ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume X Issue IX September 2023

Relationship between Physical Performance and Prolific Traits of *Peranakan Etawa* (PE) Goats Seen in Menda Kencana Farm, Semarang Regency

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DOI: https://doi.org/10.51244/IJRSI.2023.10920

Received: 13 July 2023; Revised: 10 September 2023; Accepted: 14 September 2023; Published: 09 October 2023

ABSTRACT

This study aimed to analyze the relationship between physical performance and prolificacy by examining 11 multiparous PE goats from Menda Kencana farm Semarang Regency. The data obtained for research comprised both prolific traits and the performance of the chosen sample of goats, which included body length (BL), body height (BH), chest circumference (CC), and hip width (HW). This research is categorized as survey research with the sampling method determined through purposive sampling, where the sample is determined intentionally, and the data used is primary data. Data were analyzed by simple linear regression analysis. The results of regression analysis of CC and HW each had a highly significant relationship ($P<0.01$) with the prolific nature following the regression line equations CC = 80.39 + 7.34D cm ($R2= 56\%$) and LP = 14.17 + 3.64D cm ($R2= 60.3\%$). However, BL and BH were not significantly associated with prolific traits ($P>0.05$). It is concluded that physical performance in the form of chest circumference and hip width is directly proportional to prolific traits, indicating that the greater the chest circumference and hip width, the higher the chance of PE goats bearing twins.

Keywords: PE goats, prolific traits, physical performance, productivity

INTRODUCTION

Goats are one of Indonesia's most famous dairy and meat-producing livestock and have potential for further development. Goats have several advantages, such as easy maintenance, fast breeding ability, relatively small body size, short calving interval, and the ability to bear more than one kid at a time [1]. *Peranakan Etawa* (PE) goats are famous and widely bred by the general public, particularly in the Semarang regency. PE goats are livestock produced by crossing between *Kacang* goats and *Etawa* goats. These goats are also known as native goats [2]. PE goats are considered a dual-purpose livestock species that can produce milk and meat, thus having a high economic value. One of the main reasons for choosing this breed is its rapid growth and ability to produce two or more kids in a single birth [3].

The goat population in Semarang Regency in 2018 was 117,396. In 2019, it was 117,400; in 2020, it reached 117,400 [4]. According to these statistics, there was no increase in goat population from 2019 to 2020. On the other hand, the market demand for meat production and goat butchery was increasing. It is following the data on the level of goat slaughter in 2020 of 22,231 heads, which increased to 22,232 heads in 2021. In addition, there was an increase in goat meat production in 2018 by as much as 284.40 tonnes,

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume X Issue IX September 2023

which increased to 3191.54 tonnes in 2020 [5]. The goat population will continue to decrease, so it is necessary to increase the productivity of PE goats to fulfill market needs.

One of the farms in Semarang Regency that conducts the breeding of PE goats is Menda Kencana farm, located in West Ungaran District, Semarang Regency. This farm has a considerably higher PE goat population than other farms in Semarang Regency. However, the productivity of PE goats is relatively low on the farm due to the dominant population of single-breeding goats as opposed to twin-breeding goats. Some obstacles faced by farmers in increasing livestock productivity include poor husbandry management [6]. In addition, the ability of twin breeds of goats is influenced by the relationship between genetic and environmental factors [7].

An effort to increase PE goats' productivity can be achieved by selecting superior parents. In this case, the selection is based on the physical performance of the goats. The physical performance of goats is one of the most effective alternatives in designing a breeding program [8]. Goats with a highly prolific nature usually have a large body, chest circumference, and hip width. This condition is due to the need for twins to have more space in the abdomen and uterus than single-birth mothers [9]. The prolific nature of livestock or the ability of an animal to give birth to twins can increase the productivity of the mother [10]. In addition, good feeding and sufficient nutrition will also contribute to optimal livestock productivity [11].

The potential genetic productivity of an animal can be estimated through the physical performance criteria. As the age of an animal increases, the body weight and body size will also increase. Some factors that can determine the growth of physical performance and productivity of an animal include food consumption, animal health, and environmental conditions [12]. Therefore, this study is necessary to be conducted to analyze the relationship between physical performance and the prolific traits of PE goats as well as to identify the environmental conditions and feed consumption at Menda Kencana farm. Thereby, an effort to increase the productivity of PE goats can be carried out optimally.

MATERIAL AND METHODOLOGY

This research was conducted from January 12th to February 13th, 2023, at Menda Kencana Farm in Kalisidi, West Ungaran Subdistrict, Semarang Regency.

- **Material**

The samples in this study were 11 healthy multiparous female PE goats that had given birth to single or twin kids. The instruments used in measuring the physical performance of goats were measuring tape for chest circumference and measuring sticks for height, body length, and hip width. The instrument used to measure the environment's temperature and humidity was a digital thermohygrometer.

- **Interview**

The data on the prolific nature of PE goats were obtained through interviews conducted with breeders. There were two groups of prolific traits: low prolific (LP) if the mother had a single litter and high prolific (HP) if the mother had more than one litter.

- **Observation of Environmental Conditions**

Observation of environmental conditions studied encapsulated from goat feeding activities to the food management system, observing the quality of livestock pens, and measuring environmental data, including air temperature and humidity. Temperature and humidity were recorded over 30 days every morning at 06.00 WIB and afternoon at 18.00 WIB.

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- **Measuring Physical Performance**

Measurement of the physical performance of PE goats included body height, body length, chest circumference, and hip width. The method of measuring the physical performance of goats is presented in Figure 1.

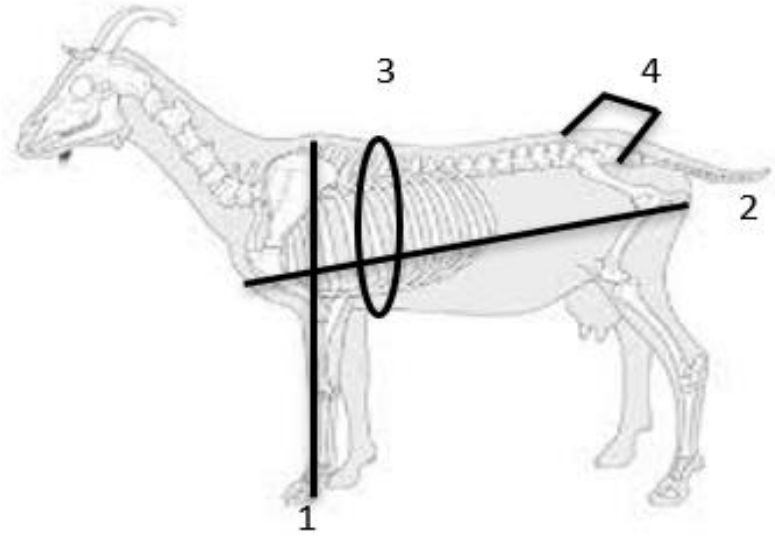

Figure 1. Measuring the physical performance of goats

Description:

1. Body Height (BH)
2. Body Length (BL)
3. Chest Circumference (CC)
4. Hip Width (HW)

- **Data Analysis**

The data analysis of the relationship between physical performance and the prolific nature of livestock was analyzed using simple linear regression analysis and correlation coefficient and used a dummy variable (D), namely if the prolific nature is low (D=0) and high prolific nature (D=1). Regression analysis aims to test the direction of the relationship of the independent variable to the dependent variable [13]. The independent variable was the physical performance of livestock, while the dependent variable was prolificacy. The summary of the regression analysis formula is as follows.

Simple linear regression formula:

$y = a + bx$

Where:

y = Dependent variable (morphometrics)

x = Independent variable (prolific nature)

a = Constant (y value if x = 0)

b = Regression coefficient (increased or decreased values)

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RESULTS AND DISCUSSIONS

The results of the research indicate that body length (BL), body height (BH), chest circumference (CC), and hip width (HW) of PE goats based on prolific traits are shown in Chart 1.

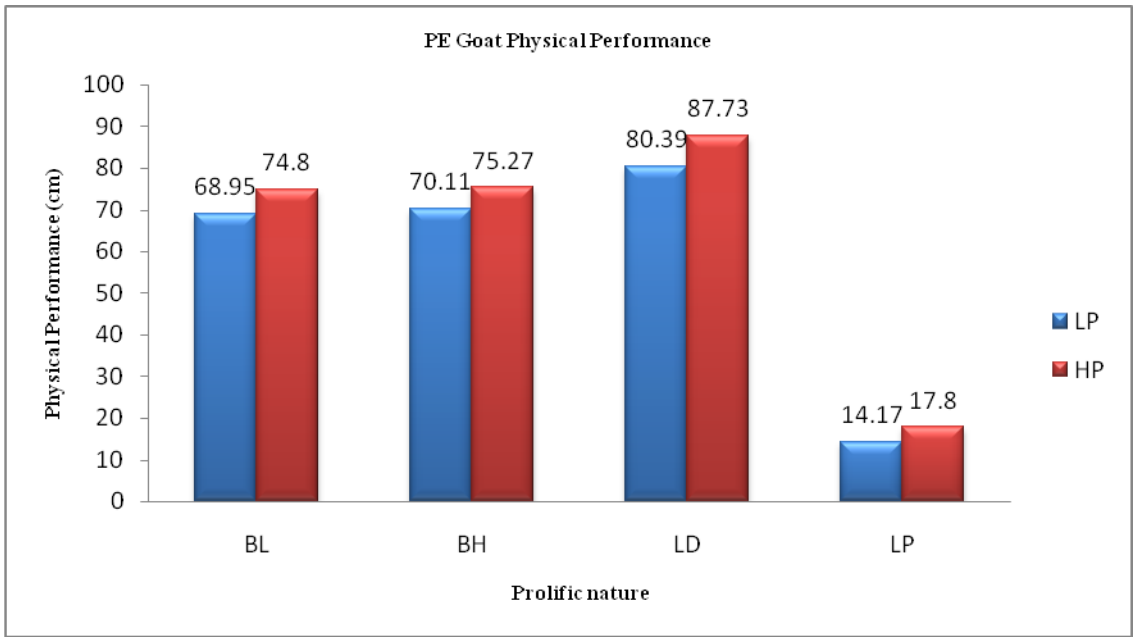

Chart 1. The physical performance of PE goats on each prolific trait

Based on the results in Chart 1, the low prolific PE goats had a BL, BH, CC, and HW of 68.95±4.76; 70.11±5.06; 80.39±2.89; 14.17±1.19 cm, respectively. For PE goats with a highly prolific nature, BL, BH, CC, and HW were 74.80±8.68, 75.27±6.80, 87.73±3.70, and 17.80±1.80 cm, respectively. These results indicated that PE goats with a highly prolific nature tend to have higher body morphometrics than goats with a low prolific nature. Body morphometrics in BL, BH, CC, and HW increased by 8, 7, 9, and 26% from low prolific to high prolific. These results follow prior research conducted by Sumaryadi *et al*. (2022), who stated that sheep with high prolific traits had a higher body size than sheep with low prolific traits. The results of this physical performance research are higher than BL, BH, CC, and HW in the results of research from Purwanti *et al*. (2019), which is in PE goats of parity two respectively 66.91 ± 2.26; 72.72 ± 4.49; 77.89 ± 4.51; 18.55 ± 2.14 cm. Differences in body size in PE goats can be caused by parity, which refers to the number of times a female goat gives birth [15].

Table I. Regression equation, correlation coefficient (r), coefficient of determination (), P value of regression analysis between BL, BH, CC, and HW with prolific properties

Performa fisik	Analisis Regresi	r		P value
BL	BL = 68.95 + 5,86D	0.43	0.093	0,188
BH	BH = 70.11 + 5,16D	0.43	0.098	0,183
CC	CC = 80.39 + 7,34D	0.78	0.560	0,005
HW	HW = 14.17 + 3,64D	0.80	0.603	0,003

Description: Body Height (BH); Body Length (BL); Chest Circumference (CC); Hip Width (HW)

Based on the result of regression analysis, the parameters of chest circumference and hip-width (TABLE I) each have significant relation forms (P?0,01) with the characteristics of prolific. As for body length and body height, it does not show significant relation forms (P>0,05) with the characteristics of prolific. The

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relation forms of chest circumference with the characteristics of prolific follow the regression equation CC = 80.39 + 7.34D with a coefficient of determination of 0.560, meaning that the characteristics of prolific influenced the chest circumference as much as 56%. In contrast, the rest are influenced by other factors (genetics and environment). Other than that, there is a close relation between chest circumference and the characteristics of prolific on the PE Goat, shown in the correlation coefficient of r = + 0.78. This equation indicated that chest circumference has a positive relationship with the goat's prolific characteristics, meaning that the bigger the chest circumference size, the higher the chance of the PE goat giving birth to twins. The chest circumference of the PE goat with a low prolific level was 80.39 cm in size, while on the PE goat with a higher prolific level, it was as wide as 87.73 cm.

The same thing happened in the hip width. The form of relation of hip width and the characteristics of prolific follow the regression equation HW = 14.17 + 3.64D with a coefficient of determination of 0.603, meaning that the characteristics of prolific influenced the hip width as much as 60.3%, while other factors influence the rest. Other than that, there is a close relation between hip width and the characteristics of prolific on the Goats, shown in the correlation coefficient of r=+0.80. This equation indicated that hip width has a positive relationship with the goat's prolific characteristics, meaning that the bigger the size of the hip width, the higher the chance of the PE goat giving birth to twins. On the PE goat with a low prolific level, the hip width is 14.17 cm in size, while on the PE goat with a higher prolific level, the hip width reached 17.80 cm.

The length and height of the body do not show significant relation forms (P>0,05) with the characteristics of prolific. It was in line with the research done by Sumaryadi *et al*. (2022), which stated that the length and height of the body were not significantly related to the characteristics of prolific in the Batur sheep. The body's length was unrelated to spinal development and growth [16]. The height of the goat's body was not related directly to the abdominal and uterine cavity, and it does not affect the area of abdominal space that is required for the survival of the child during the pregnancy, as well as not affecting the mother goat's ability to guarantee the development of the child. When young cattle go through the puberty phase, the growth of the bones will proceed rapidly [15]. The growth of the body height of goats is influenced by the growth of leg bones, which happen faster than the rest. It is related to the function of goats' forelegs as a support for the body [17].

The physical performance of PE goats, especially on the chest circumference and hip width, can be used to predict goats with highly prolific characteristics. The chest circumference was closely related to the large capacity of the lung organs that bind oxygen levels from outside the body. When metabolism happens, oxygen plays a role in the oxidation process to supply energy. Cattle with high characteristics also need a high oxygen intake, hence the need for bigger lung capacity and chest space due to the increased demand for oxygen supplies for the sake of the metabolism process. The chest circumference can be influenced by the development of related organs [18]. Thin-tailed sheep with high characteristics are presumed to have an efficient process of glucose metabolism to fulfill the energy requirements and the production process of the FSH-LH hormone, which plays an essential role in the ovulation rate [19].

Another size measurement that was related to the characteristics of prolific is hip width. This hip width is related to the abdominal space and uterus. Following Sutiyono's statement, the growth of twin fetuses inside the uterus required an expansive and sizeable abdominal space [21]. The bigger hip size will widen the abdominal and uterus space, providing more expansive spaces for the growth of twin fetuses during the goat's pregnancy [22]. On the other side, mother goats with wider hips make giving birth to kids easier. This statement indicates that the hip's width is directly related to the characteristics of prolific, as the hip width provides more space for the fetuses to develop and grow.

Goats with high characteristics have relatively good quality genetics and, thus, can be used as superior mothers. Other than good genes, other supporting factors are also required, such as sufficient environmental

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume X Issue IX September 2023

management and consumption of high-quality feed to ensure optimal goat productivity [23].

- **Environmental Condition**

Figure 2. *Peranakan Etawa* (PE) goats [24]

Environmental condition is one of the affecting factors for the growth of the PE goat (Figure 2). Animals with superior characteristics that have undergone cross-breeding and selection will only maximize productivity if the environment allows them to breed [25]. The research occurred in Kalisidi Village, West Ungaran District, Regency of Semarang, a highland area. Kalisidi Village is located in a relatively good spot for breeding PE goats (Figure 2). The maintenance system in Menda Kencana is done semi-intensively. A semi-intensive maintenance system combines intensive and extensive systems involving giving out concentrates and controlled grazing [26].

Figure 3. Housing system on Menda Kencana farm, Ungaran Barat sub-district, Semarang district

The caging system applied to this farm is a stilt system made of wood with soil underneath (Figure 3). This stilt caging system has some advantages, such as easing the process of cage sanitation and manure management and facilitating mass feeding [27].

Table II. Environmental conditions on the Menda Kencana farm

Variable	Rata-rata
Place altitude	+460 mdpl
Temperature	23,5±0,71
Humidity	90,6±5,4

Source: Results of environmental observation data management (2023)

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The results of height, temperature, and humidity observations at Menda Kencana farm are shown in Table II. Areas higher than 450 mdpl are high areas with relatively low temperatures and high air humidity. The influence of temperature and humidity is necessary for livestock production systems. Excessive temperature and humidity will cause low productivity in the goats [29]. The height of the area affected the humidity and temperature inside the cage. In nurturing goats, temperature, and humidity are important factors that impact the physiological condition of the goats [30].

Based on Table II, averaging temperature and air humidity were still in a safe and comfortable range for growing the goats. According to Diana, prosperous air temperature for goats ranges from 18 to 30ºC, with standard air humidity at 60-90% [29]. The lowest temperature suitable for the goats is 22ºC, while the optimal highest is 35ºC [31]. Hence, the statement above shows that the Menda Kencana farm has the proper location for the PE goats. The height of the place, as well as the temperature and air humidity, were within a comfortable range for the goats' lives.

- **Consumption of Feed**

Green fodder is a crucial factor in determining the productivity of the goats. The type of green fodder given in the cage is corn stalks. Corn stalks are animal feed ingredients derived from agricultural waste with a high potential for utilization as it has good nutritional content [32]. Required for good feeding management to improve the feed quality for the goats; proper feed includes carbohydrates, proteins, vitamins, fats, water, and minerals, which are needed for growing the goats' bodies to improve their productivity [33]. Before the feed is given, the farmer has to cut the stalks with the *cropping* machine first. The green fodder feeding system at Menda Kencana is done thrice a day, in the morning (08.00 WIB), noon (12.00 WIB), and evening (17.00 WIB).

The goats also got green fodder from the yard, which is done by letting the goats graze around the cages. The goats are grazed when the green fodder is protected from the rain; it was not done in the morning since parasite larvae can contaminate the fodder [33]. On this farm, the goats are grazed thrice a week around 08.00-11.00 WIB when the weather is hot. Types of wild fodders that grow around the cages include reed grass, bandotan grass, and needle grass. To fulfill the nutritional requirements in the goat's feed, using green fodder as one kind of feed must be accompanied by supplementation of food boosters or concentrates. It ensures that the goats obtain proper and sufficient nutrition for optimal productivity [34]. The composition of concentrate feed ingredients at Menda Kencana is shown in Table III below.

Table III. Composition of feed ingredients for livestock concentrates

Feed Ingredients	Percentage (%)
Pollard	30
cassava	32
Coffee skin	8
Copra	16
Soybean meal	9
DDGS	10
Molasses	5 lt

Source: Primary data from interviews

Concentrate feeds were given twice daily, in the morning (05.00 WIB) and afternoon (15.00 WIB). Concentrates are fed, digested, and fermented by the goats quicker than green fodders and consist of two or more feed ingredients containing low crude fiber nutrients and high energy [35]. The composition of

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume X Issue IX September 2023

ingredients for the concentrate feeds (TABLE III) mostly came from industrial waste such as pollard, cassava, copra, soybean meal, and DDGS. Feeds from industrial waste are one of the supplementary feeds that function as a cover for the lack of nutrients in green fodders [36].

Concentrates can also help speed up the goats' digestion of green fodders. The usage of concentrates as a supplementary feed has the benefit of increasing the availability of essential nutrients, especially proteins, that are needed by the microbes inside the rumen to grow. It can increase the population and activity of microbes in digesting organic ingredients. Other than that, using concentrates in specific rations can also raise the amount of non-structural carbohydrates. The microbes inside the rumen will quickly ferment these carbohydrates to make fermented products such as volatile fatty acids, including acetic, propionic, and butyric. It will increase the digestibility of the feed given to the goats [37].

CONCLUSION AND SUGGESTION

- **Conclusion**

The findings in this study indicate that body size factors such as chest circumference and hip width have a significant relationship with the twinning tendency in goats. As these body size factors increase, the chances of producing twin kids in PE goats also increase.

- **Suggestion**

In order to obtain more precise litter size information, further research is needed on other body size factors in PE goats that are related to specific litter sizes and in a larger dataset with relatively homogeneous ages.

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