



RESEARCH ARTICLE

# Impact of garden land ecosystem on growth, production and reproductive performance of Salem black goats

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## Abstract

Natural green pastures, weeds and tree fodders support commercial goat rearing under semi-intensive system. This study, conducted at Krishi Vigyan Kendra (KVK) in Tiruppur District, Tamil Nadu, aimed to assess the growth, production and reproductive performance of Salem black goats reared under a semi-intensive method in the garden land ecosystem. Data were collected from 10 male and 23 female Salem black goats and analysed. Body weight was recorded at birth and 1, 2, 3, 6, 9, 12 and 15 months of age. The mean ( $\pm$ SE) birth weights of male and female kids were  $2.45 \pm 0.06$  Kg and  $2.12 \pm 0.01$  Kg, respectively. The mean ( $\pm$ SE) weaning weights of male and female kids were  $11.22 \pm 0.36$  Kg and  $9.56 \pm 0.09$  Kg, respectively. Average daily gain (ADG) was calculated based on body weight, with the highest ADG recorded at three months of age-108 g/day for males and 77 g/day for females. The age at first kidding, kidding percentage, kidding rate, twinning percentage and kidding interval of Salem black females were  $14.42 \pm 0.13$  months, 100%,  $1.39 \pm 0.25$ , 39.13% and  $7.760 \pm 0.09$  months, respectively. The overall liveability percentage of Salem black goats in the study was 95.03%. The results indicate that Salem black goats perform well under the garden land ecosystem in arid and semi-arid regions.

## Keywords

garden land ecosystem; production performance; Salem black goat; semi-intensive system

## Introduction

Goat rearing primarily relies on forage crops and open grazing lands as a source of feed and nutrition. However, due to the shrinking availability of grazing land, maintaining goats on grazing alone may not be sustainable. Therefore, goat keeping should gradually transition to strategic semi-intensive and intensive systems. A variety of foliage and tree fodders such as *Moringa oleifera*, *Leucaena leucocephala*, *Glyricidia sepium* and *Azadirachta indica*, contain 15-25% crude protein and play a crucial role in supporting farmers in the garden land ecosystem. A garden land ecosystem is a biological community where plants, animals, insects and microorganisms interact with one another and their environment. Goat rearing in a garden land ecosystem typically includes a shed for housing, fertile land for growing fodder crops and grazing land with natural grasses and weeds.

In Tamil Nadu, goat farming can be integrated with other farming systems, particularly in garden land ecosystems, to enhance productivity and income. This

integration can be achieved by growing fodder crops and trees, allowing goats to graze in open yards with natural plants and weeds and adopting water conservation measures. Goats can thrive on a variety of plants, including thorny bushes, weeds and crop residues. Under proper management, they can contribute to improving and maintaining grazing lands while reducing bush encroachment through biological control, without causing environmental harm.

Goats are multifunctional animals reared for meat, milk, manure and hide. They are a major source of meat production in India and plays a significant role in the country's economy. India ranks eighth in the world in total meat production, with approximately 9.77 million tonnes produced in 2022-23, of which goats contributed 14.47% (1). The country has vast livestock genetic resources, including 34 registered goat breeds. According to the 20<sup>th</sup> livestock census, the total goat population in India was 148.88 million, accounting for 27.8% of the total livestock population. In Tamil Nadu, goat rearing is a very common allied agricultural activity, primarily practiced by small and marginal farmers as well as landless agricultural labours. It plays a crucial role in their livelihoods and helps to alleviate poverty by providing a supplementary income for family.

There are three recognized goat breeds in Tamil Nadu: Kanni Adu, Kodi Adu and Salem black (2-4). These indigenous breeds exhibit significant variations in adaptability, production performance, feeding efficiency and disease resistance. Studies on the performance of indigenous goat breeds in different ecosystems are essential to explore their genetic potential. Therefore, this study was conducted to assess the growth, production and reproduction performance of Salem black goats reared in the garden land ecosystem. The Salem black breed is an important meat goat breed distributed in Salem, Dharmapuri, Krishnagiri, Erode, Karur and Namakkal districts of Tamil Nadu. These goats are tall, with a lean body and a completely black coat. The average adult body weight ranges from 25-40Kg for males and 20-30 Kg for females. Salem black goats exhibit good reproductive potential, characterized by early sexual maturity and prolificacy (5).

Goat productivity under the prevailing extensive production system remains low, as goats primarily depend on degraded common grazing lands, tree loppings and natural vegetation. However, these grazing resources are continuously shrinking. As a result, goat rearing has gradually shifted from conventional extensive systems to more intensive systems. Nutrient-rich grasses with higher crude protein content, such as *Cynodon dactylon*, *Echinochloa colona* and *Sporobolus tremulus* are highly recommended for fodder bank development in the garden land ecosystem. Tree fodders and other natural pasturelands play a crucial role in enhancing the productivity of the Salem black goats. This study focuses on assessing their production behaviour in the garden land ecosystem and the results are discussed.

## Materials and Methods

The study was conducted on Salem black goats maintained at Krishi Vigyan Kendra (KVK) in Tiruppur District of Tamil Nadu, India located at 10°58'N; 77°23'E / 10°97'N; 77°38'E. The KVK is situated on the Palladam-Trichy National Highway at Pongalur village. Tiruppur District lies in the western part of Tamil Nadu, bordering the Western Ghats and experiences moderate climate. The mean maximum and minimum temperature during summer and winter range between 35°C to 18°C, respectively. The average annual rainfall in the plains is 700 mm, with the northeast and southwest monsoons contributing 47% and 28%, respectively, to the total rainfall.

The KVK farm includes 31.7 acres of cultivable garden land, where major crops such as banana, mango and guava are grown alongside 143 coconut trees. Additionally, 1.5 acres are dedicated to fodder cultivation. The primary fodder crops include Cumbu Napier hybrid grass (CO-5), hedge lucerne and fodder sorghum. Tree fodders like *Sesbania* (Agathi) and mulberry is planted as border crops. The grazing area contains *Cenchrus* and natural grasses such as *Cynodon dactylon* and *Echinochloa colona*, along with weeds like *Euphorbia hirta*, *Tridax procumbens* and *Acalypha indica*.

### Rearing system

A semi-intensive system was followed for rearing Salem black goats (5). All goats, except kids (upto one month of age), were allowed to graze in open fields from 9:00 AM to 1:00 PM, while for the remaining hours, they were confined inside the shed. During confinement, the animals were supplemented with concentrate feed and cultivated fodder crops according to their nutritional requirements. Additionally, crop residues obtained from the seed production unit, such as black gram stubbles and groundnut haulms, were stored and supplemented as dry fodder during the lean season. Kids were allowed to suckle freely from their dams until the age of three months.

### Collection of data

Data were collected and analysed from 10 male and 23 female goats for the study. Body weight was recorded at birth, 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup>, 12<sup>th</sup> and 15<sup>th</sup> months to assess the growth performance. Measurements were taken at monthly intervals up to 3 months and subsequently at three months intervals. Based on the body weight, the monthly weight gain was calculated. In females, reproductive parameters such as age at first kidding, kidding interval, kidding percentage, litter size and twinning percentage were recorded to assess the reproductive performance (5).

The incidence of diseases and mortality was also documented as they occurred. The data collected were subjected to standard statistical analysis (6, 7). Body weight is presented as mean ( $\pm$ SE). F-tests were conducted to assess the equality of variances between male and female goat weights. Based on the F-test results, either Welch's t-test (for unequal variances) or Student's t-tests (for equal variances) was performed to compare the mean weights.

## Results and Discussion

### Growth performance

The results for the growth parameters of Salem black goats are given in Table 1 and 2.

### Body weight

The results of the body weight of kids from research studies of different goat breeds under a semi-intensive system are in line with this study (5, 8, 9), with a mean birth weight of  $2.45 \pm 0.06$  Kg for Salem black male kids and  $2.12 \pm 0.01$  Kg for female kids, respectively (Table 1). Male kids were heavier at birth than females in all the above studies and the birth weight significantly affects the average adult body weight. The birth weight of a kid is influenced by genetic parameters, such as breed type and non-genetic factors, such as season, nutrition and parity (9). Birth weight is also influenced by the nutritional status of the dam during pregnancy (10). Single kids were heavier than twins.

The mean ( $\pm$ SE) body weight of Salem black males and females at the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> months was  $5.58 \pm 0.11$ ,  $7.98 \pm 0.16$ ,  $11.22 \pm 0.36$  Kg for males and  $5.18 \pm 0.03$ ,  $7.24 \pm 0.06$ ,  $9.56 \pm 0.09$  Kg for females, respectively. Male and female kids showed almost equal body weight in the 1<sup>st</sup> and 2<sup>nd</sup> month, while during the 3<sup>rd</sup> month, a higher body weight was recorded in male kids. A body weight of  $9.2 \pm 1.4$  Kg for males and  $8.5 \pm 1.49$  Kg for females was recorded at 3<sup>rd</sup> month for Tellicherry goats maintained under an extensive system (9).

A lower weaning weight (3<sup>rd</sup> month) of  $8.6 \pm 0.2$  Kg for males and  $8.5 \pm 0.2$  Kg for females has been reported in their native tract (5). Similar results for lower weaning weight were observed in another study, supporting this research (8). The difference in weaning weight may be due to variations in pasture quality. The mean ( $\pm$ SE) body weight of Salem black male and females at the ages of 6<sup>th</sup>, 9<sup>th</sup>, 12<sup>th</sup> and 15<sup>th</sup> month was  $17.10 \pm 0.32$ ,  $22.03 \pm 0.31$ ,  $25.47 \pm 0.32$  and  $28.09 \pm 0.32$  Kg for males and  $14.34 \pm 0.20$ ,  $18.23 \pm 0.22$ ,  $21.11 \pm 0.31$  and  $23.26 \pm 0.28$  Kg for females, respectively. The results were higher than those obtained previously, indicating that growth performance can be improved beyond their home tract with quality forage (5).

### Body weight gain

The rate of daily body weight gain was similar in both male and female kids for the first two months. However, in the 3<sup>rd</sup> month, male kids showed higher rate of daily body weight gain of about 108 g/day, compared to 77 g/day in female kids (Table 2). In both Salem black males and females, there was a gradual reduction in the rate of daily body weight gain after weaning. This indicates that birth weight of a kid and feeding management prior to weaning have a significant impact on adult body weight.

### Reproductive performance

**Age at 1<sup>st</sup> kidding:** The Salem black female goats attained sexual maturity between the ages of 9 and 11 months. As flock mating was followed, all the does were successfully covered by the buck. The mean ( $\pm$ SE) value of age at first kidding of Salem black females was  $14.42 \pm 0.13$  months and all the females on the farm completed their first kidding within 18 months of life. This result was similar to a previous study (5).

**Kidding percentage:** The kidding percentage of Salem black goats in this study was 100%, meaning all the females mated by the male successfully kidded. No incidence of infertility was observed, as the males were housed and allowed to graze alongside the females. No seasonality was observed in kidding; however more kidding was recorded between January-February and August-September.

**Kidding rate:** The kidding rate is the ratio of the number of kids born to the number of females that kidded. The mean ( $\pm$ SE) kidding rate in the present study was  $1.39 \pm 0.25$ . The result was similar to study, which reported a litter size of  $1.48 \pm 0.13$  (11). A kidding rate of  $1.38 \pm 0.18$  was recorded for Salem black goats maintained under a grazing system, whereas a kidding rate of  $1.50 \pm 0.18$  was observed for goats supplemented with 200 g of concentrate feed (12). This result indicates that the kidding rate of Salem black goats can be increased by supplementing concentrate feed or quality leguminous fodder.

**Twinning percentage:** The twinning percentage of Salem black goats in the present study was 39.13%. This result is higher than the twinning percentage reported for Salem black goats (37.5%) reared under extensive system (12). Whereas only 33.33% was observed for goats reared under a semi-intensive system, however, even under an extensive system Kanni Adu

**Table 1.** Mean ( $\pm$ SE) body weight (Kg)\* of Salem black goats

Sex	0 day	1 Month	2 Months	3 Months	6 Months	9 Months	12 Months	15 Months
Male	$2.45 \pm 0.06$	$5.58 \pm 0.11$	$7.98 \pm 0.16$	$11.22 \pm 0.36$	$17.10 \pm 0.32$	$22.03 \pm 0.31$	$25.47 \pm 0.32$	$28.09 \pm 0.32$
Female	$2.12 \pm 0.01$	$5.18 \pm 0.03$	$7.24 \pm 0.06$	$9.56 \pm 0.09$	$14.34 \pm 0.2$	$18.23 \pm 0.22$	$21.11 \pm 0.31$	$23.26 \pm 0.28$

\*Results were considered significant at a p-value threshold of 0.05.

**Table 2.** Average body weight gain and average daily body weight gain of Salem black goats

Age	Average body weight (Kg)		Average body weight gain (Kg)		Average body weight gain/day (g)	
	Male	Female	Male	Female	Male	Female
At birth	2.45	2.12	-	-	-	-
1 Month	5.57	5.18	3.12	3.06	104.00	102.00
2 Months	7.98	7.24	2.41	2.06	80.33	68.67
3 Months	11.22	9.56	3.24	2.32	108.00	77.33
6 Months	17.1	14.34	5.88	4.78	65.33	53.11
9 Months	22.03	18.23	4.93	3.89	54.78	43.33
12 Months	25.47	21.11	3.44	2.88	38.22	32.00
15 Months	28.09	23.26	2.62	2.15	29.11	23.89

goats recorded the highest twinning percentage of 46.50% (8, 13). These variations may be due to differences in the availability of green fodder, its nutritional value and seasonal effects. Twin births were more common in pluriparous females, though they were not uncommon in primiparous females. This result was lower than the twinning percentage reported for Kanni Adu goats of 46.50% (13).

**Kidding interval:** The mean ( $\pm$ SE) kidding interval for Salem black females observed in this study was  $7.76 \pm 0.09$  months. A kidding interval of 8-10 months for Salem black goats in Tamil Nadu was reported (11). A similar range was noted for Kanni Adu and Kodi Adu (3, 13).

**Disease tolerance and liveability:** During the study period, no incidence of infectious diseases was recorded. However, cases of non-specific enteritis and respiratory tract infections were observed and the animals responded well to treatment. All the affected animals fully recovered from the ailment. The overall liveability percentage of Salem black goats was 95.03%. From these results, it can be inferred that Salem black goats are highly resistant to most infectious diseases affecting small ruminants and thrive well under a garden land ecosystem. This resilience might be due to the high crude protein, crude fiber and dry matter content of the available fodder, tree fodder and grasses, along with weeds in the semi-intensive rearing system, as well as the nutritional impact (14, 15). However, periodical deworming, regular vaccination and maintaining a hygienic environment are necessary to achieve maximum productivity.

## Conclusion

The growth, production and reproductive performance of Salem black goats observed in this study were comparable to the performance of Salem black goats in their native tract. The birth weight and kidding rate were notably higher than those of goats maintained under a grazing system alone. The average daily growth (ADG) of males and females recorded at three months was 108 g/day and 77 g/day, respectively. Hence, it can be concluded that Salem black goats perform well under a semi-intensive rearing system in a garden land ecosystem and the maximum production potential can be achieved with quality pastures and cultivated fodder crops. Furthermore, studies on the production and reproduction performance of Salem black goats in various agroclimatic zones of India need to be conducted in the future to fully explore their utility.

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## Authors' contributions

AS have written the manuscript. GK and CSRK guided to write the manuscript in a proper format and approved the final manuscript. All authors read approved the final manuscript.

## Compliance with ethical standards

**Conflict of interest:** Authors do not have any conflict of interests to declare.

**Ethical issues:** None

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