabel 8. Selection intensity in various proportions (continued)

	%♂	6.67	8.00	9.33	10.67
%♀	*head*	5	6	7	8
11.59	8	1.77	1.73	1.70	1.67
23.19	16	1.60	1.56	1.52	1.50
34.78	24	1.47	1.43	1.40	1.37
46.38	32	1.37	1.33	1.30	1.27
57.97	40	1.28	1.24	1.21	1.18
69.57	48	1.19	1.16	1.12	1.09
81.16	56	1.11	1.07	1.04	1.01
92.75	64	1.02	0.98	0.95	0.92

Source: own calculation

Table 8 shows the highest selection intensity value is 2.03 which is achieved using 1.33% (1 male) with 11.59% (8 females). Genetic progress achieved in the population will be fast because of the balanced population because according to the male and female ratios that are used and seen in terms of livestock raising efforts will be more effective. The ratio between males and females used for sheep is 1: 8.

Estimated Response Value of Body Weight Selection

The average value of selected livestock breeding over all livestock available for selection depends on three factors, genetic diversity, selection intensity, and accuracy in estimating breeding values [10]. The amount of genetic progress obtained as a result of selection, can be estimated by calculating the magnitude of the alleged selection response. the value of selection response is influenced by heritability (h^2), selection intensity (i) and standard deviation phenotypes (σ_p). An optimal selection response can be obtained by stimulating the value of the male or female selection intensity that will be used as elders in the next generation [2]. The value of local sheep body weight selection response which includes birth weight and weaning weight corrected at 100 days, is useful to estimate the magnitude of the genetic progression of local sheep body weight in the next generation. The selection response can be calculated by the formula:

$R = i \times h^2 \times \sigma_p$ [7]

Notes:

R : Selection response

i : Selection intensity

h^2: Heritability

σ_p: Standard Deviation Phenotypes

Tabel 9.The estimated value of the selection response of local sheep body weight based on heritability (h^2) birth weight

	%♂	1.33	2.67	4.00	5.33
%♀	head	1	2	3	4
11.59	8	1.51	1.44	1.39	1.35
23.19	16	1.38	1.31	1.26	1.22
34.78	24	1.29	1.22	1.17	1.13
46.38	32	1.21	1.14	1.09	1.05
57.97	40	1.14	1.07	1.02	0.99
69.57	48	1.08	1.01	0.96	0.92
81.16	56	1.02	0.95	0.90	0.86
92.75	64	0.95	0.88	0.83	0.79

Source: own calculation

The estimated value of the selection response of local sheep body weight based on heritability (h^2) birth weight of 0.32 and standard deviation of phenotypes (σ_p) of 0.61 in various selection intensities are presented in Table 9.

Tabel 9.The estimated value of the selection response of local sheep body weight based on heritability (h^2) birth weight (continued)

	%♂	6.67	8.00	9.33	10.67
%♀	Head	5	6	7	8
11.59	8	1.32	1.29	1.27	1.25
23.19	16	1.19	1.16	1.14	1.11
34.78	24	1.10	1.07	1.04	1.02
46.38	32	1.02	0.99	0.97	0.95
57.97	40	0.95	0.93	0.90	0.88
69.57	48	0.89	0.86	0.84	0.82
81.16	56	0.83	0.80	0.77	0.75
92.75	64	0.76	0.73	0.71	0.68

Source: own calculation

Table 9 shows that the selection of selected livestock affects the size of the selection response. If the proportion of selected livestock is higher, it will reduce the selection intensity and the selection response value will be smaller; and the response value of local sheep body weight based on the highest heritability of birth weight (1.51 Kg) which was achieved in the proportion of male livestock 1.33% (1 head) and of female livestock 11.59% (8 heads). Based on these results it can be expected that the increase in local sheep body weight at birth is 1.51 Kg in the next generation. This condition can occur due to the parent's genetic influence, maintenance during the pregnancy phase, and the number of livestock used as elders in the next generation.

Table 10. The estimated value of the selection response of Local sheep body weight based on heritability (h^2) corrected weaning weight at 100 days

	%♂	1.33	2.67	4.00	5.33
%♀	head	1	2	3	4
11.59	8	4.22	4.02	3.88	3.78
23.19	16	3.85	3.65	3.52	3.41
34.78	24	3.59	3.40	3.26	3.15
46.38	32	3.38	3.19	3.05	2.94
57.97	40	3.19	3.00	2.86	2.75
69.57	48	3.01	2.82	2.68	2.57
81.16	56	2.84	2.64	2.51	2.40
92.75	64	2.65	2.45	2.31	2.21

Source: own calculation

Table 10. The estimated value of the selection response of Local sheep body weight based on heritability (h^2) corrected weaning weight at 100 days (continued)

	%♂	6.67	8.00	9.33	10.67
%♀	head	5	6	7	8
11.59	8	3.69	3.61	3.54	3.48
23.19	16	3.32	3.24	3.17	3.11
34.78	24	3.06	2.98	2.91	2.85
46.38	32	2.85	2.77	2.70	2.64
57.97	40	2.66	2.58	2.51	2.45
69.57	48	2.48	2.41	2.34	2.28
81.16	56	2.31	2.23	2.16	2.10
92.75	64	2.12	2.04	1.97	1.91

Source: own calculation

The estimation of response value of local sheep body weight based on heritability (h^2) corrected weaning weight at 100 days of 0.96 and standard deviation of phenotypes (σ_P) of 2.17 at various selection intensities are presented in Table 10.

Table 10 shows the highest response value of the selection of local sheep body weight based on the corrected weaning weight at 100 days was 4.22 Kg which was achieved in the proportion of male livestock 1.33% (1 head) and of female 11.59% (8 heads). Based on these results it can be expected that the increase in local sheep body weight when weaned corrected by 100 days is 4.22 Kg in the next generation. This condition can occur due to the influence of milk production produced by the parent for the lamb weaning time and the number of livestock used as elders in the next generation.

Nurseries are cultivation activities to produce livestock for their own needs or for sale [11]. The use of the highest selection intensity in this study was caused by this local sheep Breeding Site is one of the nurseries in this regency. Thus, greater intensity of selection is used for multiplication

Estimating the selection response is useful for estimating the performance of local sheep in the next generation. In this study the increase of local sheep body weight through estimation of the value of heritability based weighing selection response of birth weight was 1.51 Kg and corrected weaning weight at 100 days was 4.22 Kg.

CONCLUSIONS

Based on the discussion it can be concluded that the average local lamb birth weight in this breeding center is 2.73 Kg, weaning weight is 9.43 Kg and the corrected weaning weight at 100 days is 9.32 Kg; the heritability value of local lamb birth weight nursery is 0.32 and the corrected weaning weight at 100 days is 0.36.

The heritability value of birth weight is included in the medium category, but the heritability value of weaning weight corrected at the age of 100 days is included in the high category.

The response value of selection of local sheep body weight based on the highest heritability of birth weight is 1.51 Kg which is achieved in the proportion of rams 1.33% (1 head) and of female sheep 11.59% (8 heads). The response value of selection of local sheep body weight based on heritability corrected weaning weight at the highest 100 days was 4.22 Kg which was achieved in the proportion of rams 1.33% (1 head) and the proportion of female sheep 11.59% (8 heads) .

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