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Research Article

STUDIES ON BODY GROWTH PATTERN OF BLACK BENGAL GOAT ACCORDING TO AGRO-CLIMATIC ZONES AND REARING PRACTICES IN WEST BENGAL, INDIA.

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ABSTRACT: The present study was carried out to investigate the growth performances of Black Bengal goats reared under four different agro-climatic regions of West Bengal as well as different managerial practices during January 2012 to December'2013. Although birth weight did not show significant (p>0.05) variation irrespective of zones and rearing systems, higher birth weight was recorded in Undulating Red and Lateritic zone (1.149±0.036 kg) and Coastal Saline zone (1.148±0.053 kg) than the Gangetic Alluvial zone (1.115±0.048 kg) and Terai-Teesta Alluvial zone (1.047±0.057 kg). The zone-wise variation of body weights at 0-3 months, 3-6 months, 6-9 months and 9-12 month and above age group remained highly significant (p<0.01). At 0-3 months of age group the highest body weight was recorded in Coastal Saline zone (6.368±0.102 kg), followed by Gangetic Alluvial (5.814±0.126 kg), Undulating Red and Lateritic (5.405 ±0.105 kg) and Terai-Teesta Alluvial region (4.922±0.098 kg). At 3-6 months of age group the highest body weight was recorded in Gangetic Alluvial Zone (8.699±0108 kg), followed by Coastal Saline (8.580±0.088 kg), Undulating Red and Lateritic (7.519±0.096 kg) and Terai-Teesta Alluvial Zone (7.242±0.100 kg). At 6-9 months and 9-12 months and above age the highest body weight was recorded in Coastal Saline zone (11.713 ±0.128 kg and 12.097±0.127 kg) followed by Terai-Teesta Alluvial (10.655±0.186 kg and 11.212±0.389 kg), Gangetic Alluvial (10.577±0.157 kg and 10.928±0.197 kg) and Undulating Red and Lateritic Zone (9.075±0.107 kg and 9.671±0.116 kg). In all the age groups (except at birth) better body growth was observed in case of semi-intensive system of goat rearing.

Key words: Black Bengal, Body weight, Agro-climatic Zones, Rearing Practices.

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INTRODUCTION

The importance of goat farming in the rural economy is evident by its unparallel economic traits, ability to get acclimatized in diversified agro-climatic conditions, fastidious type in choosing of available forage, high prolificacy rate and well acceptability of its meat among all the religions. They can thrive and provide a boost to the rural economy even in areas where it is difficult to raise cows or buffaloes.Black Bengal goat is a small-sized, meat type, early maturing, non-seasonal and prolific breed (Acharya 1982), in eastern and north eastern regions of India (Zeshmarani *et al*., 2007), Bangladesh (Rahman *et al*., 2006) and also in Pakistan (Khanum *et al.*, 2007).The breed is distributed throughout West Bengal and adjoining parts of the neighbouring states, like Bihar, Jharkhand, Orissa, Assam and parts of Tripura. The goat breeds with varying capacities to produce meat, milk and fibre have been developed in India primarily through natural selection and adaptability based on their utility and production performance.

The growth performance of Black Bengal goat varied among the locations of Bangladesh having different environmental conditions (Hussain *et al.*, 1997). In West Bengal, there are six different agro-climatic regions which may influence the productive performance of the breed. But the inference in this regard is still pending due to very minimum attempt of research. Keeping the above facts in view, the present study has been carried out in four agro-climatic regions (Terai-Teesta Alluvial, Gangetic Alluvial, Undulating Red and Lateritic and Coastal Saline) of West Bengal to compare the growth performances of Black Bengal goats under different managerial practices at farmers' door step.

MATERIALS AND METHODS

Study Area

1. Terai-Teesta Alluvial Zone: District-Cooch Behar, Block- Sitalkuchi-

26°10' N and 89°11' E

2. Gangetic Alluvial Zone: District-Nadia, Block-Chakda-23°05' N and 88°31' E.

3. Coastal Saline Zone: District-South 24 Parganas, Block-Gosaba-

22°10' N and 88°48' E.

4. Undulating Red and Lateritic Zone: District-Purulia,Block-Bagmundi-

23°12' N and 86°03' E.

Experimental Period

Data on various managerial practices of Black Bengal goat rearing and productive performance were collected during the period from January, 2012 to December, 2013.

Data Collection Procedures

Considering the need for availability of data and accessibility of the area two Gram Panchayets from each district were identified. From the selected Gram Panchayets, two villages had been selected and 50 respondents were randomly chosen from each village. In this way 200 respondents were covered from each agro-climatic zone which constituted the entire sample size for the present study.

Rearing practices

The most important parameters for rearing practices include Housing System, Grazing habit and feeding system.Data on different rearing systems adopted by the goat keepers were categorized as follows.

a) Extensive system: The animals were left loose to graze over large areas of marginal lands, road side and near the canals where tender grasses were available. At evening the goats were supplied with kitchen wastes such as rice gruel, rice washed water etc (Table-1a).

Table-1a: Feeding pattern of Black Bengal goats under extensive management system in different agro-climatic zones.

Zone	Season wise grazing	Feeding pattern
Terai-Teesta Alluvial	Summer (March-June): 8 am - 12 noon & 3 pm - 6 pm Monsoon (July-Oct): 8 am - 1 pm & 3 pm - 6 pm Winter (Nov-Feb): 10 am-3 pm	In grazing field: Grasses like Durba (*Cynodon dactylon*), Chapla etc and Leaves of Subabul (*Leucaena leucocephala*),Gamar (*Gmelina arborea*) etc. Supplementary feeding: Kitchen wastes such as rice gruel, rice washed water etc.
New Alluvial	Summer (March-June): 7 am - 11:30 am & 4 pm - 6:30 pm Monsoon (July-Oct): 8 am - 12 noon & 3 pm - 6 pm Winter (Nov-Feb): 9 am - 4:30 pm.	In grazing field: Grasses like Durba, Napier (*Pennisetum purpureum*), Guinea (*Megathyrsus maximus*) etc. and Leaves of Kul (*Ziziphus jujube*), Banana (*Musa paradascica*) etc. Supplementary feeding: Kitchen wastes such as rice gruel, rice washed water etc.
Coastal	Summer (March-June): 7 am - 12 noon & 4 pm - 6 pm Monsoon (July-Oct): 8 am - 1 pm & 3 pm - 6 pm Winter (Nov-Feb): 9 am-4 pm	In grazing field: Grasses like Dhani (*Leersia hexandra*), Giria (*Suaeda maritiana*), Hybrid Napier (*Pennisetum perpureum X Pennisetum americarnum*), Paragrass (*Urochloa mutica*), Durba (*Cynodon dactylon*) etc. Supplementary feeding: Kitchen wastes such as rice gruel, rice washed water etc.
Red & Lateritic	Summer (March-June): 7 am - to 10 am & 4 pm - 6 pm Monsoon (July-Oct): 8 am - 12 noon &3 pm - 5 pm Winter (Nov-Feb): 10 am - 4 pm	In grazing field: Grasses like Durba, Gama (*Tripsacum dactyloides*) etc. and leaves of Sal (*Shorea robusta*), Kul, Banyan (*Ficus benghalensis*) etc. Supplementary feeding: Kitchen wastes such as rice gruel, rice washed water etc.

Table-1b: Feeding pattern of Black Bengal goats under semi-intensive management system in different agro-climatic zone.

Zone	Season wise grazing	Feeding pattern
Terai-Teesta Alluvial	Summer (March-June): 8 am - 12 noon & 3 pm - 6 pm Monsoon (July-Oct): 8 am - 1 pm & 3 pm - 6 pm Winter (Nov-Feb): 10 am - 3 pm	In grazing field: Grasses like Durba, Chapla etc. and leaves of Subabul, Gamar etc. Supplementary feeding: Leaves of Jackfruit (*Artocarpus heterophylus*), Neem (*Azadirachta indica*), Subabul, Gamar etc. Boiled Rice offal @ 300-400 ml.
New Alluvial	Summer (March-June): 7 am - 11:30 am & 4 pm -6:30 pm Monsoon (July-Oct): 8 am - 12 noon & 3 pm - 6 pm Winter (Nov-Feb): 9 am - 4:30 pm	In grazing field: Grasses like Durba, Napier, Guinea etc. and leaves of Kul, Banana etc. Supplementary feeding: Leaves of Jackfruits, Subabul, Lambu (*Swietenia hybrida*) etc. Paddy Straw in variable amount. Boiled Rice offal @ 200-300 ml daily. Concentrate mixture of broken rice, broken wheat, Til bran, Rice bran @ 150-200 gm daily.
Coastal	Summer (March-June): 7 am - 12 noon & 4 pm - 6 pm Monsoon (July-Oct): 8 am - 1 pm & 3 pm - 6 pm Winter (Nov-Feb): 9 am - 4 pm	In grazing field: Grasses like Dhani, Giria, Hybrid Napier, Paragrass, Dhup etc. Supplementary feeding: Leaves of Jackfruits, Subabul etc. Concentrate mixture of Oilseed cake, Broken rice, Broken wheat, Rice bran @ 200-250 gm daily.
Red & Lateritic	Summer (March-June): 7 am - 10 am & 4 pm - 6 pm Monsoon (July-Oct): 8 am - 12 noon & 3 pm - 5 pm Winter (Nov-Feb): 10 am - 4 pm	In grazing Field: Grasses like Durba, Gama etc. and leaves of Sal, Kul, Banyan etc. Supplementary Feeding: Leaves of Ficus (*Ficus benjamina*), Kalo Jam (*Syzygium cumini*), Pamkin (*Cucurbita pepo*), Jack-fruit, Mango (*Mangifera indica*) *etc.* Boiled rice offal @ 150-200 ml daily. Concentrate mixture of Broken rice, Broken wheat, Til bran, Rice bran etc. @ 100-150 gm daily.

a) Semi-intensive system: In this systemthe goats were sent for grazing and at evening fed with concentrate feeds etc (Table-1b).

Body Weight

The body weight was recorded for the kids at birth, 0-3 months, 3-6 months, 6-9 months and 9-12 months and above age by using spring balance.

Statistical Analysis

The data related to growth of goats were classified according to agro-climatic zones as well as rearing practices at different ages and were analysed following Least Squares Analysis method as described by Snedecor and Cochran (1967) and the variables varies significantly were denoted by superscripts as per Duncan's

Table - 2a: Least Square ANOVA of different parameters on Body Weight of Black Bengal goats at different age.

Body weight		Agro-climatic zones	Rearing system
Birth weight	df	3	1
	SS	0.182	0.001
	MS	0.061	0.001
	F	0.995	0.023
0-3 months body weight	df	3	1
	SS	228.222	6.163
	MS	76.074**	6.163
	F	37.432	3.032
3-6 months body weight	df	3	1
	SS	450.744	0.976
	MS	150.248**	0.976
	F	62.174	0.404
6-9 months body weight	df	3	1
	SS	1225.491	242.416
	MS	408.497**	242.416**
	F	86.719	51.462
9-12 months body weight	df	3	1
	SS	1175.588	77.594
	MS	391.863**	77.594**
	F	64.783	12.828

** Indicates Significant at 1%

Table - 2b: Agro-Climatic Zone wise Body Weight (Kg) of Black Bengal goats (Mean±SE) at different ages.

Agro-Climatic Zone	Body weight (in Kg.)				
	At Birth	At 0-3 Month	At 3-6 Month	At 6-9 Month	At 9-12 Month & above
Terai-Teesta Alluvial	1.047±0.057 (27)	4.922±0.098^{d} (213)	7.242±0.100^{c} (248)	10.655±0.186 ^{b} (138)	11.212±0.389^{b} (40)
Gangetic Alluvial	1.115±0.048 (36)	5.814±0.126^{b} (160)	8.699±0.108^{a} (278)	10.577±0.157 ^{b} (246)	10.928±0.197^{b} (193)
Coastal Saline	1.149±0.036 (77)	6.368±0.102^{a} (204)	8.580±0.088^{a} (328)	11.713±0.128^{a} (302)	12.097±0.127^{a} (401)
Red & Lateritic	1.148±0.053 (30)	5.405±0.105^{c} (202)	7.519±0.096^{b} (288)	9.075±0.107^{c} (456)	9.671±0.116^{c} (508)
Over all Mean	1.115±0.028 (170)	5.627±0.054 (779)	8.010±0.050 (1142)	10.50±0.074 (1142)	10.977±0.118 (1142)

Means bearing same superscripts (a, b, c, d) within a column do not differ significantly.
Values given in parenthesis are the number of observations.

Multiple Range Test.

Least Squares Analysis Model:

$Y_{ij} = \mu + A_i + e_{ij}$

Where, Y_{ij} is the observation on the j^{th} individual in i^{th} Agro-climatic Zone.

μ = General effect (Overall mean common to all observations);

A_i = Effect of the i^{th} Agro-climatic Zone (i=1, 2, 3, 4);

e_{ij} = Random error assumed to be normally distributed with zero mean and variance,$\acute{o}^2_e$

RESULTS AND DISCUSSION

The farmers of the study area rear goat mainly for meat purpose. Therefore, body weight of goat is an important criteria to determine their (farmers) socio-economic security.

Effect of Agro-Climatic Zones on birth weight of Black Bengal goats:

In our study no significant variation in birth weight of Black Bengal goats was recorded among different agro-climatic zones (Table 2a and 2b and Figure 1). But in Undulating Red and Lateritic zone and Coastal Saline zone to some extent higher birth weight was recorded (1.149±0.036 kg and 1.148±0.053 kg respectively) than Gangetic Alluvial zone (1.115±0.048 kg) and Terai-Teesta Alluvial zone (1.047±0.057 kg). The present finding agreed with earlier observations of Hussain *et al.* (1992) and Gokhale *et al.* (1996).

Effect of Agro-Climatic Zones on Body Weight at 0-3 months of age:

In this study, a highly significant ($p<0.01$) variation of body weight at 0-3 months of age was observed (Table 2a and 2b and Figure 1)

Table - 3: Effect of Rearing System on Body Weight (Kg) of Black Bengal goats (Mean±SE) at different ages.

	Body weight (in kg)				
Rearing System	**Birth Wt.**	**At 0-3 month**	**At 3-6 month**	**At 6-9 month**	**At 9-12 month & Above**
Semi-Intensive	1.109±0.050 (95)	5.737±0.068 (487)	8.046±0.060 (747)	11.060±0.088[a] (750)	11.282±0.130[a] (704)
Extensive	1.121±0.045 (75)	5.517±0.096 (292)	7.974±0.088 (395)	9.950±0.124[b] (392)	10.672±0.159[b] (438)
Over all Mean	1.115±0.028 (170)	5.627±0.054 (779)	8.010±0.050 (1142)	10.505±0.074 (1142)	10.977±0.118 (1142)

Means bearing same superscripts (a, b) within a column do not differ significantly.
Values given in parenthesis are the number of observations.

within the agro-climatic zones which was found to be highest in Coastal Saline zone (6.368±0.102 kg), followed by Gangetic Alluvial (5.814±0.126 kg) then by Undulating Red and Lateritic (5.405 ±0.105 kg) and lastly in Terai-Teesta Alluvial region (4.922±0.098 kg).This observation was more or less same with the finding of Mishra and Sinha (2001).

Effect of Agro-Climatic Zones on Body Weight at 3-6 months of age:

The results revealed (Table 2a and 2b and Figure 1) that body weight at 3-6 months of age was significantly ($p<0.01$) highest in Gangetic Alluvial Zone *i.e.* 8.699±0.108 kg, followed by 8.580±0.088 kg, 7.519±0.096 kg and 7.242±0.100 kg in Coastal Saline, Undulating Red and Lateritic and Terai-Teesta Alluvial Zone respectively. However, the difference between Gangetic Alluvial and Coastal Saline Zone were insignificant. The study of Gokhale *et al.* (1996) was correlated with the present study.

Effect of Agro-Climatic Zones on Body Weight at 6-9 months of age:

The body weights of Black Bengal goats at 6-9 months of age in four agro-climatic zones of West Bengal also varied ($P<0.01$) (Table 2a and 2b and Figure 1) and the highest body weight was recorded in Coastal Saline zone (11.713 ±0.128 kg) followed by 10.655±0.186 kg, 10.577±0.157 kg and 9.075±0.107 kg in Terai-Teesta Alluvial, Gangetic Alluvial and Undulating Red and Lateritic Zone respectively. However the difference between Terai-Teesta Alluvial and Gangetic Alluvial zone was statistically insignificant.

Effect of Agro-Climatic Zones on Body Weight at the age of 9-12 months and above:

The zone-wise variation in body weight at 9-12 month of age was statistically highly significant ($P<0.01$) as presented in Table 2a and 2b and Figure 1. At 9-12 months of age body weight of Black Bengal goats in Coastal Saline zone was highest i.e. 12.097±0.127 kg followed by Terai-Teesta Alluvial zone (11.212±0.389 kg) and in Gangetic Alluvial and

Figure 1:- Effect of Agro-Climatic Zone on Body Weight (Kg) of Black Bengal Goat at different age groups

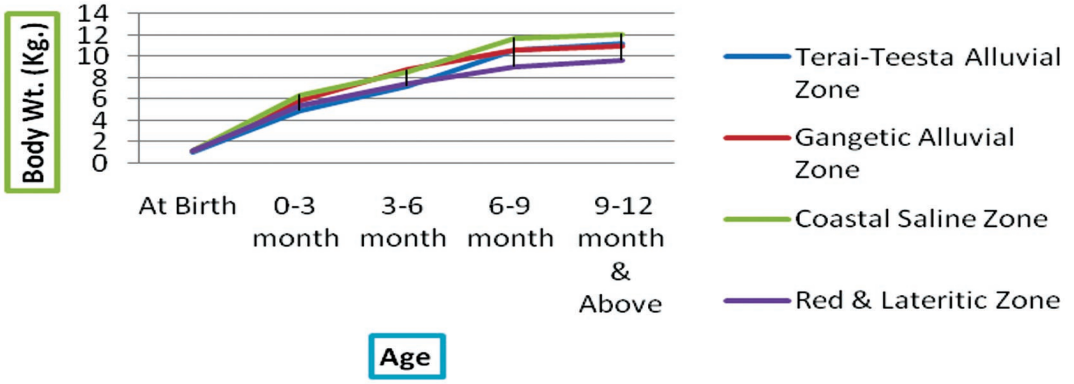
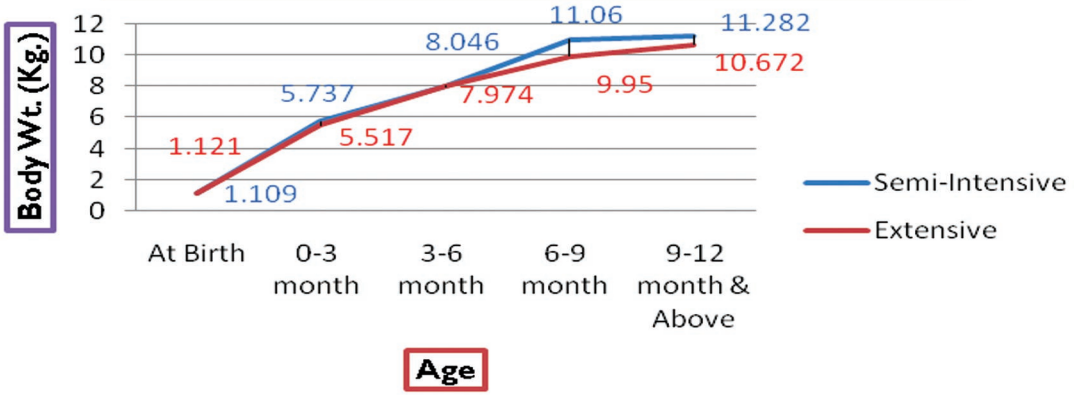


Figure 2:- Effect of Rearing Practices on Body Weight (Kg) of Black Bengal Goat at different age groups



Undulating Red and Lateritic Zone (10.928±0.197kg and 9.671± 0.116 kg). It was evident from the current study that the Terai-Teesta Alluvial and Gangetic Alluvial zone had insignificant variation but was significantly different from Coastal Saline and Undulating Red and Lateritic Zone. The Coastal Saline and Undulating Red and Lateritic Zone also differed with each other significantly.

Better body growth of goats in coastal saline zone might be due to availability of plenty native grasses and shrubs in barrel lands as well as in fellow lands between trees, which are potential source of food to goats. This also indicated that more care hadbeen taken by the farmers in that region.

Effect of Rearing Practices on Body weight at Birth:

In the present study average birth weight of Black Bengal kids was recorded as 1.121±0.045

kg and 1.109±0.050 kg for extensive and semi-intensive system of rearing respectively (Table 3 and Figure 2). They did not differ (P>0.05). However earlier workers (Faruque *et al*., 2010 and Halim *et al*., 2011) reported that semi-intensive system of rearing is having better birth weight than that of extensive system of goat rearing.

Effect of Rearing Practices on Body weight at 0-3 months of age:

Body weights of kids at 0-3 months of age under different systems of rearingshowed higher body weight (P>0.05) under semi-intensive system of rearing (5.737±0.068 kg) than the extensive system of rearing (5.517±0.096 kg) (Table 3 and Figure 2).

Effect of Rearing Practices on Body weight at 3-6 months of age:

Numerically higher (P>0.05) body weight of goats at 3-6 months age group was recorded under semi-intensive system (8.046±0.060 kg) than the extensive system (7.974±0.088 kg) (Table 3 and Figure 2). Singh and Khan (1989) also observed the same result in case of Black Bengal and Beetal crosses.

Effect of Rearing Practices on Body weight at 6-9 months of age:

At 6-9 months of age the weight of Black Bengal goats under semi-intensive system was higher (11.060±0.088 kg) than the extensive system of rearing (9.950±0.124 kg) as presented in Table 3 and Figure 2. Semi-intensive management system therefore, produced heavier goat (p<0.01) at 6-9 months of age.It might be noteworthy in this context that the farmers of the study area were used to market their goats in this age group.

Effect of Rearing Practices on Body weight at 9-12 months and above age:

Analysis of variance revealed that the system of rearing had highly significant (p<0.01) effect on the body weight at the age of 9-12 months and above (Table 3 and Figure 2). Semi-intensive system of rearing showed better result (11.282±0.130 kg) than that of extensive system of rearing (10.672±0.159 kg).

Two possibilities can account for differences in body weights of Black Bengal goats raised under semi-intensive and extensive system of management. In extensive system kids went to pasture daily with dams, which increased their maintenance requirements. It is well established that grazing animals expend more energy than the animals in confinement (Lachica and Aguilera 2005), for two main reasons. First, in the stall, food is offered in a partially processed form, which makes it easier to ingest and digest. In addition, an animal in a stall does not have to move to search for food. Second, as Blaxter (1967) suggested, the high maintenance requirements of sheep in pastures may be due to an increased cost of body movement in the pasture, especially the cost of walking and harvesting herbage. As extensive system goats did not receive any feed supplements, their growth were lower than in semi-intensive system goats, and thus, these kids showed a lower body weight with advancement of age.

CONCLUSION

Body weight of Black Bengal goat has been estimated based on agro-climatic zones and management practices. Birth weight did not show any significant variation irrespective of zones and rearing systems.Body weight at subsequent age groups were found to be higher (p<0.01) in coastal saline zone except at 3-6 months age groups, where Gangetic Alluvial Zone had the greater value.Semi–intensive management system had resulted into heavier (p<0.01) goat weight at 6-9 months, and 9-12

months and above age groups. However, the present findings are limited by time and work area. A larger surveyed population with long elapse of time may reveal more strong interactions which can serve to re-establish the optimum agro-climatic conditions and rearing practices for Black Bengal goat.

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