International Journal of Life Science and Agriculture Research
ISSN (Print): 2833-2091, ISSN (Online): 2833-2105
Volume 04 Issue 09 September 2025
DOI: https://doi.org/10.55677/ijlsar/V04I09Y2025-01
Impact Factor: 7.88 , Page No : 531-536

# Effects of Singletons and Twins on the Physical and Physiological Changes in Kacang Goats Crossed with Boer Goats

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**ABSTRACT**

This study aimed to determine the physiological responses of PE does crossed with Boer bucks and their relationship with litter size and the sex of the kids. The method used was a farm experiment conducted on a goat farm owned by PT. Sedana Arif Nusa NTB. The study involved 48 pregnant does, of which 24, 14, 10, 7, and 9 carried single male, single female, twin male-male, twin female-female, and twin male-female kids, respectively. Pulse rate, respiration rate per minute, and rectal temperature were measured every two weeks, and pregnancy type was detected by ultrasonography. Differences between groups were tested using Student's t-test. The results showed that the birth weight of single male kids tended to be higher (3.18 ± 0.55 kg) than that of single female, male twins, female twins, and male-female twins. The respiratory rate during the last 50 days of pregnancy tended to increase from 14.0 breaths per minute at 100 days of pregnancy to 14.7 breaths per minute at 142 days. Pulse rate increased significantly from 27.7 beats per minute after 100 days to 37.1 and 37.2 beats per minute at 135 and 142 days of pregnancy, respectively. Chest circumference, abdominal circumference, and rectal temperature also increased with advancing pregnancy age. There were no significant differences in physiological responses—such as respiratory rate, pulse rate, and rectal temperature—due to different types of pregnancies during the last trimester. However, does with twin pregnancies tended to exhibit higher values for all measured parameters compared to those with single pregnancies.

**Published Online: September 06, 2025**

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**KEYWORDS:** Respiration, pulsus, rectal, temperature, pregnancy

## 1. INTRODUCTION

and milk production. The goat population in West Nusa Tenggara Province, Indonesia, increased by 1.04%, from 266,155 in 2023 to 279,234 in 2024 (Central Statistics Agency of West Nusa Tenggara, 2024). However, goat population growth has not yet reached its full potential. Therefore, appropriate strategies are needed to increase both population and productivity. One approach is to crossbreed Etawah crossbred goats, known for their dairy qualities, with Boer goats, recognized for their meat production, to produce a dual-purpose goat with high potential for both meat and milk production (Zaenuri and Rodiah, 2016). To date, policies aimed at increasing the productivity of local goats have involved crossbreeding them with high-yield breeds such as Saanen, Etawa, or Boer goats. However, these efforts often overlook the environmental factors and physiological changes affecting the local goats involved in crossbreeding. Such physiological changes can have both positive and negative consequences.

So far, crossbreeding programs involving local goats and various other goat breeds have been evaluated primarily based on phenotypic performance, while their environmental adaptability and effects on physiological changes have not been extensively studied. This study aimed to assess the variations in physiological responses of Etawa crossbred goats crossed with Boer goats during the last 100 days of gestation. Additionally, it sought to examine changes in the physiological status of PE goats crossed with Boer goats and how these changes relate to the type of birth of their offspring.

## II. MATERIAL AND METHODS

*Time and Location of the Research*

This research was conducted at the "Kembang Turi" goat farming group in Batujai Village, West Praya District, and at the PT. Sedhana Arif Nusa goat farm in Puyung Village, Jonggat District, Central Lombok Regency, West Nusa Tenggara Province, Indonesia.

*Research Materials*

The research materials consisted of 48 PE goats, each pregnant for up to 100 days, as determined from mating records. The goats were housed individually in pens equipped as needed for administering medications and vitamins, and provided with a thermometer, measuring tape, and digital scale. Feed was given twice daily, in the morning and evening, consisting of a mixture of field grass and S. grandiflora leaves in a 25:75 ratio. Drinking water was provided ad libitum. All goats were randomly assigned to individual pens featuring a raised platform system measuring 1.25 x 1.5 m2 m² goat.

*Research Methodology*

The research method involved an on-farm experiment. The preparation phase included identifying the mating date, determining the gestational age of the does, and assigning identification numbers to the goats selected for sampling. The study was conducted on 48 PE does crossed with Boer goats, each between 90 and 100 days pregnant. The type of gestation (single or twin) was determined using ultrasound (SonoScape, Co. LTD, Shenzhen, China). Additionally, data were collected to monitor changes in the does' physiological status according to gestational age.

For mothers, the data collected included changes in abdominal and chest circumference, pulse rate (heartbeats per minute), respiration rate (breaths per minute), and rectal temperature, measured every two weeks. Data for the kids included birth weight (kg), obtained by weighing them within 24 hours after birth, litter size, and sex of the kids.

*Data Analysis*

The physiological data of the mothers were grouped and tabulated according to the type of birth. The data obtained were tabulated, and differences in the physiological and physical status of the mothers were tested according to the gestational age and type of birth using the Student's t-test (Stell and Torrie, 1991).

## III. RESULTS AND DISCUSSION

*Goat Kid Birth Weight*

Of the 48 goat mothers, 14 had singleton male pregnancies, 10 had singleton female pregnancies, and 8 and 7 mothers had twin male and twin female pregnancies, respectively. Additionally, 9 mothers had male-female twins (Table 1). Ultrasound images illustrating the different pregnancy types are shown in Figure 1. All goat mothers in this study successfully gave birth, and all offspring were healthy and alive. The birth rate observed in this study was higher than that reported by Conway et al. (1996), who noted that the birth rate in goats is generally high, at around 80%, due to their ability to adapt to unfavorable environments. This resilience may be attributed to the goat's rumen, which can act as a water reservoir, storing up to 15% of the animal's body weight to buffer against water shortages (Silanikove, 2000).

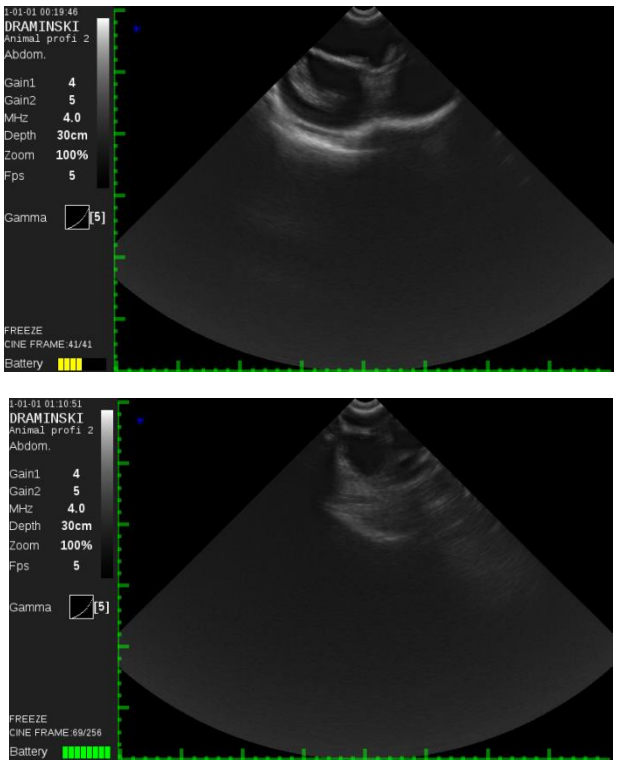


**Figure 1. Results of pregnancy examination using ultrasound identifying twins (top) and singletons (bottom)**

As shown in Table 1, the average birth weights of single mele-born, and single female born goats (SM and SF) were not significantly different ($P > 0.05$), measuring $3.18 \pm 0.55$ kg and $2.99 \pm 0.54$ kg, respectively. However, both single births had significantly higher birth weights ($P \leq 0.05$) compared to twin litters (TFF, TMM, and TMF). There was no significant difference ($P > 0.05$) among the birth weights of TFF, TMM, and TMF.

The birth weights of goats in this study did not differ significantly from those of crossbred Boer goats and Etawah cross goats, which were 3.25 kg for males and 2.48 kg for females, respectively (Sutama et al., 1995). Meanwhile, the birth weights of goats resulting from crossbreeding Boer cross goats with Kacang goats were recorded as 2.65 kg for males and 2.93 kg for females (Zaenuri, 2005).

The birth weights of kids from crossbreeding PE goats with Saanen goats were $3.60 \pm 0.72$ kg for singletons, $2.90 \pm 0.48$ kg for twins, $2.93 \pm 0.41$ kg for triplets, $3.43 \pm 0.66$ kg for females, and $2.96 \pm 0.61$ kg for males, respectively (Martawidjaya et al., 1999). Adiati et al. (1998) further noted that the birth weight of a kid significantly influences its ability to survive and grow into adulthood.

The last trimester of gestation is a period of rapid fetal growth and development, during which seventy percent of fetal growth occurs. Due to this accelerated growth, the mother goat instinctively increases her appetite to meet the nutritional demands required for fetal development and udder growth in preparation for milk production after kidding (Jaenudeen and Hafez, 1998).

**Table 1. Birth weight (kg) of goat kids resulting from crossbreeding Boer goats with PE goats according to single or twin kid**

| **Kid** | SK | | TFF | | TMM | | TM-F | |
|---|---|---|---|---|---|---|---|---|
| **No** | M | F | 1 | 2 | 1 | 2 | M | F |
| 1 | 3.4 | 3 | 2 | 2.1 | 2 | 2 | 3.2 | 2.6 |
| 2 | 3.9 | 2.4 | 3.2 | 3.1 | 2.4 | 2.3 | 3 | 1 |
| 3 | 3.5 | 2.8 | 1 | 1.5 | 2.4 | 2.4 | 3.2 | 3.7 |
| 4 | 3.0 | 3.3 | 2.3 | 2.4 | 3 | 2.9 | 1.2 | 2.8 |
| 5 | 3.7 | 3.8 | 2.4 | 2.3 | 3.4 | 2.2 | 1.4 | 1.9 |
| 6 | 3.6 | 3.5 | 2.4 | 2.5 | 2.4 | 2.3 | 2.8 | 2.2 |
| 7 | 3.4 | 3.7 | 2.5 | 2.1 | 2.3 | 2 | 2.6 | 2.9 |
| 8 | 2.3 | 2.2 | 3.7 | 2.8 | | | 3 | 2.3 |
| 9 | 3.6 | 2.4 | | | | | 2.4 | 2.4 |
| 10 | 3.2 | 2.8 | | | | | | |
| 11 | 3.3 | | | | | | | |
| 12 | 2.2 | | | | | | | |
| 13 | 2.3 | | | | | | | |
| 14 | 4.0. | | | | | | | |
| Mean | 3.18 | 2.99 | 2.33 | | 2.43 | | 2,48 | |
| SD | 0.55 | 0.54 | 0.6 | | 0.36 | | 0.70 | |

Note: SK = Single kid (M male; F female), TMM (twin male-male), TFF (twin female-female), TMF (twin male female).

*Physical and Physiological Changes in the Mother Goats*

The internal condition of the animal is constantly dynamic as it progresses through various phases of its reproductive cycle (Mellado et al., 2025). Due to rapid fetal growth and increased feed intake, the animal's metabolic system undergoes significant adjustments. These metabolic changes can be assessed by monitoring alterations in physiological functions such as respiratory rate, pulse rate, and rectal temperature (Jaenudeen and Hafes, 2000). The results of this study indicated a slight, but statistically insignificant, increase in respiratory rate during the last 50 days of gestation, rising from 14.0 breaths per minute at 100 days to 14.7 breaths per minute at 142 days of gestation. In contrast, the pulse rate increased significantly, from 27.7 beats per minute at 100 days to 37.1 and 37.2 beats per minute at 135 and 142 days of gestation, respectively. Similarly, chest circumference, abdominal circumference, and rectal temperature all increased with gestational age (Table 2).

**Table 2. Physical and physiological changes in PE goats crossed with Boer goats in the third trimester of pregnancy**

| Gestational Age (Days) | Physiological and physical changes in pregnant goats | | | | Rectal Temp (˚C) |
|---|---|---|---|---|---|
| | Frequencies/minute | | Circumference (cm) | | |
| | breath | pulse | chest | Abdomen | |
| 100 | 14.0 | 27.7 | 77.0 | 92.9 | 37.7 |
| 107 | 13.6 | 32.8 | 77.5 | 93.2 | 38.5 |
| 114 | 14.1 | 34.8 | 77.8 | 94.3 | 38.7 |
| 121 | 12.1 | 35.0 | 78.4 | 93.4 | 38.8 |
| 128 | 12.6 | 36.4 | 78.8 | 94.6 | 38.6 |
| 135 | 12.7 | 37.1 | 79.3 | 94.9 | 39.9 |
| 142 | 14.7 | 37.2 | 79.9 | 96.4 | 39.9 |

**Source:** Research results

Physiological changes, such as respiratory rate, pulse rate, and rectal temperature, result from an increased metabolic rate. Zaenuri (1998) explains that the rising nutritional demands with advancing gestational age lead to increased feed consumption, thereby accelerating feed turnover rates. Similarly, blood circulation increases to distribute nutrients throughout the body, particularly to the fetus, which ultimately causes a slight increase in rectal temperature, although this increase is not significant. Sutama et al. (1999) reported comparable findings: PE goats crossed with Saanen goats exhibited no significant physiological changes—such as differences related to sex or litter size—in rectal temperature, respiratory rate, or pulse rate during gestation.

Fluctuations in the respiratory rate are caused, among other factors, by reduced oxygen consumption and decreased thyroid activity during metabolic processes. Additionally, the respiratory rate decreases with reduced feed intake and water shortages. Therefore, lowering the respiratory frequency is one of the animal's defense mechanisms to prevent water loss and dehydration through evaporation occurring in the lungs (Umesiobi et al., 2005; Casamassima et al., 2016). Conversely, an increase in pulse frequency may result from heightened feed consumption activity to meet the needs of the fetus (Casamassima et al., 2016).

Physical changes, including increases in chest and abdominal circumference, typically occur in mother goats during the last trimester of pregnancy. These changes result from increased feed consumption, weight gain in preparation for kidding, and the growing size of the fetus within the mother's reproductive tract (Zaenuri, 1998). During pregnancy, goats require additional nutrients to support fetal development (Sahlu et al., 1995).

Sutama et al. (1999) reported that PE goats crossed with Saanen goats exhibited a significant increase in body weight, rising from 36.4 kg shortly before or after fertilization to 44.6 kg by the end of gestation. Similarly, Subhagiana (1998) and Zaenuri (1998) explained that the increase in body weight and, consequently, body size of the mother during pregnancy and before parturition is a natural process to accommodate the growing needs of the fetus, which is also increasing in size.

Physiological parameters such as rectal temperature, pulse rate, and respiratory rate are key indicators of an animal's physiological status. Monitoring these parameters is crucial for the early detection of health issues in livestock. The sooner physiological abnormalities are identified, the more promptly preventive and therapeutic measures can be implemented (Jaenudden and Hafez, 2000). Galem et al. (2012) also emphasized that physiological indicators—including respiration, pulse rate, and rectal temperature—are essential for assessing livestock health and can be measured directly through data recording.

The physiological status of livestock indicates their health and adaptation to their environment. Additionally, physiological status can change or adapt in response to alterations in the hormonal system caused by shifts in physiological conditions, disease, and other factors (Zaenuri, 1999; Jaenudden and Hafez, 2000b). Similarly, livestock continuously adapt to their living environment. Environments with high temperature and humidity can induce stress because the body's heat regulation system becomes unbalanced in relation to the surrounding conditions (Jaenudden and Hafez, 2000b).

**Table 3. Changes in respiratory frequency, pulse and rectal temperature of PE goats crossed with Boer goats in the single or twin bearing fetus in the third trimester.**

| Gestational Age (Days) | Respiration Frequencies/minute | | Pulsus frequencies/minute | | Rectal Temperature (°C) | |
|---|---|---|---|---|---|---|
| | Number of fetus | | Number of fetus | | Number of fetus | |
| | single | Twin | Single | Twin | Single | Twin |
| 100 | 28.0 | 30.0 | 93.0 | 112.4 | 38.2 | 38.5 |
| 107 | 25.8 | 28.8 | 93.6 | 112.8 | 38.4 | 38.6 |
| 114 | 26.2 | 30.2 | 96.6 | 104.4 | 38.5 | 38.8 |
| 121 | 28.2 | 30.0 | 96.6 | 104.6 | 38.6 | 38.8 |
| 128 | 28.2 | 29.2 | 96.7 | 104.6 | 38.8 | 38.5 |
| 135 | 28.2 | 29.4 | 102.4 | 112.2 | 38.6 | 38.9 |
| 142 | 30.6 | 31.0 | 107.6 | 114.4 | 38.6 | 38.9 |

**Source:** Research results

The results of this study showed no significant differences in respiratory rate, pulse rate, or rectal temperature during the last trimester of pregnancy (Table 3). However, does with twin pregnancies tended to exhibit higher values for all measured parameters compared to those with single pregnancies (Table 3). According to Hafez (2000), the normal respiratory rate for sheep and goats ranges from 20 to 50 breaths per minute. Therefore, the respiratory rates observed in the goats in this study were within the normal range. Adaptability to the environment varies depending on the breed. Livestock from tropical regions generally demonstrate better adaptability than those from subtropical regions. For example, research on Indian cattle, which live in hot climates and are maintained at 27°C, showed faster feed consumption and growth compared to Shorthorn cattle from subtropical regions (Prosser and Brown, 1992).

## IV. CONCLUSION

There were no significant differences in physiological responses based on the number of fetuses in the womb, as indicated by changes in respiratory rate, pulse rate, and rectal temperature during the last trimester of pregnancy. However, mothers carrying twins tended to exhibit higher values for all measured parameters compared to those carrying singletons.

## V. ACKNOWLEDGMENTS

We would like to express our gratitude to the Rector of Mataram University for funding this research through the DIPA BLU (PNBP) research scheme for the fiscal year 2023.

## VII. DISCLOSURE

The author reports no conflicts of interest in this work.

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