Morphological Characterization of Doe Kacang Goat in the Dry Land Area

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ABSTRAK

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Penelitian dilakukan untuk menyeleksi bibit sebagai populasi dasar berdasarkan karakter morfologi kambing Kacang betina dewasa di daerah lahan kering, menggunakan 31 ekor induk kambing Kacang. Sistem pemeliharaan semi intensif (tanpa pemberian konsentrat), pemberian air, hijauan (turi, gamal, dan lamtoro) dan rumput lapangan secara *ad libitum*. Deskripsi karakter kuantitatif dan indeks morfologi, korelasi pearson's bobot badan dengan ukuran dan indeks tubuh, dianalisis menggunakan program SPSS 25.0. Hasil analisis deskriptif BB, PB, TP, LiD, LD, DD, LPi, TPi, PPi, PKp, LKp, dan TKp berturut-turut adalah: 20.72±3.26 kg, 44.34±8.17 cm, 55.42±7.84 cm, 62.68±7.12 cm, 10.98±2.07 cm, 22.74±2.12 cm, 8.44±1.38 cm, 54.96±6.44 cm, 12.55±0.85 cm, 14.07±0.55 cm, 10.19±0.36 cm, dan 11.69±0.45 cm. Nilai indeks morfologi yakni WS, BI, DI, LI, PI, B, HS, FL, dan CI berturut-turut adalah 0.78+0.12, 71.06±12.38, 0.42±0.06, 0.81±0.18, 67.55±11.93, 0.43±0.08, 11.18±5.78, 32.68±7.40, dan 72.48±2.82. Kesimpulannya bahwa bobot badan dan ukuran tubuh induk kambing kacang pada sistem pemeliharaan semi intensif di daerah lahan kering masih dibawah standar mutu kambing Kacang Indonesia, koefisien korelasi bobot badan dengan ukuran tubuh berada pada kisaran positif sedang sampai tinggi ($P<0.05$) kecuali korelasi bobot badan dengan tinggi kepala menunjukan korelasi negatif. Koefisien korelasi bobot badan dengan indeks morfologi berada pada kisaran positif rendah kecuali koefisien korelasi bobot badan dengan width slope, balance dan heigth slope memiliki koefisien korelasi negatif.

Kata Kunci: Kambing Kacang Betina Dewasa, Lahan Kering, Indeks Morfologi

ABSTRACT

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This study was conducted to select a breed based on the morphological characteristics of Kacang goats in the dry land area, by assessing 31 doe Kacang goats. Semi-intensive raising system is carried out (without giving concentrate), yet water; forage (such as *Gliricidia sepium leaves, Sesbania grandiflora leaves, Leucaena leucocephala leaves*) and local grass are given by applying *ad libitum* method. Description of morphological characteristics, Pearson's correlation between body weight and body size, and body index, were analyzed using SPSS 25.0 program. The result of descriptive analysis for BW, BL, WH, CG, CW, CD, RW, RH, RL, HL, HW, and HH are 20.72±3.26 kg, 44.34±8.17 cm, 55.42±7.84 cm, 62.68±7.12 cm, 10.98±2.07 cm, 22.74±2.12 cm, 8.44±1.38 cm, 54.96±6.44 cm, 12.55±0.85 cm, 14.07±0.55 cm, 10.19±0.36 cm, dan 11.69±0.45 cm respectively. The value of the morphological index for WS, BI, DI, LI, PI, B, HS, FL, and CI are 0.78+0.12, 71.06±12.38, 0.42±0.06, 0.81±0.18, 67.55±11.93, 0.43±0.08, 11.18±5.78, 32.68±7.40, dan 72.48±2.82, respectively. The conclusion is that the body weight and body measurements in the dry land area are still below the quality National standards of Indonesia. The correlation coefficient of body weight with body size is in the positive range of moderate to high except, the correlation of body weight with head height which shows a negative correlation. The correlation coefficient of body weight with the morphological index is in the low positive range except for the correlation coefficient of body weight with width slope, balance, and height slope which has a negative correlation coefficient.

Key Words: Doe Kacang Goat, Dry Land, Morphological Index

INTRODUCTION

Small ruminants (goats) have become farmers' choice because they have been part of local farming, especially in rural areas for quite a long time, easily adapt to climatic conditions (pasture conditions and other natural conditions), reproduce quickly, have high economic value, easy to raise, does not require large areas of land to raise, matures quickly, and is prolific (Rahadi et al. 2020; Suwignyo et al. 2018; Restitrisnani et al. 2013). Mashudi et al. (2022) reported that the land capacity of 2,014.87 can accommodate a goat population of 1,323,42 livestock units. Kacang goat is one of the genetic resources of local livestock in Indonesia,

including in Malaka Regency, East Nusa Tenggara Province. Kacang goat is mostly reared by farmerson a small scale (scale of ownership of 2-3 head of Kacang goat). This becomes a side business that is dominated by extensive and semi-intensive rearing systems and this business relies more on local potential. The world's goat breeding systems are dominated by extensive and semi-intensive systems with very low production costs (Escareño et al. 2013). Small and marginal farmers have very little capital, resources, and formal training (Ghosh et al. 2019). In Malaka, apart from Balinese cows and local pigs, Kacang goats can meet the needs of animal protein in overcoming the problem of stunting, as sacrificial animals in traditional rituals, and help farmers' finance, especially to pay their children's education costs of in Malaka Regency. Goats have a very significant contribution to rural communities, especially during crop failure. They are very adaptive and spread over various geographical conditions (Rawat et al. 2019; Berhe 2017).

Malaka Regency is a district whose government has the main work program, namely Malaka Agricultural Revolution (MAR), including the livestock sub-sector, namely the development of Kacang Goats. The goat population in Malaka Regency between 2019-2020 increased by 3.966 heads of the total increase in the goat population in East Nusa Tenggara Province during the same period was 164,116 heads (BPS-Statistics of Nusa Tenggara Timur Province 2021). The maintenance system in the Malaka district is dominated by an extensive and semi-intensive rearing system causing the productivity of goats to decrease due to inbreeding and negative selection. Population increase should be followed by improving the productivity of goats, especially the quality of livestock breeds. The morphological index can be used to determine the type and function of livestock so that it can help breeders to select livestock. The research on the morphological characteristics of the Kacang goat in the dry land area of Malaka Regency for selection purposes has never been carried out.

Characterization in livestock breeding systems is the first step in establishing policies for the development of the livestock sub-sector sustainably. This step is an alternative option and an important input for the efficiency of a breeding program design. This is also urgently needed in the development and conservation strategy and selection of productivity improvements. Further, this process can maintain livestock genetic resources and describes the type and phenotypic character of goats (Laouadi et al. 2018; Hosseini et al. 2016; Stojiljkovic et al. 2015; Mdladla et al. 2017; Pares Casanova, 2015). Furthermore, the assessment of variations in morphological traits is the first step in characterizing the genetic resources of local livestock (Rotimi et al. 2015). The characteristics of livestock breeds, namely size, and structure, especially livestock functions, are described through morphological index values (Dauda. 2018). One of the basic methods of classifying domestic goats based on origin, use, shape, and length of ears, is based on body size (Rotimi et al. 2017). Differences in climatic conditions between regions, adaptability, diversity of gene groups, natural selection, irregular mating systems, breeds, and livestock populations lead to differences in the characteristics of goat and sheep populations (Pares-Casanova. 2015). This study aims to breed select to form a basic population of Kacang goats in dryland areas based on the morphological characteristics.

MATERIALS AND METHODS

Goat population, location, and rearing system

A total of 31 doe Kacang goats aged 2-3 years, not pregnant, healthy, not disabled, has qualitative characteristic of black, white, brown, and mixed coat colors white, black, and brown, horns small and upright, ears small and erect side, straight and concave backlines, were used in this current study conducted at the Kacang goat breeding center in Naas Village, West Malaka District, Malaka Regency, East Nusa Tenggara Province, Indonesia. In this study, the rearing system was semi-intensive, adapting to the rearing patterns of local breeders. During the day, the goats are released for 8 hours in the pasture around the stables. The goats are not given concentrate, yet drinking water and forage are always available in the pen throughout the day (*ad libitum* method) in the form of *Gliricidia sepium leaves, Sesbania grandiflora leaves, Leucaena leucocephala leaves,* and field grass. The group pen is made of local materials, is divided into 6 plots measuring 4x5 m2, each plot containing five doe Kacang goats. Health control is carried out every 2 weeks and *B-com* vitamins are given once every 3 months.

Weight and size measurement

Goat's Body Weight (BW) was measured in kilograms (using a sitting scale with a capacity of 150 kg and an accuracy rate of 0.1 gr). Furthermore, linear body size was measured in centimeters (using measuring tape and calipers), i.e., measuring body Length (BL) according to Simmons & Ekarius (2009). Another way of measuring body size according to (Heriyadi et al. 2012) is Wither of Height (WH), Chest girth (HG), Chest Width (CW), Chest Deep (CD), Rump Width (RW), Rump Height (RH), and Rump Length (WL). Moreover, Head size Tagoi et al. (2020) is measured by calculating some aspects, namely Head Length (HL), Head Width (HW), and Head Height (HH). Kacang goat morphology index according to instructions (Salako. 2006; Pares-Casanova et al. 2013) is calculated by these formulas,

Table 1. The chemical composition of the research feed

Ingredients	Dry matter	Organic matter	Crude protein	Crude fat	Crude fiber	NNFE	Energy (Kkal/Kg)
Field grass[1]	32.50	91.49	9.74	3.67	29.66	48.40	3.06
Leucaena leucocephala[1]	27.50	93.44	26.85	7.41	13.90	42.57	3.39
Sesbania grandiflora[2]	27.87	91.50	27.37	11.48	7.30	52.90	4.378
Gliricidia sepium[3]			20.44	3.45	15.83		

Source: [1]Sanan (2018), [2]Tahuk et al. 2021), [3]Aminullah et al. (2022)

those are, Width slope (WS)= Hip Width (cm)/Chest Width (cm). Depth index (DI)= chest deep (cm)/Wither of Height (cm). Balance (B)= [waist length (cm) x hip width (cm)]/[chest deep (cm) x chest width (cm)]. Height slope (HS)= Wither of Height (cm) - waist height (cm). Pelvic index (PI)= (Rump width/ Rump length) x 100. Length index (LI)= body length (cm)/Wither of Height (cm), if the value of the positive length index is less than one then the livestock is included in the height type and if it is more than one then the livestock is included in the long type. Foreleg length (FL)= Wither of Height (cm) - chest deep (cm). Body Index (BI)= (Body length/ Chest girth) x 100, body index of goats can be grouped into three categories: long-line animals (BI>88); medigline animals (86<BI<88), and short or brevigline animals (BI<85). Cranial index (CI)= (Head width/head length) x 100.

Data analysis

Data analysis was carried out using descriptive analysis, namely the mean value, standard deviation, coefficient of variation (quantitative characters and morphological index), correlation of body weight with body size, and body index (analyzed using the Pearson correlation method) with the SPSS 25.0 program.

The variables of the correlation coefficient were computed as follows Sugiyono (2017):

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{(n\sum x^2 - (\sum x)^2)(n\sum y^2 - (\sum y)^2)}}$$

where r is the correlation coefficient of the variable x and variable y, n is number of sample, x is body weight and y is body size/body index.

RESULTS AND DISCUSSION

General description of the study area

Malaka Regency has an area of 1,160.63 km with conditions the morphology of most of the area hilly and mountainous with a degree of inclination (50%), temperatures ranging from 16.4-38.7, humidity 34-100%, average wind speed of 6.7 m/s, solar radiation 7.12%/month, low rainfall (16-69 mm/month), dominates the eastern region while high rainfall (120-172 mm/month) is found in most of the northern region (BPS-Statistic of Belu Regency 2020). The Kacang goat's rearing system is more dominated by traditional rearing system compared to semi-intensive and intensive rearing system. The purpose of raising Kacang goat is only a business side.

The location for the breeding of the Kacang goats is a new location formed as a center for breeding Kacang goats with a basic population of as many as 31 doe and 6 buck head, total area ± 1,500 m, located at Naas Village, West Malaka Sub District, Malaka District, Nusa Tenggara Province. At the breeding center, there is one pen unit in the form of group cages measuring 24x5 m, divided into 6 plots. Feed source comes from the pasture, agricultural, and forage wastes obtained around the breeding center location. During the rainy season, the temperature range in the study area is 20-29°C, and in the dry season 28-38°C.

Quantitative characters

The basic data for determining livestock rearing management and evaluating livestock development are body weight and body size. Quantitative characteristics of doe Kacang goats in this study are presented in Table 1. Body weight, wither of height, body length, and chest girth of the doe Kacang goats in this study did not meet the quality standards of the Kacang goat breeds according to the Decree of the Minister of Agriculture of the Republic of Indonesia No. 2840/Kpts/LB.430/8/2012, regarding the determination of the Kacang goat breed. It explains that body weight, body length, Wither of Height, and chest girth, are respectively 21.6±5.9 kg, 58.9±5.6 cm, 55.6±4.2 cm, and 63.2±7 cm. There is a difference in these average values because the standard setting for determining the breed of Kacang goats has gone through various stages and consideration of the commission for determining/releasing livestock breeds and strains (Heriyadi et al. 2012). Meanwhile, body weight, body length, chest girth, and wither of the height of the Kacang goats in this study were in the early stages of developing

Kacang goats with semi-intensive rearing management without giving concentrates.

In the semi-intensive rearing system, body weight, body length, Wither of Height , chest girth, chest width, chest deep, head length, rump height, and rump width of does Kacang goats respectively were 15.95±2.15 kg, 49.76±2.52 cm; 47.26±2.60 cm; 53.19±2.95 cm; 13.82±1.87 cm; 22.09±1.23 cm; 13.26±0.73 cm; 46.32±2.60 cm, and 15.92±1.74 cm (Azmidaryanti et al. 2017). Body weight, chest girth, chest deep, rump height, and head length (bigger) and the other body size lower from other studies on the same rearing pattern, sex, and age due to differences in rearing management (type and frequency of feeding), differences in adaptability to ecological conditions where rearing, and environmental conditions (temperature and humidity). Variations in livestock production performance are influenced by genetic and environmental factors in each region, such as feed, agro-climatic conditions, differences in management, selection systems, geographical location, and natural resources (Depison et al. 2020). In the dry land areas, ambient temperature and humidity range are between 23.67-28.23°C and 80.50-88.50%, respectively (Beyleto et al. 2022). High environmental temperatures have an impact on reducing feed consumption and increasing the frequency of drinking livestock, causing differences in the values of body weight and body size of livestock in different climatic conditions. The goats behavior to neutralize their hot body temperatures when they are in hot environmental temperatures includes lying in the shade, breathing with an open mouth, panting, reducing feed consumption, and increasing water consumption (Silanikove & Koluman. 2015; Mulyono et al. 2018). The response of livestock behavior in the production process has changed due to the influence of environmental changes (Rahmawati et al. 2022).

The coefficient value of body weight and body size variations of Kacang goats in this study was included in the medium category, which ranged from 10-20%. (Putra & Ilham 2019) stated that the coefficient of variation is in the moderate category if it ranges from >10% to <20%. The non-uniformity of the body weight and body size of the Kacang goats in this current study appeared because the goats come from several sub-districts around the location of the development of Kacang goats (Malaka Regency) with different initial rearing patterns and water availability. Some goats come from areas with abundant water availability and the provision of various types of feed, namely grass, gamal, waru, lamtoro, and agricultural waste (corn and peanuts). While, other goats come from areas with limited water availability and goats are released all day in pastures then kept in pens at night without feeding by breeders. Variations in ecological zones accompanied by unique climates and plant vegetation and have an impact on different management and environmental influences can cause morphological variations within and between goat populations (Birhanie et al. 2019).

The cranium size of Kacang goat in this study had a low level of variation, which was below 10%. The low value of the coefficient of diversity indicates that the head size of the Kacang goat at the study site is similar and has a close kinship relationship between individual livestock. Gomes & Valente (2016); Mahdi et al. (2013) stated that the craniometric approach is an effective method and does not require a large amount of money to determine the kinship of populations between and within an area, genetic distances, and population or individual characteristics.

Correlation of body weight with body size

One of the statistical values used to describe the degree of relationship between two variables is the correlation coefficient (Shirzeyli et al. 2013). The value of the correlation coefficient between body weight and body size of Kacang goats is described in Table 2.

The body weight of the Kacang goat has a positive correlation with all body measurements except head height. Body weight and body size of goats have a moderate to high positive correlation (Karna et al. 2020). The existence of mentioned correlation shows that these body measurements can be used to estimate body weight. Body size (body length, Wither of Height, and chest girth) can be used for individual selection, determining body weight, and describing frame size (Habib et al. 2019; Hankamo et al. 2020; Karna et al. 2020). Body weight with chest girth, chest width, and chest depth has the highest correlation coefficient values, namely 0.47, 0.66, and 0.60.

The correlation coefficient of body weight with body length, Wither of Height, chest girth, chest width, and hip length in Woyto-Guji goats was 0.84, 0.66, 0.85, 0.45, and 0.62 respectively (Zergaw et al. 2017). Depison et al. (2020) reported the correlation values of body weight with body length, Wither of Height, chest girth, chest depth, hip height, and hip width in Kacang goats in the lowland areas were 0.76, 0.79, 0.81, 0.75, 0.76, and 0.68, respectively. The correlation coefficient in this study differs from previous studies due to differences in the average value of body weight and body size. The differences in the correlation coefficient are due to differences in body weight and body measurement of Kacang goats.

Morphological index value of the Kacang goat

The body index method is very practical to use in the field because it is useful to describe the function and type of livestock based on body dimensions. In livestock scoring systems, the morphological index is an indicator

Table 1. Body weight and body size of Kacang goat

Variables	n	Mean±standard deviation	KV (%)
Body Weight (Kg)	31	20.72±3.26	15,75
Body Length (Cm)	31	44.34±8.17	18,42
Wither of Height (Cm)	31	55.42±7.84	14,15
Chest Girth (cm)	31	62.68±7.12	11,35
Chest Width (cm)	31	10.98±2.07	18,84
Chest Deep (cm)	31	22.74±2.12	19,31
Rump Width (cm)	31	8.44±1.38	16,41
Rump Height (cm)	31	54.96±6.44	11,72
Rump Length (cm)	31	12.55±0.85	16,77
Head Length (cm)	31	14.07±0.55	3.91
Head Width (cm)	31	10.19±0.36	3.53
Head Height (cm)	31	11.69±0.45	3.85

Table 2. Correlation coefficient of body weight and body size of Kacang goats

	BW	BL	SH	HG	CW	IC	HiW	WH	WL	HL	HW	HH
BW	1											
BL	0.42*	1										
SH	0.24	-0.17	1									
HG	0.47**	0.33	0.41*	1								
CW	0.66**	0.38*	0.24	0.46*	1							
IC	0.60**	0.43*	0.22	0.49**	0.72**	1						
HiW	0.32	0.21	0.13	0.30	0.55**	0.23	1					
WH	0.60**	0.43*	0.15	0.38*	0.53**	0.59**	0.28	1				
WL	0.38*	0.26	0.342	0.33	0.33	0.67**	-0.07	0.38*	1			
HL	0.31	-0.05	0.52**	0.15	0.11	-0.01	-0.02	0.11	0.17	1		
HW	0.40*	0.12	0.2566	0.22	0.25	-0.07	0.31	0.17	-0.11	0.47**	1	
HH	-.127	.094	0.13	0.20	0.12	-0.04	0.29	-0.13	0.04	0.09	0.31	1

*=P < 0.05; **=P < 0.01; BW=body weight; BL=body length; SH= Wither of Height ; HG=chest girth; CW=chest width; IC=chest deep; HiW=hip width; WH=waist height; WL=waist length; HL=head length; HW=head width; HH=head height

for determining the function and type of livestock and describes the relationship between various body sizes (Abdurrahman & Setiasih. 2017; Khargharia et al., 2015) The morphological index value of the Kacang goat is shown in Table 3.

An important parameter for estimating the function of a livestock breed is the width slope (Dauda. 2018). The width slope of the Kacang goat in this study was 0.78±0.12. Body index, length index, and depth index values for Kacang goats aged 2.5-3.5 years were 86.95±5.4, 1.07±0.09, and 0.46±0.04 respectively (Putra & Ilham. 2019). Body index, pelvic index, height slope, length index, and width slope of the local doe Ethiopian goat in the traditional rearing system were: 90.16±4.47,

68.53±8.56, 2.69±1.20, 92.41±4.86, and 1.04±0.12 (Getaneh et al. 2022). Pelvic index, balance, and height slope in Assam Hill goats were 92.49±2.54, 5.63±0.23, and 3.43±0.29 respectively (Khargharia et al. 2015). The cranial index value in Markhoz goats is 54.04±2.29 (Goodarz & Hoseini. 2014). Body index, pelvic index, length index, and foreleg index in local southern Ethiopian goats were: 87.5±0.28, 102±11.3, 1.03±0.04, and 18.8±4.38 (Dea et al. 2019). Differences in the morphological index values of Kacang goats in this study and other studies occur due to differences in body size and head size which become the components of the calculation of each morphological index value.

The pelvic index in this study is included in the linear-convex category because the result showed <100 where the hip length is greater than the hip width (Silva-Jarquin et al. 2019). It was further stated that based on baronian systematics, the body index values were longlinear (≥90), mesolinear (>86 and <88), and brevilinear (≤85). Based on baronian systematics, the body index of the Kacang goat obtained in this study was categorized into the brevilinear group (≤85) which shows that the width is smaller than the length.

The coefficient of variation in the morphological index of the Kacang goat is in the moderate category (Depth Index) to high (Width Slope, Body Index, length, balance, height slop, and Foreleg length) while the pelvic index and cranial index values are in a low category.

Correlation of body weight with the morphological index of Kacang goat

The correlation of body weight with morphological index is shown in Table 4. The correlation coefficient of body weight with length index, depth index, and body index in this study was higher than that of the Katjang goats in the Bone Balango Regency, respectively: 0.13, 0.01, and -0.25 (Putra & Ilham. 2019). It was further

Table 3. Morphology index of Kacang goat

Variable	n	Mean±standard deviation	KV(%)
Width Slope (WS)	31	0.78+0.12	15.03
Body Index (BI)	31	71.06±12.38	17.42
Depth Index (DI)	31	0.42±0.06	14.41
Length Index (LI)	31	0.81±0.18	22.71
Pelvic Index (PI)	31	67.55±11.93	3.88
Balance (B)	31	0.43±0.08	19.26
Height Slope (HS)	31	11.18±5.78	51.72
Foreleg Length (FL)	31	32.68±7.40	22.64
Cranial index (CI)	31	72.48±2.82	3.88

Table 4. Body weight correlation coefficient with Kacang goat morphological index values

	BW	BI	DI	LI	PI	WS	B	HS	FL	CI
BW	1									
BI	.19	1								
DI	.17	.43*	1							
LI	.19	.82**	.70**	1						
PI	.14	.02	-.05	.07	1					
WS	-.43*	-.23	-.28	-.18	.41*	1				
B	-.47**	-.25	-.35	-.25	.17	.93**	1			
HS	-.44	.13	-.06	.13	.10	.23	.30	1		
FL	.04	-.44*	-.93**	-.70**	.07	.12	.13	-.70*	1	
CI	.04	.12	.23	.27	.35	.05	-.05	.19	-.25	1

*=P<0.05; **=P<0.01;BW=body weight; BI=body index; DI=depth index; LI=length index; PI=pelvic index; Width slope; B=Balance; Height slope (HS); FL=Foreleg length; CI=Cranial index

stated that the correlation value between body weight and body index is included in the high category if it is $0.60<r<0.80$. From this explanation, the correlation value of body weight and body index in this study is involved in the low category, namely 0.19. The correlation of body weight with length index, depth index, and body index in Kacang goats in the lowland areas is 0.11, 0.58, and 0.20 respectively (Depison et al. 2020), -0.11, -0.33, and 0.47 in doe south African goats (Tyasi & Putra. 2021). The results showed that body weight with body index and length index had the highest correlation value (low positive) while body weight with width slope, balance, and height slope had negative correlation values in Kacang goats in dryland areas.

CONCLUSION

The body weight and body size of Kacang goats in dryland areas do not meet the quality standards of Indonesian Kacang goats. The value of the correlation coefficient of body weight and body size is in the low to high positive category except for the correlation coefficient of body weight and head height. The results showed that body measurement can be used to estimate the body weight of doe Kacang goat in dry land areas. The morphological index shows the characteristics of the Kacang goat, namely small and slender, while the value of the body weight correlation coefficient with the morphological index is in the negative to low positive range ($P<0.05$). For increase the value of morphological characteristics of Kacang goats in the dry land area, need to add concentrate in the feed.

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