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Multiple Linear Regression Equations to Estimate the Body Weight of Waringin Sheep Based on Morphometric Characteristics in Various Age Groups.

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Abstract. Waringin sheep is a new breed of sheep resulting from a cross between local sheep, Barbados sheep and St.Croix sheep. This study aims to determine the morphometric characteristics of ewes and rams Waringin sheep at different ages in Stabat District, Langkat Regency. This study used a descriptive method by collecting data in the field, the data collected were 99 ewes Waringin sheep and 66 rams Waringin sheep and observed their morphometric characteristics starting from body weight, body length, skull length, skull width, body height, and chest circumference, chest width, chest depth, front leg length, hind leg length, hip width, hip height, tail length, tail width, crotch length, crotch width, and canon circumference. Data were analyzed using the SPSS application with multiple linear regression methods used to determine the relationship between the morphometric relationship between Waringin sheep and their body weight. The results showed that almost 90% of the morphometrics of Waringin sheep affected the body weight of the sheep using linear regression analysis.

Keywords: sheep, morphometric characteristics, body weight, chest depth, front leg length

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1. Introduction

Sheep are small ruminant animals that can adapt to their environment so that they can reproduce quickly and easily. Sheep in Indonesia have diversity according to the type of sheep and also their genetics. Waringin sheep is a new breed of sheep resulting from cross-breeding between local Thin Tailed sheep and Barbados sheep, St. Croix, and Suffolk sheep. The characteristics of Waringin sheep are different from sheep in general [1].

Morphometric displays in general can still be used practically to characterize and select livestock. Efforts that can be made to obtain the genetic quality of livestock are to analyze the morphometric characteristics of livestock. The importance of characterizing the morphometrics of sheep is one

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of the first ways to maintain the characteristics of the livestock itself and a way to increase their productivity. To identify the main characteristics of livestock species in populations spread across the region, thus enabling us to provide an overview of the morphological relationships within the region [2]. Body weight measurement makes it possible to obtain body weight and carcass weight measurements so that we can choose quality sheep. The morphometric determination of sheep can measure quantitative traits in sheep which are used to obtain good quality.

2. Materials and Methods

The research was conducted from October to November 2022 in Stabat District, Langkat Regency, North Sumatra Province. The materials in this study were **rams** Waringin sheep aged 6-12 months (33 heads), 12-18 months (21 heads), 18-24 months (12 heads), and **ewes** Waringin sheep aged 6-12 months (41 heads). 12-18 months (33 heads), and 18-24 months (25 heads). The equipment used in this study used measuring tapes with an accuracy of 0.1 cm, measuring sticks, scales, cameras, and stationery.

This study used a descriptive method by collecting data in the field and observed their morphometric characteristics starting from body weight, body length, skull length, skull width, body height, and chest circumference, chest width, chest depth, front leg length, hind leg length, hip width, hip height, tail length, tail width, crotch length, crotch width, and canon circumference

2.1 Research parameters

2.1.1 Body weight

Body weight is carried out on sheep, sheep are weighed using a scale, before weighing the livestock should not be fed and weighing the body weight of the livestock should be done in the morning.

2. 1.2 The body length

The body length of the sheep is measured from the distance from the outer front edge of the scapula bone to the lump of the sitting bone. The measuring tape is pulled straight from the front line of the sternum to the sitting bone of the sheep [3].

2.1.3 Long skull

The length of the skull measured the distance between the anterior point of the head to the posterior point of the skull. The measuring tape is pulled from the anterior bone and pulled straight across the posterior head bone [4].

2.1. 4 Skull width

The width of the skull measured the distance between the left and right outermost protrusion of the skull. The measuring tape is pulled from the outermost protrusion of the skull from the left and then

pulled straight towards the right side of the skull protrusion [4].

2.1.5 Body height

Body height is measured perpendicularly from the highest point of the backbone to the ground level behind the front legs, the measuring stick is pulled from the highest point of the livestock body to the ground level [3].

2.1.6 Chest circumference

Chest circumference, measured in a circle around the chest cavity behind the elbows to the shoulders using a measuring tape. The measuring tape is wrapped around the chest cavity which is behind the elbows of the feet [3]

2.1.7 Chest width,

Chest width, measured from the distance between the centre of the left and right breastbones. The measuring tape is pulled from the outermost left breastbone to the outer right breastbone [3].

2.1.8 In the chest

In the chest, measured from the highest point of the shoulder and lower sternum, the measuring tape is pulled from the highest point of the shoulder to the lower sternum [3].

2.1.9 Long forelegs

The length of the forelegs is measured from the protruding part of the bone at the front of the chest to the ground. The measuring tape is pulled from the protruding sternum and pulled down the front legs to the ground [4].

2.2. Analysis of Data

The data were analyzed descriptively by calculating the mean and standard deviation values for each observed parameter and also analyzed by multiple linear regression to obtain the relationship between body weight and morphometrics. Multiple linear regression analysis was performed using SPSS version 25. Multiple linear regression aims to prove whether there is a functional relationship between the dependent variable to two or more independent influencing factors [5].

3. Results and Discussion

3.1 Multiple linear regression analysis of male Waringin sheep data

Table 1. Multiple linear regression analysis of male Waringin sheep data

Unstandardized Coefficients					
Standard Coefficients					
	B	Std.Error	Beta	T	Sig.
Constant	-62.654	6.114		-.10.248	.000
X1	.707	.186	.499	3.796	.000
X2	.549	.324	.099	1.694	.097
X3	-.473	.211	-.053	-2.244	.029
X4	-.124	.146	-.059	-.850	.400
X5	.091	.096	.068	.948	.348
X6	.305	.361	.048	.845	.402
X7	.080	.121	.030	.659	.513
X8	.434	.157	.133	2.759	.008
X9	-.219	.198	-.077	-1.106	.274
X10	.1255	.287	.300	4.381	.000
X11	.236	.116	.084	2.042	.047
X12	.115	.106	.045	1.080	.285
X13	.813	.403	.047	2.017	.049
X14	-.073	.154	.-.018	-.477	.635
X15	-.1.074	.247	-.170	-.837	.000
X16	.630	.638	.005	.099	.922
a.Dependent	Variable	: body weight			

In Table 1, The results of multiple linear regression analysis in Table 2, it was found that the equation Y = -62.654 + 0.70X1 + 0.549X2 - 0.473X3 - 0.124X4 + 0.091X5 + 0.305X6 + 0.080X7 + 0.434X8 + 0.219X9 + 1.255X10 + 0.236X1 1+ 0.115X12 + 0.813X13 - 0.073X14 + 1.074X15 + 0.063X16. Based on the research, several factors affect body weight significantly, namely body length, foreleg length, hip width, hip height and groin width where the significant value is smaller than P (0.05). Based on these data it can be seen that body length, foreleg length, hip width, hip height and crotch width greatly affect body weight in rams. This is not following [6] which states that body length, chest circumference and hip height are morphometric characteristics that have a very close relationship in determining the body weight of sheep. In this study, it was found that chest circumference did not affect body weight in Waringin rams, but other morphometric factors affected body weight which included body length, hip width and crotch width.

3.2 Factors Affecting Body Weight of Female Waringin Sheep

Table 2. Multiple linear regression analysis of male Waringin sheep data

Unstandardized Coefficients				
Standardized Coefficients				
	B	Std.Error	T	Sig.
Constant	-55.517	2.851	19.472	.000
X1	.489	.087	5.629	.000
X2	-.447	.208	-2.142	.035
X3	.176	.191	.922	.359
X4	-.036	.091	-.396	.693
X5	.542	.086	6.317	.000

X6	.416	.223	2.069	.042
X7	.282	.084	3.346	.001
X8	-.078	.102	-.769	.001
X9	-.207	.126	-1.647	.103
X10	.290	.125	2.328	.022
X11	.393	.140	2.812	.006
X12	-.256	.076	-3.373	.001
X13	1.136	.386	2.944	.004
X14	-.252	.139	-1.818	.073
X15	-.432	.113	-.837	.000
X16	.670	.403	1.664	.100
a.Dependent	Variable	: body weight		

Based on the results of multiple linear regression analysis, it is found in Table 2 that the multiple linear regression equation Y = -55,517 + 0.489X1 - 0.447X2 + 0.176X3 - 0.036X4 + 0.542X5 + 0.461X6 + 0.282X7 - 0.078X8 - 0.207X9 + 0.290X10 + 0.393X11 - 0.256X12 + 1.136X13 - 0.252X14 - 0.432X15 + 0, 670X16 + e. Based on Table 2, several factors affect body weight in ewes, namely, body length (X1), chest circumference (X5), chest depth (X7), front leg length (X8), hip height (X12), tail width (X13) and the width of the crotch (X15), where the significant value is below P (0.05). Based on these data it is known that the morphometric parts that affect body weight are body length, skull length, chest circumference, hip height, tail length, tail width and crotch width. This is following [6] which states that body length, chest circumference and hip height are morphometric characteristics that have a very close relationship in determining the body weight of sheep.

Morphometric Characteristics of Waringin Sheep

Table 3. Mean and standard deviation of body weight of Waringin sheep

Variable observed	Age	Gender	
		Male	Female
BB (Kg)	6-12 bulan	19,55 ± 1,76	18,44 ± 1,59
	12-18 bulan	35,34 ± 4,90	28,33 ± 2,91
	18-24 Bulan	67,75 ± 4,65	45,44 ± 2,25

Description: BB (body weight)

Based on the research, which can be seen from Table 5 it is known that the average body weight of Waringin sheep aged 6 – 12 months, male 19.55 ± 1.76 cm, female is 18.44 ± 1.59 cm, sheep at 12 -18 months, males 35.34 ± 4.90 cm and females 28.33 ± 2.91cm, then Waringin sheep aged 18-24 months, males 67.75 ± 4.65 cm and females 45.44 ± 2,25. The body weight of Waringin sheep in the Stabat sub-district has a higher body weight than the thin-tailed and fat-tailed sheep, this is due to genetic and environmental factors in the Stabat sub-district. The body weight of adult Fat tail sheep was 23.14 ± 1.62 kg, while the body weight of Thin tail sheep was 20.24 ± 2.51 kg [8]. Waringin sheep can be categorized as sheep that have a large body weight when compared to Thin-tailed sheep and Fat-tailed sheep. Based on the results of the study in Table 5, there is a very significant difference in male and female body weight at the age of 18-24 months. This is following [9] which states that rams have the potential to grow faster than ewes because rams have rapid

body weight growth and consume more feed, so the use of feed is more efficient which will increase faster body weight growth [9].

Table. 4 Mean and standard deviation of body length of Waringin sheep

Variable observed	Age	Gender	
		Male	Female
PB (Cm)	6-12 Bulan	58,12 ± 3,12	57,29 ± 2,43
	12-18 bulan	70,24 ± 4,90	65,06 ± 3,76
	18-24 Bulan	90,58 ± 4,40	76,80 ± 2,25

Description: PB (body length)

The results of the study based on Table 6 shows that the average body length of Waringin sheep aged 6-12 months, in males 58.12 ± 3.12 cm, in females 57.29 ± 2.43 cm, then at the age of 12-18 months, males 70 .24 ± 4.90 cm, females 65.06 ± 3.76 cm and at the age of 18-24 months, males 90.58 ± 4.40 cm and females 76.80 ± 2.25 cm. Waringin sheep have a longer body length than Tangkas-type Garut sheep. This is due to differences in the speed of genetic potential found in sheep. That the body length of agile Garut sheep at the age of less than one year has an average body length of 42.52 ± 12.82 cm and 62.45 ± 4.48 cm for ages 1-5 years and an average body length of Garut sheep aged less than one year was 47.91 ± 8.26 cm and at the age of 1-5 years was 54.33 ± 3.21 cm [10]. The average body length for fat-tailed sheep was 56.77 ± 2.49 cm and for thin-tailed sheep it was 51.00 ± 3.59 cm [8].

Table 5. Mean and standard deviation of Waringin sheep skull length

Variable observed	Age	Gender	
		Male	Female
PT (Cm)	6-12 bulan	16,00 ± 1,36	15,02 ± 0,98
	12-18 bulan	19,57 ± 1,32	19,18 ± 1,62
	18-24 bulan	23,83 ± 1,16	20,00 ± 2,27

Description: PT (skull length)

Based on Table 5 it is known that the average skull length of Waringin sheep at the age of 6-12 months in males is 16.00 ± 1.36 cm, in females 15.02 ± 0.98 cm, then in Waringin sheep aged 12-18 months, males are 19 .57 ± 1.32 cm, females 19.18 ± 1.62 cm, and in Waringin sheep aged 18-24 months, males 23.83 ± 1.16 cm and females 20.00 ± 2.27. Based on research, it is known that the length of the skull of Waringin sheep is longer than Kisar sheep which are <2 years old. This statement is following [11] 71 ± 1.73 females, therefore the Waringin sheep can be categorized as a sheep with a long skull. The length of the skull greatly affects the size of the shape of the sheep's head.

Table 6. Mean and standard deviation of the skull width of the Waringin sheep

Variable observed	Age	Gender	
		Male	Female
LT (Cm)	6-12 Bulan	10,55 ± 1,17	9,95 ± 1,04
	12-18 bulan	12,57 ± 2,80	11,85 ± 1,37

	18-24 Bulan	11,92 ± 1,24	12,56 ± 2,25

Description: LT (cranium width)

Based on the research results, it is known that the average size of the skull width in Waringin sheep aged 6-12 months in males is 10.55 ± 1.17 cm, females are 9.95 ± 1.04 cm, at ages 12 -18 months, males are 12.57 ± 2.80 cm, females 11.85 ± 1.37 cm, then in sheep aged 18-24 months 11.92 ± 1.24 cm and females 12.56 ± 2.25 cm. Based on the research, it is also known that the width of the skull of the Waringin sheep is wider than that of the Kisar sheep. This statement is following [11] which stated that the morphometric size of the width of the Kisar sheep was based on the age of maturity <2 years and sex. The skull width of the male Kisar sheep was 11.31 ± 1.03 cm and 10.12 ± 0 .57 cm in the ewe. Based on the research, it is also known that the skull width of Waringin sheep is wider than that of local sheep which only has a skull width of 4.66 ± 1.03 cm for males and 3.32 ± 0.57 cm for female sheep, this statement is in accordance [12]

Table 7. Mean and standard deviation of Waringin sheep height

Variable observed	Age	Gender	
		Male	Female
TB (Cm)	6-12 Bulan	52,18 ± 2,61	50,90 ± 3,32
	12-18 bulan	63,48 ± 5,30	55,88 ± 2,28
	18-24 Bulan	72,50 ± 1,16	60,60 ± 5,62

Description: TB (Height).

Based on Table 7, it was found that the average body height of Waringin sheep aged 6-12 months for males was 52.18 ± 2.61 cm, for females 50.90 ± 3.32 cm, for sheep aged 12-18 months for males 52.18 ± 2.61 cm and in males aged 18-24 months, 72.50 ± 1.16 cm, females 60.60 ± 5.62 cm. The body height of local sheep aged 2 years is between 50.5 – 66.5 cm, with an average of 58.29 ± 3.95 cm. The height measurement of adult rams with fat tails has a value of 54.53 ± 2.37 cm, while in thin-tailed sheep the height value is 51.17 ± 2.16 cm [8]. Waringin sheep have a higher body height when compared to Fat-tailed sheep and Thin-tailed sheep, the difference in shoulder height in these sheep is greatly influenced by the length of the legs found in the sheep.

Table 8. Mean and standard deviation of breast circumference of Waringin sheep.

Variable observed	Age	Gender	
		Male	Female
LiD (Cm)	6-12 Bulan	62,33 ± 2,94	61,61 ± 2,56
	12-18 bulan	75,95 ± 7,27	71,61 ± 3,12
	18-24 Bulan	96,42 ± 5,63	82,28 ± 2,77

Description: LiD (Chest Circumference)

Based on the research in Table 8, it is known that the chest circumference of Waringin sheep aged 6-12 months in males is 62.33 ± 2.94 cm, in females 61.61 ± 2.56 cm, in male Waringin sheep aged 12-18 months 75.95 ± 7.27 cm, females 71.61 ± 3.12 cm and in sheep aged 18-24 months in males

96.42 ± 5.63 cm, females 82.28 ± 2.77 cm. The chest circumference of Waringin sheep is larger than that of local sheep, ranging from 65.5-86.5 cm at 12-18 months of age. When compared with the results on Fat and Thin Tailed sheep, the results were 63.76 ± 2.12 cm and 55.90 ± 5.29 cm [8]. The chest circumference of Waringin sheep is relatively larger than Fat and Thin-tailed sheep, the difference in chest circumference size is caused by genetic and environmental factors. Where in the measurement of the chest circumference, the sheep wool that is measured is not sheared first.

Table 9. Mean and standard deviation of breast width of Waringin sheep.

Variable observed	Age	Gender	
		Male	Female
LeD (Cm)	6-12 Bulan	14,88 ± 0,92	14,59 ± 0,92
	12-18 bulan	17,00 ± 2,19	16,61 ± 1,47
	18-24 Bulan	21,58 ± 1,16	18,72 ± 1,20

Description: LeD (Chest Width)

Based on the results of the study in Table 9, it was found that the average chest width of Waringin sheep aged 6-12 months in males was 14.88 ± 0.92 cm, in females 14.59 ± 0.92 cm, Waringin sheep aged 12-18 months in males 17, 00 ± 2.19 cm, females 16.61 ± 1.47 cm then in Waringin sheep aged 18-24 months males 21.58 ± 1.16 cm and females 18.72 ± 1.20 cm. The chest width of the Waringin sheep is wider than that of the Wonosobo adult ewe and the fat-tailed sheep. This statement is following [13] which states that the chest width of female Wonosobo sheep is 22.10 ± 0.99 cm. The chest width of female Fat Tailed Sheep at 18 months old was 14.07 ± 0.95 cm, and the chest width based on was 14.69 ± 1.15 cm [14].

Table 10. Mean and standard deviation in the breast of Waringin sheep

Variable observed	Age	Gender	
		Male	Female
DD (Cm)	6-12 Bulan	22,94 ± 2,65	22,00 ± 2,17
	12-18 bulan	30,29 ± 5,98	26,36 ± 3,24
	18-24 Bulan	37,58 ± 2,50	29,16 ± 3,21

Description: DD (In Chest)

Based on Table 10, it was found that the average breast size of Waringin sheep aged 6-12 months for males was 22.94 ± 2.65 cm, for females 22.94 ± 2.65 cm, for males aged 12-18 months 30.29 ± 5, 98 cm and females 26.36 ± 3.24 cm, ages 18-24 months 37.58 ± 2.50 cm and females 29.16 ± 3.21 cm. The breast size of adult local female sheep is 20.5 - 34.75 cm and the average is 28.23 ± 3.48 cm. The breast size of Waringin sheep is larger when compared to the size of the Garut and Thin-tailed sheep, this is in accordance [15] that the average breast size of Garut and Thin-tailed sheep at 6 months of age is 21.41 ± 0. 86 cm and 19.51 ± 1.08 cm. Meanwhile, the Garut and Thin Tail sheep aged 11 months ranged from 23.42 ± 0.91 cm and 21.67 ± 0.54 cm.

Table 11. Mean and standard deviation of leg length of Waringin sheep

Variable observed	Age	Gender	
		Male	Female
PKD (Cm)	6-12 bulan	43,79 ± 1,65	43,93 ± 2,41
	12- 18 bulan	51,43 ± 4,89	50,42 ± 5,91
	18-24 bulan	55,92 ± 3,82	51,76 ± 5,50
PKB (Cm)	6-12 bulan	49,18 ± 1,64	48,46 ± 2,50
	12-18 bulan	55,43 ± 5,16	54,03 ± 5,02
	18-24 bulan	67,35 ± 2,41	55,12 ± 6,37

Description: PKD (front leg length), PKB (back leg length)

Based on Table 11, it was found that the average length of the forelegs of Waringin sheep aged 6-12 months for males was 43.79 ± 1.65 cm and for females 43.93 ± 2.41 cm, for rams aged 12-18 months 51.43 ± 4.89 and females 50.42 ± 5.91 cm. Based on this research, it is known that the length of the forelegs in males aged 6-12 months is shorter than in females aged 6-12 months. The length of the hind leg is measured from the random underfloor to the protrusion of the sift bone, the measuring tape is pulled from the thigh joint to the lower leg, based on research that found the average hind leg length of male Waringin sheep aged 6-12 months 49.18 ± 1, 64 cm and female 48.46 ± 2.50 cm, male waringin sheep aged 18-24 months 67, 35 ± 2.41 cm and females 55.12 ± 6.37 cm. Broiler lambs do not expect high leg length, because the legs are not included in the carcass [16].

Table 12. Mean and standard deviation of hip width of Waringin sheep.

Variable observed	Age	Gender	
		Male	Female
LP (Cm)	6-12 bulan	13,45 ± 0,86	13,07 ± 1,57
	12-18 bulan	17,38 ± 2,59	14,30 ± 1,66
	18-24 bulan	24,17 ± 1,89	16,72 ± 3,27

Description: LP (width of the hips)

Based on the results of the study in Table 12, it is known that the hip width of male Waringin sheep aged 6-12 months is 13.45 ± 0.86 cm and that of females is 13.07 ± 1.57 cm, male waringin sheep aged 12-18 months is 17.38 ± 2.59 cm and females 14.30 ± 1.66 cm. Based on the research, it is known that the hip width of Waringin sheep is wider than that of local sheep which only has a hip width between 11.5 - 21.5 cm and the mean value is 15.97 ± 2.41 cm. According to Hafiz (2009), the hip width of thin-tailed sheep is 12.10 ± 1.02 cm while the hip width of fat-tailed sheep is 13.03 ± 0.84 cm [8]. Waringin sheep have larger hip widths when compared to thin-tailed and fat-tailed sheep. As the cattle age, the hip width of the sheep will also increase. This is following [17] which state that other factors that can affect body weight are chest circumference, chest depth, chest width, hip height and crotch length.

Table 13. Mean and standard deviation of Waringin sheep length.

Variable observed	Age	Gender	
		Male	Female
PE (Cm)	6-12 bulan	24,00 ± 1,88	24,61 ± 3,72
	12-18 bulan	25,67 ± 4,64	24,85 ± 5,08
	18-24 bulan	39,50 ± 6,94	27,44 ± 5,01

Description: PE (tail length)

Based on the research in Table 13, in measuring the length of male and female Waringin sheep, the average length of Waringin sheep was 24.00 ± 1.88 cm for males and 24.61 ± 3.72 cm for females with an age range of 6-12 months. In male and female Waringin sheep aged 12-18 months, the average tail length was 25.67 ± 4.64 in males and 24.85 ± 5.08 cm in females. The tail length of male and female Waringin sheep based on the age range of 18-24 months was found to be 39.50 ± 6.94 cm in males and 27.44 ± 5.01 cm in the length of females sheep. The length of the tail of the Waringin sheep is longer than that of the local sheep, this is following the statement. This is following [18] which states that the length of the tail of the local sheep is generally short with an average size of only around 19.3 cm.

Table 14. Mean and standard deviation of the width of the Waringin sheep

Variable observed	Age	Gender	
		Male	Female
LE (Cm)	6-12 bulan	6.58 ± 0,70	6,20 ± 0,55
	12-18 bulan	8,24 ± 0,70	6,91 ± 0,63
	18-24 bulan	8,00 ± 0,73	8,00 ± 0,57

Description: LE (wide tail)

Based on the research in Table 14. measurements of the width of male and female Waringin sheep obtained an average of 6.58 ± 0.70 cm for males and 6.20 ± 0.55 cm for females with an age range of 6-12 months. In male and female waringin sheep aged 12-18 months, the average tail width was 8.24 ± 0.70 cm, and in males and females 6.91 ± 0.63 cm. Waringin sheep tail width at the age of 18-24 months was 8.00 ± 0.73 cm in males and 8.00 ± 0.57 cm in females 8.00 ± 0.57 cm. Based on this study, it is known that the width of the tail of Waringin sheep is wider than that of the local sheep.

Table 15. The mean and standard deviation of the crotch length of the Waringin sheep

Variable observed	Age	Gender	
		Male	Female
PK (Cm)	6-12 Bulan	19,24 ± 1,50	19,20 ± 1,45
	12-18 bulan	21,24 ± 2,25	22.33 ± 2,25
	18-24 Bulan	30,08 ± 3,57	23,08 ± 1,32

Description: PK (croft length)

Based on the research in Table 15. Measuring the crotch length of male and female Waringin sheep obtained an average of 19.24 ± 1.50 cm in males and 19.20 ± 1.45 cm in the age range of 6-12 months. In Waringin sheep aged 12-18 months, the average crotch length was 21.24 ± 2.25 cm in

males and 22.33 ± 2.25 in females. The length of the crotch in Waringin sheep aged 18-24 months was 30.08 ± 3.57 cm in males and females. Based on the research results, it is known that the length of the crotch of the Waringin sheep is longer than that of the Garut sheep and also the Fat-tailed sheep. This is in accordance with [3] which states that the length of the crotch of the male Garut sheep is 22.76 ± 2.083 cm and that of the female is 18.42 ± 1.19 cm, the collar width of the Garut sheep in males is 22.7 ± 1.54 and in females, 15.49 ± 0.83 cm, the collar length of the Fat Tailed Sheep in males is 20.16 ± 1.80 cm and in females 16.76 ± 1.09 cm and the width of the crotch of Fat Tail rams is 21.01 ± 1.09 cm and in females 15.03 ± 1.20 cm.

Table 16. Mean and standard deviation Width of the crotch of Waringin sheep

Variable observed	Age	Gender	
		Male	Female
LeK (Cm)	6-12 bulan	12,18 ± 1,31	12,83 ± 2,59
	12-18 bulan	15,29 ± 3,08	14,55 ± 1,20
	18-24 bulan	16,42 ± 2,71	13,8 ± 3,21

Description: LeK (crotch width)

Based on the research in Table 16, measurements of the crotch width of male and female Waringin sheep obtained an average of 12.18 ± 1.31 cm for males and 12.83 ± 2.59 cm for females for the age range of 6-12 months. In Waringin sheep aged 12-18 months, the average crotch width was 15.29 ± 3.08 cm and 14.55 ± 1.20 cm in females. In Waringin sheep aged 18-24 months the width of the crotch of Waringin sheep is 16.42 ± 2.71 cm in males and 13.8 ± 3.21 cm in females. Based on research, it is known that the width of the crotch of Waringin sheep is smaller than that of Garut sheep and Ekor Gemuk sheep, the following [3] states that the length of the crotch of Garut sheep in males aged ± 2.083 cm is 22.76 ± 2.083 cm and females are 18 .42 ± 1.19 cm, the collar width of the Garut sheep in males is 22.7 ± 1.54 and the females are 15.49 ± 0.83 cm. 1.09 cm and the width of the crotch of Fat Tail rams is 21.01 ± 1.09 cm and in females 15.03 ± 1.20 cm.

Table 17. Mean and standard deviation of the Waringin canon circumference of the Waringin sheep.

Variable observed	Age	Gender	
		Male	Female
LiK (Cm)	6-12 bulan	6,94 ± 0,34	6,80 ± 0,45
	12-18 bulan	7,52 ± 0,68	7,12 ± 0,33
	18-24 bulan	9,50 ± 0,52	8,08 ± 0,40

Based on the research in Table 19, in measuring the cannon circumference of male and female Waringin sheep, the average result was 6.94 ± 0.34 cm for males and 6.80 ± 0.45 cm for females in the age range of 6-12 months. In Waringin sheep aged 12-18 months, the mean circumference of the cannon in Waringin sheep was 7.52 ± 0.68 cm in males and 7.12 ± 0.33 cm in females. Waringin sheep canon circumference at the age of 18-24 months was 9.50 ± 0.52 cm in females and 8.08 ± 0.40 cm in females. Based on the research, it is known that the average canon circumference of Waringin sheep is larger than the canon circumference of the Garut sheep and Fat

Ekor sheep. This is following [3] which states that the canon circumference of male Garut aged ± 2 years is 7.83 ± 0.59 cm and for females it is 6.74 ± 0.51 cm, male Fat Tailed Sheep is 7.00 ± 0. 33 cm and in females 7.57 ± 3.73 cm.

4. Conclusion

Based on the results of the study it was found that the morphometrics of male Waringin sheep had a close relationship with body weight, namely body length, forelegs length, hip width, hip height and crotch width, while in female Waringin sheep, the morphometric part had a close relationship with body weight. Body length is body length, skull length, chest circumference, hip height, tail length, tail width and groin width.

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