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PB Meshram
Ph.D Student, Department of Animal Husbandry and Dairy Science, MPKV, Rahuri, Maharashtra, India

SD Mandakmale
Chairman, Ex-Senior Scientist, AICRP on Goat Improvement, (Sangamneri Field Unit) Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

DK Deokar
Senior Scientist, Research Cum Development Project on Cattle, MPKV, Rahuri, Ahmednagar, Maharashtra, India

US Gaikwad
Professor, Department of Animal Husbandry and Dairy Science, MPKV., Rahuri, Ahmednagar, Maharashtra, India

DK Kamble
Head, Department of Animal Husbandry and Dairy Science, MPKV., Rahuri, Ahmednagar, Maharashtra, India

Corresponding Author:
PB Meshram
Ph.D Student, Department of Animal Husbandry and Dairy Science, MPKV, Rahuri, Maharashtra, India

Genetic and non-genetic factors affecting birth weight of sangamneri goat kid at organized farm

PB Meshram, SD Mandakmale, DK Deokar, US Gaikwad and DK Kamble

Abstract
This study investigates the factors influencing the birth weight of Sangamneri goat kids at an organized farm, considering both genetic and non-genetic elements. In order to determine the birth weights of 1596 Sangamneri goat kids, examining the influence of birth period, season, village cluster, and sire. The overall birth weight recorded at the farm was 2.64±0.026 kg. Analysis of variance revealed significant effects on birth weight across different factors. Notably, kids belonging to cluster C_3 exhibited a significantly higher mean birth weight (2.75±0.02 kg) compared to clusters C_1, C_2, and C4. Furthermore, birth weights were highest in period P_3 (2.80±0.034 kg), followed by P_4 (2.78±0.040 kg), P_2 (2.64±0.037 kg), and P_1 (2.219±0.038 kg). The study also identified a highly significant effect (p<0.01) of the sire on birth weight, suggesting a potential correlation with the availability of quality green fodder during the breeding and pregnancy periods. This research provides valuable insights into the factors influencing Sangamneri goat birth weights, contributing to our understanding of optimal breeding and management practices.

Keywords: Growth traits, birth weight, sangamneri, genetic and non-genetic factors

Introduction
Agriculture is a backbone of Indian economy and livestock plays an important role in Indian agriculture, which provides gainful income and employment to millions of people engaged in dairy industry in all parts of the country. In the present scenario of rapidly declining natural resources, goat has tremendous potential to be projected as the 'Future Animal' for rural prosperity that can provide nutritional as well as financial security to millions of deprived people. They are prolific breeders and thrive mainly on wild grasses, tree buds and leaves. They require less care and reproduce quickly as they start to bear kids from the age of one year old. They are polygenic in nature and influenced by environmental factors such as feeding and management. The Sangamneri goat, also known as the Sangamneri Mehsana goat or Mehsana goat, originates from the Sangamner region of Maharashtra, India. This breed is named after its place of origin and has a significant history in the local agricultural community. The Sangamneri goat breed was developed through selective breeding practices aimed at improving meat and milk production in the region. The breed is believed to have emerged from the crossbreeding of local goats with imported breeds, including the Jamunapari and Mehsana breeds. The Jamunapari breed, native to the Uttar Pradesh and Rajasthan regions of India, is known for its large size and excellent milk production. The Mehsana breed, originally from Gujarat, India, is renowned for its adaptability to arid and semi-arid environments, as well as its good meat yield. Birth weight is an economic indicator for any livestock production purpose. There is a positive correlation in birth weight and further increasing of the live weight of animals.

Materials and Methods
In this comprehensive study, birth records of 1596 Sangamneri goats from 28 villages within the breeding tract, including Ahmednagar, part of Nashik, and Pune districts, were meticulously maintained by the All India Co-ordinated Research Project on Goat Improvement (Sangamneri field unit) at the Department of Animal Husbandry and Dairy Science, M.P.K.V., Rahuri, Dist. Ahmednagar (M.S.). The goats were subjected to a feeding management system allowing grazing on various terrains for 6-8 hours daily, supplemented with feeds such as bhusa, turchuni, dry grasses, jowar straw, groundnut leaves, and husk. Green fodder, including Lucerne and Maize, was provided based on availability, while top feeds like *Acacia* spp., Ber,

Shevari, Neem, *etc*., were offered during scarcity periods and the summer season. Housing comprised kutcha floor permanent goat sheds covered with asbestos cement sheets, regularly disinfected and cleaned. Data spanning 16 years (2005-2021) on growth traits birth records categorized by non-genetic factors i.e. season, periods, village clusters, and sire, were collected at the All India Coordinated Research Project on Goat Improvement (Sangamneri field unit), MPKV, Rahuri. The 12-month data were further stratified into three kidding seasons (Winter, Summer, Rainy). Genetic effects were evaluated using Sire = S1…..Sn, and statistical analyses followed the procedures recommended by Harvey (1990) [9], with significance testing conducted through Duncan's multiple range and F Test.

Statistical methods

The data on growth trait was analyzed through mixed model least-squares. To study the effect of various genetic and non-genetic factors on body weight the statistical model used was as under:

Model used for growth traits

$$Yijklm = \mu + Ai + Bj + Dl + eijklm$$

Where,
Yijklm = Observation of mth individual under ith year, jth Season birth/kidding, kth sex and lth cluster of village
μ = Population mean
Ai = Effect of ith period of birth/kidding (i = 1…5)
Bj = Effect of jth season of birth/kidding (j = 1, 2 and 3)
Dl = Effect of lth cluster of village (l = 1…4)
eijklm = Random error NID (∂2 e)

Results and Discussion

Birth weight

The analysis of variance indicating the significance of different effects on birth weight is reported in Table 1. The effect wise least squares means of weight at birth are presented in Table 2. The overall weight at birth in Sangamneri kids recorded at farm was 2.64±0.026 kg.

Data of 1596 birth weight of Sangamneri kids were recorded over the different periods and four clusters. The overall mean for birth weight of Sangamneri kids under field condition was 2.64±0.026 kg. Most of the environmental factors (period, season, village cluster) are responcible for highly significant effects on body weights at different ages.

The similar values were reported by Deshmukh (1996) [6] in Osmanabadi goats. Comparatively higher body weight at birth were reported by Saxena *et al.* (1990) [27] in Jamunapari (3.51±0.08 kg), Kumar *et al.* (1992) [13] in Jamunapari (3.15±0.06), Pander *et al.* (1989) [18] in Beetal (3.10±0.10), Rai *et al.* (2004) [21] in Marwari (3.05±0.05), Swami *et al.* (2006) [32] in Sirohi (2.80±0.03), Singh and Parekh (1985) [37] in Changthangi (2.12±0.01), Singh *et al.* (2002) [28] in BB x B (2.20±0.06), Tyagi *et al.* (1992) [35] in Jakhrana (2.15±0.06), Singh and Singh (2002) [28] in Jakhrana (2.60±0.05), Roy *et al.* (1997) [22] in Jamunapari (2.88±0.06) goats. Syahirah *et al.* (2016) [33] in Crossed boer kids (2.65±0.14) goats. Afzal *et al.* (2004) [1] reported the significant effects on birth weight in beetal goat kids 3.38±0.06 kg.

On the contrary less body weight at birth were reported by Nahardeka *et al.* (2000) [17] in Assam local (1.08±0.02 kg), Saikia *et al.* (2004) [24] in Assam local (1.10±0.03 kg), Mia and Bhuiyan (1997) [16] in Black Bengal (1.35±0.03 kg), Singh and Singh (1998) [29] in Black Bengal (1.45±0.27 kg), Singh *et al.* (2000) [38] in Beetal halfbreds (1.55±0.01 kg), Anonymous (1999) [2] in Osmanabadi (1.76±0.01 kg), Mandakmale (2002) [15] in Osmanabadi (field) (1.84±0.01 kg) and Bobhate *et al.* (2003) [4] in Osmanabadi (1.76±0.03 kg). Therefore, based on the results from the studies, we can conclude that nutrition become main factors on affecting body weights of kids.

The observed variations in birth weights across studies may be attributed to genetic divergence, environmental conditions, and management practices. Understanding these factors is crucial for devising effective breeding and management strategies aimed at enhancing birth weights in Sangamneri goats and other breeds under similar conditions.

Table 1: Analysis of variance of Sangamneri goats at birth weight as affected by non-genetic and genetic factors.

Sources of variation	d.f.	M. S.S	F CAL
Village cluster	3	1.503	5.338**
Period of birth	3	17.004	60.365**
Season of birth	2	0.868	3.080**
Error	1585	0.282	
Total	1594		

* = $p<0.05$, ** = $p<0.01$

Table 2: Least squares means for body weight at birth in Sangamneri goats as affected by non-genetic and genetic factors

Effects	N	Body weight (kg)	
		Mean	SE
Overall	1596	2.641	0.026
Village cluster			
Sangamner (C_1)	478	2.755[b]	0.027
Shrirampur (C_2)	403	2.720[b]	0.029
Rahuri (C_3)	679	2.504[b]	0.025
Belha (C_4)	34	2.385[a]	0.094
Period of birth			
2005-2009 (P_1)	279	2.219[a]	0.038
2009-2013 (P_2)	354	2.649[b]	0.037
2013-2017 (P_3)	503	2.808[c]	0.034
2017-2021 (P_4)	458	2.784[c]	0.040
Season of birth			
Winter (S_1)	877	2.783[c]	0.028
Summer (S_2)	346	2.599[a]	0.036
Rainy (S_3)	371	2.696[c]	0.037

Means under each class in the same column with different superscripts differ significantly

Effect of village cluster

The analysis of variance indicated significant ($p<0.01$) effect of village cluster on birth weight in Sangamneri goat (Table 1). The mean for body weight of Sangamneri kids at birth belongs to cluster C_1 (2.75±0.02 kg) were significantly higher than cluster C_2, C_3 and C_4, while weights of kids belonging to cluster C_2 (2.72±0.02), C_3 (2.50±0.02) and C_4 (2.38±0.09 kg) were at par with each other.

Dudhe *et al.* 2015 [7] reported that the village cluster was highly significant ($p<0.01$) at birth weight. Similarly, Sharma *et al.* (2010) [25] observed highly significant effect of cluster on at birth in Sirohi goats. However, Patil *et al.* (2013) [19] observed highly significant effect on BG at 1 month of age. Kharkar *et al.* (2014) [11] observed a significant effect on BL at birth. Gohain *et al.* (2014) [8] observed highly significant effect of cluster on BG and BH in Assam local goats.

Kuralkar *et al.* (2013) [14] reported highly significant. The lighter weight of multiple birth kids at birth might be due to decreased availability of nutrients due to competition and reduced space in the prenatal development. These differences may be due to the differences in location of dams, managemental practices, or genotype x environment interaction.

Effect of Period of birth

The analysis of variance (Table 1) revealed that period of birth had highly significant (p<0.01) effect on the body birth weight in Sangamneri goat. The birth weight of kids born in Period P_3 (2.80±0.034 kg) was highest and was followed by P_4 (2.78±0.040 kg), P_2 (2.64±0.037 kg) and P_1 (2.219±0.038 kg). The body weight recorded in P_3 was significantly differed from the body weight observed in period P_2 and P_4. Significantly lowest body weight at birth was noticed in P_1 born kids.

The results were in agreement with the findings of Biswas *et al.* (1990) [3] in Chegu, Kumar *et al.* (1992) [13] in Jamunapari, Deshmukh (1996) [6] in Osmanabadi goats, Koul and Biswas (1987) [12] in Black Bengal, Sheikh (1996) [26] in Changthangi, Beetal, Das *et al.* (1998) [39] in Black Bengal and their crosses, Roy *et al.* (2003) [23] in Jamunapari and Rai *et al.* (2004) [21] in Marwari goats in Assam local goats and their crosses with Beetal, Singh *et al.* (2002) [28] in Beetal, Bobhate *et al.* (2003) [4] in Osmanabadi and their crosses, Swami *et al.* (2006) [32] in Sirohi and Beetal x Sirohi goats. Patel *et al.* (2013) [20] Mehsana Goat Kid 2.54±0.025 kg.

The significant differences in body weight among kids born in different periods may be attributed to differences in management, selection of bucks and environmental conditions such as the ambient temperature, humidity, rainfall, *etc.*

The variation in birth weight of kids born in different years reflected variation in level of management, some environmental effects like temperature and humidity and availability of good quality feed in sufficient quantity. The level of management can vary according to the ability of the farm manager, his system of crop husbandry, methods and intensity of culling and his efficiency in the supervision of the farm labor as well as availability of financial resources.

Effect of season of birth

The analysis of variance (Table 1) indicated significant effect (p<0.01) of season of birth on weight at birth. It is clear from the table that the average birth weight of kids was higher during winter season than autumn season. This might be attributed to abundant availability of good quality green fodder during gestation period of does.

The DMRT indicated that the birth weight of kids born in season S_1 (2.78±0.028 kg) was highest followed by S_3 (2.69±0.037 kg) and S_2 (2.59±0.036 kg). The body weight recorded in S_1 significantly differed from body weight observed in season of birth S_2 and S_1 which were at par from each other.

The analysis of variance (Table 1) indicated significant effect (p<0.01) of season on birth on body weight at birth which agreed with Das *et al.* (1995) [5] in Barbari goats, Deshmukh (1996) [6] in Osmanabadi goat in Black Bengal, Singh *et al.* (2002) [28] in Beetal, Balck Bengal and their crossbreds, Mandakmale (2002) [15] under field condition in Osmanabadi goat and Swami *et al.* (2006) [32] in Sirohi goats. Patel *et. al* (2019) [20] revealed that maximum birth weight mehsana goat kid was observed in winter season 2.604±0.022 kg. Jat, *et. al* (2018) [10] in Sirohi Goat significant effect was observed.

The season had significant effect on birth weight of kids. The higher birth weight during the winter season might be due to good quality forage available and more number of kidding than the other season. Reduced feed intake in summer due to scarcity of available fodder may also be another important reason. Growth rate of kids born between December and February was relatively higher than those born in other months and this can result from seasonal changes and suggests that it is necessary to plan the kidding season rationally by controlling the oestrus and mating time.

Effect of sire

Highly significant effect (p<0.01) of sire on body weight at birth was observed in Sangamneri (Table 2). Sire No. 3 showed highest body weight (2.071±0.742 kg) while Sire No. 16 showed lowest body weight (1.26±0.842 kg) at birth in Sangamneri goats.

Table 3: Analysis of variance birth weight affected by sire in Sangamneri goats.

Source of variation	d.f	M.S.S	F CAL
Sire	73	153.427	476.615**
Error	1522	0.322	
Total	1596		

* = p<0.05 ** = p<0.01

Similar results were observed by Roy *et al.* (1997) [22] in Jamunapari goat Yadav and Khada (2009) [36] in Kutchi goats, Rai *et al.* (2004) [21] except on 12 months of age in Marwari goats, Sharma (2005) [40] in Sirohi goats. Significant effect of sire (p≤0.05) at birth was reported by Bobhate *et al.* in Chegu, Afzal *et al.* (2004) [1] in Beetal goats.

The finding was in agreement with the observations of Dudhe *et al.* (2015) [7] reported highly significant at birth and all ages indicating the existence of additive genetic variability among these traits and significant influence of sire might be attributed to relative merits of the sires used. However, non-significant effect of sire was reported by Kumar *et al.* (1992) [13] on birth in Jamunapari Yadav and Khada (2009) [36] on birth in Kutchi goats. Kumar *et al.* (1992) [13] in Jamunapari goats in Cheghu goats. Tomar *et al.* (2004) [34] reported no significant effect of sire on the three morphometric traits.

This indicates that sire contributes significantly in the variability of growth traits, superior sire could be used effectively for further improvement of body weight at different ages in farmer's flock. Hence while redistribution of sires in farmer's flock inferior sires should be culled on the basis of progeny proofs.

Conclusion

In conclusion, higher initial body weight in Sangamneri goats correlates with improved later-stage performance. Sire impact underscores genetic significance, while non-genetic factors, especially feeding and management, heavily influence growth traits. Effective genetic improvement is vital for enhancing Sangamneri goat performance.

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