# Weight estimation accuracy of certificated garut ewes by using novel formula, schoorl formula, and winter arjodarmoko formula

Jois Harsa<sup>\*1)</sup>, Denie Heriyadi<sup>1)</sup> and Diky Ramdani<sup>1)</sup>

<sup>1)</sup> Department of Animal Production, Faculty of Animal Husbandry, Padjadjaran University Jalan Raya Bandung-Sumedang Km 21 Sumedang 45363

Submitted: 17 May 2019, Accepted: 27 March 2020

**ABSTRACT:** The body weight (BW, in kg) of sheep can be estimated by measuring the body length (BL, in cm) and chest circumference (CC, in cm). The study aimed to conduct a novel formula to predict BW of Garut ewes based on its BL and Chest Circumference CC. The accuracy of the novel formula is then compared to the commonly used Schrool and Winter Arjodarmoko formulas. The materials of the study were taken from the 1 to 7 certified data of adult Garut ewes with a total of 118 heads from three different regions: Bandung (73 ewes), Sumedang (22 ewes) and Garut (23 ewes). The observed variables were Body Weight (BW), Body Length (BL), and Chest Circumference (CC). The data showed that the average adult Garut ewes BW was at  $44.05 \pm 10.65$  kg, BL at  $62.35 \pm 5.34$  kg, and CC at  $83.89 \pm 6.25$  kg. The novel formula regression analaysis for BW estimation was (-91.1+0.575 (BL) + 1.18 (CC))with  $R^2 = 81.0\%$ . Moreover, BL and CC showed highly significant correlation (P<0.001) with the BW. The novel formula calculation showed the average BW was 42.74 kg (-0.32 kg deviation), while the Schrool formula showed the average BW was 44.47 kg (+0.42 kg deviation), and Winter Arjodarmoko was 44.48 kg (+0.43 kg deviation). The research concludes that the novel formula for Garut ewes BW estimation had the smallest deviation compared to Schoorl and Winter Arjodarmoko formulas.

Keywords: Garut ewe; Body weight; Body length; Chest circumference

<sup>\*</sup>Corresponding Author: joisharsa08@gmail.com

# **INTRODUCTION**

Garut sheep is an Indonesian native sheep family established by the Ministry of Agriculture (No: 2914 / Kpts / OT.140 / 6/2011), and widely known as one of the small ruminant breeds with good production performance to be reared in Indonesia. Garut sheep has relatively high production and body weight gain, while also showed good prolific performance and characteristics to developed be (Gunawan, Jamal. and Sumantri, 2008). Garut sheep is mainly reared for meat producers, but due to its high durability with excellent body weight and quality, the breed is also reared for fighting (recreational purpose). A crossbreeds of Garut sheep are mainly from native sheep in Cikajang, Cibuluh, and Wanaraja subdistrict, Garut. According to the common theory, sheep breeds are grouped into two catogry: black-faced sheep and white-faced sheep (Heriyadi, 2005). Gunawan and Noor (2006) described that the superiorities of Garut sheep are its good resistance againts disease. high-performance, and good productivity compared to other breeds.

Sheep weight can be measured by weighing the livestock, whether with digital or analog scales, but the equipment is rarely available in local farms. Pratama, Purbowati, and Lestari (2016) described that body weight measurement is essential to determine the livestock productivity during rearing, and the body weight can also be used as the indicator for offspring selection. The body weight estimation could be done to estimate the weight of an animal by using a certain formula, but the weight estimation formula is still mainly used to estimate the weight of large ruminants such as cattle and buffalo.

This research was conducted to generate a novel formula for body weight estimation of Garut ewes based on its body size. The taken approach is by comparing the accuracy level of body weight estimation between the novel formula to Schoorl and Winter Arjodarmoko formula. The result is expected to determine the best formula to be used for Garut ewes body weight estimation based on the body length (BL) and chest circumference (CC).

# MATERIALS AND METHODS Research material

The material of study was taken from the 1 to 7 certified Garut ewes data in West Java, with a total of 118 Garut ewes, in Bandung (73 ewes), Sumedang (22 ewes), and Garut (23 ewes). The research data were consisted of body measurements of adult Garut ewes data, which include body weight (BW), chest circumference (CC), body length (BL) and wither height (WH). Pratama, Purbowati, and Lestari (2016) described that the parameters observed in the study are measurements of chest circumference (CC), body length (BL) and wither height (WH). Heriyadi and Mayasari (2006) described that measurement of WH is the height from ground until the wither by using a measuring stick, while the measurement of body length is from the pocessus spinous bones from the highest vertebrae thoracalis until the sitting bone lump and measurement of the chest circumference by circling the tape measure to the chest cavity through the os scapula bone.

# **Research methods**

The method used in this study is measuring chest circumference (CC), body length (BL), wither height (WH), and body weight (BW). The method of measurement is based on SNI (2015), with body length measurement is from the edge of the highest joint to *tuber ischi* by using a measuring stick and the tape measure used for measuring the chest circumference by circling tape on the sheep's chest precisely behind the wither. Heriyadi, Sarwesti, and Nurachma (2012) described that the characteristics of Garut sheep are the shape of the ears like sliced leaves (4-8 cm) or clumps (length <4 cm) with a sheep's tail resembling a pig's tail or mice, at the age of 1.5 -4 years old a shape of the sheep's tail is a triangle, base of the tail is large and smaller at the end.

#### Data analysis

The data analysis used to obtain the formula Garut ewes BW estimation is regression analysis with body weight (BW), body lenght (BL), chest circumference (CC), and wither height (WH) as the input variables, and the results are presented in mean value with standard deviation (SD). The novel formula for BW estimation the BW from BL and CC is generated by regression analysis using the MINITAB 16. The formula for body weight estimation:

Novel formula:  
BW (kg) = 
$$(-91, 1+0, 575 (BL) + 1, 18 (CC))$$

Desription:

Estimation	Value	
BL against BW	P<0,001	
CC against BW	P<0,001	
$\mathbb{R}^2$	81,0%	

Winter Arjodarmoko formula:

$$BW (kg) = \frac{(CC)^2(cm) \times BL (cm)}{10.000}$$
  
Schoorl formula:  
$$BW (kg) = \frac{(CC) (cm) + 22)^2}{100}$$

100

The difference of estimated Garut ewes BW between the novel formula to Schoorl's and Winter Arjodarmoko formula is measured with the following formula:

BW difference (kg)	=	Estimated BW $(kg) - BW (kg)$	
		BW (kg)	

#### **RESULTS AND DISCUSSION Body size of Garut Ewes**

The increased body size of livestock indicates its bones growth which made up the body frame, while bone is known to be developed earlier compared to fat and muscle. The average body weight, body length and chest circumference of Garut ewes can be seen in Table 1.

The Garut ewes showed average BW at  $44.05 \pm 10.65$  kg, BL at  $62.35 \pm 5.34$  cm, CC at 83.89  $\pm$  6.25 cm, and WH at 70.36  $\pm$ 4.10 cm. According to the Decree of the Minister of Agriculture no. 2914 / Kpts / OT.140 / 6/2011 concerning Garut sheep breed, it is stated that the body sizes of adult Garut ewes are as follow: BL at  $56.37 \pm 4.6$ cm CC at 77.41  $\pm$  6.7 cm, and WH at 65.61  $\pm$  4.8 cm. The average body size measurement of adult Garut ewes in this study was higher than the Decree of the Minister of Agriculture. The body measurement (BL and CC) obtained in this study were higher than research by Mulyono, Rahayu and Hanibal (2013), with Garut crossbreed had BL at  $53.59 \pm 3.55$  cm and CC at  $67.59 \pm 3.65$  cm. The average BW of Garut ewes in this study were higher than research by Malewa and Samin (2008) which showed that the highest BW of local sheep in Biromaru aged at 36 months was 30.14 kg. Gunawan, Jamal, and Sumantri (2008a) described that Garut sheep with superior body measurements, both in the fighting Garut sheep, or Garut sheep for meat producers and Garut crossed breed can widely found in Wanaraja and Sukawening, Garut. On the other hand, the average BW of local ewes reared in Majalengka is still below average, which is between 18.7-27.5 kg (Somanjaya, Heriyadi and Hermana, 2015). The fighting Garut sheep in Wanaraja showed higher body size compared to the Garut sheep for meat producer in the same

area, with the BW of Garut ewes at 26.9 kg, BL at 58.1 cm, and CC at 74.5 cm (Mansjoer, Kertanugraha, and Sumantri, 2007). The offspring of Garut sheep have a larger body size and better uniformity due to the selection (Gunawan and Sumantri, 2008b). The fighting Garut sheep has good performance as the selection determined at least 2 kg birth weight (Inounu, Mauluddin, and Subandriyo, 2007).

	Average	SD
BW	44,05 kg	10,65 kg
BL	62,35 cm	5,34 cm
CL	83,89 cm	6,25 cm
WH	70,36 cm	4,10 cm

 Table 1. Average body size of Garut ewes

Source: Certified 1 to 7 data of Garut wews

### Prediction equation body measurements for body weight (BW)

Regression analysis showed that the BW of Garut ewes can be estimated. Weight estimation is done by measurement of BL and CC. This is supported by a high determinant value. The utility of BL and CC of Garut sheep as BW estimation has a very good probability value (P < 0.001) with  $R^2$  at 81.0%. Tama, Nasich, and Wahyuningsih (2016) described that BL in goats has a strong correlation value with body weight, which is equal to 0.92. The high correlation between CC and BW occurs because of the size of CC increases following body growth and development of muscle tissue in the chest (Basbeth, Dilaga, and Purnomoadi, 2015). The average chest circumference in Donggala ewes has a value of regression diversity efficiency equal to 9.91%.

# Comparison between BW estimation formula

The comparison of average body weight and BW estimation using the novel, Arjodarmoko school, and winter formula can be seen in Table 2. The average BW in Garut ewes is 44.05 kg. The results of BW estimation analysis of Garut ewes with the equation of novel formula had better accuracy with the BW deviation at -0.32 kg, and followed with the Shoorl formula (+0.42 kg deviation) and Winter Arjodarmoko formula (+0.43 kg deviation). It is shown that the novel formula had the best BW estimation. The average BW results from the new equation formula get a figure of 43.74 kg with a deviation of -0.32% of the real weight (44.05).

This means that using a new formula, weight estimation is better with an error rate of -0.32%. According to the Decree of the Minister of Agriculture no. 2914/Kpts/OT.140/6/2011 concerning Garut sheep breed, the standard BW of Garut ewes is  $36.89 \pm 9.3$  while the average BW obtained from this study is 44.05  $\pm$ 10.65, so the average weight obtained is better than the standard BW. Tama, Nasich, and Wahyuningsih (2016) described that the weight estimation in goats using the Schoorl formula was obtained by a higher deviation of 28.09% this is because the Schoorl formula is intended to estimate the BW of cattle, but in Garut sheep approach the weight weighing results with a difference of +0.42 kg.

The Schoorl formula used in sheep is better, but in male river buffaloes, the percentage of deviations is 5.15% or equivalent to -17.07 kg (Naibaho, Hasnudin and Hamdan, 2016). Malewa (2009) described that the average body weight of Doggala ewes at the age of 12-30 months is 25.53-30.14 kg compared with the average weight Garut sheep is higher than Dongala sheep.

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Formula	Equation	Average	Result of	Deviation
	Equation	BW (kg)	Equation (kg)	(kg)
Novel Formula	= -91.1+ 0.575 (PB) + 1.18 (LD)	44.05	43.74	-0.32
Schoorl Formula	$=((LD+22)^2/100)2.53$	44.05	44.47	+0.42
Winter Ardjo	$= (LD)^{2} x PB / 10.000$	44.05	44.48	+0.43
Formula				

Table 2. Average Body Weight and Body Weight Results of the Equation.

# CONCLUSION

The body weight estimation of Garut ewes can be done with the novel formula, with equation: (-91.1+0.575 (BL)+1.18 (CC)). The BW estimation of Garut ewes by using novel formula had better accuracy with the deviation at -0.32 kg, while the Schoorl formula had deviation at +0.42 kg, and Winter Arjodarmoko formula at +0.43 kg. The utilization of the novel BW formula of Garut ewes is then recommended due to its better accuracy.

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