Studies on post weaning growth performance of Black Bengal goat under different system of management

A Thesis

Submitted to the
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in partial fulfillment of the requirement
for the Degree of Master of Veterinary Science
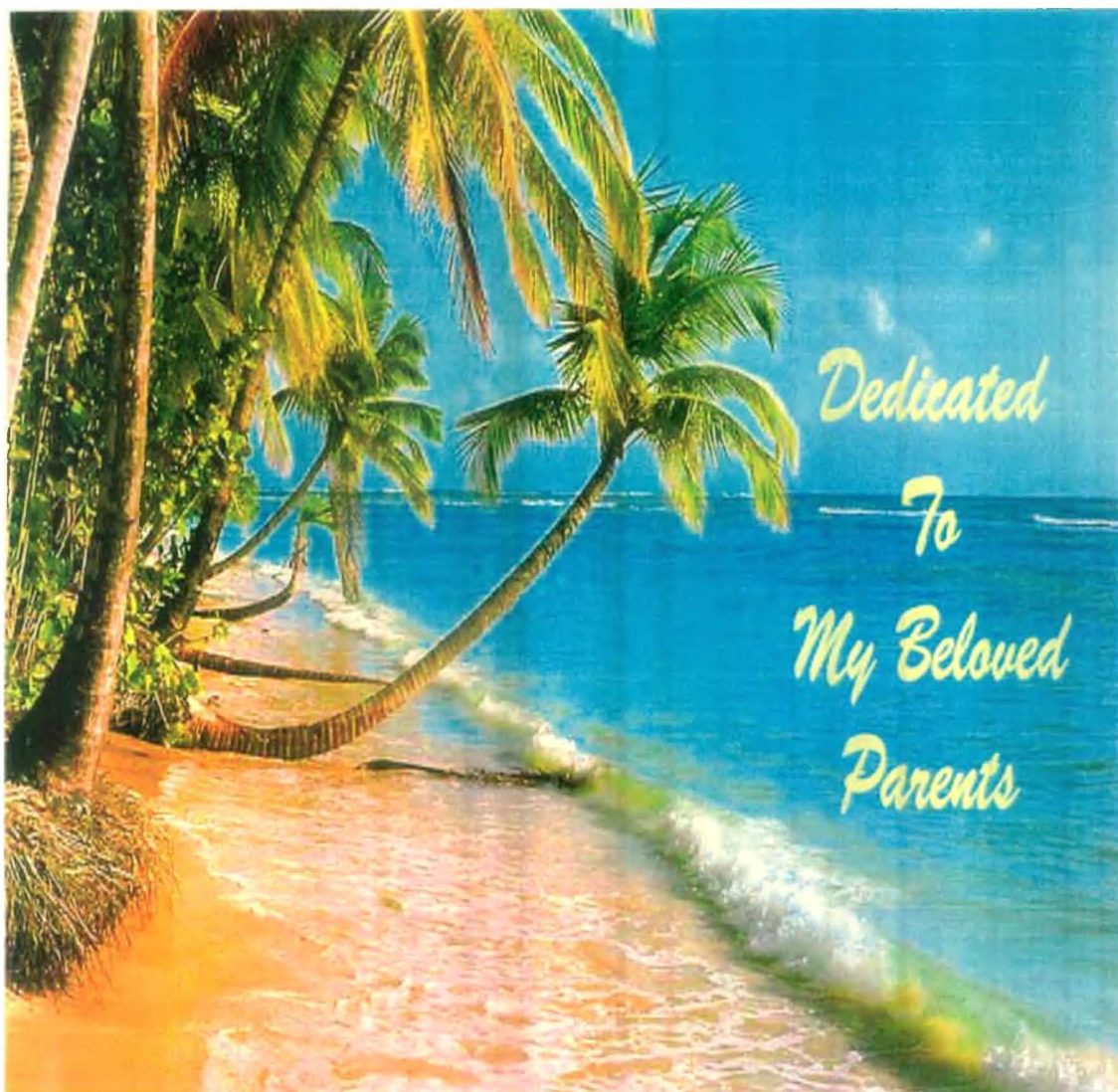*in*
Animal Production and Management

By

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DEPARTMENT OF ANIMAL PRODUCTION AND MANAGEMENT

2006

Dedicated

To

My Beloved

Parents

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We, the undersigned, having been satisfied with the performance of Miss Hidam Anjali Devi, in the Viva – Voce Examination, conducted today, the .08.09.06.... 2006, recommended that the thesis be accepted for the award of the Degree of Master of Veterinary Science in Animal Production and Management.

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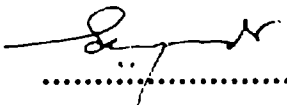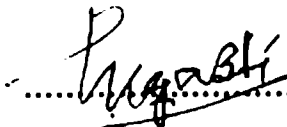   Advisory Committee

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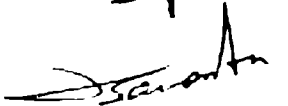   Advisory Committee

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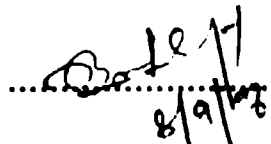   Advisory Committee

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Certificate

*This is to certify that the work embodied in the thesis entitled **"Studies on post weaning growth performance of Black Bengal goat under different system of management"** submitted by **Miss Hidam Anjali Devi** in partial fulfillment of the requirement for the Award of the **Degree of Master of Veterinary Sciences in Animal production and Management** of the **West Bengal University of Animal and Fishery Sciences, Belgachia, Kolkata is the faithful and bona-fide research work carried out** under my personal supervision and guidance.*

It is further certified that the results of the investigation reported in this thesis have not so far been submitted for any other degree or diploma to any University/Institute.

The assistance and help received during the course of investigation have been duly acknowledged.

(Dr. A. K. Samanta)
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Dated 17th August, 2006
Belgachia, Kolkata

Acknowledgement

I greatly appreciate the care, patience, skill and meticulous typing of this manuscript by Dr.A.K.Samanta and Mr.Raju of Apex computer center.

Last but not the least, I express my sincere gratitude, indebtness and affection to my parents for their blessing and sacrifice throughout my life which immensely has helped me to reach upto this of my life. I also want to put my sincere gratitude and affection to my only brother Hidam Armstrong and to my well wishers.

Dated : 17th August, 2006

Place : Belgachia, Kolkata

(HIDAM ANJALI DEVI)

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List of Abbreviations

AICRP-G	All India Co-ordinated Research Project on Goat improvement
BHTI	Benezera Heat Tolerance Index
BL	Body Length
Cm	Centimeter
CG	Chest girth
DSI	Dairy Search Index
°C	Degree centigrade
Fig	Figure
G	Gram
HE	Height at elbow
HR	Height at rump
HS	Height at stifle
H	Mean humidity
HW	Height at wither
IHI	Iberia heat tolerance index
Kg	Kilogram
Km/h	Kilogram per hour
MTR	Mean total rainfall
MT	Metric tonnes
mm	Millimeter
NC	Neck circumference
PG	Paunch girth
%	Percent
SE	Standard error
TM	Maximum temperature
T	Mean temperature
Tm	Minimum temperature

Chapter I

Introduction

Introduction:

India possesses an enormous goat population numbering 124.5 million (FAOSTAT, 2003), 17% of the world. The annual growth rate of the population shown fluctuating trend varied from 0.72% (1966-1972) to 5.20% (1977-1982) with an average growth rate of 3.49% during 1951-1997.

As per livestock census (Dept. Of A.R.D., Govt. of West Bengal) the goat population in West Bengal in the year 2003 – 2004 was estimated to be 18.77 millions with the annual growth rate of about 8 percent. The year wise goat population are :–

Goats	1951	1961	1972	1982	1989	2000-01	2003-04
Total	4031000	4513000	5211446	10996394	11890278	17224707	18774270

India has rich diversity of goat breeds with varying capacities to produce meat, milk, fiber and skin etc. These breeds have been developed mainly through natural selection, isolation and adopted to diverse agro-climatic conditions. Goat diversity provides a dependable source of income to 40% people living at marginal and below poverty line. It is the choice of animal due to small size, high fertility rate, ability to utilize a wide range of feed and fodder resources, low initial investment and good remunerations (Singh,2003). Goat provides multiple products like meat (chevon), milk, skin, fiber, manure and transport. The father of the nation, Mahatma Gandhi has given privileged position to goat by calling it "poor man's cow".

There are 351 breeds of goats in the world, out of which 22 breeds are found in India. India can be considered into four regions on the basis of population size of goats viz. North-western and Central Arid / Semi-Arid region, Southern Peninsular Region, Eastern Region and Northern Temperate Region (Acharya,1982). The highest concentration of goats is found in North-western Region (39%), followed by Eastern Region (32%). Southern Peninsular Region (26%) and Northern Temperate Region (2%).

Small ruminants make an important contribution to the sustenance of small and marginal land holders and landless rural people by their contribution towards marketable commodities such

as meat, milk, fiber and skin. They are referred as the "Bank of hooves" providing a cash buffer to the small farmers livelihood.

All the breeds of goat to a greater extent are meat breeds, however, some breeds are reared for milk and fibre production. There is no clear-cut distinction between meat and milch breed. Milch breeds are also used for meat purpose. Thus the definition of a meat breed will largely confined in two characteristics, viz., pre-slaughter body weight and dressing percentage. On the basis of body size, the breeds can be classified into three groups, viz., large, medium and small (Acharya et al.,1982). The contribution of chevon is slightly higher as compared to mutton production towards Asia and world's chevon production as the chevon production in India was 4.47 million tonnes in 2003,which is only 17.1 and 12.2% of Asia and world's production. The goat meat contributes 9.96% in terms of India's total meat production. The chevon production has registered an increase from 0.45 to 0.47 million tones during 1996 to 2003, which is 0.63% per year, thereby indicating an identical progress in production of goat meat over the years.

The goat population, slaughter rate and meat production in India over the years has been presented below:

Year	Goat population (million)	Goat Slaughtered (million)	Percent Slaughter	Meat (MT)	%increase /year	Meat (kg/animal)
1961	60.86	23.50	38.61	235,000		10
1966	64.59	24.20	37.47	242,000	0.60	10
1971	67.03	24.40	36.40	244,000	0.16	10
1976	74.00	26.73	36.12	267,300	1.91	10
1981	91.00	31.26	34.35	312,600	3.39	10
1986	102.87	37.03	36.00	370,000	3.69	10
1991	114.20	43.40	38.00	434,000	3.44	10
1996	119.48	45.40	38.00	454,000	0.92	10
2000	123.00	46.70	37.98	467,000	0.72	10
2003	124.5	47.30	37.99	473,000	0.43	10

The ultimate objective of goat production is to maximize profit with available resources. Efficiency of any production system should always be considered under prevailing socio-economics, cultural conditions, utilization of local resources and profit. Goats are opportunistic foragers and can be maintained on variety of diets under diverse conditions. In India goats are reared by resources poor people on zero input, however, some relatively resourceful farmers (10-20%) also maintained more productive goats of their flocks under semi-intensive / stall-feeding production system. Farmer's housed goats in kutcha sheds are temporary shelters made up of thorny shrubs and bushes mainly protect them from wild animals. Bucks are proportionally less in number, normally stayed with flock throughout the year. Goat keepers who followed extensive production system prefer kidding once in a year for an adjustment of seasonal availability of feed resources. Indigenous goat breeds have an immence production potential, however, their optimum potential has not expressed due to subsistence production system (Rai and Singh, 2005; ISGP-Report, 1992).

An attempt has been made to critically examine the various management system and their effects on the growth, adaptability and carcass performance in Black Bengal goat under extensive and semi-intensive system in the Agro climatic condition of West Bengal. The best production system varies in different agro-ecological zone depending upon availability of local resource, agro-ecological conditions, culture and socio-economics of goat keepers but mostly determined not by productive efficiency but profit. Three type of management system with overlapping characters are normally practiced in India. These managemental system are Extensive production system, Intensive production and semi-intensive production system.

Extensive Production System:

This system is characterized by low-input & low-output system. This system is integrated with arable crop, tree, shrubs, herbs, etc. There is minimum investment on housing, feed and health care.

Semi-intensive production System:

Goats were allowed to graze for 5-8 hours in pasture land and further requirement were meet out through supplementation of concentrate. It is less expensive as compared to intensive production system. Supplementation of traditional feeding with concentrate promote growth and milk production as dry matter energy intake is positively associated with production.

Intensive production system

It is characterized by high input and high output and usually practiced for high potential animals. It involves cultivated fodder with zero grazing; low forage and high plane of concentrate diet.

The present study work is undertaken by recording data from field units of AICRP, Black Bengal goat field unit with the following objective: -

a) To study the post weaning growth performance of Black Bengal Goat under extensive i.e. grazing and tethering & semi-intensive system of management.

b) To study the climate adaptability of Black Bengal Goat under extensive i.e. grazing and tethering & semi-intensive system of management.

c) To study the carcass quality at marketing age of Black Bengal Goat under extensive i.e. grazing and tethering & semi-intensive system of management.

Chapter II

Review of literature

Review of literature:

The references regarding growth, thermal adaptability & carcass character under different managemental practices have been reviewed which have been presented below.

2.0 Growth study :

The review of body weight , body measurement & gain in weight of Black Bengal goats under different managemental practices have been summarized below.

2.1 Body weight in different age groups:

Ali et al. (1973) reported birth weight averaged 1.60 lb and weaning weight averaged 19.50 lb in Black Bengal kids.

Senegar (1978) reported the average body weight at 3 months, 6 months, 9 months and 12 months of age of male Black Bengal goat as 4.64kg, 6.64 kg, 11.76 kg and 12.35 kg respectively.

Mukherjee et al. (1979) recorded body measurements of gray & Brown Bengal goats at 3-months & 6-months are tabulated below:

Age group	Breed	Body weight(kg)	Body length(cm)	Height at wither(cm)	Chest girth(cm)
0-3 months	Gray	6.1±0.44	30.4±0.91	35.6±0.94	38.6±1.16
	Brown	5.1±0.39	29.1±0.89	34.7±0.87	36.5±0.06
3-6 months	Gray	11.5±0.48	40.2±0.83	45.8±0.82	55.4±0.79
	Brown	11.6±0.69	40.8±0.73	47.2±0.67	50.8±0.79

The average body weight of Brown Bengal goats maintained under different agro-climatic zones of Bihar from 6 months to 1 year of age was 15.6±1.38 kg (Mukherjee et al., 1980).

Singh and Sahani (1980) reported the mean body weight at 3 months, 6 months, 9 months and 12 months of age in male Black Bengal goat to be 5.05 kg, 6.78 kg, 8.23 kg and 11.44 kg respectively.

Acharya (1982) reported body weights of Bengal goat at birth; weaning & 9 month of age were 1.31±0.01, 6.09±0.10 & 8.80±0.11 kg, respectively at Eastern India.

Acharya et al. (1982) reported average body weight at 3 months and 12 months age in Black Bengal goat to be 4.75 ± 0.14 kg and 12.08 ± 0.10 kg respectively.

Kumar and Singh (1983) recorded body measurements of Black Bengal goats and its cross with Jamunapari at birth, 1-month, 4-month, & 6-month of age are tabulated below:

Breed / Breed cross	Parameters	Age (months)				Place
		Birth	1	4	6	
Black Bengal	Body weight (kg)	1.21±0.07	2.74±0.12	5.76±0.25	7.82±0.38	
	Body length (cm)	22.88±0.27	30.22±0.39	37.96±0.59	42.31±0.75	
	Height (cm)	26.67±0.41	32.58±0.41	40.25±0.61	43.52±0.72	Bihar
	Chest girth (cm)	25.13±0.33	32.47±0.47	41.84±0.59	44.41±0.78	
Jamunapari x Black Bengal	Body weight (kg)	1.32±0.04	3.07±0.12	6.84±0.30	9.96±0.42	
	Body length (cm)	24.98±0.52	32.76±0.30	41.19±0.38	46.08±0.65	
	Height (cm)	28.02±0.43	34.48±0.45	43.63±0.66	47.54±0.64	
	Chest girth (cm)	26.51±0.33	33.72±0.44	43.69±0.53	48.21±0.63	

In a study of growth rate in Black Bengal goat at Ranchi Veterinary College, Singh et al. (1983) obtained body weight at birth to be 1.3 kg and 1.2 kg in male and female kid respectively. The authors also studied the body weight at 48 weeks of age and found to be 11.4 kg and 10.9 kg in male and female goat respectively. Only significant difference of body weight due to was found in 48 weeks of age.

Sinha and Sahni (1983) reported that the averaged birth weight of Jammunapari, Beetal, Barbari and Black Bengal to be 2.97±0.13, 2.76±0.51, 1.84±0.22 and 0.98±0.10 kg respectively.

Saini et al. (1986 a) found that the body weight of Jamunapari kids reared under intensive, semi-intensive and extensive system of management at 180 days of age were 15.49, 15.16 &14.95 kg respectively.

Saini et al. (1986 b) reported that the body weight of Barbari kids of 6 months of age reared under intensive, semi-intensive & extensive system were 15.80±0.88, 14.25±1.01 and 13.03±0.76 kg respectively and they also reported that average growth rate per day was 61, 45 & 30 g respectively.

Malik et al. (1986) reported 3-month, 4-month & 6-month body weight of Black Bengal and its cross with Beetal at Haryana:

Breed / Breed cross	Body weights (kg) at			Place
	3 month	4 month	6 month	
Black Bengal	8.01±0.09	8.94±0.14	10.59±0.29	Haryana
Beetal x Black Bengal	8.37±0.12	9.67±0.19	11.10±0.37	
Beetal x Black Bengal	8.50±0.12	9.73±0.18	11.35±0.36	

Ganjam breeds of goats under field condition in Orissa at 9 months of age had a body weight of 12.41±0.18 kg and daily weight gain of 29.11 g (Pantro and Mishra, 1987).

Pantro and Mishra, (1987), also recorded the physical & economic characters of 723 Ganjam goats reared in village of Orissa. From birth to 24 months of age and they reported that there was an increase in live weight accompanied by a decrease in the live weight gain with an increase in age (P<0.01). However, they reported that the increase in live weight was fast upto 9 months and decrease in live weight gain was sharp beyond this age.

Mittal (1988), reported that the mean body weight of Marwari kids at birth, 3 months, 6 months, 9 months, 12 months & full grown adults was 2.35±0.15, 10.50±0.82, 12.73±0.42,

17.20±1.05, 20.51±1.60 and 39.71±1.72 kg in males and 2.02±0.21, 9.55±0.13, 10.40±0.36, 12.42±1.55, 15.93±2.17 and 28.74±2.02 kg in female respectively.

Patnaik and Nayak (1988) reported at Orissa the body weight of Black Bengal goat at birth, 3 month & 12 month were 1.52±0.06, 5.85±0.43 & 9.29±0.52 kg, respectively.

According to Kanujia and Pander (1988) body weights of Black Bengal and its cross with Beetal at different ages were:

Breed / Breed cross	Body weights (kg) at			
	Birth	3 months	6 months	12 months
Black Bengal	1.13±0.03	5.41±0.06	7.96±0.14	12.12±0.23
Beetal x Black Bengal	1.42±0.03	6.38±0.13	10.00±0.22	15.87±0.04
Black Bengal x Beetal	2.26±0.04	8.62±0.23	12.23±0.32	18.45±0.61

Saini et al.(1988) in Uttar Pradesh occurred that growth rate of Barbari goatling were significantly lower under extensive system than under intensive system during the 6-9 months of age period, and in the Jamunapari kids the growth rate was significantly lower under extensive system than in both semi-intensive & intensive system during the 6-9 months of age period.

Bhattacharya (1989) observed the weighted means with standard errors for the body weight (kg) in Bengal breed. He observed that body weight at birth, 3 month, 6 month, 9 month and 12 month were 1.20±0.30, 4.60±0.11, 7.20±0.15, 9.40±0.20 and 11.40±0.23 respectively.

Gupta et al. (1989) studied on the body weight of male and female Black Bengal at birth and 16 weeks and observed to be:

Age	Weight of male (kg)	Weight of female (kg)
0 day	1.13	1.04
16 weeks	5.48	5.17

He reported that the body weight at 16 weeks of age was not influenced by sires birth weight or body weight.

Roy et al. (1989) stated that the body weight of Jamunapari goat at birth, 3, 6, 9 & 12 months of age was 3.02±0.04, 8.74±0.15, 12.44±0.28, 16.33±0.29 and 19.31±0.38 kg respectively.

Paul et al. (1990) observed that body weight of Beetal x Sirohi kids at 6 months of age maintained under browsing and browsing & concentrate was 16.48±1.14 and 26.08±9.75 kg respectively.

The study of Singh et al. (1990) at Agra revealed pure breed Black Bengal goat to be 1.10 kg of average birth weight. The mean body weight of Black Bengal at 3 months, 6 months, 9 months and one year of age were 4.53 kg, 6.50 kg, 9.27 kg and 11.20 kg respectively. Variations due to age were found significant (P<0.05).

The body weight of Kutchi and Marwari kids reared under extensive system of management at arid Western Rajasthan at 9 months of age was 18.14±0.80 and 12.55±0.50 kg respectively (Mittal, 1991).

Malik and Kanaujia (1991), reported that the body weight of Beetal kids under semi-intensive system at birth, 1, 2, 3, 4, 5 and 6 months of age was 2.01±0.04, 5.21±0.12, 6.77±0.19, 8.41±0.25, 10.52±0.80, 11.07±0.13 and 13.11±0.19 kg respectively. The pre and post weaning gains were 65.44 and 40.09 gm per day.

Singh et al. (1991) reported 0 & 3-month body weight of Black Bengal, Jamunapari half – breds and Beetal half – breds:

Breed/Breed cross	Birth weight(kg)	3-months weight	Place
Black Bengal	1.24±0.02	5.65±0.10	
½ Jamunapari + ½ Black Bengal	1.75±0.02	7.16±0.07	
½ Beetal + ½ Black Bengal	1.93±0.04	7.83±0.19	Bihar

Acharya (1992) tabulated average birth weight and 3-month weight of Bengal goat of different colour:

Bengal goat (strain)	Birth weight	3-months weight (kg)
Black	0.99	5.19
Brown	1.09	5.64
White	1.12	6.11

Arora (1992) reported the average body weight of Black Bengal at 3 months and 6 months of age to be 6.8±0.21 and 12.1±0.18 kg respectively.

Husain et al. (1992) reported at Bangladesh the body weight of Black Bengal goat at birth, 2 month, 4 month & 6 month of age were 0.99±0.05, 3.44±0.31, 5.51±0.39 &8.14±0.50 kg, respectively.

Mia et al. (1993) reported that the average body weight of Black Bengal at birth, 6 months and at 12 months were 1.35, 7.69 and 11.28 kg respectively.

Shinde et al. (1995) reported that the final body weight of Marwari kids at the time of slaughter under intensive and semi-intensive system were 23.0±0.71 and 26.2±0.69 kg.

Husain et al.(1996) reported that the birth weight of Black Bengal kids had a large within breed variation ranging from 0.50 to 1.60 kg. The birth weight of kids increased with increasing body weight of the dams. Body weight at 9 and 12 months also showed a large variation ranging from 5.0 to 18.0 kg and from 16.0 to 19.0 kg respectively. The birth weight of kids born in selected group (1.13 ± 0.2 kg) was higher (P<0.01) than in the randomly rated control group (0.93 ± 0.05 kg). Body weight in the selected group at 3 and 6 months of age were 4.94 ± 0.04 and 8.40 ± 0.05 kg respectively and in the control group. 3.99±0.08 and 7.07±0.11 kg difference between groups were significant. Significantly higher average daily gains were found in the selected group (42.7±0.43 g/day) than in the control group (33.3±0.81 g/day).

Mohapatra and Nayak (1996) reported that the averaged body weight for Black Bengal x Ganjam were 2.15 ± 0.07 kg at birth and 11.39 ± 0.85 kg 180 days.Withers height was correlated (P<0.01) with body weight at all ages, except at birth.

Roy et al.(1997) reported that the overall mean body weight of Jamunapari kids maintained under semi-intensive system of management at 9 months of age was 17.54±0.34 kg.

Singh (1997) reported that the overall body weight of Black Bengal and its halfbreds with Jamunapari and Beetal goats at 3,6,9 and 12 months of age were 5.88±0.08, 10.62±0.08, 13.59±0.11 and 15.95±0.17 kg respectively. Purebred Black Bengal kids weighed significantly lighter than both halfbreds at weaning.

Breed/Breed cross	Body weight (kg) at				Place
	3 months	6 months	9 months	12 months	
Black Bengal	5.65±0.10	8.97±0.14	11.79±0.19	14.05±0.29	
Jamunapari x Black Bengal	7.16±0.07	11.40±0.15	14.51±0.14	17.22±0.21	Bihar
Beetal x Black Bengal	7.83±0.19	11.48±0.15	14.48±0.21	16.58±0.32	

Singh and Singh (1998) reported that the overall body weight of Black Bengal from birth, 1, 2, 3, 4, 5, 6, months were 1.459±o.274, 2.809±0.11,3.538±0.015, 5.670±0.477, 5.570±o.122, 6.22±0.233 and 7.135±0.25 in village conditions.

Shinde et al. (2000) recorded the body weight of Marwari kids at 8 months of age under intensive, semi-intensive & extensive systems were 19.71±0.13, 23.90±0.18 and 21.77±0.13 kg respectively.

Singh (2000) studied on growth of Black Bengal and Jamunapari kids castrated at 1,2 and 3 months of age and observed that the kids castrated at 2 months of age had significantly higher daily gain in body weight during 3-6, 6-9 and 3-9 months of age than those castrated at 1 and 3 months of age, which did not differ between themselves.

Singh and Singh (2000) reported that the average body weight of Black Bengal from birth, 3, 6, 9, 12 months were 1.352±0.029, 5.663±0.120, 8.206±0.20, 11.505±0.32 and 13.581±0.506 kg respectively and the average daily gain (g/day) from 0-3 months, 3-6 months of age were 50.59±1.48, 28.94±2.8g/day.

Kumar et al. (2001) studied on relative growth rate (RGR) in body weight of Beetal half bred (1/2 Beetal x ½ Black Bengal) during 0-4, 4-8, 8-12 and 0-12 weeks of age. The variation on RGR in body weight during 0-4 weeks of age due to birth weight (P<0.01) was significant RGR during 4-8 weeks of age also varied significantly due to birth weight (P<0.05).

Mishra and Sinha (2001) reported that the body weight of Black Bengal goats at birth, 3 and 6 months of age were 1.19±0.0, 3.85±0.30 and 7.01±0.9 kg respectively.

Nahardeka et al. (2001) reported the body weight of Assam Local at 6, 9, and 12 months of age to be 7.5±0.2, 9.4±0.3 and 11.8±0.3 kg respectively.

Sinha et al. (2001) studied on the growth of Black Bengal goats kept under deep litter and free range system of rearing and observed the growth and daily gain. The average live weight gain of goats kept in deep litter were significantly (P<0.05) higher than those maintained under free range grazing (20.36 vs 16.31 g).

Barua et al. (2002) observed the body weight and body measurement of Beetal, Assam local and their crossbreds at birth and at 1,3,6 and 10 months of age. Body weight and height at withers varied (P<0.05) between breeds, while between months of age the variation was highly

significant (P<0.01). It was observed that the rate of increase in body weight with age was rapid in Beetal x Assam local goats especially between 30 and 90 days as compared to purebreds.

Moniruzzaman et al. (2002) studied on the effect of 4 feeding system on body weight of Black Bengal goats. Feeding system were stall feeding (T1), tethering (T2), restricted grazing (T3) and grazing (T4) concentrate supplement was given at the rate of 150 g/day/goat for all the treatments. Daily live weight gain was significantly (P<0.05) higher in stall fed goat compared to other groups. Birth weight of kids was significantly higher in stall fed goats compared to other groups.

Singh (2002) reported that the body weight of Black Bengal goat at 6 months of age to be 8.97±0.14.

Singh et al. (2002) studied on the relative growth rate (RGR) in body weight of Black Bengal, Jamunapari x Black Bengal, Beetal x Black Bengal during 0-4, 408, 8-12 and 0-12 weeks of age. The variation in RGR in body weight during 0-4 weeks, 4-8 weeks and 0-12 weeks 0f age due to birth weight were significant.

Tiwari et al. (2002) studied on the body weight, from birth to 1 year of age at monthly interval on Barbari male kids and revealed that the kids were having a progressive increase in body weight. The monthly increase in body weight was 2.32 kg upto 2 months of age and a subsequent increase was half of the above increase upto their sexual maturity i.e. 9-10 months.

2.1.1 Body weight in different age groups under different system of managemental practices:

Singh and Khan (1989) recorded the body weight of Black Bengal goats and it was observed to be 1.35, 2.83, 4.08, 5.66 and 8.21 kg at birth, 4 weeks, 8 weeks, 3 months 6 months respectively. They also reported that the average daily gain in weight was 50.59 and 28.94 gm during 0-3 and 3-6 months period in grazing condition and that for Beetal x Black Bengal crosses

during 90-180 days of age were 49.128, 80.77 and 34.55 gm for intensive, semi intensive and free range condition.

Sinha et al. (2001) studied on the growth of Black Bengal goats kept under deep litter and free range system of rearing and observed the growth and daily gain. The average live weight gain of goats kept in deep litter were significantly (P<0.05) higher than those maintained under free range grazing (20.36 vs 16.31 g).

Moniruzzaman et al. (2002) studied on the effect of 4 feeding system on body weight of Black Bengal goats. Feeding system were stall feeding (T1), tethering (T2), restricted grazing (T3) and grazing (T4) concentrate supplement was given at the rate of 150 g/day/goat for all the treatments. Daily live weight gain was significantly (P<0.05) higher in stall fed goat compared to other groups. Birth weight of kids was significantly higher in stall fed goats compared to other groups.

2.2 Body measurements in different age groups

Mukherjee et al. (1979) recorded the body measurements viz., body length, body height and chest girth in different age group of Grey and brown type Bengal she-goats and the observed values were as follows:

Age group (months)	Body length(cm)		Body height(cm)		Chest girth(cm)	
	Grey	Brown	Grey	Brown	Grey	Brown
0-3	30.4±0.91	29.1±0.89	35.6±0.94	34.7±0.87	38.6±1.16	36.5±.06
3-6	40.2±0.83	40.8±0.73	45.8±0.82	47.2±0.67	50.4±0.9	50.8±0.79
6-12	43.9±0.70	45.8±0.81	50.9±0.73	51.2±0.76	55.5±0.65	56.8±0.95

Mukherjee et al. (1981) recorded the phenotypic correlation of body weight with body measurements viz., body length, body height and chest girth in different age group of Grey Bengal goats and the observed values were as follows:

Age group(months)	Body length(cm)	Body height(cm)	Chest girth(cm)
0-3	0.82±0.01**	0.90±0.06**	0.95±0.04**
3-6	0.82±0.09**	0.77±0.10**	0.82±0.09**
6-12	0.76±0.10**	0.71±0.11**	0.84±0.08**

**P<0.01

Singh et al. (1981) studied on the body measurement of Black Bengal at different ages. The obsereved value are as follows:

Age group(months)	Body length(cm)	Body height(cm)	Chest girth(cm)
0-3	28.3±0.85	33.9±0.84	3.37±1.30
3-6	41.4±0.66	46.4±0.64	51.5±0.90
6-12	44.2±0.73	44.6±0.64	56.2±0.90

Kumar and Singh (1983) studied on the body measurements (cms) of Black Bengal at birth, 1, 4 and 6 months of age. The observed values are as follows.

Age	Body length	Body height	Chest girth	Paunch girth
Birth	22.88±0.27	26.67±0.406	25.13±0.326	24.28±0.79
1 month	30.22±0.39	32.58±0.410	32.47±0.468	31.61±0.573
4 month	37.96±0.59	40.25±0.612	41.84±0.59	46.19±0.690
6 month	43.31±0.75	43.52±0.721	44.41±0.783	48.96±0.79

*Mean values bearing the same superscript in a line did not differ significantly.

Phenotypic correlation of body weights with length, height and chest girth were significant at birth, fourth and 6 months indicating significant association between body weight and body measurements.

The mean body weight, heart girth, height at wither, length and circumference of neck in Black Bengal goats were, 13.14±0.52kg, 55.24±0.72, 46.53±0.57, 46.15±0.68 and 30.06±0.51 cm respectively (Bhattacharya,1984).

Subhas Bose and Basu (1984) observed that the mean body length, heart girth, paunch girth and height at wither of Beetal male kids at 12 months of age were 56.74±0.48, 60.03±0.54, 60.98±0.05 and 60.15±0.43 cm respectively.

Patro and Mishra (1987) reported that the Ganjam goats reared under field condition of Orissa showed significant increase in all body measurements with increase in age & live weight.

Das et al. (1990) stated that the linear body measurements was found to be poor predictor for body weight at birth in Barbari & Jamunapari goats. The combination of heart girth and height was a better predictor for body weight at 3 & 6 months of age.

Singh et al. (1990) observed that the mean value of body length, height at wither, hearth girth and paunch girth of Black Bengal goats at 6-9 months of age were 48.32±0.73, 45.85±0.71, 52.77±0.81 and 57.69±0.96 cm respectively. The corresponding values for Jamunapari x Black Bengal were 51.35±0.87, 51.27±0.85, 52.70±0.97 and 55.83±1.15 cm and for Beetal x Black Bengal 49.07±0.77, 48.48±0.75, 50.92±0.86 and 53.28±1.01 cm.

Mittal (1991) found that body measurements viz., height at wither, length and hearth girth of Kutchi kids reared under extensive system of management in Western Rajasthan at 9 months of age were 67.80

Mittal (1993) observed that the height at withers of male Marwari kids at birth, 3, 6, 9 and 12 months of age was 35.02±0.78, 50.15±0.57, 55.80±1.95, 58.46±1.40 and 61.87±0.95 cm respectively. The body length at corresponding age was 27.32±1.14, 45.45±0.09, 55±2.25, 56.92±1.95 and 58.15±1.78 cm and the heart girth 31.40±1.25, 50.75±1.45, 55.58±1.98, 59.62±1.57 and 62.54±1.08 cm respectively.

Mahapatra and Nayak (1996) observed that the averaged body weight for Black Bengal were 11.39±0.85 kg at 180 days and body measurements of Black Bengal x Ganjam kids on their body length, wither weight, chest girth at birth and at 30, 60, 90,120,150 and 180 days correlation \

between body weight and the body measurements were tabulated. Wither height was correlated (P<0.01) with body weight at all ages except at birth.

Deb et al. (1998) also found lower growth in winter in Pashmina goats because of less availability of greens and portion of energy consumed was used for maintenance of body temperature leaving lesser energy for body weight gain.

Bhat (1998) studied on Beetal x Black Bengal weaner kids under intensive, semi intensive and extensive management systems. With different feeding regimes and observed that gains in body weight and body measurements were highest in intensive and ad libidum semi intensive groups.

Majid et al. (1999) reported that the body weight and body measurements of Black Bengal were affected (P<0.01) by age. There was a positive correlation (P<0.01) between body weight and body measurement.

Singh (1999) observed the body weight of Black Bengal and body biometrics within 2-3 hours after birth. The observed value were as follows:

Birth weight(kg)	Body length(cm)	Body height(cm)	Hearth girth(cm)	Paunch girth(cm)
1.24±0.02	23.10±0.15	25.62±0.16	25.06±0.15	24.10±0.17

Singh and singh (1998) also reported higher body weight for Black Bengal and its crosses with Beetal in summer compared to that in winter. Further the tethered animals were subjected to tethering stress, resulting in lesser gain in body weight and measurement when compared to those under free grazing.

Singh (1999) studied on the factors affecting body weight and measurement of Black Bengal and its half bred kids at birth and observed the estimated value of the body weight at birth

were 1.64 ± 0.02 kg and body length, body height, heart girth and paunch girth were 24.68 ± 0.11, 27.92 ± 0.11, 26.55 ± 0.11 and 24.97 ±0.12 cm respectively.

Thiruvenkadan et al. (2000) found that the body measurement such as height at withers, chest girth & body length of Kaneiadu male kids under farmers flock at 9 months of age were 64.62±1.67, 60.37±2.47 and 58.48±1.74 cm. The corresponding figures in the females kids were 64.12±0.70, 55.88±0.86 and 55.22±0.64 cm respectively.

Amcha sebside et al (2001) reported that the average value of final body measurements at slaughter age of Barbari goats were 51.04±0.92, 57.72±0.94, 57.21±0.84, 63.24±0.88, 31.25±0.56 and 25.38±0.50 cm for BL,BH,HG,PG,NC & thigh circumference respectively.

Das et al. (2001) studied on the body length, height at withers and heart girth of Assam Local. The observed value were as follows:

Effect	Body length(cm)	Height at wither(cm)	Heart girth(cm)
Birth	24.3±0.3	25.3±0.3	25.9±0.3
1 month	29.7±0.4	30.0±0.4	31.2±0.4
3 month	35.7±0.5	35.1±0.5	37.0±0.5

Tomar et al. (2001 b) stated that the overall mean body height, BL, HG & PG of Sirohi kids at birth were 34.77±0.25, 31.07±0.22, 30.86±0.27 and 29.18±0.28 cm and at 3 months of age were 50.02±0.51, 47.38±0.48, 48.01±0.40 and 51.51±0.51 cm and at 6 months of age were 50.02±0.51, 47.38±0.48, 48.01±0.40 and 51.51±0.51 cm and at 6 months of age were 57.14±0.70, 55.02±0.67, 56.35±0.71 and 61.10±0.76 cm respectively.

Badi et al. (2002) reported that the linear equation of heart girth and height at wither accounted for 95% & 91% respectively of the total variability in body weight of Eritrean goats.

The average body dimension score (sum of body length, HW, HG and PG) was highest in Osmanabadi goats (274.03±1.37 cm) and lowest in Barbari goats (243.05±1.59 cm). Jamunapari

and Sirohi had the intermediate value of 273.85±2.08 cm and 262.84±1.58 cm respectively. (Banait et al., 2002).

Singh (2002) reported that the body length, height at withers and heart girth of Black Bengal at 6 months of age to be 42.41±0.41 cm, 43.48±0.39 cm and 44.71±0.44 cm respectively.

Tiwari et al. (2002) studied on body weight,body length, body height and chest girth from birth to 1 year of age at monthly interval on Barbari male kids and revealed that the kids were having a progressive increase in body weight and body measurement. The maximum increase in body weight and measurement were observed between birth to one month of age and revealed a positive correlation among body weight and body measurement.

Ambhore et al. (2003) studied on body weight and body measurements of Barbari goats and the observed results were as follows :

Characters	6 months	9 months
Body weight (kg)	12.17±0.18	15.84±0.21
Body length (cms)	45.77±0.71	50.11±0.62
Height at wither (cms)	54.00±0.43	60.77±0.55
Heart girth (cm)	56.88±0.35	63.33±0.46

The correlation of body weight with body length was highly significant (0.80) whereas correlation between heart girth (0.52) and abdominal girth (0.76) for 6 months of age were high but non significant.

Talukdar et al. (2005) reported that the relationship of body measurement and weight in crossbred (Beetal x Assam local) kids revealed that height at wither gained maximum (7.29±0.09 cm) followed by height at rump (6.88±0.08 cm), paunch girth (6.76±0.92 cm), chest girth (6.40±0.11 cm) and body length (6.30±0.08 cm).

2.2.1 Body measurements in different age groups under different system of managemental practices:

Bhat (1998) studied on Beetal x Black Bengal weaner kids under intensive, semi intensive and extensive management systems. With different feeding regimes and observed that gains in body weight and body measurements were highest in intensive and semi intensive groups.

Singh and Singh (1998) also reported higher body weight for Black Bengal and its crosses with Beetal in summer compared to that in winter. Further the tethered animals were subjected to tethering stress, resulting in lesser gain in body weight and measurement when compared to those under free grazing.

2.3 Growth rate:

Kumar and Singh (1983) reported the average daily gain in weight from birth to 6 months in Black Bengal and its crosses with Jamunapari as tabulated below.

Daily gain (gm)	Jamunapari x Black Bengal	Black Bengal
Birth – 1 month	54.0±7.72	51.0±6.89
1 – 4 months	48.0±4.89	39.2±5.39
4 – 6 months	42.1±4.56	36.8±3.51

Singh et al. (1983) reported that the average daily gain in body weight in the periods 0-12,13-24 week 41.5, 28.56 gm. In Black Bengal kids & 50.12, 32.68 gm in Jamunapari x Black Bengal cross-bred respectively.

Malik et al. (1986) observed that post weaning weight gain of Beetal & Black Bengal kids at 6 months of age maintained under semi-intensive system were 37.84±2.73 and 34.65±3.33 g per day respectively.

Saini et al. (1986 b) reported that the body weight gain of Barbari kids from 90 to 180 days of age was lowest in extensive system (2.7 kg) compared to semi-intensive (3.95 kg) and intensive system (5.57kg).

Pander et al. (1989) reported that the average daily gain of Beetal, Black Bengal, Beetal x Black Bengal, Black Bengal x Beetal and synthetic goats in the period of 3-6 months of age under feed lot conditions were 59.90, 53.20, 50.4, 55.90 and 81.90 g per day respectively.

Singh and Khan (1989) recorded the body weight of Black Bengal goats and it was observed to be 1.35, 2.83, 4.08, 5.66 and 8.21 kg at birth, 4 weeks, 8 weeks, 3 months 6 months respectively. They also reported that the average daily gain in weight was 50.59 and 28.94 gm during 0-3 and 3-6 months period in grazing condition and that for Beetal x Black Bengal crosses during 90-180 days of age were 49.128, 80.77 and 34.55 gm for intensive, semi intensive and free range condition.

Mishra & Ghei (1990) reported that the average birth weight of Sikkim local goats were 1.6±0.05 kg and daily weight gains from 0-8, 8-16 & 16-24 weeks averaged 72.0±2.18,61.2±2.36 &46.1±2.21 gm respectively.

Nagpal et al. (1990 a) concluded that the average daily gain of Sirohi, Marwari and Kutchi goats at 6 months of age reared under intensive system of management were 45.44±5.62, 55.69±7.03 and 52.64±6.74 g per day and under semi-intensive system of management 85.96±6.61, 99.02±7.99 and 92.96±9.99 g respectively.

Nagpal et al. (1990b) found that the Sirohi and Kutchi kids maintained under browsing plus concentrate supplementation @ 2% of body weight had higher body weight gain (5.08±0.53 kg) from 3-6 months of age than the kids maintained under browsing plus concentrate supplementation @ 1% body weight (3.76±0.54 kg) and kids maintained under browsing alone (2.16±0.65 kg).

Husain et al. (1992) recorded the averaged daily weight gain from birth to 6 months of age as 39.66 gm in Black Bengal kids at Bangladesh.

Singh and Singh (1998) reported that the average daily gain in body weight during 0-3 and 3-6 months of age in Jamunapari x Black Bengal kids were 61.169 ± 2.272 and 32.424 ± 2.843 gm/day respectively..

Shinde et al. (2000) in Rajasthan recorded that growth performance of Marwari kids under three different management system and they reported that overall average daily gain of kids during 0-3 months of age was higher in semi-intensive (93g) than the extensive (84g) and the intensive system (76g).

Paramasivam et al. (2002a) reported that the Barbari goats reared under semi-intensive system recorded significantly (P<0.01) under average daily gain (66.22 ± 0.73g) followed by intensive (56.99 ± 0.71g) and extensive system (40.60 ± 0.71g).

Effect of managemental practices on body weight Feeding:

Singh and Khan (1989) reported that the average daily gain in weight for Beetal x Black Bengal cross during 90-180 days were higher in the semi-intensive system, followed by intensive and then extensive system.

Extensive system of sheep and goat management is profitable if the animals were supplemented with kitchen wastes, cereal brans and crop residues, the animal if kept free of internal and external parasites, showed higher growth rate and improved fertility was observed by Abubakar and Isa (1994).

Sukanten et al. (1996) reported that supplementary feeding significantly improved body weight and carcass quality of goats in comparision to the ones maintained on natural grass alone.

Khound et al. (1996) observed the highest body weight gain for kids under semi-intensive system, followed zero-grazing and then free-range system.

Singh (1998) concluded that the does maintained under semi-intensive system performed significantly better than those maintained under intensive and extensive systems in respect to live weight gain.

Sankhayan et al. (2002) concluded that the supplementation of concentrate mixture @ 1% of body showed no significant effect on growth traits of Marwari kids maintained on silvipastoral system. However, they obtained higher daily gain in body weight in the group supplemented with concentrate than the group solely maintained on grazing.

2.4 Carcass traits

Various carcass traits like weight at slaughter, carcass weight, dressing percentage and skin yield are very important to evaluate the meat production efficiency of the animals. The carcass traits of different breeds of goat have been reviewed here to have an idea about meat production efficiency of Bengal goats.

Singh and Sengar (1978) studied on the live weight (kg), dressed carcass weight (kg) and dressing percentage of Black Bengal and observed to be 11.59, 5.173 and 44.62 respectively.

Acharya (1982) reported the carcass traits of different goat breeds as tabulated below :

Breed	Slaughter age (months)	Dressing (%)
Beetal	9	49.68
Bengal	-	45.7
Jamunapari	6	44.57±1.09
	9	48.16±0.91
Sangamneri	6	41.16
	9	44.7
Surti	6	47.3±0.9

Saini et al (1986 b) reported that the dressing % of Barbari kids at 6 months of age maintained under intensive, semi-intensive and extensive system of management was 47.02±1.12, 44.72±1.15 and 42.28±1.09 % respectively.

Anjaneyulu and Joshi (1992) reviewed the following data of carcass characteristics of different goat breeds.

Breed	Slaughter weight (kg)	Dressing %	Reference
Black Bengal (Male)	19.25±1.94	44.68±1.20	Kesava Rao et al. (1984)
Barbari (Male)	19.18±0.34	42.86	Das et al. (1986)
Beetal	16.16	44.70	Mishra (1979)
Alpine x Beetal	21.44	49.29	Mishra (1979)
Sannen x Beetal	21.60	47.27	Mishra (1979)
Jamunapari Male	14.20±1.04	50.79±0.99	Kesava Rao et al. (1984)
Jamunapari Female	18.46±0.87	49.21±1.19	Kesava Rao et al. (1984)
Barbari Male	19.57±0.97	50.41±1.02	Kesava Rao et al. (1984)
Barbari female	17.28±0.72	48.79±1.36	Kesava Rao et al. (1984)
Thakhrana	23.66±0.99	44.60±0.59	Prasad et al. (1992)

Kulkarni et al. (1992)reported the following carcass traits in Gaddi bucks.

Slaughter weight (kg)	Hot carcass weight (kg)	Dressing %
17.71±0.84	6.78±0.49	38.80±1.26

Kesava Rao et al. (1992) reported that the carcass weight were in the range of 10-15 kg for Barbari male goats of 18 months of age. Dressing percentage<20,20-25 and 25-35 kg live weight groups were 51.9±0.25, 44.41±0.74 and 41.9±0.24 kg respectively.

Bhattacharya (1993) observed variation in slaughter weight and dressing percentage of goats due to breed effect as being reviewed below :

Breed	Slaughter age (Months)	Slaughter weight (kg)	Carcass weight (kg)	Dressing %	References
Jammunapari	12	22.91	10.42	45.5	Srivastava et al. (1968)
Beetal	12	20.33	9.38	46.2	Sengar (1978)
Black Bengal	12	11.59	5.17	46.6	Sengar (1978)
Sangamneri	12	12.60	5.80	46.10	Mishra (1989)
Angora Local	12	16.50	7.73	46.90	Acharya (1990)
Kutchi	6	15.85	7.58	47.52	Negpal et al. (1990)
Marwari	6	17.75	8.35	46.90	Negpal et al. (1990)
Serohi	6	18.93	8.15	48.08	Negpal et al. (1990)
Thakhrana	12	20.90	9.40	44.50	Agnihotri and Pal (1993)
Chegu	12	14.27	6.55	45.40	Kaul et al. (1993)

Singh et al. (1994) reported that the Black Bengal castrated male kid when analysed to study the effect of age and height at slaughter and weaning weight at 3 months of age. Body weight at slaughter had significant effect on hot carcass weight dressing percentage on empty live weight. Age at slaughter had significant effect on dressing percentage on empty live weight (ELW), weaning weight influenced hot carcass weight dressing percentage on ELW). Hot carcass weight and dressing percentage increase with the increase in body weight at slaughter.

Mehta and Khan (1995) reported that the dressing percentage was slightly higher (57.5%) in Kutchi kids than in Serohi kids (56%) on empty live weight basis slaughtered at 9 months of age.

Misra and Prasad (1996) in Rajasthan studied the carcass characteristics in Sirohi and Beetal x Sirohi cross bred male kids under different system of feeding management and they recorded dressing % of the kids under semi-intensive system as 48.90±0.01 and 51.70±0.72 under intensive system as 47.90±0.59, 53.50±0.00 and under extensive system as 44±1.15, 49.20±0.95% at 6 months and 9 months of age respectively which were significantly different (P<0.05) between systems.

Singh et al. (1996) studied on three groups of Beetal x Assam Local goats aged 3 months which were castrated by Baibeertcjan, Burdizzo methods or were not castrated (controls). All goats were maintained under similar feeding regime and were slaughtered at 9 months of age. For 3 groups slaughtered weight average 15.00 ±1.30, 15.10 ± 1.02 and 15.75 ± 2.41 kg respectively. Hot carcass weight 7.23 ± 0.66, 7.27 ± 0.50 and 7.26 ± 0.15 kg and dressing percentage 48.20 ± 0.34, 48.15 ± 6.24 and 46.10 ± 0.21. The dressing percentage of controls were significantly lower than that of castrates. Body weight at slaughter were not significantly affected by the methods of castration.

Singh et al. (1997) reported that the dressing percentage of Beetal x Black Bengal male goats castrated at 2 months of age and slaughtered at 6, 9, 12 or >12 months of age and <10, 10-15 or >15 kg body weight increase with increasing slaughter weight.

Singh et al.(1997) studied the carcass characteristics of 76 Jamunapari x Black Bengal castrated kids. They found that the average dressing percentage on pre slaughter body weight and hot carcass weight were 46.912 ± 0.639 % and 6.029 ± 0.169 kg respectively.

Bhusan et al. (2000) reported that the pre slaughter live weight in Sikkim local male goats as 14.01±0.52 kg. The dressed weight was 6.77±0.29 kg and dressing percentage to be 48.31%.

Shinde et al. (2000) reported that the dressing percentage on live weight basis of Marwari goats under semi intensive system of management was 44.78±0.87%.

Singh (2000) studied on the effect of age at castration on carcass characteristics on Black Bengal kids observed that the dressing percentage of kids castrated at 2 months was higher (47.10±3.78%) than those castrated at 1 month (42.96±2.67%) and 3 months of age (41.55±4.56 %), though the difference were not significant.

Singh (2000) studied on the effect of age at castration on carcass characteristics of kids castrated at 1, 2 and 3 months of age. He observed that the kids castrated at 2 months had higher dressing percentage and lower bone percentage in the carcass compared with those castrated at 1 and 3 months of age, though the deficiencies were not significant.

Shinde et al.(2000) reported that superior dressing % of Marwari kids at 8 months of age on both live weight basis and empty live weight basis was recorded semi-intensive system (44.78±0.87 and 54.41±0.87) followed by intensive system (43.63±0.78 and 52.93±0.66) and extensive system (41.86±0.69, 52.04±0.56).

The dressing % of local non-descript male kids under intensive system of feeding was 46.2% and under extensive system was 42.4% (Reddy and Reddy, 2001).

Sebside et al. (2001) reported that the respective mean find slaughter weight, hot carcass weight and chemon yield in Barbari goats were 17.69±0.77, 7.27±0.41 and 7.77±0.43 kg respectively.

The effect of different feeding systems viz., stall feeding, tethering, restricted grazing and grazing had no significant effect on yield of edible and non-edible by product except empty gut weight in Black Bengal goats. The empty gut weight were 1.10±0.17, 2.10±0.61, 1.75±0.35 and 2.50±0.35 kg respectively and higher was in case of grazing groups (Moniruzzaman et al., 2002).

Moniruzzaman et al (2002) found that the dressing of Black Bengal goats reared under stall feeding, tethering, restricted grazing and grazing upto 7 months of age was 42.18±3.31, 39±1.73, 36.79±0.83 and 34±1.41 % respectively.

Edible offals proportion on empty live weight of Marwari goats maintained on grazing plus concentrate and grazing alone were 5.31±0.13, 4.76±0.04 %. The corresponding value per non edible offals were 44.37±0.87 and 46.85±0.86 % respectively (Sankhyan et al., 2002).

Paramasivam et al. (2002 a) stated that the superior dressing % of 48.62±0.43 % was recorded under semi-intensive system and lowest % of 40.55±0.37 % under extensive system. In the intensive system the dressing % was 47.75±0.39 %.

Paramasivam et al. (2002 a) reported that the value of edible and in-edible offals were higher in intensive system, followed by extensive and semi-intensive system of management in Barbari kids. He also found that stomach & intestine % was higher in extensive system (3.86±0.88) followed by intensive (3.85±0.87) and semi-intensive (2.86±1.18) system.

Ambhore et al. (2003) studied on the pre slaughter body weight (kg), carcass weight and dressing % of Berari goat at 6 and 9 months of age and observed to be as follows:

Characters	6 months	9 months
Pre slaughter body weight (kg)	12.17±0.18	15.84±0.21
Carcass weight (kg)	5.73±0.90	7.52±0.11
Dressing %	47.78±1.00	48.00±0.94

There is a significant relationship between carcass weight and dressing percentage in both the age group. Correlation of carcass weight with pre slaughter body weight was found non significant in both the age groups.

Saha et al. (2004) reported that the dressing percentage of Andaman local goats was 49.65±2.82.

Jain and Bohrey (2004) studied on the carcass characteristics in male Barbari goats under semi intensive system of management and observed that the pre slaughter live weight (kg) slaughter weight (kg) and dress carcass weight (kg) and dressing percentage of Barbari goat were 30.50±0.70, 28.80±0.70, 14.40±0.40 kg and 47.21±0.23 % respectively.

Chapter III

Materials and method

Materials and method:

The present investigation was carried out at Farm unit of AICRP-G (All India Co-ordinated Research Project on Goat improvement) of West Bengal University of Animal and Fishery Sciences, Kolkata.

3.1 Climatic condition:

The monthly mean climatic attributes of Kolkata were presented in the table given below.

	TM (°C)	Tm (°C)	T (°C)	H (%)	V (Km/h)	MTR (mm)
December 2005	27	13.8	19.4	68.5	3.7	
January 2006	26.8	11.8	18.5	66	3.5	16.8
February 2006	32.8	18	24.5	59.6	3.1	22.9
March 2006	34.3	21	27.1	56	4	32.8
April 2006	35.9	25	29.8	69.3	8.9	47.7
May 2006	35.7	25.5	30.5	72.6	5.4	101.7

T :   Mean temperature (°C)

TM :   Maximum temperature (°C)

Tm :   Minimum temperature (°C)

H :   Mean humidity (%)

V :   Mean wind speed (km/h)

MTR : Mean Total Rainfall (mm)

The farm unit is located at an altitude of 4 meters above sea level (22.65°N latitude and 88.45°E longitude).

3.2 Period of experiment:

The study was conducted for a period of 180 days (6 months) i.e. from 15th December 2005 to 15th May 2006.

3.3 Investigation procedure:

A total of eighteen Black Bengal male kids of 3 months of age with an average body weight of 5 to 6 kg were selected for the study. The kids were randomly divided into 3 different groups. The kids were managed under 3 different system of management (i.e. grazing, tethering and semi-intensive) for a period of 180 days. The kids were allowed to graze between 8:30 am to 4:30 pm during winter months and between 6.00 am to 6:00 pm during summer months.

3.4 Seasons of study:

The study was carried out in two seasons, viz., winter (December 2005 – February, 2006) and summer (March to May, 2006).

3.5 Experimental animals:

Experiments were conducted on eighteen Black Bengal male goats. The animals were allotted to different managemental practices as per Table below.

EXPERIMENTAL ANIMALS IN GRAZING FIELD

EXPERIMENTAL ANIMALS

Table: Distribution of animals under different grazing management

Type of animal	Total no.	Type of grazing management					
		Grazing		Tethered		Semi-intensive	
		No. of animal	Body wt. (Mean±S.E.)	No. of animal	Body wt. (Mean±S.E.)	No. of animal	Body wt. (Mean±S.E.)
Black Bengal	18	6	5.17±0.04	6	5.24±0.06	6	5.48±0.13

3.6 Grazing management:

The kids were allowed to graze on the pasture comprising mainly of doop grasses (*Cynodon dactylon*) between 8:30 am to 4:30 pm during winter months and between 6.00 am to 11.00 am & 3.00 pm to 6:00 pm during summer months.

The animals were allowed for grazing for 8 hours in grazing and tethered groups and 4 hours in semi-intensive groups. The tethered animals were tied with 3 meter long nylon rope and bamboo pegs, the pegs were shifted for every hours to provide fresh grazing area.

All the animals were given various tree leaves viz., magni, soobabul, mango, jack fruit, etc. and some fodder crops like, napier grass, rice bean, berseem, etc. in addition to their daily schedule after returned from grazing in the evening, as per experimental procedure. The animal in semi-intensive groups were shifted in the shed and offer concentrate feed @150 g apart from various tree leaves. They were adequately watered in all seasons.

Table: Composition of concentrate mixture

Sl no.	Ingredients	Amount(%)
1	Maize crush	30%
2	Gram crush	28%
3	Groundnut cake	25%
4	Wheat bran	10%
5	Gram chuni	5%
6	Mineral mixtures and salts	2%
	Total	100%

3.7 General managerial practice:

The animals were housed in groups during night in close housing. They were provided with floor space as per B.I.S.

Routine vaccination against endemic diseases were carried out. Experimental animals were clinically checked routinely and regularly dewormed. Animal sheds were cleaned every day. Dipping also done from time to time to protect them from ectoparasite.

3.8 Growth study:

Growth is a complex set of metabolic events, which are environmentally and genetically controlled. Growth was quantified in terms of change in body weight and linear body measurements.

Body weight and body measurements of Black Bengal goat under grazing, tethered and semi-intensive were taken monthly for the whole experimental period (from 3months to 9 months) 6 months.

EXPERIMENTAL ANIMALS IN THE STALL FOR TOP FEEDING

WEIGHING OF EXPERIMENTAL ANIMALS

a) Body weight:

Body weights were recorded by electronic weighing balance in the morning hours before offering food and water to the animals.

b) Body measurements:

Body measurements were taken with a measuring tape after properly securing the animal. Care was taken so that animal stands squarely on plane surface while taking measurement.

Following body measurements were taken in centimeters

(i)   Body length (BL):

Linear distance from the point of shoulder to the tip of pin bone.

(ii)   Height at wither (HW):

Vertical distance from ground to point of wither.

(iii)   Height at rump (HR):

Vertical distance from ground to point of rump.

(iv)   Chest girth (CG):

The smallest circumference at chest closely behind the elbow.

(v)   Neck circumference (NC):

At the base of the neck.

(vi)   Paunch girth (PG):

The body circumference in front of the sacrum.

(vii) Height at elbow (HE):

Vertical distance from ground to the point of elbow.

(viii) Height at stifle (HS):

Vertical distance from the ground to the point of stifle.

c) Growth of the experimental animals were expressed using following formula :

$$\text{Average daily weight gain} = \frac{\text{Final body weight} - \text{initial body weight}}{\text{Total no. of days observed}}$$

3.9 Assessment of thermal adaptability of Black Bengal goat by field and laboratory test: -

3.9.1 HEAT TOLERANCE INDEX:

1) Iberia heat tolerance index:

IHI=100-[10(Body temperature-Normal body temperature]

2) Benezara heat tolerance index (1954) :

$$\text{Co-efficient of heat tolerance index} = \frac{\text{Rectal temperature}}{\text{Normal rectal temperature}} + \frac{\text{Respiratory rate}}{\text{Normal respiratory rate}}$$

3) Thomas C.K. & Acharya (1969):

Dairy Search index = $0.5(x_1 / x) + 0.2 (y_1 / y) + 0.3 (z_1 / z)$

Where, x ,y, z were normal values of rectal temperature, respiratory rate, pulse rate. x_1, y_1, z_1 were observed values of rectal temperature, respiratory rate, pulse rate after exposure to heat stress for 6 hours.

3.10 Assessment of carcass quality

3.10.1 Methods of slaughter:

The animals were slaughtered by Halal method (Gracey and Collins, 1992) skinned and eviscerated.

3.10.2 Carcass traits:

6 healthy male goats from three different managemental practices of similar age groups (9 months of age) were use for the study. The carcass traits includes.

3.10.3 Live weight before slaughter:

Data on live weight were taken 2 hours prior to slaughter. Animals were deprived of feed after taking the body weight. Ad libidum water is given. Body weight were taken in electronic weighing balance.

3.10.4 Hot carcass weight:

The hot carcass weight were recorded in electronic weighing balance after eviscerating a non edible parts.

3.10.5 Dressing percentage:

The dressing percentage were determined by using the formula,

$$\text{Dressing percentage} = \frac{\text{Hot carcass weight}}{\text{Live weight before slaughter}} \times 100$$

3.11 Statistical analysis :

The data were subjected to statistical analysis according to the standard methods described by Snedecor and Cochran (1994).

Results and Discussion:

The present study was conducted for growth, climate adaptability and carcass character under three different managemental practices viz. semi-intensive, grazing and tethering in Black Bengal goat.

The results of the research work have been presented under different topics and sub topics below:

4.1 Body weight of different ages under different managemental groups.

Mean body weight at different age groups under different managemental practices were presented in Table no. 4.1.1 which were also shown in Fig. 4.1.1 and the analysis of variance for effect of different managemental practices on body weight have been presented in table 4.1.2.

From the table 4.1.1 it was revealed that with increasing age the body weight increases in all age groups. While the body weight were found to be highest in semi-intensive practices in all age groups, the value were lowest in tethering group, it being intermediate in goats with grazing practices.

The differences among the managemental groups in all ages under study were found to be highly significant as shown by analysis of variance presented in table 4.1.2.

The body weight of semi-intensive group were significantly higher than those of grazing and tethering groups in all the months. The difference among grazing and tethering groups were significant in 5, 6, 7, 8 & 9 months age group whereas it was non significant in 3 & 4 months age between these two groups.

From these observation, it can be inferred that the final body weight at 9 months of age are highest in semi-intensive group (11.20±0.09), following by grazing (10.76±0.07) and tethering (9.61±0.14).

The present results of body weight at 3 months of age in different managemental practices are in agreement with Singh and Sahani (1980), Patnaik and Nayak (1988), Kanujia & Pander (1988), Singh & Khan (1989), Singh et al. (1991), Acharya (1992), Singh (1997), Singh & Singh

Table 4.1.1: Mean body weight (kg) of Black Bengal goat

	3mths	4mths	5mths	6mths	7mths	8mths	9mths
Semi-intensive	5.48±0.13	6.24±0.10^a	7.44±0.11^a	8.27±0.10^a	8.98±0.07^a	10.21±0.14^a	11.20±0.09^a
Grazing	5.17±0.04	5.61±0.12^b	6.61±0.09^b	7.44±0.13^b	8.67±0.09^b	9.64±0.06^b	10.76±0.07^b
Tethering	5.24±0.06	5.54±0.10^b	6.16±0.07^c	6.92±0.03^c	7.81±0.04^c	8.74±0.05^c	9.61±0.14^c
Overall	5.30±0.05	5.80±0.09	6.74±0.13	7.54±0.14	8.48±0.12	9.53±0.15	10.52±0.17

Means having same superscripts in a column does not differ significantly.

Table 4.1.2: Analysis of variance for effect of different managemental practices on body weight

Source	d.f	M.S.						
		3 months	4 months	5 months	6 months	7 months	8 months	9 months
Between groups	2	0.161	0.877**	2.522**	2.757**	2.191**	3.294**	4.035**
Within groups	15	0.050	0.076	0.053	0.060	0.029	0.058	0.072

** P<0.01

Chapter IV

Results and Discussion

Fig.4.1.1: Body weight of Black Bengal goat at different ages in three managemental practices
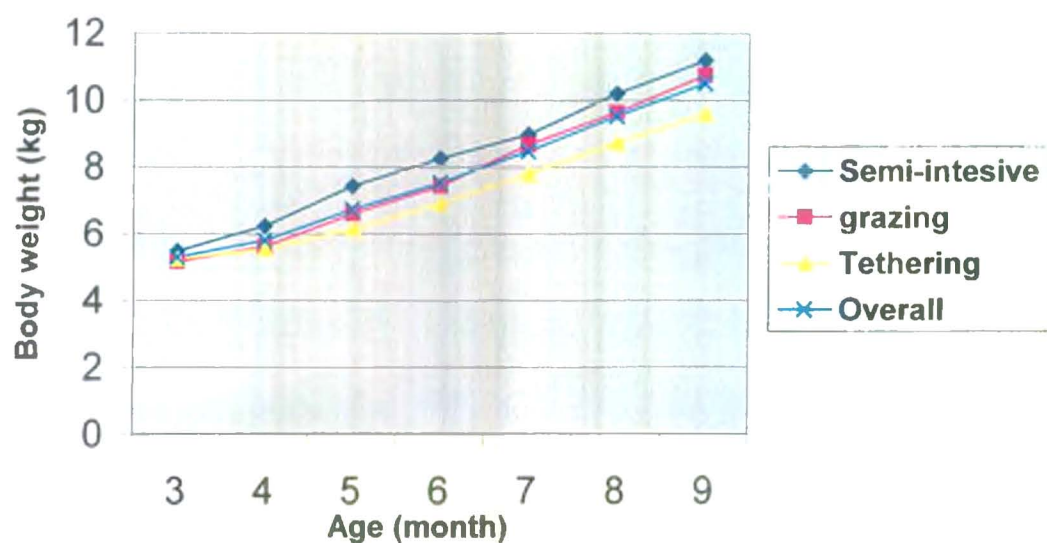
Fig. 4.2.1 Average daily weight gain of different ages in three managemental practices
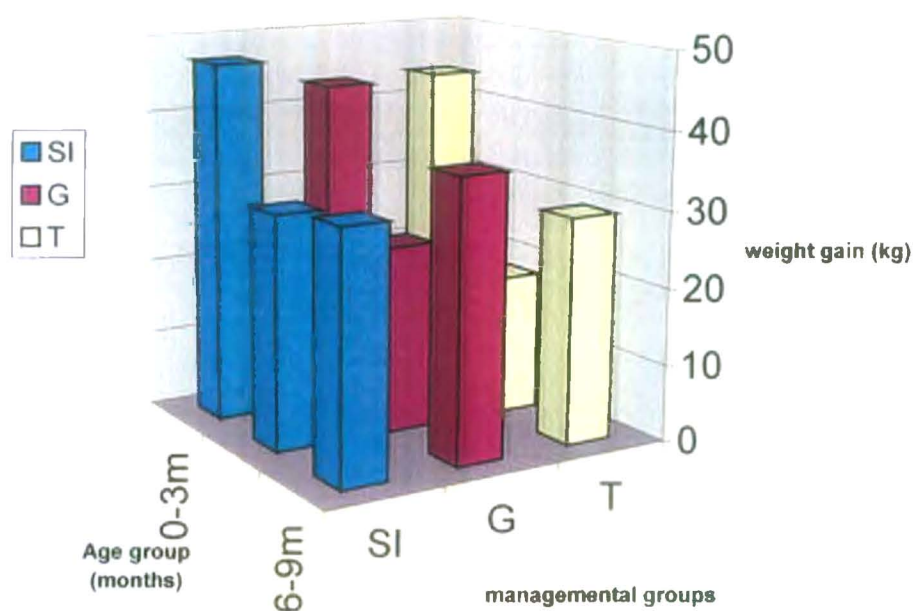
(1998), Singh & Singh (2000), whereas, the present values were lower than the findings of Acharya (1982), Malik et al. (1986), Arora (1992) and higher than Acharya et al. (1982), Singh et al. (1980), Hussain et al. (1996) and Mishra & Sinha (2001).

The body weight at 9 months of age for semi-intensive was similar with reported value of Senegar (1978), Singh (1997), Singh & Singh (2000) whereas the present value were higher than Singh & Sahani (1980), Acharya (1982), Bhattacharya (1989) , Singh et al. (1990).

As regards the effect of managemental practices on body weight in different age groups the present finding was in agreement with the findings of Singh & Khan (1989), Singh et al. (2001), Monizuzzaman et al. (2002) that the Black Bengal goats under grazing managemental practices are inferior than semi-intensive system.

While comparing the effect of different managemental system on the body weight of goats with other breeds it was observed that the goats under semi-intensive system of management were better as compared to extensive system as reported by Saini et al. (1986 a) in Jamunapari, Saini et al. (1986 b) in Barbari, Pantro and Mishra (1987) in Ganjam, Mittal (1988) in Marwari, Saini et al. (1998) in Barbari, Roy et al. (1989) in Jamunapari, Paul et al. (1990) in Beetal x Sirohi, Mittal (1991) in Kutchi and Marwari, Malik and Kanaujia (1991) in Beetal, Shinde et al. (1995) in Marwari, Shinde et al. (2000) in Marwari, Paramasivam et al. (2002).

4.2 Average daily weight gain in different age group under three managemental practices.

The mean daily weight gain at various ages under different managemental practices were presented in table 4.2.1, which were also shown in fig. 4.2.1. The analysis of variance for the effect of different managemental practices under different age groups have been presented in table 4.2.2.

From the table 4.2.1 it can be observed that the semi-intensive group of goat excels in daily weight gain in 0-3 and 3-6 age groups than grazing and tethering whereas the gain in weight was highest at 6-9 months age group in grazing management.

The gain in weight in these goats of present study are almost similar with findings of Kumar & Singh (1983), Singh et al (1983) and Hussain et al. (1989).

Table 4.2.1: Average daily weight gain (gm) in different age group in 3 (three) managemental practices:

AGE GROUP	SEMI INTENSIVE	GRAZING	TETHERING
0-3mths	47.00 ± 1.23^a	43.16 ± 0.16^b	43.66 ± 0.49^b
3-6mths	30.50 ± 1.38^d	24.50 ± 1.17^c	18.33 ± 0.91^f
6-9mths	32.00 ± 0.68^d	36.33 ± 1.14^c	29.50 ± 1.60^d
OVERALL	44.61 ± 0.58	24.44 ± 1.36	32.61 ± 0.94

Means having same superscripts in a column does not differ significantly.

Table 4.2.2: Analysis of variance of daily gain in Black Bengal Goat.

Source of Variation	SS	df	MS
Groups	340.3333	2	170.1667**
Age	3704.333	2	1852.167**
G x A	299.3333	4	74.83333
Error	309.3333	45	6.874074
Total	4653.333	53	

** P<0.01

The present result of highest gain in weight at 0-3 months age group was in conformity with the earlier works.

The highest gain in weight in semi-intensive group of goats during the study period are in agreement with the observation of Singh & Khan (1989), Sukanta et al. (1996), Khound et al. (1996), Singh (1998) who also observed semi-intensive groups have highest gain in weight in Black Bengal goat.

While comparing the effect of different managemental system on the average daily weight gain with other breeds it was observed that the goats under semi-intensive system of management were better as compared to extensive system of management as reported by Saini et al. (1986 b) in Barbari goats, Nagpal et al. (1990 a) in Sirohi, Marwari and Kutchi, Nagpal et al. (1990 b) in Sirohi and Kutchi, Shinde et al. (2000) in Marwari, Paramasivam et al. (2002 a) in Barbari goats, Singh and Khan (1989) in Beetal x Black Bengal, Sukanten et al. (1996), Khound et al. (1996), Singh (1998), Sankhayan et al. (2002) in Marwari goats.

4.3 Body length of different ages under different managemental groups.

Mean body length at various ages under different managemental practices were presented in Table no. 4.3.1 , which were also shown in fig. 4.3.1 and the analysis of variance for effect of different managemental practices on body length have been presented in table 4.3.2.

From the table 4.3.1 it was revealed that the body length of different managemental practices showed a steady increasing trend with increasing age while the body length were found highest in semi-intensive groups in all age groups and these values were lowest in tethering group as compared to semi-intensive and grazing practices.

The difference among the managemental practices in all ages under study were found to be highly significant whereas there was no significant effect found at 3 months of age as shown by analysis of variance presented in table 4.3.2.

The body length of semi-intensive groups were significantly higher than that of grazing and tethering groups at 6, 7 and 8 months of age. At 5 & 9 months of age there was no effect found between semi-intensive & grazing, whereas the tethering group were found to be less significantly less from the other groups.

Table 4.3.1 Mean body length (cm) of Black Bengal goat

	3mths	4mths	5mths	6mths	7mths	8mths	9mths
Semi-intensive	33.83±0.30	34.58±0.15	35.58±0.20^a	36.6±0.16^a	37.63±0.15^a	38.5±0.12^a	39.08±0.12^a
Grazing	33.5±0.18	34.33±0.16	35.08±0.15^a	36±0.12^b	37.00±0.12^b	38.08±0.08^b	38.5±0.08^a
Tethering	33.58±0.20	33.91±0.23	34.41±0.20^b	35.00±0.12^c	35.66±0.16^c	36.41±0.15^c	37.58±0.23^b
Overall	33.63±0.13	34.27±0.12	35.02±0.15	35.86±0.17	36.76±0.21	37.66±0.22	38.66±0.20

Means having same superscripts in a column does not differ significantly.

Table 4.3.2 Analysis of variance for effect of different managemental practices on body length

Source	d.f	M.S.						
		3 months	4 months	5 months	6 months	7 months	8 months	9 months
Between groups	2	0.181	0.681	2.056**	3.920**	6.038**	7.292**	5.309**
Within groups	15	0.336	0.217	0.208	0.120	0.136	0.094	0.182

** P<0.01

Fig. 4.3.1 : Body length of Black Bengal goat at different ages in three managemental practices
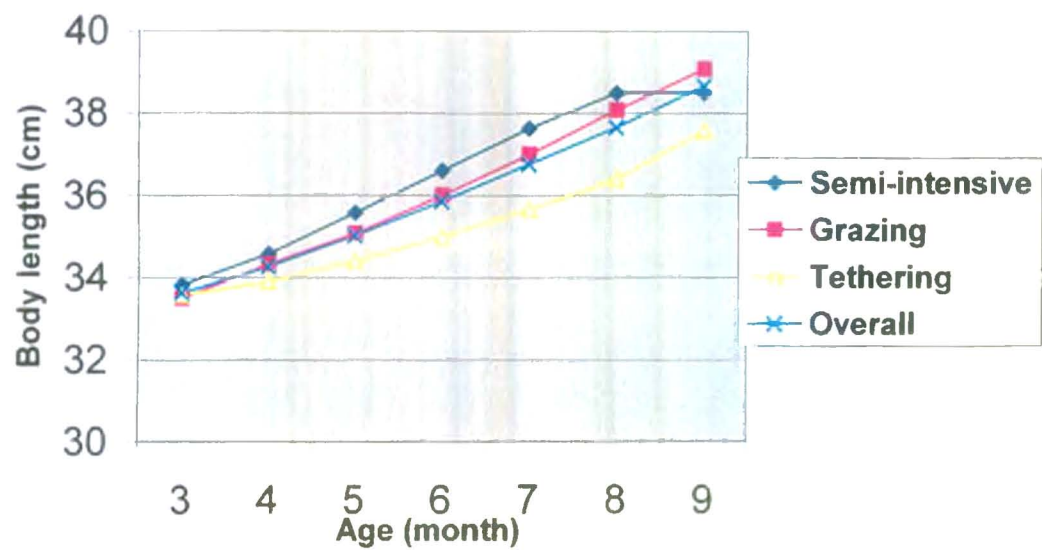
Fig. 4.4.1 : Height at wither of Black Bengal goat at different ages in three managemental practices
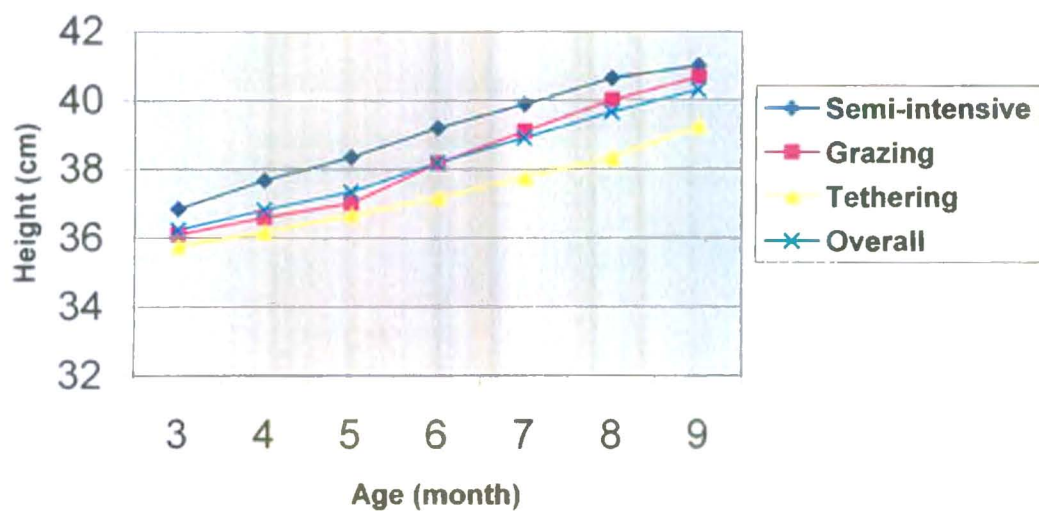
From these findings, it can be observed that the final body length at 9 months of age were highest in semi-intensive (39.08±0.08), followed by grazing (38.5±0.12) and than tethering (37.58±0.23).

The present results of body length at 3 months of age in three managemental practices of these goats have lower value than the findings of Mukherjee et al. (1979), Paramasivam et al. (2002), Singh et al.(1981), but have similar findings at 3 months of age as observed by Das et al. (2001) in Assam local.

At 4 months of age and 6 months of age, the present findings were lower than the findings of Mukherjee et al. (1979), Singh et al. (1981), Kumar & Singh (1983), Singh (2002).

4.4 Height at wither of different ages under different managemental groups.

Mean height at wither at various ages under different managemental groups were presented in Table no. 4.4.1 which were also shown in fig. 4.4.1 and the analysis of variance for effect of different managemental practices on height at wither have been presented in table 4.4.2.

From the table 4.4.1 it was revealed that with increasing age height at wither increases in all the three managemental practices. The height at wither were observed to be lowest in tethering groups, while in grazing groups the value almost similar to the overall values in all age groups. But the semi-intensive groups have the highest values as compared to other groups as well as overall values in all age groups.

Among the managemental groups there was significant effect found in age groups 6 & 7 months but at 3, 4 & 5 months there was significant effect observed in grazing & tethering with semi-intensive but there was no effect observed between grazing & tethering.

At 8 & 9 months of age, there was significant effect observed in tethering with semi-intensive & grazing but no significant effect found between semi-intensive & grazing.

The present results of height at wither at 3 months of age in different managemental practices are in agreement with findings of Mukherjee et al.(1979) & Das et al. (2001) in Black Bengal goat, whereas the present values were higher than the findings of Singh et al. (1981).

At 6 months of age, the present values observed by Singh et al. (1981), Kumar & Singh (1983), Singh (2002) and Ambhore et al. (2003).

Table no. 4.4.1 Mean height at wither (cm) of Black Bengal goat

	3mths	4mths	5mths	6mths	7mths	8mths	9mths
Semi-intensive	36.83 ± 0.16^a	37.66 ± 0.33^a	38.33 ± 0.33^a	39.18 ± 0.34^a	39.88 ± 0.31^a	40.63 ± 0.37^a	41 ± 0.28^a
Grazing	36.08 ± 0.15^b	36.58 ± 0.20^b	37 ± 0.12^b	38.16 ± 0.21^b	39.08 ± 0.23^b	40 ± 0.18^a	40.66 ± 0.16^a
Tethering	35.75 ± 0.17^b	36.16 ± 0.10^b	36.66 ± 0.10^b	37.16 ± 0.16^c	37.75 ± 0.17^c	38.33 ± 0.21^b	39.25 ± 0.17^b
Overall	36.22 ± 0.14	36.80 ± 0.19	37.33 ± 0.21	38.17 ± 0.24	38.90 ± 0.25	39.65 ± 0.27	40.30 ± 0.21

Means having same superscripts in a column does not differ significantly.

Table no. 4.4.2 Analysis of variance for effect of different managemental practices on height at wither

Source	d.f	M.S.						
		3 months	4 months	5 months	6 months	7 months	8 months	9 months
Between groups	2	1.847**	3.597**	4.667**	6.101**	6.969**	8.469**	5.181**
Within groups	15	0.161	0.325	0.278	0.378	0.373	0.438	0.281

** P<0.01

At 9 months of age, the present findings have lesser values than the findings observed by Ambhore et al. (2003).

4.5 Height at rump of different ages under different managemental groups.

Mean height at rump at various ages under different managemental practices were presented in Table 4.5.1 which were also shown in fig. 4.5.1 and the analysis of variance for effect of different managemental practices on height at rump of various age groups were presented in table 4.5.2.

From the table 4.5.1, a steady increasing trends were also observed with the advancement of ages under different managemental practices in these parameters.

The height at rump were found to be highest in semi-intensive, intermediate in grazing and lowest in tethering in all age groups.

There was significant effect found only at 7 months of age among all managemental practices whereas at 3, 4, 5 months of age there was significant effect found in grazing & tethering with semi-intensive but no effect observed among grazing & tethering. While at 6, 8 & 9months of age significant effect were observed between semi-intensive with tethering & grazing with tethering but not between semi-intensive and grazing.

At present no literature was available with the present author on this parameter in Black Bengal goat.

4.6 Chest girth of different ages under different managemental groups.

Mean chest girth at various ages under different managemental practices were presented in Table 4.6.1 which were also shown in fig. 4.6.1 and the analysis of variance for effect of different managemental practices on chest girth have been presented in table 4.6.2.

From the observation in table 4.6.1, the chest girth also increases with increasing age. The chest girth circumference under different managemental practices were highest in semi-intensive groups followed by grazing and tethering in all age groups.

Table 4.5.1 Mean height at rump (cm) of Black Bengal goat

	3mths	4mths	5mths	6mths	7mths	8mths	9mths
Semi-intensive	38.16±0.21^a	38.83±0.21^a	39.35±0.32^a	40.08±0.27^a	40.91±0.23^a	41.53±0.26^a	42.08±0.23^a
Grazing	37.50±0.18^b	38.08±0.15^b	38.66±0.21^b	39.50±0.18^a	40.33±0.16^b	41.00±0.12^a	41.50±0.18^a
Tethering	37.16±0.10^b	37.66±0.10^b	38.08±0.08^b	38.58±0.08^b	39.08±0.08^c	39.83±0.25^b	40.58±0.15^b
Overall	37.61±0.13	38.19±0.14	38.70±0.17	39.38±0.18	40.11±0.20	40.78±0.19	41.38±0.18

Means having same superscripts in a column does not differ significantly.

Table 4.5.2 Analysis of variance for effect of different managemental practices on height at rump

Source	d.f	M.S.						
		3 months	4 months	5 months	6 months	7 months	8 months	9 months
Between groups	2	1.556**	2.097**	2.412**	3.431**	5.264**	4.536**	3.431**
Within groups	15	0.178	0.158	0.308	0.228	0.183	0.191	0.228

** P<0.01

Fig. 4.5.1 : Height at rump of Black Bengal goat at different ages in three managemental practices
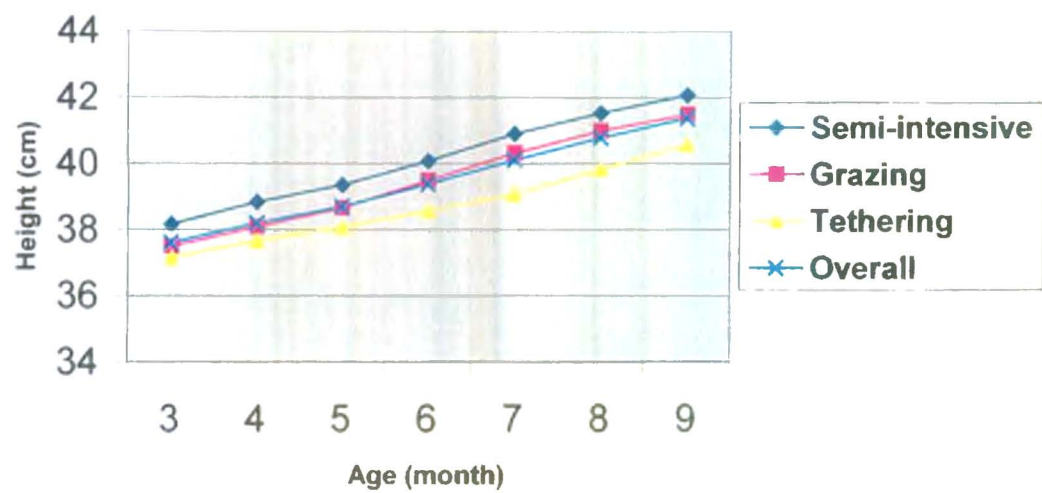
Fig. 4.6.1 : Chest girth of Black Bengal goat at different ages in three managemental practices
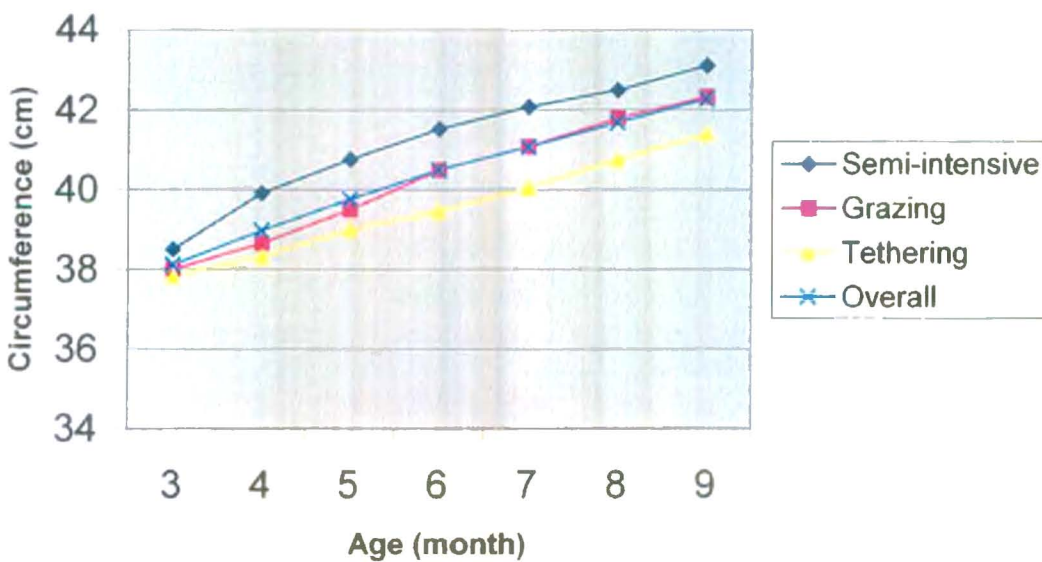
Table 4.6.1 Mean chest girth (cm) of Black Bengal goat

	3mths	4mths	5mths	6mths	7mths	8mths	9mths
Semi-intensive	38.50±0.31	39.91±0.45^a	40.75±0.65^a	41.53±0.67^a	42.08±0.65^a	42.50±0.63^a	43.10±0.58^a
Grazing	38.00±0.22	38.66±0.27^b	39.50±0.22^b	40.5±0.18a^b	41.08±0.08a^b	41.80±0.16a^b	42.33±0.16^b
Tethering	37.83±0.10	38.33±0.10^b	39.00±0.00^b	39.46±0.03^b	40.05±0.03^b	40.75±0.11^b	41.41±0.08^b
Overall	38.11±0.14	38.97±0.23	39.75±0.28	40.50±0.29	41.07±0.28	41.69±0.27	42.28±0.25

Means having same superscripts in a column does not differ significantly.

Table 4.6.2 Analysis of variance for effect of different managemental practices on chest girth

Source	d.f	M.S.						
		3 months	4 months	5 months	6 months	7 months	8 months	9 months
Between groups	2	0.722	4.181**	4.875**	6.407**	6.202**	4.681**	4.262**
Within groups	15	0.322	0.592	0.958	0.978	0.863	0.881	0.763

** P<0.01

There were no significant effect observed among different managemental practices at 3 months of age.

The chest girth of semi-intensive groups were significantly higher than those of grazing and tethering at 4 &5 months of age but no significant difference were observed between grazing & tethering.

At 6,7,8 & 9 months of age there was significant effect between semi-intensive and tethering but no effect among semi-intensive & grazing and grazing & tethering.

The present findings of chest girth at 3 months of age are in agreement with Mukherjee et al. (1979) & Das et al. (2001) whereas the present values were higher than the findings of Singh et al. (1981).

At 4 months of age it was observed that the present findings were lower than the findings of Kumar & Singh (1983).

At 6 months of age it was found that the present values were lower than the values observed by Mukherjee et al (1979), Singh et al. (1981), Kumar & Singh (1983) and Ambhore et al. (2003) in Black Bengal goat.

At 9 months of age, the present findings were lower than the findings of Mukherjee et al. (1979), Singh et al. (1981) and Ambhore et al. (2003).

4.7 Paunch girth of different ages under different managemental groups.

Mean paunch girth at various ages under different managemental practices were presented in Table 4.7.1 which were also shown in fig. 4.7.1 and the analysis of variance for effect of different managemental practices on paunch girth have been presented in table 4.7.2.

From the value observed in table 4.7.1, it was revealed that the paunch girth in these three managemental practices were found to be highest in semi-intensive practices in all age groups, followed by grazing and tethering.

The paunch girth at 6, 7 and 8 months of age were found to be highly significantly different among all managemental practices but there was no effect observed at 3 months.

At 4 & 5 months of age there was significant effect found between semi-intensive & tethering but no effect between semi-intensive with grazing and grazing with tethering.

Table 4.7.1 Mean paunch girth (cm) of Black Bengal goat

	3mths	4mths	5mths	6mths	7mths	8mths	9mths
Semi-intensive	39.66±0.30	40.56±0.29^a	41.58±0.43^a	42.25±0.42^a	43.2±0.34^a	43.7±0.25^a	44.16±0.24^a
Grazing	39.00±0.15	40±0.18^{ab}	40.83±0.16^{ab}	41.41±0.15^b	42.08±0.08^b	42.83±0.10^b	43.58±0.20^a
Tethering	39.08±0.15	39.5±0.12^b	40.08±0.08^b	40.58±0.15^c	41.08±0.15^c	41.58±0.20^c	42.33±0.16^b
Overall	39.27±0.13	40.02±0.15	40.83±0.21	41.41±0.22	42.12±0.24	42.70±0.23	43.36±0.21

Means having same superscripts in a column does not differ significantly.

Table 4.7.2 Analysis of variance for effect of different managemental practices on paunch girth

Source	d.f	M.S.						
		3 months	4 months	5 months	6 months	7 months	8 months	9 months
Between groups	2	0.681	1.709*	3.375**	4.167**	6.727**	6.794**	5.264**
Within groups	15	0.283	0.269	0.450	0.453	0.294	0.236	0.258

** P<0.01   * P<0.05

Fig. 4.7.1 : Paunch girth of Black Bengal goat at different ages in three managemental practices
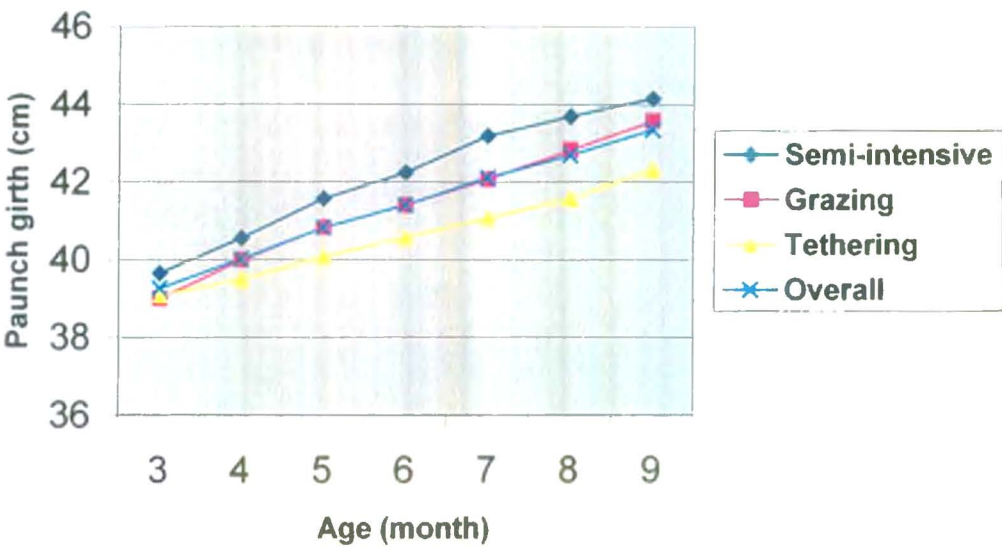
Fig. 4.8.1 : Height at elbow of Black Bengal goat at different ages in three managemental practices
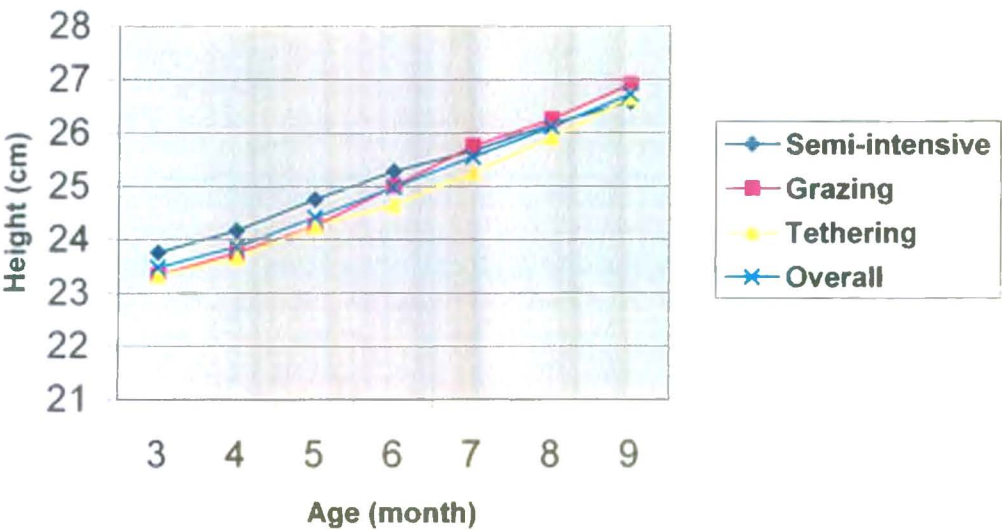
At 9 months of age there was significant effect found between semi-intensive with tethering and grazing with tethering but no effects were observed between semi-intensive with grazing.

At 4 and 6 months of age the present values were found lower than the values observed by Kumar and Singh (1983).

4.8 Height at elbow of different ages under different managemental groups.

Mean height at elbow at various ages under different managemental practices were presented in Table 4.8.1 which were also shown in fig. 4.8.1and the analysis of variance for effect of different managemental practices on height at elbow have been presented in table 4.8.2.

From the table 4.8.1 it was revealed that the height at elbow increases with increasing age in all the managemental groups. The semi intensive groups were found to have highest value followed by grazing and than tethering.

From the analysis of variance table 4.8.2 that there were no significant effect observed on all age group except at 6 months of age significant effect were observed between semi-intensive & tethering but not in semi-intensive with grazing and grazing with tethering.

4.9 Height at stifle of different ages under different managemental groups.

Mean height at stifle at various ages under different managemental groups were presented in Table 4.9.1 which were also shown in fig. 4.9.1 and the analysis of variance for effect of different managemental practices on height at stifle have been presented in table 4.9.2.

It is evident from the table 4.9.1 that the height at stifle were found to be highest in semi-intensive groups than grazing and tethering.

From the analysis of variance table 4.9.2 that there were no significant effect observed on height at stifle of 4 months whereas at 3 months of age there was significant effect between semi-intensive with grazing and semi-intensive with tethering but no effect were observed between grazing and tethering.

Table 4.8.1 Mean height at elbow (cm) of Black Bengal goat

	3mths	4mths	5mths	6mths	7mths	8mths	9mths
Semi-intensive	23.75±0.21	24.16±0.16	24.75±0.17	25.28±0.18	25.66±0.24	26.25±0.21	26.91±0.15
Grazing	23.33±0.10	23.75±0.17	24.25±0.17	25±0.18	25.75±0.21	26.16±0.21	26.66±0.16
Tethering	23.33±0.16	23.66±0.21	24.25±0.17	24.66±0.16	25.25±0.21	25.91±0.20	26.58±0.15
Overall	23.47±0.10	23.86±0.11	24.41±0.10	24.98±0.11	25.55±0.13	26.11±0.11	26.72±0.09

Table 4.8.2 Analysis of variance for effect of different managemental practices on height at elbow

Source	d.f	M.S.						
		3 months	4 months	5 months	6 months	7 months	8 months	9 months
Between groups	2	0.347	0.431	0.500	0.572	0.431	0.181	0.181
Within groups	15	0.169	0.203	0.175	0.189	0.306	0.261	0.150

Table 4.9.1 Mean height at stifle (cm) of Black Bengal goat

	3mths	4mths	5mths	6mths	7mths	8mths	9mths
Semi-intensive	25.66 ± 0.21^a	25.91 ± 0.27	26.58 ± 0.23^a	27.56 ± 0.38^a	28.5 ± 0.43^a	29.41 ± 0.43^a	30.11 ± 0.38^a
Grazing	25.08 ± 0.08^b	25.53 ± 0.15	26.16 ± 0.10^{ab}	26.83 ± 0.16^{ab}	27.83 ± 0.21^a	28.75 ± 0.11^a	29.75 ± 0.17^a
Tethering	24.91 ± 0.15^b	25.33 ± 0.16	25.83 ± 0.16^b	26.33 ± 0.16^b	26.91 ± 0.15^b	27.66 ± 0.24^b	28.58 ± 0.15^b
Overall	25.22 ± 0.11	5.61 ± 0.12	26.19 ± 0.12	6.91 ± 0.18	27.75 ± 0.21	28.61 ± 0.23	29.48 ± 0.21

Means having same superscripts in a column does not differ significantly.

Table 4.9.2 Analysis of variance for effect of different managemental practices on height at stifle

Source	d.f	M.S.						
		3 months	4 months	5 months	6 months	7 months	8 months	9 months
Between groups	2	0.931*	0.514	0.847*	2.309*	3.792**	4.681**	3.847**
Within groups	15	0.150	0.250	0.192	0.407	0.469	0.528	0.399

** P<0.01 * P<0.05

Fig. 4.9.1 : Height at stifle of Black Bengal goat at different ages in three managemental practices
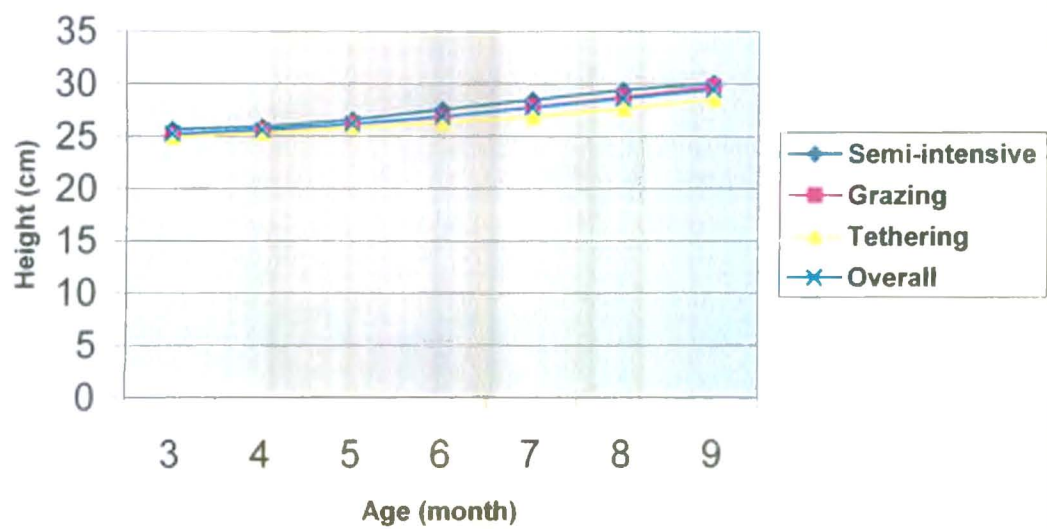
Fig. 4.10.1 : Neck circumference of Black Bengal goat at different ages in three managemental practices
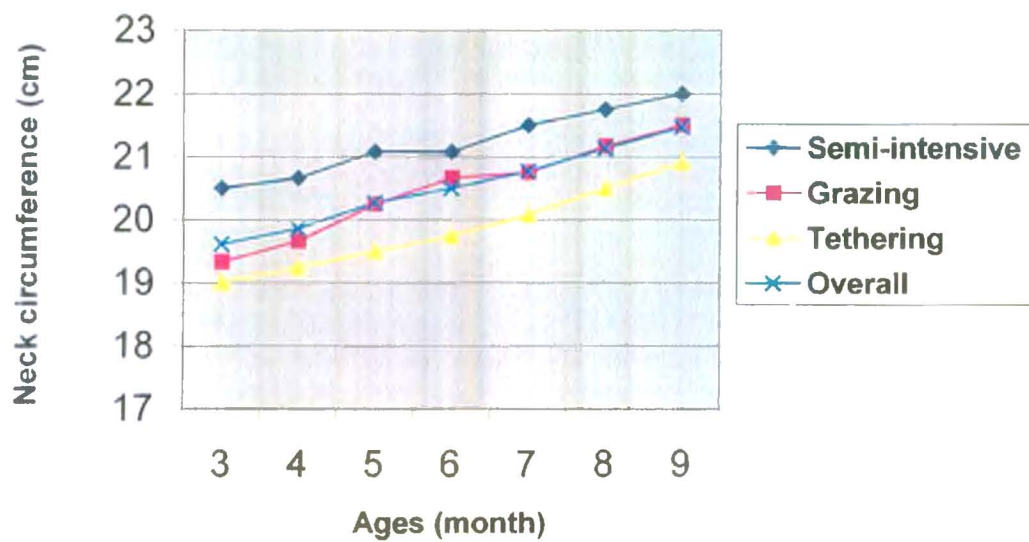
At 5 & 6 months of age there was significant effect between semi-intensive and tethering but not in semi-intensive with grazing and grazing with tethering.

At 7, 8, 9 months of age significant effect were found in semi-intensive with tethering and grazing with tethering but no effect observed between semi-intensive & grazing.

4.10 Neck circumference of different ages under different managemental groups.

Mean neck circumference at various ages under different managemental groups were presented in Table 4.10.1 which were also shown in fig. 4.10.1and the analysis of variance for effect of different managemental practices on height at wither have been presented in table 4.10.2.

As evident from the table 4.10.1 it was observed that the 9 months neck circumference in semi intensive group (22.00±0.12) was found highest and tethered group was lowest (20.91±0.08 cm). The neck circumference in grazing groups (21.50±0.12) almost equivalent to the overall value (21.47±0.12).

From the analysis of variance table 4.9.2 it was observed that there were significant effect observed on neck circumference on all age groups. At 3 & 4 months of age semi-intensive group differ significantly with grazing and tethering but grazing and tethering does not differ significantly. At 5, 6, 7, 8 & 9 months of age it differed significantly.

4.11 Correlation of body weight with body measurement of different ages in different managemental practices

4.11.1 Correlation of body weight with body length of different ages in different managemental practices

The phenotypic correlation co-efficient of body weight with body length under different managemental practices in different age groups have been presented in table no. 4.11.1.

Table 4.10.1 Mean neck circumference (cm) of Black Bengal goat

	3mths	4mths	5mths	6mths	7mths	8mths	9mths
Semi-intensive	20.5 ± 0.18^a	20.66 ± 0.16^a	21.08 ± 0.15^a	21.08 ± 0.15^a	21.5 ± 0.12^a	21.75 ± 0.11^a	22 ± 0.12^a
Grazing	19.33 ± 0.33^b	19.66 ± 0.16^b	20.25 ± 0.11^b	20.66 ± 0.10^b	20.75 ± 0.11^b	21.16 ± 0.10^b	21.5 ± 0.12^b
Tethering	19 ± 0.12^b	19.25 ± 0.11^b	19.5 ± 0.7^c	19.75 ± 0.11^c	20.08 ± 0.08^c	20.5 ± 0.12^c	20.91 ± 0.08^c
Overall	19.61 ± 0.17	19.86 ± 0.16	20.27 ± 0.17	20.5 ± 0.15	20.77 ± 0.15	21.13 ± 0.13	21.47 ± 0.12

Means having same superscripts in a column does not differ significantly.

Table 4.10.2 Analysis of variance for effect of different managemental practices on neck circumference

Source	d.f	M.S.						
		3 months	4 months	5 months	6 months	7 months	8 months	9 months
Between groups	2	3.722**	3.181**	3.764**	2.792**	3.014**	2.347**	1.764**
Within groups	15	0.122	0.136	0.106	0.094	0.072	0.080	0.080

** P<0.01

Table 4.11.1 Correlation of body weight with body length of different ages under different managemental practices

	3m	4m	5m	6m	7m	8m	9m
SI	0.938942**	0.545536	0.040666	-0.19135	0.520361	0.543115	0.770957
G	0.952426**	0.76969	0.706778	0.467861	0.499186	0.312362	0.090389
T	0.641917	0.460569	0.064562	-0.03273	0.174912	0.312362	0.807593*
Overall	0.840338**	0.655124**	0.732643**	0.821281**	0.925422**	0.913909**	0.941071**

** P<0.01   * P<0.05

Table 4.11.2 Correlation of body weight with height at wither of different ages under different managemental practices

	3m	4m	5m	6m	7m	8m	9m
SI	0.748876	0.918718*	0.288052	0.220196	0.663494	0.488331	0.549723
G	0.314347	0.676725	0.29774	-0.09152	0.432097	0.200494	0.247381
T	0.275979	-0.20853	0.312893	0.261951	-0.04655	0.200494	0.694165
Overall	0.635003*	0.829318**	0.819076**	0.779161**	0.87245**	0.883041**	0.881653**

** P<0.01   * P<0.05

Table 4.113 Correlation of body weight with height at rump of different ages under different managemental practices

	3m	4m	5m	6m	7m	8m	9m
SI	0.310297	0.51211	-0.0063	-0.15375	0.68108	0.548064	0.295158
G	0.952426**	0.866041*	0.596183	-0.26191	0.309334	0	0.16937
T	0.068135	0.009699	-0.18376	-0.29575	0.318022	0	0.603323
Overall	0.561355*	0.791511**	0.69999**	0.688381**	0.911407**	0.877424**	0.830939**

** P<0.01   * P<0.05

From the table it was evident that the co-efficient of correlation were mostly positive except at 6 months of age in semi-intensive & tethering groups. The relationship between the two characters were found to be highly significant in semi-intensive and grazing groups at 3 months of age whereas it was significant at 5% level in tethering group at 9 months of age. While considering the overall correlation between the characters it was found to be highly significant in all age groups.

4.11.2 Correlation of body weight with height at wither of different ages in different managemental practices

The phenotypic correlation co-efficient of body weight with height at wither under different managemental practices in different age groups have been presented in table no. 4.11.2.

From the table it was observed that the co-efficient of correlation were mostly positive except at 4 & 7 months of age in tethering groups and 6months of age in grazing groups, where it was negative. At 4 months of age, it was found that the semi-intensive groups was found to be significant at 5% level. While considering the overall correlation between the characters it was found to be highly significant in all age groups, whereas at 3 months of age it was significant at 5% level.

4.11.3 Correlation of body weight with height at rump of different ages in different managemental practices

The phenotypic correlation co-efficient of body weight with height at rump under different managemental practices in different age groups have been presented in table no. 4.11.3.

From the table it was observed that the co-efficient correlation were mostly positive except at 5 & 6 months of age groups. It was also observed that at 3 months of age, the grazing groups were highly significant at 1% level and at 4 months the grazing groups were significant at 5% level. While considering the overall correlation between the characters, it was found to be highly significant in all age groups whereas at 3 months age groups it was significant at 5%level.

4.11.4 Correlation of body weight with chest girth of different ages in different managemental practices

The phenotypic correlation co-efficient of body weight with chest girth under different managemental practices in different age groups have been presented in table no. 4.11.4.

From the table it was evident that the co-efficient of correlation were mostly positive except at 6 & 8 months age groups in tethering and at 8 months in grazing groups. The co-efficient was significant at 5% level only in grazing group. As evident the overall correlation between the characters were found to be highly significant in the age groups of 4, 5, 6, 7, 8 & 9 months whereas at 3 months age group it was significant at 5% level only.

4.11.5 Correlation of body weight with paunch girth of different ages in different managemental practices

The phenotypic correlation co-efficient of body weight with paunch girth under different managemental practices in different age groups have been presented in table no. 4.11.5.

From the table it was revealed that the co-efficient of correlation were mostly positive except at 6 months in semi-intensive groups & 8 months of age in grazing & tethering groups. At 3 months of age groups it was highly significant in grazing groups whereas at 4 months of age it was significant at 5% level in tethering groups. Overall correlations between the characters were found to be highly significant in all age groups.

4.11.6 Correlation of body weight with height at elbow of different ages in different managemental practices

The phenotypic correlation co-efficient of body weight with height at elbow under different managemental practices in different age groups have been presented in table no. 4.11.6.

Table 4.11.4 Correlation of body weight with chest girth of different ages under different managemental practices

	3m	4m	5m	6m	7m	8m	9m
SI	0.460686	0.57563	0.441899	0.031059	0.586281	0.283518	0.547251
G	0.670916	0.910134*	0.212829	0.110276	0.486096	-0.45878	0.551849
T	0.672834	0.499506	0.684818	-0.41405	1.05E-15	-0.45878	0.289917
Overall	0.603723*	0.813349**	0.684512**	0.637043**	0.727786**	0.654815**	0.691873**

** P<0.01   * P<0.05

Table 4.11.5 Correlation of body weight with paunch girth of different ages under different managemental practices

	3m	4m	5m	6m	7m	8m	9m
SI	0.432253	0.565145	0.338981	-0.15254	0.504792	0.239505	0.395397
G	0.935646**	0.630114	0.355095	0.279798	0.486096	-0.42444	0.108645
T	0.663128	0.890923*	0.494727	0.691984	0.172471	-0.42444	0.734906
Overall	0.649397**	0.771387**	0.733509**	0.691452**	0.845268**	0.873897**	0.877742**

** P<0.01   * P<0.05

Table 4.11.6 Correlation of body weight with height at elbow of different ages under different managemental practices

	3m	4m	5m	6m	7m	8m	9m
SI	-0.10966	0.501402	0.514431	0.257685	0.724149	0.619742	0.62676
G	0.79787	0.7899	0.40727	-0.01378	0.215014	0.763718	0.678545
T	-0.20469	-0.75896	0.29658	0.211251	-8.2E-16	0.763718	0.431504
Overall	0.227723	0.435951	0.588264*	0.523968*	0.445007	0.375134	0.172116

** P<0.01   * P<0.05

Table 4.11.7 Correlation of body weight with height at stifle of different ages under different managemental practices

	3m	4m	5m	6m	7m	8m	9m
SI	0.818574*	0.781501	0.444617	0.793203	0.628893	0.631539	0.844905*
G	0.620543	0.785825	0.497784	-0.08053	0.768586	0.632983	0.940141**
T	-0.04966	-0.05214	-0.62194	0.574602	0.344943	0.632983	0.74227
Overall	0.705498**	0.63329*	0.619103*	0.73092**	0.800668**	0.797148**	0.862742**

** P<0.01   * P<0.05

Table4.11.8 Correlation of body weight with neck circumference of different ages under different managemental practices

	3m	4m	5m	6m	7m	8m	9m
SI	0.94301**	0.809717*	0.418664	0.50665	0.38315	0.020562	0.801664*
G	0.79787	0.906645*	0.916802*	0.748096	0.806974*	0.493888	0.921251**
T	0.083448*	0.397783	-0.47446	0.547951	0.795054	0.493888	0.289917
Overall	0.718986**	0.893124**	0.887613**	0.872259**	0.912126**	0.865277**	0.891927**

** P<0.01   * P<0.05

It is evident from the table that the co-efficient of correlation were found to be positive in most of the cases except at 3 months age in semi-intensive & tethering, 4 & 7 months age in tethering and 6 months age in grazing groups. The overall correlation between the characters showed significance only at 5% level in 5 and 6 months of age.

4.11.7 Correlation of body weight with height at stifle of different ages in different managemental practices

The phenotypic correlation co-efficient of body weight with height at stifle under different managemental practices in different age groups have been presented in table no. 4.11.7.

From the table it was revealed that the co-efficient of correlation were found to be positive in most of the cases except at 3, 4, 5 months of age in tethering groups & 6 months of age in grazing groups. At 3 & 9 months of age, it was found that the semi-intensive groups were significant at 5% level and also observed that the grazing groups were highly significant at 9 months of age. The overall correlation between the character showed significance at 1% level in 3, 6, 7, 8 & 9 months age groups whereas at 4 & 5 months age groups level of significance were at 5%.

4.11.8 Correlation of body weight with neck circumference of different ages in different managemental practices

The phenotypic correlation co-efficient of body weight with neck circumference under different managemental practices in different age groups have been presented in table no. 4.11.8.

From the significance test it was found that the co-efficient were highly significant at 3 months for semi-intensive & 9 months for grazing groups. Whereas the co-efficient were significant at 5% level at 4, 5, 7 months in grazing groups, 4 & 9 months in semi-intensive groups & only at 3 months in tethering groups.

In the overall coefficient correlation, all the co-efficient were highly significant in all age groups.

4.12 Climate adaptability:

To find out the thermal adaptability of Black Bengal goat in three managemental practices in two seasons the data were put to 3 different heat tolerance indices. The average value of these results have been presented in Table 4.12.1. From the above table it can be observed that the indices were much higher in summer than winter in IHI in all the managemental groups. While considering the effect of managemental practices it was found that the index was highest in semi-intensive followed by grazing and tethering in winter season. In summer season IHI was highest in tethering group and semi-intensive & grazing groups were almost identical.

In BHTI the tethering group showed highest indices in both winter & summer season followed by semi-intensive and grazing groups.

As regards the DSI, the indices also showed similar trend in both winter & summer season.

4.13 Carcass traits :

The hot carcass weight & dress carcass weight were recorded after deskining and dressing the animals. The dressing percentage were calculated on live weight basis. (Table 4.13.1).

Table 4.13.1 Mean carcass traits under different managemental practices :

Groups	Pre-slaughter weight	Hot carcass weight	Dressing %
Semi-intensive	11.20±0.09	5.45±0.04	47.33±0.40
Grazing	10.76±0.07	4.98±0.03	45.52±0.29
Tethering	9.61±0.14	4.44±0.06	43.44±0.66
Overall	10.52±0.17	4.96±0.10	45.43±0.46

Fig.4.13.2 Carcass trait of Black Bengal goat in three managemental practices
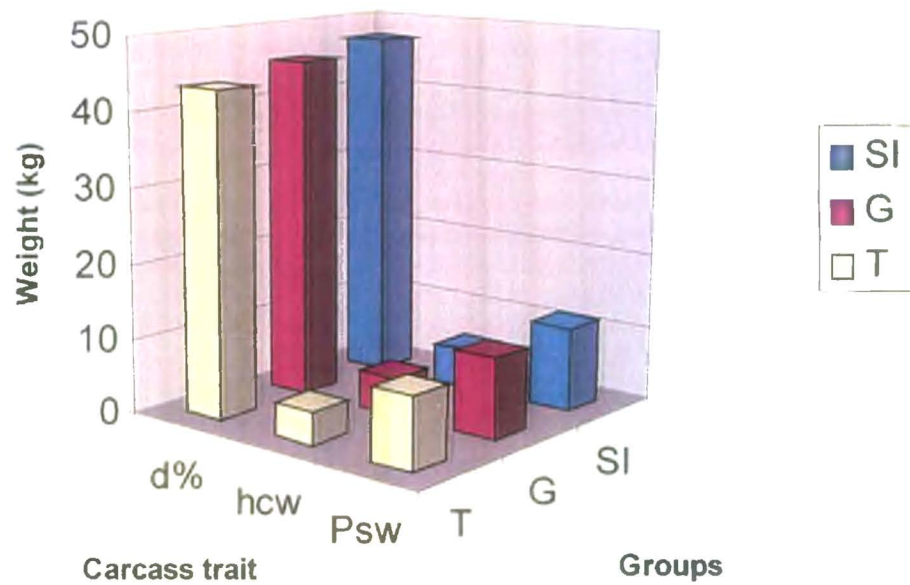
SI – Semi-intensive, G – Grazing , T – Tethering

d % - Dressing percentage, hcw – Hot carcass weight, Psw – Pre-slaughter weight

Table 4.12.1 Assessment of thermal adaptability during winter & summer season

	IHI(W)	IHI(S)	BHTI(W)	BHTI(S)	DSI(W)	DSI(S)
Semi-intensive	81.58±1.15	90.98±1.85	2.76±0.09	2.82±0.06	1.18±0.01	1.18±0.02
Grazing	75.66±1.96	90.81±1.07	2.64±0.09	2.75±0.05	1.15±0.02	1.16±0.01
Tethering	70.33±1.64	93.5±1.33	3.30±0.13	2.88±0.04	1.29±0.02	1.19±0.01
Overall	75.86±1.42	91.76±0.84	2.90±0.09	2.82±0.03	1.20±0.01	1.18±0.01

The mean carcass traits of Black Bengal goats under three different managemental practices were presented in table no. 4.12.1.

From the table it was revealed that the semi-intensive groups were having better carcass weight (5.45±0.04) and dressing percentage (47.33±0.40), followed by grazing (4.98±0.03 kg & 45.52±0.29 %) and tethering groups (4.44±0.06 kg & 43.44±0.66 %). The overall mean values of carcass weight (4.96±0.10) and dressing percentage (45.43±0.46) were almost similar to that of grazing groups.

The carcass weight of Bengal goat in semi-intensive groups of the present study were found to be similar as reported by Singh and Sengar (1978), who observed the same as 5.173 kg in Black Bengal goat.

While comparing the effect of different managemental system on the dressed carcass weight it was observed that the semi-intensive groups were higher value than that of grazing & tethering groups in Black Bengal goats under study whereas the value of extensive group were higher than semi-intensive group in Barbari goats as observed by Paramasivam et al. (2002).

The dressing percentage of Bengal goats in semi-intensive groups (47.33%) in the present study were found similar to those reported by Sengar (1978), whereas the grazing and tethering groups were having almost similar value as reported by Kesava Rao et al. (1984) [44.68%], Acharya (1982) [45.7%], Anjaneyulu and Joshi (1992) [44.68%].

The managemental groups of Black Bengal goats in the present study were found to have higher values as compared to the findings reported by Moniruzzaman et al. (2002) [39% in tethering, 34% in grazing, 36.79% in semi-intensive groups].

While comparing the effect of different managemental system on the dressing % of Black Bengal goats with other breeds, it was observed that the goats under semi-intensive managemental groups were better compared to extensive system as reported by Saini et al. (1986 b) in Barbari (Semi-intensive 44.72%, extensive 42.28%), Misra & Prasad (1996) in Sirohi (Semi-intensive 48.90%, extensive 44%)and Beetal x Sirohi (Semi-intensive 51.70%,extensive 49.20%) , Shinde et al. (2000) in Marwari (Semi-intensive 44.78%,extensive 41.86%), Sankhyan et al. (2002) in Marwari goats (Semi-intensive 46.85%,extensive 44.37%), Paramasivam et al.(2002 a) in Barbari (Semi-intensive 48.62%,extensive 40.55%).

Chapter V

Summary and conclusion

Summary and conclusion

The study was undertaken to obtain an idea in respect of growth, body measurements, climate adaptability and carcass characters under three different mangemental practices in Black Bengal goat.

A total of eighteen Black Bengal male kids of 3 months of age with an average body weight of 5 to 6 kg were selected for the study. The kids were managed under 3 different system of management (i.e. grazing, tethering and semi-intensive) for a period of 180 days (6 months) i.e. from 15th December 2005 to 15th May 2006.

Body weight

The body weights under three different mangemental practices in Black Bengal goat showed a steady increasing trend with increase in age. The body weight was found to be highest in semi-intensive practices in all age groups than grazing and tethering.

The body weight of semi-intensive group are significantly higher than those of grazing and tethering groups in all the months. The final body weight at 9 months of age are highest in semi-intensive group (11.20±0.09), followed by grazing (10.76±0.07) and tethering (9.61±0.14).

Weight gain

The daily weight gain in semi-intensive group excels significantly in 0-3 and 3-6 months age groups than grazing & tethering groups, whereas it was significantly highest in grazing management at 6-9 months age group.

Body measurement

Body length : The body length of different managemental practices showed a steady increasing trend with increasing age while the body length were found highest in semi-intensive

groups in all age groups and these values were lowest in tethering group as compared to semi-intensive and grazing.

The difference among the managemental practices in all ages under study were found to be highly significant whereas there was no significant effect found at 3 months of age. The final body length at 9 months of age were highest in semi-intensive (39.08±0.08), followed by grazing (38.5±0.12) and than tethering (37.58±0.23).

Height at wither : With increasing age height at wither increases in all the three managemental practices. The height at wither were observed to be lowest in tethering groups, while in grazing groups the value almost similar to the overall values in all age groups. But the semi-intensive groups have the highest values as compared to other groups as well as overall values in all age groups.

Height at rump : A steady increasing trends were also observed with the advancement of ages under different managemental practices in these parameters.

The height at rump were found to be highest in semi-intensive, intermediate in grazing and lowest in tethering in all age groups.

Chest girth : The chest girth also increases with increasing age. The chest girth under different managemental practices were highest in semi-intensive groups followed by grazing and tethering in all age groups. There were significant effect in all age groups among different managemental practices except at 3 months of age.

Paunch girth : It was revealed that the paunch girth in these three managemental practices were found to be highest in semi-intensive practices in all age groups, followed by grazing and tethering.

Height at elbow : It was revealed that the height at elbow increases with increasing age in all the managemental groups. The semi intensive group were found to have highest value followed by grazing and than tethering.

There were no significant effect observed on all age group except at 6 months of age significant effect were observed between semi-intensive & tethering but not in semi-intensive with grazing and grazing with tethering.

Height at stifle : It was observed that the height at stifle were found to be highest in semi-intensive groups than grazing and tethering.

Neck circumference : It was observed that at 9 months of age neck circumference in semi intensive group (22.00±0.12) was found highest and tethered group was lowest (20.91±0.08 cm). The neck circumference in grazing groups (21.50±0.12) almost equivalent to the overall value (21.47±0.12).

It was observed that there were significant effect observed on neck circumference on all age groups.

Correlation of body weight with body length

The co-efficient of correlation were mostly positive except at 6 months of age in semi-intensive & tethering groups but it was highly significant in semi-intensive and grazing groups at 3 months of age whereas it was significant at 5% level in tethering group at 9 months of age.

Correlation of body weight with height at wither

The co-efficient of correlation were mostly positive except at 4 & 7 months of age in tethering groups and 6 months of age in grazing groups, where it was negative. At 4 months of age, it was found that correlation was found to be significant at 5% level in semi-intensive groups.

Correlation of body weight with height at rump

The co-efficient correlation were mostly positive except at 5 & 6 months of age groups. It was also observed that at 3 months of age, the correlation were highly significant at 1% level and at 4 months 5% level in grazing groups.

Correlation of body weight with chest girth

The co-efficient of correlation were mostly positive except at 6 & 8 months age groups in tethering and at 8 months in grazing groups. The co-efficient was significant at 5% level only in grazing group.

Correlation of body weight with paunch girth

The co-efficient of correlation were mostly positive except at 6 months in semi-intensive groups & 8 months of age in grazing & tethering groups. At 3 months of age groups it was highly significant in grazing groups whereas at 4 months of age it was significant at 5% level in tethering groups.

Correlation of body weight with height at elbow

The co-efficient of correlation were found to be positive in most of the cases except at 3 months age in semi-intensive & tethering, 4 months age in tethering, 6 months age in grazing groups & 7 months age in tethering groups.

Correlation of body weight with height at stifle

The co-efficient of correlation were found to be positive in most of the cases except at 3, 4, 5 months of age in tethering groups & 6 months of age in grazing groups. At 3 & 9 months of age,

it was found that the semi-intensive groups were significant at 5% level and also observed that the grazing groups were highly significant at 9 months of age.

Correlation of body weight with neck circumference

The co-efficient were highly significant at 3 months for semi-intensive & 9 months for grazing groups. Whereas the co-efficient were significant at 5% level at 4, 5, 7 months in grazing groups, 4 & 9 months in semi-intensive groups & only at 3 months in tethering groups.

Climate adaptability:

The indices were much higher in summer than winter in IHI in all the managemental groups. While considering the effect of managemental practices it was found that the index was highest in semi-intensive followed by grazing and tethering in winter season but in summer season IHI was highest in tethering group and were almost identical in semi-intensive & grazing groups.

In BHTI the tethering group showed highest indices in both winter & summer season followed by semi-intensive and grazing groups.

As regards the DSI, the indices also showed highest indices in both winter & summer season in tethering groups followed by semi-intensive groups.

Carcass traits

From the table it was revealed that the semi-intensive groups were having better carcass weight (5.45±0.04) kg and dressing percentage (47.33±0.40) %, followed by grazing (4.98±0.03 kg & 45.52±0.29 %) and tethering groups (4.44±0.06 kg & 43.44±0.66 %). The overall mean values of carcass weight (4.96±0.10) kg and dressing percentage (45.43±0.46) % were almost similar to that of grazing groups.

From the above study it can be concluded that the growth performance like body weight in different age, daily weight gain and body measurements were found to be highest in semi-intensive followed by grazing and tethering.

The climatic adaptability of Black Bengal goat under study did not show any regularity of efficiency according to 3 different managemental practices.

As regards the carcass traits under study the semi-intensive groups showed higher results in carcass weight and dressing % than grazing and tethering groups.

Thus from the present study it can be advocated that the goats should be reared in semi-intensive system of management for hot and humid climate of West Bengal. It is also suggested that more study is required in this respect with large number of animals for longer periods of time in different agro-climatic condition of West Bengal on this respect.

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