STUDY OF THE CHARACTERISTICS AND PERFORMANCE OF BENGAL GOATS IN ORISSA

A THESIS
PRESENTED TO THE
ORISSA UNIVERSITY OF AGRICULTURE
AND TECHNOLOGY, BHUBANESWAR
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF VETERINARY SCIENCE
IN
ANIMAL PRODUCTION

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1984

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C E R T I F I C A T E

This is to certify that the thesis entitled, "Study of the characteristics and performance of Bengal goats in Orissa", submitted in partial fulfilment of the requirements for the degree of Master of Veterinary Science in Animal Production of the Orissa University of Agriculture and Technology, Bhubaneswar, is a faithful record of bonafide and original research work carried out by Bhuban Mohan Pattnaik under my guidance and supervision.

It is further certified that no part of the thesis has been submitted for any other degree or diploma, or published in any other form.

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A C K N O W L E D G E M E N T S

I take this unique opportunity to express my deep sense of gratitude and indebtedness to my Advisor, Dr. M. Mishra, B.V.Sc. (Madras), M.S., Ph.D. (Missouri, U.S.A.), Professor and Head, Department of Animal Production, College of Veterinary Science and Animal Husbandry, Orissa University of Agriculture & Technology, Bhubaneswar for his constant guidance, constructive criticism and sound advice during the entire course of my M.V.Sc. research work and writing of this manuscript. I am grateful to my advisor for imparting adequate knowledge through course work in support of my research. Further, I have no words in which I can express my sincere gratitude for the affection, love, sympathy and encouragement which he has showered on me during the entire period of two years of my Postgraduate studies.

My grateful acknowledgements are due to the Director of Animal Husbandry, Dairy and Veterinary services, Orissa for sanctioning me study leave to continue Postgraduate studies.

I am grateful to Dr. J. B. Nayak, Reader and Dr. A. Mohanty, Dr. B. Pradhan, Dr. S. C. Mohanty, Dr. K.K. Kanungo and Dr. K. R. Rout, Lecturers of the Department of Animal Production for their encouragement and valuable help throughout my course and research work during my Postgraduate studies.

Thanks are due to the non-teaching staff members of the Department of Animal Production for their hearty cooperation during my Post-graduate studies.

My sincere thanks are due to my Department colleagues Dr. R.N. Mayee, Dr. J. K. Chowdhury, Dr. J. K. Behuria, Dr. P. C. Patra, Dr. P. Nath, Dr. P. J. Sharma and Dr. B. Mohanty, for their hearty cooperation during the course of my work.

I express my gratitude to my sisters, Basidei, Pandei, Minidei, Lila and Lisa for their constant inspirations and cooperation during my Postgraduate studies.

I wish to express my thanks to my friends Sri S. K. Mohanty (Nitu), Sri S. R. Mohanty (Dui), Sri K. P. Padhy (Tuna), Sri A. K. Pattnaik (Tuna), Sri S. S. Patnaik (Sashi) and others for their sincere help while conducting the experimental work in the field and printing of the thesis.

I also express my thanks to my younger brothers Sri M. M. Pattnaik, (Babu), Sri L. M. Pattnaik (Lalu) and Sri M. M. Pattnaik (Dubu) for their cooperation during my Post-graduate studies.

Thanks are also due to Sri B. C. Khuntia for typing out this manuscript in time.

My heartfelt thanks go to my wife 'Rani' for her constant inspiration and readiness to suffer from hardship during the entire course of my M.V.Sc. studies. I acknowledge the loving and cheerful inspiration of my sons Pintu (three and half years) and Kuku (one and half years) for completion of my work.

Bhubaneswar.

Dated, the 18th May, 1984

18/5/84

(B. N. Pattnaik).

CONTENTS

LIST OF TABLES

CHAPTER-I
INTRODUCTION

I N T R O D U C T I O N

Goats were the oldest animal to be domesticated in the ancient Egypt, which was evident from the fossils found in the New Stone Age. According to the old Testament literature goat served as the most versatile help-mate to man in Biblical days. They consumed shrubs, weeds and troublesome, which no other livestock relished and produced fibre for clothing, skin for making bottles, produced the best quality meat and served as the object for sacrifice at ceremonial functions. In the words of Lindsjo goat was the "poor man's cow" which produced relatively large quantities of milk in proportion of her body weight and food requirements. Goat has proved its adaptability to diverse agroclimates and it has the ability to thrive and grow well on very low quality forage, tree leaves, pasture, weeds, shrubs and even on kitchen wastes. The goat was considered as an economic animal for the poorer section of people. Goat farming is quite suitable for the landless agricultural labourers and marginal farmers who have surplus labour to tend the goats in the breeding area. In addition to their contribution for the economic improvement of the rural man in India, they have several advantages over other livestock which are furnished below :

1. Goats are quite hardy and they have been found to readily adapt to almost all climates.

2. They are of small size with early maturity and an early slaughter age. As such, more production units can be obtained per unit of investment thereby facilitating a faster turnover of capital.

3. They are ruminants and natural browsers and they can thrive on a variety of herbs, shrubs, woods and grasses. In fact, they browse on materials, which would starve other domestic animals if they were reliant on such materials. Besides, they can eat wild plants, vegetable and fruit peelings, kitchen waste and such other waste materials which are not relished by other live stock.

4. It has also been observed that they have increased digestive efficiency as the forage quality decreases.

5. They browse in the sun throughout the day and as such they are more heat tolerant than other livestock.

6. They are generally resistant to diseases and the mortality under the wild or semi-domesticated state is relatively low.

7. Goats are prolific breeders and certain breeds give birth to twin and even triplets in a litter. There are breeds of goats which yield three litters in two years period. Therefore, goats have unique role in the growth of farm economics in shorter period.

8. Goats have small carcasses that are easily dressed and quickly consumed without involving the costly refrigeration facilities.

9. They are active, agile and smart and as such they do not store much of fat in their carcass thereby producing lean meat.

10. Their energetic efficiency for production has been reported to be higher than other animals.

11. They have no religious taboos and their meat is relished by all sections of the society.

12. Goats have not exacting demands of housing and management.

13. Besides producing meat, goats also produce milk, kidskin, pashm, and other byproducts such as skin, bone, and manure etc. Catgut is also made from goat intestine, which are important for the national economy.

14. Goats are often used in research work due to their low investment and maintenance cost as well as easy handling for research.

15. Goat milk, by nature, is homogenized as it contains very small sized fat globules forming soft curd in the stomach which is easily digestible. Hence, goat milk

due to its easy digestibility is specially suitable for consumption by infants, children, aged and sick persons and convalescent people recovering from chronic diseases.

16. Goat farming needs relatively low capital investment compared to other livestock farming, while the rate of capital turnover in the goat business is high. In fact, in the goat farming it is the capital investment on purchase of goats, which is important. Housing is not at all elaborate. Feeding may include very little concentrate and it is mostly browsing. Labour expenditure is next to investment on purchase of goats, but no labour needs to be hired as goat husbandry is practised by landless labourers and marginal farmers who have surplus labour for the purpose.

There is a distinct zonal distribution of goats in India for production of meat, milk, meat and milk, mohair and pashmina (Tanuja, 1979). Those zones are as follows :

(1) Pashmina goats of Ladakh and Himachal Pradhesh

There are 1.5 lakhs pashmina goats in valleys of Ladakh and Himachal Pradesh with a rainfall as low as 2", summer temperature as high as 40°C and winter temperature as low as 40°C.

(ii) North Western Zone of milk goats : This zone comprises of Haryana, Punjab, Rajasthan and Western U.P. extending into Gujarat, Himachal Pradesh, Kashmir. Summers are dry and winters are cool in this zone. The important milk breeds inhabiting the zone are Jamnapari, Beetal, Barbari, Alwari and Sindhi.

(iii) Dry Southern Zone of meat and milk goats : There are no distinct breeds of goats in the Indian Peninsula except in Kerala where there is the Malabari breed producing meat with relatively more milk. The southern goats are of dual type yielding both meat and milk. However, relatively more emphasis is given on milk production.

(iv) North Eastern Zone of meat goats : This zone is comprised of Bihar, Orissa, Bengal, Assam, Himachal Pradesh, Meghalaya, Manipur, Nagaland, Tripura and Sikkim. This zone has high rainfall with hot and humid summer as well as cold and wet winter. In this zone there are highly prolific meat breeds known as Assam hill goats and Black Bengal goats which are very small in size and are well known for giving birth to twins and triplets and for breeding twice a year.

In fact, in India the breeds/types of goats that are of economic importance are (a) Jamnapari and Beetal (Large size) and Barbari (Small size and small fat) for milk production, (b) Assam hill goat and Bengal goat for meat production (small size, prolific breeder with twin and

triplets and breeding twice a year), (c) Dual type goats of Southern India meant for milk and meat production with emphasis on meat production. Some of such southern goat breeds are Malabari/Pallichanny and Osmanabadi, (d) Pashmina goats of Ladakh and Himachal Pradesh meant for production of Pashmina. The breeds of this zone are Changthangi, Kaundni, Gaddi and Deora Din Parmah.

According to 11th Live stock census of 1972 there were about 178 million cattle, 53 millions buffaloes, 40 million sheep, 61 million goats, 6 millions Pigs, 137 million poultry and 3 million other livestock in India. Hence the goat population exceeded that of sheep. According to FAO (1977) in Asia, there was a positive rate of increase in the goat population (+31.5 %) compared to sheep (+6.0 %), the major increases being due to the high goat population of India, Iran and Pakisthan. The steady increase of goat population in India is evident from the fact that it was 47.14 million in 1951, 55.42 million in 1956, 60.94 million in 1961, 64.93 million in 1966, 69.02 million in 1971 and 70.39 million in 1977. Thus, the goat population in India was increasing at the rate of about 1 million per year. It is important to note that the rise in goat population has been occuring every year inspite of the lack of adequate goat development programmes in the country. This might be due to a high birth rate and low death rate due to their inherent resistance to diseases as well as acceptability of goat husbandry as the means of living by the poorer section of the rural population.

The goat population of Orissa is also on the increase from year to year, which is evident from the goat census from time to time. According to the census the goat population of Orissa was 2.934 million in 1972, 3.416 million in 1977 and 4.091 million in 1982. The goats in Orissa are mainly used for meat production and to some extent milk from them is utilised for consumption. Goat skin constitutes an important byproduct which adds to the earning of the goat husbandry men. The total annual production and its value for goat meat and skin in Orissa has been detailed below.

	Production '000 MT & Rs. in '000					
	1978-79		1979-80		1980-81	
	Production	Value	Production	Value	Production	Value
Goat meat (Chevon)	3292	12190	3365	12613	3431	13047
Goat skin	613584	2535	634484	2654	655311	2776

Goat meat or chevon is the meat of choice for the people of Orissa while sheep meat or mutton is not preferred by most of the consumers in the State. In fact, the consumers are so conscious that while purchasing meat, they carefully examine the carcass to distinguish goat from sheep and accept the meat, provided it comes from the carcass of the goat. Goats are transported from the rural areas or far off places to the urban and industrial areas for slaughter and sale of meat to the consumers who have the purchasing power

There are two breeds/types of goats in Orissa. They are Bengal and Ganjam goats. The Bengal goats are popular in north Orissa and they are usually of small size with compact body, yielding about 3 litters in two years and giving birth to twins or even triplets in each litter. Their meat is tender, palatable and very much relished by the consumers. On the other hand, Ganjam goats are popular in South Orissa. They are tall, long legged and less compact bodied animals. They are dual purpose goats kept in south Orissa primarily for meat and to some extent milk production. Milk produced from Ganjam goat is often sold as fluid milk or made into ghee and marketed in the southern parts of Orissa. But the meat produced from them is somewhat tough and fibrous and it is not as palatable as the meat of Bengal goats. However, no authentic and detailed study have been made so far on the breed characteristic, and performance of Bengal and Ganjam goats in Orissa, although the Government of Orissa is carrying out several goat development schemes with both Bengal and Ganjam goats in northern and southern parts of Orissa, respectively. The Government is providing subsidy for purchase of goats at the rate of 25 % for the small farmers, 33.3 % and for the marginal farmers and landless agricultural labourer, and 50 % for the scheduled caste and scheduled tribe people.

Although Orissa has been included under the North-Eastern zone having Bengal goats for meat production (Taneja, 1979) in reality the State has two breeds of goats i.e. Bengal goats and Ganjam goats. Bengal goats are distributed in North of Orissa while Ganjam goats in the southern part of the State. Unlike Bengal goats which are of only meat type, the Ganjam goats are of dual type yielding both meat and milk which are typical to the Southern India. It was possible that before the formation of Orissa as a seperate State, the north part of it was linked with Bihar and Bengal while the southern part was connected with the Madras presidency. As such, in North Orissa, Bengal goats became popular while in South Orissa the dual type of goats were known as Ganjam goats in course of time.

Although studies on Bengal goats belonging to some other states of the Eastern region and their performance have been conducted, no authentic and detailed studies have been made on the characteristics and performance of Bengal goats in Orissa where they are very popular for meat production, particularly in the northern part of the State. An attempt has been made in this study to find out the geographical distribution and habitat, description of the agroclimate in which they lived, breed characteristic, growth study i.e. birth weight and live weight and gain at quarterly intervals, phenotypic measurements i.e., straight and oblique lengths, heights at wither, croup, elbow and

stifle and heart girth, average twins in., age and live weight at first kidding, gestation period, service period and kidding interval in the Black Bengal goats in their native tract. The experimental data were subjected to statistical analysis as per Snedecor and Cochran (1967) for interpretation of the findings.

CHAPTER-II

REVIEW OF LITERATURE

REVIEW OF LITERATURE.

BREED CHARACTERISTICS

Narendra (1970) reported that the Black Bengal were black in colour and both males and females had horns. Back was straight, legs short, ears pointed. They were good meat producers, but produced very little milk. They were prolific breeders with twins and multiple births being common.

Describing the Black Bengal goats Joshi (1970) observed that they were widely distributed through-out the state of West Bengal, Bangladesh as well as Kuch Bihar. It was a small breed. The average weight of buck being 11 to 15 kg and of the nanny 8 to 13.6 kg. Generally both males and females carried horns 3-4 inches long tilted upward or straight. The body was deep, the back straight, the shoulders and hips of equal height. The chest was wide and legs were short. The animal possessed a soft and short coat of black colour. They were poor milkers, the average lactational yield being 16 to 20 kg. The breed was a producer of

excellent quality of meat and very high quality skin raised for show making. Multiple births were very common in this breed, two or three kids were born twice a year.

According to Banerjee (1982) the Bengal goats were small legged weighing over 15 kg, yielding excellent quality meat. Skin was of superior quality and was in demand both in India and abroad. Except for nourishing the kids for a brief period, the goat did not yield any appreciable quantity of milk. Shoulders and hips were of equal height, chest was wide, ears were nearly upright. The animal possessed soft but short hairs. Multiple births were common, twins or triplets were born to does or twelve to fourteen months of age. There were different types of the breed such as Black Bengal Brown Bengal and White Bengal out of which Black Bengal was the most popular being jet black in colour.

Singh and Moore (1983) reported that Black Bengal was located in West Bengal, Assam and adjoining areas. This small Bengal goat, which might be dark black or some time white or spotted. This breed was known for its excellent cotton quality and superior skin. The goats were prolific. The Bengal goat was short legged, compact animal. Ears were upright, chest wide and the back straight. The body was deep, and the shoulders and hips were of equal height.

GROWTH STUDY

Birth weight

Gahe et al. (1968) observed that the average live weight at Birth of Black Bengal goats was 1.50 ± 0.32, 1.32 ± 0.20, 1.19 ± 0.23 and 1.26 ± 0.30 kg for single, twin, triplet and quadruplet males and the overall live weight at birth was 1.32 ± 0.20 and 1.16 ± 0.26 kg for male and female respectively.

Bhatnagar et al. (1971) reported the average birth weight of Beetal kids to be 2.8 kg in male.

Jehani and Talpara (1971) observed the average birth weight of Jamunpari kids as 3.19 to 3.3 kg in case of male and 3.0 to 3.65 kg in female.

Modell (1977) reported the average birth weight of Gujam kids as 2.34 ± 0.033 kg in male and 2.26 ± 0.030 kg in female.

Nath and Chawla (1978) studied the Birth weight of Beetal, Alpine, Alpine X Beetal, Saanen X Beetal and Saanen X (Alpine X Beetal) and reported that the birth weight of kids averaged 2.86, 3.47, 3.24, 3.25 and 3.43 kg respectively for male and 2.77, 3.15, 3.01, 3.10 and 3.24 kg for the female.

Joshi (1970) reported that the birth weight of Barbari, Black Bengal, Jamunari, and Beetal male were 1.80,

1.10, 3.60 and 2.94 kg and for female it was 1.66, 1.91, 2.92 and 2.74 kg respectively.

Khan et al. (1978) observed the average birth weight of 83 Jamnapari kids as 3.04 kg.

Mishra (1979) observed that the birth weight of Sanjan kids was 2.37 ± 0.022 and 2.39 ± 0.024 kg for female and male respectively.

Ali (1980) observed that the average birth weights of Black Bengal kids were 1.80 and 1.75 lbs in the male and female respectively.

Sharma et al. (1981) studied on the local Assam hill goats and observed that the birth weight of kids averaged 1.17 kg.

Kumar and Singh (1983) reported the mean values of body weight at birth of Sirohi, Jamnapari, Barbari, ♀ Jamnapari × ♂ Black Bengal and Black Bengal as 3.23 ± 0.230, 2.38 ± 1.41, 1.80 ± 0.021, 1.32 ± 0.037 and 1.21 ± 0.07 kg, respectively.

Sinha and Sahni (1986) found the average birth weight to be 2.97 ± 0.13, 2.76 ± 0.51, 1.84 ± 0.22, 0.98 ± 0.10, 2.36 ± 0.43, 2.10 ± 0.16, 2.63 ± 0.23 and 1.56 ± 0.17 kg in Jamnapari, Beetal, Barbari, Black Bengal, Jamnapari X Barbari, Jamnapari X Black Bengal, Beetal X Barbari and Barbari X Black Bengal kids respectively.

Body weight at 3 months

Joshi (1979) reported that the body weight of Barbari, Black Bengal, Jamnapari and Beetal male kids at the

age of 3 months were 6.10, 4.75, 8.00, 10.14 kg and for female it was 5.63, 4.27, 8.21, 8.05 kg respectively.

Hildru (1979) reported that the 3 months body weight of Ganjam goats averaged 6.03 ± 0.119, 7.55 ± 0.174 and 7.74 ± 0.187 kg for female, male uncastrated and male castrated respectively.

Mohanty (1979) reported the average live weight of Ganjam goats in 3 different groups at the age of 3 months were 6.30 ± 0.330, 7.80 ± 0.341 and 8.70 ± 0.382 kg.

Sharma et al. (1981) studied on growth of Assam local goat and observed that the 90 days weight of Assam hill kids were 4.75 kg.

Body weight at 6 months

Nadell (1977) observed the average 6 months body weight of male castrated, male uncastrated and female Ganjam goats to be 9.89 ± 0.204, 9.06 ± 0.220, and 9.00 ± 0.161 kg respectively.

Joshi (1979) reported that the body weight at 6 months of age in Barbari, Black Bengal, Jamnapari and Beetal male were 8.86, 6.94, 10.14 and 12.74 kg and in females it was 7.63, 5.97, 8.94 and 11.50 kg respectively.

Hildru (1979) reported that the average body weight at 6 months of age in Ganjam female, male uncastrated and male castrated as 9.97 ± 0.136, 9.91 ± 0.106 and 9.71 ± 0.207 kg respectively.

Rehenky (1979) studied that the average body weight at 6 months of age in Ganjam goats was 9.30 ± 0.451, 10.33 ± 0.394 and 8.33 ± 0.406, kg in three groups of goats.

Sharma et al. (1981) reported that the body weight at 6 months age of Assam hill goats was 7.06 kg.

Kumar and Singh (1983) reported that the average values of body weight at 6 months of age in gurgaon, Jamnapari, Barbari, ½ Jamnapari + ½ Black Bengal and Black Bengal were 12.64 ± 0.394, 12.72 ± 0.393, 9.81 ± 0.360, 9.66 ± 0.419 and 7.22 ± 0.362 kg respectively.

Body weight at 9 months

Ali et al. (1972) observed the average body weight of female Black Bengal goats to be 11.51 kg at the age of 10 months which was the average age at first conception.

Mittal and Pandey (1978) observed the body weights of Barbari Goat at 9 months of age to be 13.31 ± 1.932, 13.65 ± 0.295 and 13.50 ± 0.725 kg in males and 16.33 ± 1.23, 16.93 ± 0.575 and 15.59 ± 0.230 kg in female in three experimental groups respectively.

Singh and Sengar(1978) reported that the body weights at 9 months age in Jamnapari goat were 12.53 kg for male and 14.56 kg for female.

The body weights of Barbari, Black Bengal, Jamnapari and Beetal at 9 months were 12.39, 8.57, 13.53 and

17.36 kg in male and it was 10.28, 7.39, 14.56 and 14.01 kg in female respectively (Joshi, 1979).

Mishra (1979) recorded the live weight of Sanjan goats at the age of 9 months as 10.23 ± 0.160, 11.29 ± 0.256 and 11.13 ± 0.223 kg for female, male uncastrated and male castrated goats respectively.

Mohanty (1979) studied the average body weight of Sanjan goats at the age of 9 months as 11.30 ± 0.520, 12.77 ± 0.316 and 10.80 ± 0.431 kg in three different groups.

Body weight at 12 months

Guha et al. (1968) observed that the average body weight at 12 months of age of Black Bengal was 13.01 ± 3.11 kg in male and 11.18 ± 2.76 kg in female.

Nadell (1977) reported the average body weight of male castrated, male uncastrated and female Sanjan goats at the age of 12 months as 11.04 ± 0.313, 12.29 ± 0.234 and 11.30 ± 0.334 kg respectively.

Singh and Sengar (1976) observed the average body weight of male and female Jamunapuri goats as 20.40 and 17.00 kg respectively.

Mishra (1979) reported the average body weight of female, male uncastrated and male castrated Sanjan goats at the age of 12 months as 11.40 ± 0.31, 12.23 ± 0.291 and 12.01 ± 0.281 kg respectively.

Mohanty (1979) studied the average live weight of Ganjam goats in three different feeding groups at the age of 12 months and found that it was 13.00 ± 0.412, 14.33 ± 0.225 and 12.75 ± 0.476 kg respectively.

Prasad et al. (1971) studied on biometrics of Black Bengal goats in four different agroclimatic regions and observed the average body weights at one year of age to be 20.7 ± 0.05, 21.5 ± 0.57, 19.6 ± 0.43 and 23.3 ± 0.71 kg respectively.

Body weight at 15 months

Mishra (1970) reported that the average body weight of Ganjam goat at the age of 15 months for female, male uncastrated and male castrated were 12.23 ± 0.251, 13.53 ± 0.370 and 13.50 ± 0.365 kg respectively.

Mohanty (1979) reported that the average body weight of Ganjam goat at the age of 15 months for three experimental goats were 13.30 ± 0.426, 16.10 ± 0.203 and 13.30 ± 0.450 kg respectively.

Body weight at 18 months

The live weight of Barbari goats at 18 months age averaged 21.040 and 21.197 kg for male and female respectively (Srivastav et al., 1960).

Chandran et al. (1973) observed that the live weight of crossbred (Angora buck x Local breeds of Maharashtra)

male progeny was 17.767 ± 1.41.74 kg at 18 months.

Nadoll (1977) reported that the live weight of Sanjan goats at 18 months of age averaged 14.07 ± 0.535, 14.46 ± 0.348 and 13.42 ± 0.302 kg in male castrated, male uncastrated and female respectively.

Mishra (1979) observed that the average body weight of Sanjan goats at the age of 18 months were 13.61 ± 0.229, 14.51 ± 0.306 and 15.00 ± 0.400 kg for female, male uncastrated and male castrated goats respectively.

Body weight at 21 months

Mishra (1979) reported that the average body weights of Sanjan goats at the age of 21 months were 15.11 ± 0.236, 15.83 ± 0.320 and 16.51 ± 0.334 kg for female, male uncastrated and male castrated goats, respectively.

Body weight at 24 months

Chauhan et al. (1973) reported the live weight at 24 months of age of male crossbred progeny (Angora buck X Local nondescript breeds of Maharashtra) to be 26.160 ± 0.2813 kg.

Nadoll (1977) found the average live weight of Sanjan goats at 24 months of age to be 16.82 ± 0.821, 17.45 ± 0.377 and 16.22 ± 0.306 kg in male castrated, male uncastrated and females respectively.

Mishra (1979) reported that the average body weights of Gunjam goats at the age of 24 months were 16.42 ± 0.374, 17.79 ± 0.678 and 15.69 ± 0.622 kg for female, male (castrated and entered goats respectively.

PHENOTYPIC MEASUREMENTS

Body length

Sylvester et al. (1968) reported that the average body length of Jamnapari goats at one year of age and Barbari goats at 18 months of age were 654.4 ± 18.0 mm and 660.7 ± 23.9 mm for male 760.3 ± 7.6 mm and 7837.0 ± 8.7 mm for female respectively.

Average body lengths in Barbari goats were 65.5 ± 1.20, 68.7 ± 0.60 and 60.4 ± 2.11 cm in age groups of 1-2, 2-4 and 4-6 years respectively as reported by Mittal (1979).

Mukherjee et al. (1979) reported that the body lengths of the she goats were 30.4 ± 0.91, 40.2 ± 0.83, 43.0 ± 0.70, 49.3 ± 0.65 and 51.3 ± 0.54 cm for Grey Bengal and 30.1 ± 0.80, 40.8 ± 0.73, 45.3 ± 0.81, 51.3 ± 0.37 and 53.9 ± 0.35 cm for Brown Bengal goats at the age groups of 0-3 months, 3-6 months, 6-12 months, 1-3 years and above 3 years respectively.

Singh et al. (1979) studied the body measurements of Black Bengal she goats of different age groups. They

observed that the body length averaged 43.7 ± 0.70 cm, 48.0 ± 0.44, 48.6 ± 0.37, 50.7 ± 0.67 and 54.2 ± 1.77 cm when there were milk teeth, one, two, three and four pairs of incisors in the mouth respectively.

The body length of matured Grey Bengal she goats was 52.9 cm as reported by Mukherjee et al., (1959).

Naik (1961) observed the phenotypic measurements of Sanjan goats as follows.

		Straight length	Oblique length
Birth	Male	26.35 ± 0.21	28.22 ± 0.21
	Female	25.34 ± 0.26	27.36 ± 0.03
	Overal average	26.34 ± 0.23	28.04 ± 0.12
6 months	Male castrated	44.90 ± 0.73	50.65 ± 0.72
	Male uncastrated	44.86 ± 0.87	47.70 ± 1.47
	Female	44.20 ± 0.52	46.86 ± 0.46
	Overall average	44.65 ± 0.70	48.57 ± 0.97
12 months	Male castrated	50.36 ± 0.55	52.77 ± 1.30
	Male uncastrated	49.57 ± 0.52	52.43 ± 0.44
	Female	49.53 ± 0.42	52.01 ± 0.13
	Overall average	50.01 ± 0.51	52.40 ± 0.65
18 months	Male castrated	55.76 ± 0.66	57.65 ± 0.67
	Male uncastrated	51.44 ± 0.63	56.31 ± 0.91
	Female	53.07 ± 0.51	56.53 ± 0.35
	Overall average	54.43 ± 0.61	56.86 ± 0.55
24 months	Male castrated	60.33 ± 0.93	61.51 ± 0.89
	Male uncastrated	58.20 ± 0.70	60.60 ± 0.78
	Female	54.83 ± 1.74	60.00 ± 1.79
	Overall average	57.37 ± 1.15	60.41 ± 1.15

Bawa and Singh (1969) observed that the average body length of Black Bengal goat was 42.31 ± 0.734 cm.

Height at withers

Rama (1963) reported that the average height for male and female in Jamnapari, Barbari and Beetal were 91-102 and 78-86, 66-76 and 60-71 and 89 and 84 cm respectively.

Agarwala (1964) reported that the mean heights at wither for male and female in Jamnapari, Beetal and Barbari goats were 91 and 76, 89 and 84 and 81 and 66 cm respectively.

According to Pattabiraman (1965) the average height at withers of the Malabarcutch and Malbar Pallichcherry female goats from South India were 76 and 63 cm respectively.

Singh and Sengar (1970) observed that the body height for Jamnapari male at the age of 0 day, 3 months, 6, 9 and 12 months were 35.00, 51.43, 54.75, 61.60 and 66.80 cm where as in female it was 34.04, 42.75, 59.00, 60.00 and 62.75 cm respectively.

Mukherjee et al. (1972) found that the height at withers of Grey Bengal she goats was 43.0, 45.6, 50.9, 56.5 and 56.9 cm for the age groups of 0-6, 3-6, 6-12 months and 1-2 and more than 2 years respectively.

Singh et al. (1972) studied the body measurements of Black Bengal she goats of different age groups. They

observed that the height at withers averaged 49.1, 51.8, 55.1, 56.0 and 51.0 cm when there were milk teeth, one, two, three and four pairs of incisors in the mouth respectively.

Mukherjee et al. (1959) reported the height at withers to be 26.0 cm in adult grey Bengal she goats.

According to Mishra (1962) the averages of the height at withers in Sanjan goats at different age groups were as follows :

Age	Female (cm)	Castrated (cm)	Uncastrated (cm)
Birth	33.71±3.95	-	33.12 ± 3.67
6 months	51.57 ± 5.23	54.33 ± 4.16	51.35 ± 5.30
12 months	52.67 ± 4.96	50.47 ± 3.56	57.31 ± 5.72
18 months	61.35 ± 4.07	65.39 ± 3.60	60.75 ± 5.00
24 months	66.30 ± 5.25	66.20 ± 4.95	64.51 ± 5.06

Height at Croup

Mishra (1962) reported the averages of height at croup of Sanjan goats at different age groups as follows :

Age	Female (cm)	Male castrated (cm)	Male uncastrated (cm)
Birth	35.53 ± 3.60	-	35.02 ± 3.67
6 months	56.03 ± 5.75	59.01 ± 4.43	56.94 ± 6.00
12 months	61.80 ± 4.43	63.66 ± 3.77	60.43 ± 4.86
18 months	66.69 ± 4.93	67.90 ± 4.16	65.01 ± 5.30
24 months	70.36 ± 6.04	72.23 ± 4.52	69.07 ± 4.90

Height at Elbow

According to Mishra (1970) the average height at Elbow of Sanjan goats at different age groups was as follows :

Age	Female (cm)	Male uncastrated (cm)	Male castrated (cm)
Birth	24.81 ± 0.126	24.74 ± 0.221	-
6 months	34.68 ± 0.230	35.36 ± 0.229	33.68 ± 0.365
12 months	37.99 ± 0.281	39.02 ± 0.41	39.42 ± 0.422
18 months	41.12 ± 0.401	41.52 ± 0.491	42.16 ± 0.297
24 months	42.51 ± 0.382	43.96 ± 0.302	44.46 ± 0.620

Height at Withers

The height at withers of Sanjan goats, according to age and sex were as follows (Mishra, 1970).

Age	Female (cm)	Male uncastrated (cm)	Male castrated (cm)
Birth	26.04 ± 0.205	26.40 ± 0.140	-
6 months	37.48 ± 0.256	38.81 ± 0.082	38.28 ± 0.419
12 months	41.72 ± 0.298	43.36 ± 0.300	42.34 ± 0.345
18 months	44.65 ± 0.383	45.59 ± 0.452	46.11 ± 0.573
24 months	46.14 ± 0.534	47.54 ± 0.530	48.15 ± 0.618

Heart girth

Singh and Sengar (1978) reported that the heart girth for Jamunapari male at the age of 0 day, 3, 6, 9 and 12 months were 31.72, 47.33, 50.04, 57.90 and 62.60 cm and the same in female were 30.44, 45.64, 48.72, 54.20 and 57.28

Mittal (1979) studied the heart girth in Barbari goats which averaged 72.6 ± 2.22, 76.2 ± 2.35 and 72.1 ± 1.62 cm in age groups of 1-2, 3-4 and 4-6 years respectively.

Mukherjee, et al. (1979) studied the Phenotypic measurements in Grey Bengal and Brown Bengal goats. They reported that the chest girth averaged 53.6 ± 1.16, 54.4 ± 0.79, 55.5 ± 0.65, 62.2 ± 0.87 and 63.4 ± 0.60 cm in Grey Bengal goats at the age of 0-3, 3-6, 6-12 months, 1-2 years and above 2 years of age respectively. The same in Brown Bengal goats were 53.3 ± 0.66, 50.3 ± 0.79, 55.6 ± 0.95, 60.0 ± 0.42 and 67.7 ± 0.32 cm respectively.

Singh et al. (1979) recorded the average chest girth in Black Bengal goats as 59.3 ± 0.76, 61.8 ± 0.41, 60.2 ± 0.88, 62.6 ± 0.91 and 64.7 ± 1.25 cm at the age of milch teeth, one, two, three and four pairs of incisors in the mouth respectively.

Mishra et al. (1980) studied on the phenotypic measurement of Sirohi goat and observed that the chest circumference was 68.79 cm in 6 tooth female goats.

Mukherjee et al. (1980) observed the chest circumference in mature Grey Bengal goats as 63.4 cm.

Naik (1961) reported the mean measurement of heart girth in Ganjam goats according to age and sex as follows :

Age	Male castrated (cm)	Male uncastrated (cm)	Female (cm)
Birth	-	31.67 ± 0.66	30.96 ± 1.02
6 months	49.41 ± 0.60	49.30 ± 0.47	48.64 ± 0.55
12 months	58.49 ± 1.64	58.34 ± 0.44	55.20 ± 0.49
18 months	61.31 ± 0.65	59.93 ± 0.52	60.57 ± 0.51
24 months	66. 33 ± 0.73	65.63 ± 0.50	62.77 ± 1.91

ECONOMIC TRAITS

Gestation period

Gupta et al. (1964) recorded the gestation length in Black Bengal goat as 144.3 ± 0.17 days.

Ali et al. (1973) observed the reproductive performance of 100 female Black Bengal goats at Bangladesh and noticed that the average gestation length was 143 ± 6.75 days.

Sudarsanan and Raja (1973) observed the gestation period in Malabari goats to be 146.20 and 146.30 days in single, twin and triplet pregnancies respectively.

According to Joshi (1970) the average gestation period for Jamnapari, Beetal, Barbari and Black Bengal goats were 149, 149, 147 and 145 days respectively.

In a study with 309 parturitions during 1977-78, involving Sirohi female goats mated to Beetal or Sirohi male, Mishra et al. (1979) observed the gestation length as 146.42 ± 0.24 days.

Khan et al. (1981) studied the breeding performance in Jamnapari goats and recorded the average gestation length as 149.78 ± 0.41 days which ranged from 145 to 154 days.

According to Khan et al. (1982) the gestation period in Jamnapari goats averaged 147.0 ± 0.24 days.

The gestation period of Barbari nanny goats averaged 144.67 ± 0.40 days in 62 females when bred in summer and 145.57 ± 1.49 days in 55 females when bred in winter as reported by Prasad and Pandey (1982).

Mukundan et al. (1983) studied on reproduction traits in Malabari goats and their halfbreds with Saanen and observed the gestation period as 147.1 and 147.7 days respectively.

Age at first kidding

Ali et al. (1979) observed the growth and reproductive performance of Black Bengal goats under farm condition at Bangladesh. In their studies they recorded the average age at first kidding as 15 ± 2.52 month.

Raja and Mukundan (1979) studied the age at first kidding in Malabari and Jamnapari x Malabari goats. The age

at first kidding was 495.1 and 533.0 days ($P < 0.05$) from 100 kiddings of 40 Halfbred female and 144 kidding of Jamunapari X Halfbred female respectively.

Hasnain (1976) observed the average age at first kidding for Pashmina goats as 550.80 days.

According to Mishra et al. (1976) the average age at first kidding in Beetal, Alpine and Beetal X Alpine were 525.91 ± 34.53, 542 ± 41.70 and 481.16 ± 14.28 days respectively.

The average age at first kidding in Ganjam goats was found to be 1066.00 ± 25.00 days by Nedeli (1977).

Rahman et al. (1977) studied the reproductive performance of Black Bengal goat on the basis of data collected on 216 female in a field survey and found the average age at first kidding as 15.27 ± 1.76 months.

Khan et al. (1978) recorded the age at first kidding in Jamunapari goats averaging 751 days.

Singh and Sengar (1978) reported that the age at first kidding was (32).1 days in Black Bengal goats.

According to Joshi (1978) the age at first kidding was 35 and 39 weeks in Barbari and Beetal goats respectively.

Mishra (1979) reported that the average age at first kidding in Beetal goats was 692.35 ± 16.11 days.

Rana et al. (1981) studied on breeding performance in Jamnapari goats and observed the average age at first kidding to be 762.50 ± 21.21 days.

According to Mukundan et al. (1983) the age at first kidding for Malabari goats and their halfbreds with Saanen were 616 and 498 days respectively ($P < 0.05$).

Weight at first kidding

Ali et al. (1973) observed the growth and reproductive performance of Black Bengal goats under farm condition at Bangladesh. In their studies they recorded the average weight at first kidding as 32 ± 0.08 pounds.

According to Nadkli (1977) the weight at first kidding in Ganjam goats averaged as 22.36 ± 0.36 kg.

Singh and Sengar (1978) reported the breed variation in the weight at first kidding. The body weight variations recorded by them in different breeds were as follows :

Breed variation in the weight at first kidding.

Breed type	No.of observations	Body weight (kg)
Black Bengal X Black Bengal	29	15.56
Jamnapari X Jamnapari	1	33.00
Beetal X Beetal	5	32.35
Barbari X Barbari	10	21.60

The weight at first kidding in Malabari doe averaged 20.30 ± 1.00 kg as recorded by Nair (1979).

Khan et al.(1981) observed the breeding performance in Jamunapari goat. In their studies they recorded the average weight at first kidding as 27.36 ± 0.91 kg in 11 observations which ranged from 21.5 to 30.0 kg.

The average weight at first kidding was observed to be 20.6 and 25.3 kg ($P < 0.01$) in a study of reproduction traits in unspecific numbers of Malbari goats and their halfbreds with Saanen as reported by Mukundan et al. (1982).

Mishra et al. (1983) studied on season of breeding in relation to reproductive and productive performance in Sirohi does. In their studies they observed the body weight at kidding to be 22.77, 23.52 and 23.41 kg for 3 groups of does in 3 different seasons like February-March, June-July and September-October respectively.

Service period

Ali et al. (1973) observed the growth and reproductive performance of Black Bengal goats under farm condition of Bangladesh on 100 does and 9 bucks. In their study they recorded the service period ranging from 90 to 120 days.

Mukundan (1976) studied on goat breeding for 220 Malabar female and observed that the average service period was 120 days.

The average service period of Barbal goats was found to be 170.37 ± 5.39 days as reported by Mishra (1979).

Khan et al. (1981) in their study on breeding performance of Jamunapari goats. In their study they observed the average service period to be 102.30 ± 15.05 days which ranged from 65-210 days.

According to Prasad and Pandey (1980) the service period averaged 54.25 ± 2.56 days in a study of the reproductive performance of Barbari female goats.

Mukundan et al. (1980) in their study with reproductive traits in Malabari goats and their half-breds with Saanen, recorded the average service period of Malabari goat as 155.3 days and for its cross with Saanen as 235.2 days.

Kidding Interval

Ali et al. (1975) observed the growth and reproductive performance of Black Bengal goats under farm condition at Bangladesh and recorded the kidding interval as 151.0 days.

Raja and Mukundan (1979), while studying the kidding interval of Malabari and its crosses with Jamunapari, observed the same to be 334.7 days from 101 kidding of 40 Malbari female goats and 299.3 days from 144 kiddings of crossbred goats.

According to Subramanian and Raja (1973) the kidding interval for Malabari goats was 234.60 ± 12.50 days.

The average kidding interval in a flock of Jamnapari goats was recorded to be 376.10 ± 6.74 days by Mudeli (1977).

Some reproductive performance of Black Bengal goat was studied by Rahman et al. (1977) in Bangladesh. It was reported that the kidding interval of this breed of goat was 7.46 ± 1.23 months.

According to Joshi (1970) the average kidding interval for Jamnapari, Beetal, Barbari and Black Bengal were 323, 329, 263 and 219 days respectively.

Khan et al. (1971) studied the reproductive performance in Jamnapari goat and observed the average kidding interval as 323.30 ± 26.7 days which ranged from 150 to 362 days.

According to Prasad and Pandey (1974) the kidding interval of Barbari goats was recorded as 157.55 ± 2.61 days.

The average kidding intervals were observed to be 259 and 277 days in a study of reproduction traits in unspecific number of Malabari goats and their half-breds with Saanen as reported by Mahender et al. (1975).

CHAPTER-III

MATERIALS AND METHODS

MATERIALS AND METHODS

LOCATION AND FACILITIES FOR THE EXPERIMENT

The "Study of the characteristics and performance of Bengal goats in Orissa" was conducted in the Department of Animal Production, Faculty of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar for a period of one year from February, 1993 to March, 1994. During this period the Bengal goats were surveyed in their native tract in the coastal districts of Orissa i.e. Puri, Cuttack and Balasore and their breed characteristics and performance were investigated as per the records available with the owners as well as with the local Veterinary Officers belonging to the Department of Animal Husbandry, Dairy and Veterinary Services, Orissa.

EXPERIMENTAL PROCEDURE

In a study with 100 numbers of Bengal goats from birth to 24 months of age, belonging to the coastal districts i.e. Puri, Cuttack and Balasore of Orissa, their breed characteristics and performance were determined by recording the geographical distribution and habitat of the animals, observation of agriculture in which they lived, breed characteristics, growth study (birth weight, live weight and gain at quarterly interval), phenotypic measurements (straight and chest length, hight at withers, girth,

ciliary and stillio and heart girth) and economic traits (gestation period, age and live weight at first kidding, service period and kidding interval) in their native tract in Orissa. The experimental animals were maintained under free range condition i.e. browsing only. The data were subjected to statistical analysis as per snedecor and cochran (1967) for interpretation of the findings.

METEOROLOGICAL OBSERVATIONS

Meteorological data comprising of the ambient temperature, relative humidity and rainfall pertaining to the districts of Puri, Cuttack and Balasore were obtained from the meteorological centre, Bhubaneswar. The data were statistically analysed and the performance of the goats in relation to the agroclimate of the region was interpreted.

BREED CHARACTERISTICS

The phenotype of Black Bengal goats are carefully observed in respect of body colour, distribution of hair, body size and shape, head, horn, ears and legs to ascertain the breed characteristics.

GROWTH STUDY

The live weights of the experimental goats were recorded at birth using Avery Pan type balance of 100 g sensitivity and there-after at monthly intervals up to 24 months of age with the help of spring balance (Salter)

in the morning hours before they went out for browsing or had any access to food and water. Besides, the live weight of the goats at 1st kidding were also recorded using the spring balance.

BODY MEASUREMENTS

The body measurements of Bengal goats were made in the three districts already mentioned at quarterly interval from birth to 24 months of age and the average at different ages (0-24 months) for the following body measurements was determined.

Straight length

It was the length measured from the pin bone to the level of the point of the withers of the same side in a straight line by a measuring tape, when the animal was standing squarely with the head erect on a plain ground. The mean of the lengths on either sides was taken as the straight length for the animal.

Oblique length

Oblique length was measured from the pin bone to the point of shoulder of the same side, when the animal was standing squarely with the head erect on a plain ground. The mean of the oblique length on either sides was taken as the oblique length for the animal.

Height at withers.

It was measured from the lateral lower edge of the claw (fore) on either sides to the point of withers, when the animal was standing squarely with the head erect on a plane ground. The mean of the above two measurements was taken as the height at withers.

Height at croup

It was measured from the lower lateral edge of the claw (hind) on either sides to the point of croup, when the animal was standing squarely with the head erect on a plane ground. The mean of the two measurements was taken as the height at croup.

Height at elbow

It was measured from the lower lateral edge of the claw (fore) to the point of elbow on either sides while the animal was standing squarely with head erect on a plane ground. The mean of the above two measurements was taken as the height at elbow.

Height at stifle

It was measured from the lower edge of the claw (hind) on either sides to the stifle joint, while the animal was standing squarely with the head erect on a plane ground. The mean of the above two measurements was taken as the height at stifle.

Heart girth

Heart girth was taken as the circumference of the chest immediately behind the point of elbow passing over the withers.

ECONOMIC TRAITS

Estimates of the following economic traits were made as per the records available with the owners of the animals as well as at the Veterinary Dispensary and Livestock Aid Centres of the area.

Gestation length

It was taken as the interval between the date of effective service and the next date of kidding.

Age at first kidding

It was taken as age from birth to the date of first kidding.

Weight at first kidding

It was the weight of the doe on the date of her first kidding.

Services required

It was taken as the period in days from the date of parturition to the date of next conception.

Kidding interval

It was taken as the period in days from one kidding to the next one.

STATISTICAL ANALYSIS

The experimental data were subjected to statistical analysis as per Snedecor and Cochran (1967) to find out means and standard error, analysis of variance and critical difference (C.D.) test of the experimental findings for interpretation of the results.

CHAPTER-IV
RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

GEOGRAPHICAL DISTRIBUTION AND HABITAT

The goat census in the principal states of India, 1972 is given at Table 1. The goat population of different states union territories has been shown in the descending order in which Rajasthan had the highest goat population, the lowest being in Tripura. Orissa was eleventh in order of goat population in the country. The goat population of Orissa as per 1972 census was 2.204 million and it contributed 4.37 % of the India's total goat population (67.618 million). According to the Bureau of statistics and economics, Orissa (1984) the District-wise goat population of Orissa as per 1982 census was furnished in Table 2. The goat population as mentioned in the Table is in descending order in which the highest population was in Cuttack and the lowest being in Phulbani district. In Orissa there were two goat breeds i.e. Bengal goats and Ganjam goats. The Ganjam goats were distributed predominantly in their native tract i.e. Ganjam (3,60,700), Koraput (4,27,323) and Phulbani (2,51,507) with a total population of (10,39,530) which constituted 20.38 % of the Orissa goat population (4.9 million). On the other hand, Bengal goats were distributed in their home tracts i.e. the remaining 19 districts with a total of 32,61,713 goats, contributing 79.19 % of the total goat population of Orissa. Thus in Orissa, Bengal goats (79.19 %) predominated over

Ganjam goats (20.8%). Prior to the [illegible] of Orissa state, the southern part of Orissa was in the Madras presidency and the northern part with Bihar and Bengal. It was therefore, likely that the people in south Orissa were accustomed to rear dual type goats of southern India, and these goats after formation of a separate state of Orissa, were known as Ganjam goats. Similarly, in the north of Orissa the people used to rear the Bengal goats which were distributed in Bihar and Bengal. Thus, Bengal goats prevailed in the northern Orissa, while Ganjam goats in the southern Orissa.

The habitat of Ganjam and Bengal goats were different from each other. The Bengal goats were usually kept by the farmers or shepherds in their homes in the villages. They were taken out for browsing in the day time to the nearby hillocks and browsing areas. Besides, tree leaves and twigs were collected by the shepherds and fed to them. The goats were brought back home in the evening for shelter at night only. Since they remained in house they were also fed rice gruel and kitchen waste. The manure collected from the goats shed was utilised for fertilising the agricultural land. These goats were never milked and their milk was hardly sufficient to nurse the kids. On the other hand, they produced excellent meat.

METEOROLOGICAL OBSERVATION

The meteorological data of Puri, Cuttack and Balasore districts where the experimental observations had been made are presented in Tables 3, 4 and 5 respectively. The average annual ambient temperature, relative humidity and rain fall were 27.3°C, 79 % and 96.5 cm for the districts of Puri, while the same for Cuttack were 26.4°C, 69 % and 116.1 cm and for the district of Balasore the values were 26.0°C, 71.6 % and 95.9 cm respectively. Puri, Cuttack and Balasore districts, all being coastal districts had more or less similar agroclimates. The ambient temperatures in summer and rainy seasons were high for Puri (29.2 and 28.1°C), Cuttack (30.7 and 28.5°C) and Balasore (29.2 and 28.0°C). The temperature was relatively lower in winter for the above three districts (24.8, 25.0 and 22.9°C). The relative humidity was higher for all the districts during summer and rainy seasons (Puri : 81.3 and 8.6 %, the same during winter being high (Puri: 74.6, Cuttack 64.7 and Balasore 65.9 %). All the districts had very high rainfall during rainy season (Puri: 210.3, Cuttack 240.0, Balasore :130.1 cm). The rain fall during summer was also high, the same in winter being low. Thus from the analysis of the above data the agroclimates of the above three coastal districts consisted of hot and humid environment in summer and rainy seasons accompanied by cool and humid atmosphere during

winter and with rainfall throughout the year. Thus the goats in the coastal agroclimate lived under hot and humid climate in summer and cool and humid condition in winter. The agroclimate was favourable for availability of browsing materials and tree leaves throughout the year.

BODY CHARACTERISTICS

Colour Bengal goats in the state of Orissa were observed to be of 4 body colours i.e. Black, Brown, Grey and White. Black Bengal goats were found in maximum number compared to any other variety.

The Black variety were mostly jet black in colour but some had white hair along the nasal bones as well as white spot/patch on the body.

Brown Bengal goats were found relatively less in number than the Black Bengal goats. Brown variety had brown body with black chest and belly in their ventral surface. Some had black colour in the lower part of the feet. Most of the Brown Bengal goats had a single longitudinal black line along the vertebral column. Some had black face, whereas the faces of some brown goats had two longitudinal stripe of black hairs along the nasal bridge.

Grey Bengal goats were common next to the Brown Bengal. Most of them had black color on the ventral

Body weight: The body weight at 25 months (adult age) was 13.89 ± 0.11 kg.

Phenotypic measurements: The adult Bengal goats had straight length : 45.30 ± 0.36 cm, oblique length: 43.70 ± 0.35 cm, hight at withers 50.45 ± 0.34 cm, hight at croup 51.66 ± 0.34 cm, hight at elbow 36.95 ± 0.40 cm, hight at stifle 30.95 ± 0.34 cm and heart girth 58.38 ± 0.34 cm.

Meat quality: The meat was tender and palatable.

Milk yield: The milk was hardly sufficient to nurse the kids born.

Reproduction: Bengal goats were prolific breeders giving birth to twins twiplets per litter at the rate of 3 litters in 2 years.

Breed characteristics in Bengal goats have been described by other authors(Ingwal, 1964; Devendra and Burns, 1970; Joshi, 1970; Banerjee, 1982; Singh and Moore, 1982) whose observations were similar to those of the present study, but not in detail.

GROWTH STUDY

Birth weight: The Bengal goats had 1.30 ± 0.04 kg of live weight at birth, which was similar to that observed in Black Bengal by Guha et al., 1968 (Male: 1.32 ± 0.29 kg and female : 1.01 kg), Rana and Singh, 1983 (1.21 ± 0.07 kg),

in Assam hill goats by Sharma et al., 1981 (1.17 kg), in Beetal by Joshi, 1979 (male : 1.80 kg and female : 1.66 kg) and in Barbari x Black Bengal cross by Sinha and Sahani, 1983 (1.56 ± 0.17 kg). On the other hand higher birth weights have been reported in Beetal (Bhatnagar et al., 1971), Jamnapari (Johri and Talpadre, 1971), Ganjam (Mudali, 1977), Beetal and its crosses with Alpine and Saanen (Nath and Chanda, 1978), Jamnapari, (Khan et al., 1979) and Saanen and Jamnapari, (Kumar and Singh, 1983). Lower birth weights have been recorded in Black Bengal (Ali, 1980; Sinha and Sahani, 1983).

Thus the birth weight of Bengal goats (1.20 ± 0.041 kg) in the present study were similar to the small breeds of goats like Black Bengal, Assam hill and crosses of Black Bengal with Barbari and Jamnapari, while it was lower than that of the large breeds of goats like Beetal, Jamnapari, Ganjam, Saanen and crosses between Beetal and Alpine/Saanen.

Live weight and gain : The live weight and gain of Bengal goats are recorded in Table 6. It was observed that the live weight increased with increase in age up to 24 months (Fig. 1). There was significant difference ($P \leq 0.01$) in live weights between months (Table 7) and the C.D. test (Table 8) revealed that the live weights from birth to 24 months of age at quarterly intervals were significantly different from each other except

SCALE: 'X' AXIS, 1 cm = 3 month [where 1 is the birth wt.
'Y' AXIS, 0.5 cm = 1 kg

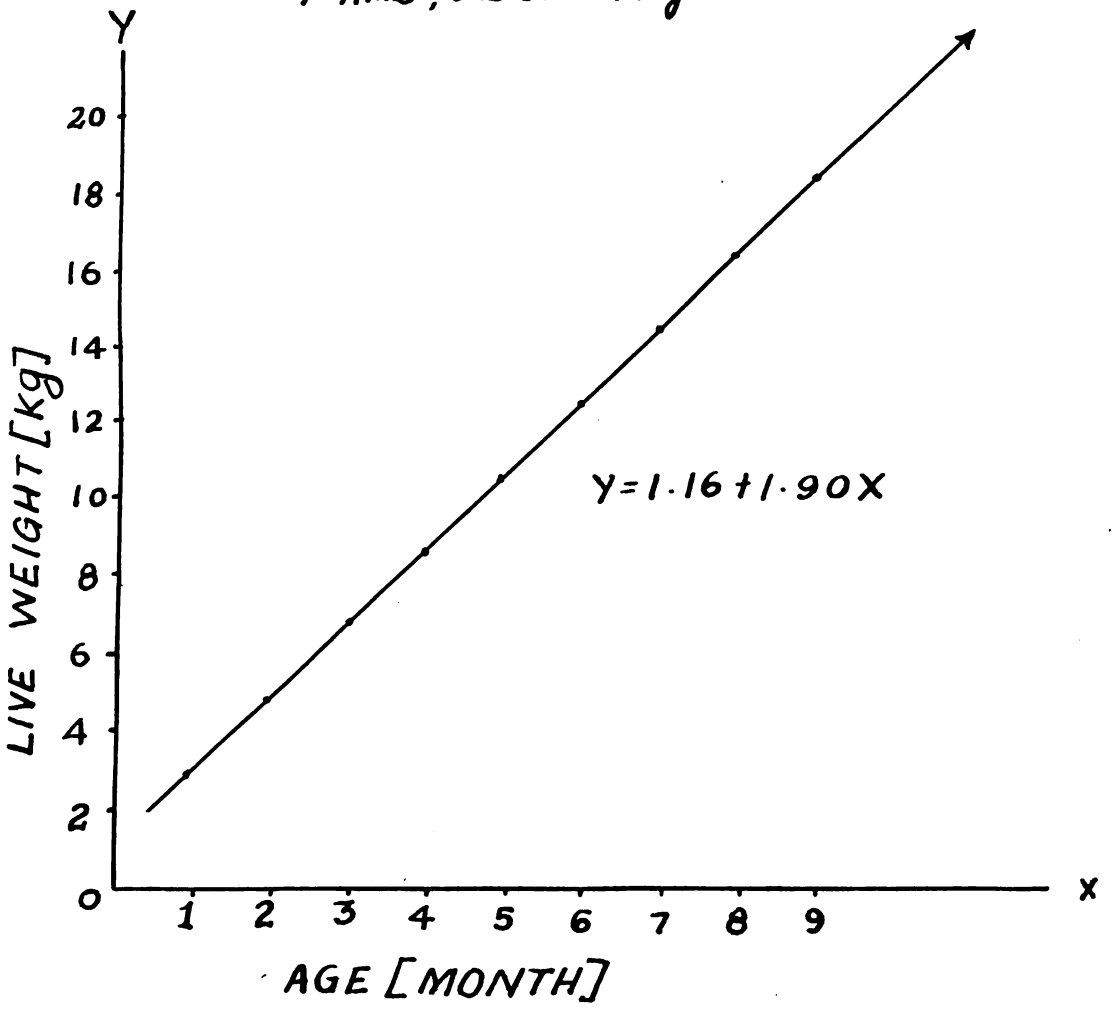

Fig. 1: GROWTH CURVE

between 21 and 24 months of age during which these were similar. It was observed that the live weight gain was the highest at 3 months of age followed by a decline until 24 months (Fig.3). But the decline was gradual up to 15 months of age, beyond which it was sharp. The cumulative live weight gain increased with increase in age. It kept on increasing until 15 months of age after which the decline was slow. In view of the sudden drop in live weight gain and slow increase in the cumulative gain after 15 months of age, it appeared desirable that the Bengal goats were slaughtered with advantage at the age of 15 months.

A comparative study in respect of live weight at different ages between Bengal and other breeds showed that the Bengal kids had similar growth with that of the small breeds like Assam hill goats and Beetal x Black Bengal crosses (Joshi, 1975; Sharma et al., 1981). On the other hand, it was observed that the live weight of Sanjan goats were higher than those of Bengal goats from birth up to 9 months of age (Mandal, 1977; Mishra, 1978; Mohanty, 1979), but of the next age i.e. 12 months the live weight of Black Bengal goat became similar to that of male castrated, male uncastrated and female Sanjan goats, although Black Bengal was a small breed, Sanjan being the large one. Subsequently at the ages of 15, 18 and 21 months the live weights of Bengal goats became

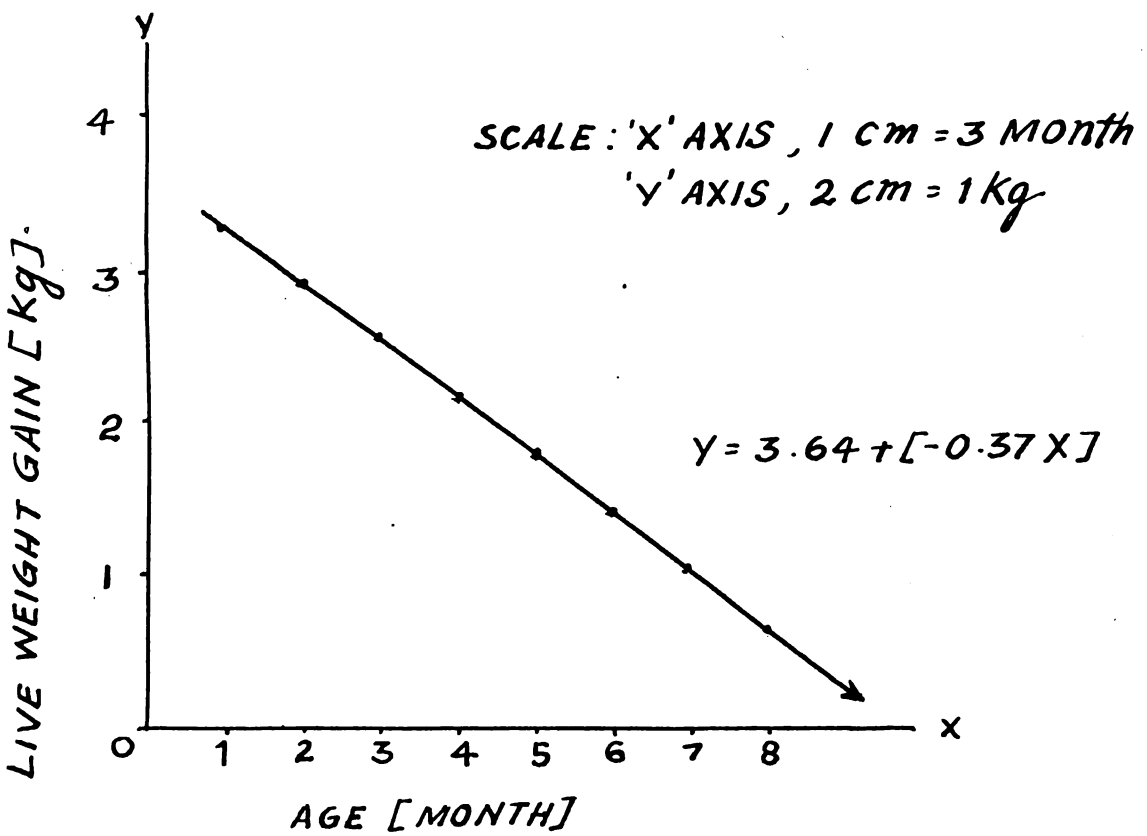

Fig. 2: LIVE WEIGHT GAIN CURVE

even higher than that of Sanjan female goats (Nadoll, 1977 and Mishra, 1979). But at the age of 24 months the live weight of Sanjan female bosses similar to that of Bengal and the male castrated and male unmastrated goats excelled the Bengal in live weight (Nadoll, 1977 and Mishra, 1979), suggesting that the Sanjan still continued to grow beyond 24 months while Bengal goats grew at a relatively slow rate.

The Bengal goats had a significant increase in ($P < 0.01$) in live weight, quarterly and daily live weight gain and cumulative live weight gain from birth to 24 months of age. The increase was the highest at 3 months and higher upto the age of 15 months, beyond which it became relatively slow. The live weight, quarterly live weight gain, daily live weight gain and cumulative live weight gain at the age of 15 months (slaughter age) were 13.2 ± 0.10 kg, 2.00 ± 0.10 kg, 22.22 g and 12.30 kg, while the same at the end of the experimental period i.e. 24 months of age were 14.70 ± 0.15, 0.70 ± 0.21, 7.77 g and 15.30 kg respectively. In view of the fast rate of increase in live weight, live weight gain, live weight gain per day and cumulative live weight gain upto the age of 15 months followed by a subsequent sharp decrease, it would be desirable that the Black Bengal goats should be slaughtered with an advantage at the age of 15 months. It was interesting to observe that although up to the age of 9 months the live weight of Bengal goats (small breed)

were lower than that of Ganjam goats (large breed), subsequently at 12 months the weights were similar. The live weight of Ganjam female became lower at 18 and 21 months. At 24 months the live weight of Ganjam male exceeded the weight of Bengal, whereas that of Ganjam female remained similar, suggesting that the Ganjam goats continued to grow beyond 24 months while Bengal grow at a relatively slow rate.

PHENOTYPIC MEASUREMENTS

The different body measurements (Table 9) significantly increased ($P < 0.01$) between months of growth from birth to 24 months of age (Tables 10, 12, 14, 16, 18, 20 and 22). The C.D. test (Tables 11, 13, 15, 17, 19, 21 and 23) revealed that the different body measurements at the age of 0 and 3 months were significant between each other and from those at 6 to 24 months of age. Further, the straight length was significantly different between 0 and 24 and 9 and 24 months of age, while the oblique length significantly differed between 0 and 12, 9 and 21 and 12 and 21 months; the height at withers between 0 and 12, 9 and 18, 12 and 21 and 15 and 24 months; the height at croup between 0 and 15, 9 and 18 and 12 and 24 months; the height at elbow between 0 and 15, 9 and 15, 12 and 18 and 15 and 24 months; the height at stifle between 0 and 15, 9 and 15 and 18 and 24 months and the heart girth between 0 and 12, 9 and 15 and 12 and

24 months. The straight and oblique lengths, heights at withers, croup, elbow and stifle as well as heart girth were 45.3 ± 0.35, 48.7 ± 0.34, 50.48 ± 0.34, 52.65 ± 0.34, 36.08 ± 0.40, 39.86 ± 0.38 and 50.25 ± 0.33 cm at the slaughter age of 15 months while, the same at the end of the experimental period i.e., 24 months of age were 47.76 ± 1.04, 50.05 ± 0.54, 55.23 ± 0.57, 53.76 ± 0.43, 39.52 ± 0.53, 42.58 ± 0.64 and 50.47 ± 0.62 cm respectively. It appeared that the body measurements increased similar to that of live weight with increase in age from birth to 24 months. Similar straight length measurements have been reported by Mukherjee et al. (1979) in Grey and Brown Bengal goats at the age of 0-3, 3-6, 6-12 months, Kalb (1981) in Jamnapari goats at the age of 6 months, Kumar and Singh (1982) in Black Bengal goats at the age of 6 months and Singh et al. (1979) in Black Bengal at the age of 24 months. Higher straight length have been observed in Barbari and Jamunapari (Mittal and Pandey, 1978; Sivasubramanian et al., 1984; Mittal, 1979), in Grey Bengal (Mukherjee et al., 1980). In respect of oblique length similar measurements at 6 months of age and higher values at 12, 18 and 24 months of age has been reported by Kalb (1981). Regarding height at withers similar measurements have been recorded by Mukherjee et al. (1979) in Grey/Black Bengal goats at 3, 12, and 24 months of age and by Singh et al. (1979) in Black Bengal female goats at 24 months of age. Higher height at withers has been recorded by Kaura (1942) and Agarwala (1954) in Barbari at 24 months,

Pattabiraman (1966) in Malabar Ostch and Malabar Tellicherry at 24 months, Singh and Sengar (1978) in Jamnapari goats at 3, 6 and 9 months of age and Mishra (1982) in Ganjam goats at 6, 12, 18 and 24 months of age. In respect of height at croup higher results have been recorded by Mishra (1982) in Ganjam goat at 6, 12, 18 and 24 months of age. In respect of height at elbow and height at stifle, higher results have been observed in Ganjam goats at 6, 12, 18 and 24 months of age by Mishra (1979). In respect of heart girth, similar measurements have been reported by Singh et al. (1979) in Black Bengal, Mukherjee et al. (1979) in Grey Bengal and Naik (1982) in Ganjam goats, while higher heart girths have been noticed by Singh and Sengar (1978) in Jamnapari, Mukherjee et al. (1979) in Brown Bengal and Mittal (1979) in Barbari goats.

Thus in respect of different body measurements there was significant increase ($P < 0.01$) with increase in age from birth to 24 months, as has been observed in case of live weight. The measurements for straight and oblique length, heights at withers, croup, elbow and stifle and heart girth at 15 months (slaughter age) were 48.30 ± 0.35, 49.70 ± 0.34, 50.45 ± 0.34, 55.05 ± 0.34, 36.05 ± 0.40, 30.95 ± 0.38 and 56.85 ± 0.35 cm, while the same at the end of the experiment i.e., 24 months were 47.76 ± 1.04, 52.05 ± 0.54, 55.23 ± 0.57, 58.76 ± 0.43, 39.52 ± 0.53, 42.50 ± 0.54 and 63.47 ± 0.58 cm, respectively.

Similar body measurements have been reported in large breeds i.e., Sonjan, as well as in small breeds such as Brown, Grey, Black Bengal and Barbari goats.

ECONOMIC TRAITS

The economic traits of Bengal goats have been presented in Table 24. Results and discussion pertaining to each of the traits are presented below :

Gestation period : The gestation period in Bengal goat was 144.91 ± 0.77 days. Similar gestation periods have been observed in Black Bengal goats by Gupta et al., 1964 (144.3 ± 0.17 days), Ali et al., 1973 (148.0 ± 6.73 days) and Joshi, 1979 (145 days), in Malabari goat by Sudhrsana and Raja, 1973 (145.30 days), in Sirohi female goat mated to Rootal or Sirohi male by Mishra et al., 1979 (146.62 ± 0.24 days) and in Barbari goat by Prasad and Pandey, 1982 (144.67 ± 0.40 days), while higher gestation periods have been reported by Joshi, 1979 in Barbari (150.7 days) and in Jamnapari and Beetal (149 days), Khan et al., 1981 in Jamnapari (149.73 ± 0.41 days), Khan et al., 1983 in Jamnapari (147.0 ± 0.24 days) and Sukumaran et al., 1983 in Malabari and its crossbred with Saanen (147.1 and 147.7 days).

Age at first kidding : The age at first kidding in Bengal goat was 301.23 ± 24.84 days. Similar age at first kidding

has been observed by Singh and Sengar, 1978 in Black Bengal goats (322.1 days), Raja and Mahender, 1973 in Malabari (406.1 days) and Mishra et al., 1976 in Beetal (326.91 ± 34.58) and Alpine (322 ± 41.79 days). Higher results have been reported by several authors viz., Nadoli, 1977 in Ganjam goat (1066.00 ± 35.03 days). Khan et al., 1978 in Jamnapari (751 days), Joshi, 1979 in Beetal (89 weeks), Mishra, 1970 in Beetal (352.35 ± 16.11 days), Khan et al., 1981 in Jamnapari (751.00 ± 21.22 days) and Mahender et al., 1982 in Malabari (315 days), while lower results were observed by Ali et al., 1973 in Black Bengal (15 ± 2.02 months) and Joshi, 1979 in Barbari (55 weeks).

Weight at first kidding The weight at first kidding for Bengal goat was 15.09 ± 0.92 kg. Similar weights at first kidding have been noticed in Black Bengal goats by Ali et al., 1973 (31 ± 0.93 pounds) and Singh and Sengar, 1978 (15.56 kg), while higher weights have been reported by Nadoli, 1977 in Ganjam goats (26.35 ± 0.33 kg), Singh and Sengar, 1978 in Jamnapari (23 kg), Kale, 1970 in Malbari (20.39 ± 1 kg), Khan et al. (1981 in Jamnapari (27.26 ± 0.01 kg), Mahender et al., 1982 in Malbari (20.6 kg) and Mishra et al., 1983 in Alpine goat (29.77 kg).

Service period The service period for Bengal goats in the present study was 106.9 ± 4.35 days. Similar values have been recorded by Ali et al., 1973 in Black Bengal (90-120 days), Mahender, 1976 in Malabari (136 days),

Khan et al., 1981 in Jamnapari (101.40 ± 13.03 days) and Balamban et al., 1983 in Malabari goat (155.3 days). Higher values have been reported by Mishra, 1979 in Beetal (170.27 ± 5.39 days) and Balamban et al., 1983 in Malabari x Saanen cross (205.2 days), while lower value for the service period has been observed by Prasad and Pandey, 1982 in Barbari goat (44.25 ± 2.58 days).

Kidding Interval : The kidding interval for Bengal goat was 238.06 ± 3.03 days. Similar results have been reported by Rahman et al., 1977 in Black Bengal (7.45 ± 1.23 months), Joshi, 1970 in Barbari (249 days) and Black Bengal (219 days) and Khan et al., 1981 in Jamnapari goat (283.30 ± 26.70 days). Higher kidding intervals have been observed by Raja and Balamban, 1973 in Malabari (294.7 days) and Malabari x Jamnapari cross (325.3 days); Subramania and Raja, 1979 in Malabari (334.60 ± 13.50 days); Kadeli, 1977 in Sanjan (376.10 ± 6.74 days) and Balamban et al., 1983 in Malabari goat (290 days) and Malabari X Saanen cross (377 days), while lower value for kidding interval have also been observed by Ali et al., 1973 in Black Bengal (151.0 days) and Prasad and Pandey, 1982 in Barbari goats (197.83 ± 2.83 days).

Mean the Bengal goats had gestation period : 144.31 ± 0.77 days, age at first kidding : 500.32 ± 24.24 days, weight at first kidding : 16.00 ± 0.32 kg, service

period : 100.90 ± 4.35 days and kidding interval : 214.06 ± 3.02 days. It appeared that the findings of the present study in respect of each of the above economic traits were similar/higher/lower than those observed by others in different breeds of goats, indicating that these did not vary according to the breed size i.e. large and small.

CHAPTER-V

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

In a study with 835 numbers of Bengal goats from birth to 24 months of age, belonging to the coastal districts i.e. Puri, Cuttack and Balasore of Orissa, their characteristics and performance were determined by recording the geographical distribution and habitat of the animals, observation of agroclimate in which they lived, breed characteristics, growth study (birth weight, quarterly and daily gain and cumulative live weight gain), phenotypic measurements (straight and oblique lengths, heights at withers, croup, elbow and stifle as well as heart girth) and economic traits (gestation period, age and live weight at first kidding, service period and kidding interval) in their native tract in Orissa. The experimental animals were maintained under free range condition i.e., browsing only. The data were subjected to statistical analysis as per Snedecor and Cochran (1967) for interpretation of the findings.

The results of the study are summarised below.

1. The Bengal goats were distributed in all the 13 districts of Orissa except Ganjam, Koraput and Phulbani where they were in small numbers. Their population in Orissa was 30,01713 constituting 72.12 % of the total goat population of the State (4.2 million).

Prior to the formation of the Orissa State, Northern Orissa was with Bihar and Bengal. It was therefore,

likely that the people in North Orissa were accustomed to rear Bengal goats as in Bengal and Bihar. The Bengal goats were housed by farmers in villages and were taken out for browsing in hillocks and fed tree leaves and twigs, providing them shelter in villages at night when they were fed also gruel and kitchen waste. The milk produced by the goat was hardly sufficient to nurse the kids.

2. The agroclimate of the coastal districts i.e., Puri, Cuttack, Balasore consisted of hot, and humid environment in summer (temperature 30.7°C, relative humidity 72.6 %, rainfall 97.5 mm) and rainy (temperature 29.1°C, relative humidity 77.6 %, rainfall 305.2 mm) accompanied by cool and humid atmosphere during winter (temperature 24.2°C, relative humidity 63.5 %, rainfall 16.5 mm) and with rainfall throughout the year.

3. Bengal goats were of 4 colours i.e., black, brown, grey and white which were in descending order in their distribution. They possessed small flesh, deep and wedge shaped body with short legs. The head was small with horns of 2-4" long, mostly straight but in some kids backward with ears mostly erect. Bengal goats were prolific breeders giving birth to twins/triplets per litter at the rate of 3 litters in 2 years. They produced excellent meat that was tender and palatable.

4. The birth weight of Black Bengal goats (1.0 ± 0.04 kg) in the present study was similar to the

small breeds of goats like Black Bengal, Assam hill and crosses of Black Bengal with Barbari and Jamunapari, while it was lower than that of the large breeds of goats like Beetal, Jamunapari, Sanjan, Saanen and crosses between Beetal and Alpine/Saanen.

5. The Bengal goats had a significant ($P < 0.01$) increase in live weight, quarterly and daily live weight gains, and cumulative live weight gain from birth to 24 months of age. The increase was the highest at 3 months and higher up to the age of 15 months beyond which it became relatively slow. The live weight, quarterly live weight gain, daily live weight gain and cumulative live weight gain at the age of 15 months (slaughter age) were 13.3 ± 0.10 kg, 2.00 ± 0.15 kg, 22.2 g and 12.60 kg, while the same at the end of the experimental period i.e. 24 months of age were 16.70 ± 0.16 kg 0.70 ± 0.21 kg, 7.77 g and 15.50 kg, respectively. In view of the fast rate of increase in live weight, quarterly, daily and cumulative live weight gains up to the age of 15 months followed by a subsequent sharp decrease, it would be desirable that the Bengal goats were slaughtered with advantage at the age of 15 months.

6. The Bengal goats had straight and oblique lengths of 45.3 ± 0.36 and 53.70 ± 0.34 cm heights at withers, croup, elbow and stifle of 50.45 ± 0.36, 50.65 ± 0.34, 32.05 ± 0.40 and 30.35 ± 0.39 cm respectively and heart girth, 51.25 ± 0.33 cm at the age of 15 months (slaughter age). The

mens at the end of the experimental period i.e., 24 months were 47.76 ± 1.04, 51.05 ± 0.54, 50.33 ± 0.37, 50.76 ± 0.43, 33.43 ± 0.53, 42.89 ± 0.54 and 38.47 ± 0.62 cm. respectively. There was significant increase ($P < 0.01$) in all the body measurements with increase in age from birth to 24 months of age, as it was observed in case of live weight.

7. The gestation period, age and weight at first kidding, service period and kidding interval, in Bengal goats were 144.91 ± 0.77 days, 508.23 ± 24.24 days and 15.00 ± 0.22 kg, 108.89 ± 4.35 days and 335.06 ± 3.02 days, respectively. The above values were similar/ higher/ lower than those observed by others in different breeds, indicating that these did not vary according to the breed size i.e. large and small.

C O N C L U S I O N

The Bengal goats were distributed in the Northern part of Orissa (39,01,713) constituting 70.13 % of the total state population (4.0 million). Black Bengal goats were predominant, followed by Brown, Grey and White. They possessed small, dainty, compact, and wedge shaped body with straight back and short legs. They were prolific breeders giving birth to twins/triplets per litter at the rate of 3 litters in 2 years. They produced excellent meat that was tender and palatable.

The live weight as well as quarterly, daily and cumulative live weight gains increased fast upto 15 months of age followed by a sharp decline, indicating that the Black Bengal kids should be slaughtered with advantage at the age of 15 months.

The average birth weight was 1.50 ± 0.04 kg. The live weight, quarterly live weight gain, daily live weight gain and cumulative live weight gain at 15 months (slaughter age) were 13.8 ± 0.10 kg, 2.00 ± 0.10 kg, 22.22 g and 12.00 kg while the same at 24 months of age were 16.70 ± 0.16 kg, 0.70 ± 0.22 kg, 7.77 g and 15.00 kg, respectively.

The body measurements viz., straight and oblique lengths, heights at withers, croup, elbow and stifle as well as heart girth at 15 months (slaughter age) were 45.3 ± 0.35, 48.70 ± 0.34, 57.45 ± 0.34, 55.65 ± 0.34, 36.05 ± 0.40, 38.85 ± 0.53 and 56.25 ± 0.33 cm, while the same at 24 months were 47.70 ± 1.04, 53.05 ± 0.54, 55.23 ± 0.67, 53.70 ± 0.43, 38.32 ± 0.53, 42.53 ± 0.61 and 58.67 ± 0.52 cm respectively.

The values for the economic traits viz., gestation period, age and weight at first kidding, service period and kidding interval were 144.01 ± 0.77 days, 511.22 ± 21.24 days and 16.60 ± 0.32 kg, 166.0 ± 4.35 days and 215.01 ± 3.02 days respectively.

The Bengal goats were popular and were spread over the entire state and they will adapted to different agroclimates of Orissa.

LIST OF TABLES

Table 1 : Goat Population in the principal states of India, 1972.

States/U.T.	No. of Goats in thousand		Total
	Over one year	Upto one Year	
Rajasthan	7955	4148	12103
Bihar	4442	2922	7364
Uttar Pradesh	4181	2429	6610
Madhya Pradesh	3933	2234	6167
Maharashtra	3874	1937	5811
West Bengal	3132	2479	5611
Andhra Pradesh	2928	1922	4850
Tamilnadu	2358	1596	3954
Karnataka	2481	1245	3726
Gujarat	2294	716	3010
Orissa	1680	1204	2884
Kerala	839	629	1468
Assam	700	553	1253
Himachal Pradesh	704	202	906
Punjab	499	302	801
Jammu and Kashmir	Details not available		569
Haryana	316	163	479
Tripura	88	59	147
Other Territories	122	67	310(b)
Total	43733	24098	67610(d)

(b) Includes 121 for which details are not available.

(d) Includes 720 for which details are not available.

Table 2 : District-wise goat population of Orissa, 1982.

Name of the District		Total Goats
1.	Cuttack	616303
2.	Mayurbhanja	457613
3.	Koraput	427333
4.	Balasore	421122
5.	Sambalpur	417559
6.	Dhenkanal	401319
7.	Bolangir	356244
8.	Ganjam	356703
9.	Sundargarh	339232
10.	Keonjhar	316173
11.	Puri	309701
12	Kalahandi	269161
13	Phulbani	251507
State Total		4924958

Table 3 : Meteorological Observation of Puri District, 1982

Season/ Month	Ambient Temperature in °C			Relative Humidity in %			Rain fall in mm	No. of rainy days
	Max.	Min.	Avg.	8.30 hrs	17.30 hrs.	Avg.		
Winter								
January	31.9	26.5	29.2	82	81.7	81.8	64.9	2
March	31.0	24.6	27.8	79	77	78	16.1	2
April	31.6	26.3	28.9	88	82	88	0.9	-
May	32.5	27.4	29.9	92	83	82.5	15.2	2
June	32.7	27.8	30.2	84	84	84	223.0	4
Rainy	31.8	26.6	29.1	82.7	78.6	80.6	210.5	9.7
July	32.1	26.2	30.1	85.	81	83	201.4	15
August	30.6	26.2	28.4	87	86	86.5	371.3	12
September	32.3	26.4	29.3	82	77	79.5	256.3	8
October	32.6	25.4	29.0	77	70	73.5	30.0	3
Winter	29.1	20.6	24.9	78.5	71.2	74.9	11.2	1.5
November	31.5	22.0	26.2	76.	64	70	29.0	1
December	28.8	18.6	23.7	71	65	68	-	-
January	29.8	19.3	23.7	85	77	81	-	-
February	29.1	22.5	25.8	82	70	80.5	24.9	5
Annual	31.0	24.6	27.8	81	77	79	1146.6	52

Table 4 : Meteorological observation of Cuttack District, 1982.

Season/ Month	Ambient Temperature in °F			Relative Humidity (Air) in %			Rain fall in mm	No. of rainy days
	Max.	Min.	Average	8.30 hrs.	17.80 hrs	Ave-rage		
Summer	36.0	22.4	30.7	71.7	50.7	65.2	91.8	3.5
March	33.3	22.1	28.2	77	53	67.5	33.3	4
April	37.2	25.4	31.3	66	32	63	6.3	--
May	38.4	26.7	32.6	65	32	32.5	37.0	2
June	35.2	26.4	30.8	77	71	74	238.7	8
Rainy	33.5	25.6	29.6	79.5	71.5	75.5	240.0	11.4
July	34.6	26.6	30.7	78	70	74	155.6	14
August	31.3	25.5	28.4	88	87	87.5	574.2	19
September	33.7	25.8	29.7	79	71	75	224.3	10
October	34.2	21.5	29.4	73	52	62.5	16.1	3
Winter	30.6	19.4	25.0	76.2	53.2	64.7	22.6	1.2
November	31.6	21.2	26.4	71.	55	63	22.6	1
December	30.1	17.1	23.6	70	40	55	--	--
January	29.7	18.6	24.1	85	60	60	--	--
February	31.1	21.0	26.0	79	59	69	22.2	4
Annual	33.4	23.6	28.4	78	62	80	1417.6	65

Table 5 : Meteorological observation of Bolsover Mainich, 1962.

Season/ Month	Ambient Temperature in °F			Relative Humidity in %			Rain fall in mm	No.of rainy days
	Max.	Min.	Avg.	8.30 hrs.	17.30 hrs.	Avg.		
January	84.4	24.2	29.2	70.7	70.7	70.7	136.7	6.2
March	30.7	21.2	25.9	74	70	72	102.6	7
April	34.7	24.0	29.3	71	72	71.5	65.9	7
May	37.6	26.0	31.8	57	65	61	6.6	-
June	34.4	25.6	30.0	70	76	77.5	325.0	11
Rainy	32.9	24.7	28.8	77.2	76	76.6	136.1	8.5
July	33.8	25.2	29.5	80	75	77.5	63.0	10
August	31.3	25.3	28.3	83	82	82.5	320.3	15
September	33.1	25.4	29.2	78	78	78	121.1	7
October	33.6	22.9	28.3	68	69	68.5	23.0	2
Winter	30.9	17.9	24.9	60.7	65.2	63.9	17.1	1
November	30.7	19.2	24.9	64	67	65.5	0.7	1
December	29.4	14.7	22.0	59	60	59.5	-	-
January	27.1	16.1	21.6	75	71	73	75.2	1
February	29.6	18.1	23.9	70	64	67	15.7	2
Annual	32.1	22.0	27.0	72	71	71.5	1151.1	68

Table 6 : Live weight and gain

Age (Months)	Live weight (kg)	Quarterly Live weight gain (kg)	Daily Live weight gain (gm)	Cumulative live weight gain (kg)
0 Day(Birth)	1.30 ± 0.04	-	-	-
3	4.00 ± 0.00	2.50 ± 0.08	40.00	2.60
6	7.90 ± 0.18	3.70 ± 0.30	20.00	6.50
9	9.70 ± 0.11	2.20 ± 0.16	24.44	8.50
12	11.80 ± 0.11	2.10 ± 0.15	23.33	10.60
15	13.80 ± 0.10	2.00 ± 0.19	22.22	12.60
18	15.20 ± 0.12	1.50 ± 0.11	16.33	13.90
21	16.00 ± 0.10	1.00 ± 0.17	11.11	14.30
24	16.70 ± 0.18	0.70 ± 0.21	8.77	15.50

Table 7 : Analysis of variance of live weight

Source of variance	df	SS	MS	F
Between months	8	11985.303	1498.163	1904.012**
Error	457	361.63	0.791	
Total	** 465	12346.933		

** P < 0.01

Table 8 : C.D. test of live weight

C.D.Value at 5 % level = 0.82

	24 months	21 months	18 months	15 months	12 months	9 months	6 months	3 months	0 day (birth)
Mean value	16.7	16.0	15.0	13.8	11.3	9.7	7.5	4.3	1.2

Age (months)	Straight length (cm)	Oblique length (cm)	Height at withers (cm)	Height at croup (cm)	Height at elbow (cm)	Height at stifle (cm)	Heart girth (cm)
0 day	22.32 ±0.22	24.22 ± 0.23	30.22 ±0.20	33.06 ±0.36	21.30 ±0.27	23.34 ±0.27	30.82 ±0.32
3	30.03 ±0.37	31.34 ±0.37	36.13 ±0.37	41.13 ±0.42	25.27 ±0.36	27.27 ±0.36	37.79 ±0.40
6	42.12 ±0.44	45.00 ±0.42	47.56 ±0.33	51.81 ±0.35	31.27 ±0.46	38.08 ±0.57	49.02 ±0.45
9	43.22 ±0.21	43.15 ±0.30	48.44 ±0.21	52.94 ±0.24	33.30 ±0.22	36.50 ±0.24	51.10 ±0.20
12	44.52 ±0.25	47.47 ±0.30	49.40 ±0.28	54.52 ±0.67	34.28 ±0.23	38.52 ±0.28	54.70 ±0.26
15	45.30 ±0.35	48.70 ±0.34	50.45 ±0.34	55.05 ±0.34	36.05 ±0.40	39.85 ±0.33	55.25 ±0.33
18	46.36 ±1.23	50.25 ±1.03	52.45 ±0.93	56.45 ±0.53	37.57 ±0.57	41.10 ±0.56	57.45 ±1.05
21	47.16 ±0.73	52.27 ±0.67	54.05 ±0.73	57.77 ±0.77	38.77 ±0.76	42.00 ±0.73	58.56 ±0.75
24	47.76 ±1.04	53.05 ±0.54	55.83 ±0.97	58.76 ±0.43	39.32 ±0.53	42.50 ±0.54	59.47 ±0.52

Table 10 : Analysis of variance of straight length

Source of variance	df	SS	MS	F
Between months	8	30220.46	3780.057	171.045**
Error	457	10099.24	22.096	
Total	465	40319.7		

** P < 0.01

Table 11 : C.D. test of straight length

C.D. value at 5 % level = 4.54

	24 months	21 months	18 months	15 months	12 months	9 months	6 months	3 months	0 day (birth)
Mean value	47.76	47.16	45.35	42.3	44.62	40.32	42.12	30.08	23.02

Table 12 : Analysis of variance of oblique length

Source of variance	df	SS	MS	F
Between months	8	41016.77	5127.096	314.410^{**}
Error	457	7452.74	16.307	
Total	465	48469.51		

** P < 0.01

Table 13 : C.D. test of Oblique length

C.D. value at 5 % level = 3.73

	24 months	21 months	18 months	15 months	12 months	9 months	6 months	3 months	0 day (birth)
Mean value	53.05	50.57	50.29	48.7	47.47	43.16	45.0	41.34	34.22

Table 14 : Analysis of variance of height at wither

Source of variance	df	SS	MS	F
Between months	8	103672	12959	822.871**
Error	457	7202.6	15.76	
Total	465	110874.6		

** P < 0.01

Table 15 : C. D. test of height at wither

C.D. value at 5 % level = 3.66

24 months	21 months	18 months	15 months	12 months	9 months	6 months	3 months	0 day (birth)
Mean value 55.29	54.05	52.43	50.45	49.64	48.44	47.56	36.13	30.22

Table 16 : Analysis of variance of height at croup

Source of variance	df	SS	MS	F
Between months	8	30770.7	3846.337	279.186**
Error	457	4296.1	13.777	
Total	465	37066.8		

** P < 0.01

Table 17 : C.D. test of height at croup

C.D. value at 6 % level = 3.42

	24 months	21 months	18 months	15 months	12 months	9 months	6 months	3 months	0 day (birth)
Mean value	58.76	57.77	55.45	55.65	54.52	52.94	51.31	41.13	33.06

Table 15 : Analysis of variance of height at elbow.

Source of variance	df	SS	MS	F
Between months	8	1607.84	200.98	19.367**
Error	427	4731.33	10.352	
Total	435	20760.16		

** $P < 0.01$

Table 15 : C.D. test of height at elbow

C.D. value at 5 % level = 2.07

	24 months	21 months	18 months	15 months	12 months	9 months	6 months	3 months	0 days (birth)
Mean value	30.62	33.77	37.65	38.05	34.23	33.38	31.67	25.37	21.3

Table 20 : Analysis of variance of height at stifle

Source of variance	df	SS	MS	F
Between months	8	15040.72	2350.037	201.412**
Error	437	5100.7	11.317	
Total	445	20141.42		

** P < 0.01

Table 21: C. D. test of height at stifle

C.D. value at 5 % level = 3.17

	24 months	21 months	18 months	15 months	12 months	9 months	6 months	3 months	0 day (birth)
Mean value	42.53	42.0	41.1	39.85	38.52	36.6	35.03	27.27	23.34

Table 22 : Analysis of variance of heart girth

Source of variance	df	SS	Ms	F
Between months	8	42904.2	5363.025	304.578**
Error	457	8047	17.608	
Total	465	50951.2		

** P < 0.01

Table 23: C. D. test of heart girth

C.D. value at 5 % level = 3.37

	24 months	21 months	18 months	15 months	12 months	9 months	6 months	3 months	0 day (birth)
Mean value	59.47	58.55	57.45	56.25	54.70	51.16	43.31	37.79	30.22

Table 24 : Economic traits

Traits	Mean value
Gestation period (days)	141.01 ± 0.77
Age at first kidding (days)	503.22 ± 24.34
Weight at first kidding (kg)	15.00 ± 0.82
Service period (days)	106.80 ± 4.35
Kidding interval (days)	311.06 ± 3.02

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