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Goat farming for the farmers of Goa




Samir Kumar Das, Z B Dubal
and Narendra Pratap Singh

भाकृअनुप ICAR

ICAR RESEARCH COMPLEX FOR GOA
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
Old Goa - 403 402, Goa (India).

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Foreword

GOATS *occupy unique place among domestic livestock in India because of their high population (140.54 m) and ability to survive and produce under unfavorable climatic and managemental condition. Goats possess superior efficiency for transforming feed into milk, meat and capable of selective browsing on undesirable vegetation. Goat is known as poor man's cow, because its milk is wholesome and nourishing. It is considered especially for infants and aged persons due to easy digestibility. Goat being hardy animal, disease incidence is very less in comparison to cattle, pig and fowl. Hence health management cost is lesser.*

The ICAR Research Complex for Goa was established by ICAR, New Delhi in the year 1976 under the administrative and technical control of ICAR Research Complex for NEH Region, Barapani for a short period followed by CPCRI, Kassargod. After functioning in different Govt farms it was shifted to its present location in the year 1982. A Krishi Vigyan Kendra has also been established at the complex during 1983 to look after the transfer of technology. ICAR, New Delhi finally upgraded this as a full fledged institute in the year 1989. The main object of this institute is to carry out research, extension and developmental works on agriculture and allied sectors to increase agricultural production and productivity in Goa and coastal region.

Scientists of this institute have done good work on goat production and developed package of practices for goat production and management suitable to the coastal ecosystem. It is highly appreciable that the authors of this publication has taken lot of interest to release the publication "Goat farming for the farmers of Goa" in due time to fulfill the mandate to make agriculture locally, nationally and globally competitive. I am confident that this publication on the occasion of silver jubilee of the institute will be of immense helpful to all class of people ie researcher, extension officials, students and goat farmer .

(Narendra Pratap Singh)
Director

गोवा के लिए भा.कृ.अनु.प. का अनुसंधान परिसर, ओल्ड गोवा.
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Preface

MAJORITY *of Goan population is meat consumer. There is no religious taboo for goat meat. Goat possesses superior efficiency for transforming feed into meat, milk and manure and capable of selective browsing on undesirable vegetation. Goat consumes less feed, which is about one fifth of the consumption in cattle and buffalo. It does not compete with human beings for grains like pig and fowl. So, feed cost is lesser. Goat is prolific animal, which usually produces twin and some breeds even produce triple and quadruplet. Goat being hardy animal, disease incidence is very less in comparison to cattle, pig and fowl. Hence health management cost is lesser. Presently chevon is the costliest meat in the market. Goat meat is very rich in protein, energy and fat. Best quality meat is obtained from a goat of age group 9-12 months. At this time dressing per cent of goat is observed to be 50-55 %. Goat rearing is a subsidiary occupation. As per basic animal husbandry Statistics (2010), the state had 11,000 goats. The tourist population as well as the opportunity for export of meat offers immense scope for rearing goat in this territory. However, high rainfall and high humidity do not favour the goat production. In some areas goats are reared as herds. Konkan kanya and Osmanabadi are the popular breeds in this region. Effort was made to develop package of practices for economic goat production in this institute followed by dissemination to farmer's field.*

Authors duly acknowledge Dr Raj Narayan, Ex Programme Coordinator, KVK and Dr Avinash Nirmale, Ex SMS for introduction of goat unit at the KVK of this institute. Authors also acknowledge Mr V Y Gaonkar, I/C, Programme Coordinator and the technical assistance provided by different SMS and Mr Deep Kumar, Farm Manager. Assistance provided by all the Skilled Supporting Staff and Contractual Staff is also acknowledged for daily maintenance work in the goat farm.

So this publication will help as ready reference to the students, extension officials, researchers and above all goat farmers of Goa and Konkan region to initiate goat farming as an avenue for income generation and livelihood improvement.

Authors

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A. Introduction

Goats occupy unique place among domestic livestock in India because of their high population (140.54 m) and ability to survive and produce under unfavorable climatic and managemental condition. Goats possess superior efficiency for transforming feed into milk, meat and capable of selective browsing on undesirable vegetation. Goat is known as poor man's cow, because its milk is wholesome and nourishing. It is considered especially for infants and aged persons due to easy digestibility. Goat is the principal meat producing animal in India and therefore goat meat i.e. chevon fetches more revenue than mutton and beef.

Advantage of goat farming:-

Goat farming has several advantages over the husbandry of other livestock species. They are as follows e.g. (a) Initial investment for starting goatary is lesser than dairy, piggery, poultry. (b) Goat consumes less feed, which is about one fifth of the consumption in cattle and buffalo. (c) It does not compete with human beings for grains like pig and fowl. So, feed cost is lesser. (d) Goat is prolific animal, which usually produces twin and some breeds even produce triple and quadruplet. (e) Goat being hardy animal, disease incidence is very less in comparison to cattle, pig and fowl. Hence health management cost is lesser. (f) Goat milk is rich in certain amino acids i.e. histidine, aspartic acid, phenylalanine, threonine; certain minerals i.e. sodium, iron, copper; certain vitamins i.e., vitamin A, nicotinic acid and choline. (g) Goat milk is being used to produce different products such as cheese; curd etc. (h) Goat skin is of high values e.g. Skin form Bengal goat is of best quality in the world. (i) Besides meat, milk, skin, hair is another byproduct obtained from goat, e.g. pashmina and mohair is valued high in international market due to its several uses. (j) Faeces and urine of goat being rich in nitrogen, phosphorus and potassium used in field for improving soil fertility and to increase productivity of crop. (k) There is no prejudice about the consumption of goat meat. Above mentioned points indicate that goat is potential animal for economic growth and employment generation (Das, 2001).

Disadvantage of goat farming: -

If goat farming is practiced in extensive system, it may cause damage of crop and even soil erosion like all grazing animal e. g cattle, buffalo and sheep. Secondly consumption of goat milk is less due to bad smell.

Population dynamics of goat: -

Goat population in India is 140.54 million. State wise population revealed that highest goat population is in Rajasthan ie 21.50 m (15.30 %) followed by West Bengal (15.07 m, 10.72 %), Uttar Pradesh (14.79 m, 10.53 %) and Maharastra (10.39 m, 7.39 %). The population of male and female goat in India is 40.79 m and 99.75 m respectively. The goat population in rural and urban area of India is 133.31 m and 7.23 m respectively.

The number of goats increased from 124.36 million in 2003 to 140.54 million in 2007. In India the annual growth rate in goat population during 1982 – 1987 was 2.96 %, during 1987-1992 was 0.90 %, during 1992 – 1997 was 1.26 %, during 1997 – 2003 was 0.22 %. However, growth during 2003-2007 was accelerated to 3.10 % (Anonymous, 2012). Breed wise population dynamics revealed that Black Bengal goat has the highest population in our country ie 20.93 m followed by Marwari (7.57 m) and Sirohi goat (2.91 m).

Meat, Milk and Manure Yield from goat

Goat milk is rich in certain amino acids, certain minerals and certain vitamins. Average milk yield from milch breed of goat is 1.25 – 1.50 litre/day with a lactation period of 150 -180 days. National milk yield from goat increased from 1.1 m MT in the year 1980 to 2.5 m MT in the year 1990 with a growth rate of 6.8 %. It has increased to 4.0 m MT in the year 2008 with a growth rate of 1.2 % (FAO, 2008).

Goat meat is very rich in protein, energy and fat. Best quality meat is obtained from a goat of age group 9 - 12 months. At this time dressing per cent of goat is observed to be 50 - 55 %. In India meat production from goat increased from 0.31 m MT in the year 1980 to 0.43 m MT in the year 1990 with a growth rate of 0.9 %. It has increased to 0.48 m MT in the year 2008 with a growth rate of 0.6 % (FAO, 2008).

On an average each adult goat produces manure @ 500 g / head / day. The manural value of goat manure is also very high. Nitrogen, phosphorous and potassium content of fresh goat manure is 2.20 - 3.70 %, 0.25 - 1.80 % and 0.90 - 1.25 % respectively. Goat litter was reported to use as feed supplement replacing concentrate feed at different levels to all livestock species (Das and Pan, 1999). It was revealed that 5 % litter supplemented feed while fed to sheep and goat, sheep consumed 65.84 % whereas goat took only 30.74 %. In cattle while 10 % and 15 % supplemented feed was provided, the intake was 64.5 % and 54.8 %. In pig corresponding figure was 85.10 % and 80.30 % respectively.

B. Breeds of Goat

Black Bengal

The Black Bengal is found in the eastern region of India, in the states of West Bengal and adjoining areas in Jharkhand, Bihar, Orissa, Assam, Mizoram and Tripura. According to the 18th Livestock Census 2007, the number of Black Bengal goats in the country is 2, 09, 27, 557. This breed has the highest population in India.

The animals are predominantly black, brown or grey and sometimes white. This breed is famous for quality meat production and skin quality. They have soft, glossy short hair and are dwarfed in size. The legs are short with a straight back and a beard is found in both sexes. The horns are slightly tilted upward or straight.

It is the most prolific among Indian breeds. Multiple births are common 2, 3 or even 4 kids are born at a time. Kidding takes place twice a year. Birth weight of kid is associated with the pre and post weaning growth of goat. So, in a study on different non genetic factors affecting birth weight of Black Bengal goat it was revealed that type of birth and season of birth had significant effect on birth weight of goat while sex had no significant effect (Das and Roy, 1999).

The meat is excellent and palatable. Average adult weight of male and female is 25 - 30 kg and 20 - 25 kg respectively. Milk yield is low and is barely sufficient to feed the kids. Skin of the Black Bengal goat is used for making chamois leather – highly valued specialty leather.

Ganjam

The Ganjam breed, also known as Dalua, is found in eastern India, primarily in the Gajapati, Rayagada and Koraput districts of Odisha. According to the 18th Livestock Census 2007, the number of Ganjam goats in the country is 1, 48,473.

It is medium sized dual breed. They are tall, leggy animals. The coat may be black, white, brown or spotted, but black predominates. The hair is short and lustrous. Ears are medium sized and both bucks and does have long, straight horns, directed upward with a medium-length tail.

Average adult weight of male and female is 40 kg and 30 kg respectively. The kidding percentage is 82 and the litter size is primarily single (95 %). Kidding takes place once a year. Milk yield is about 2 kg / day and the average lactation period is 150 days.

Jakhrana

The Jakhrana breed is found in the north-west arid and semi-arid regions mainly in eastern Rajasthan. The breed derives its name from the Jakhrana village in Alwar district of Rajasthan where it is found in its purest form. According to the 18th Livestock Census 2007, the number of Jakhrana goats in the country is 19, 53,046, fairly widespread in the states of Rajasthan and Haryana. They are large milch breed.

The coat is predominantly black with white spots on the ears and the muzzle is short and lustrous. The face line is straight, with a narrow and slightly bulging forehead. The breed looks similar to the Beetal, the major difference being that the Jakhrana is taller. The ear length is medium and the udder is large, with conical teats. Does are reared for milk. Jakhrana goats graze on natural pastures but can also be managed on stall feeding.

This breed is well known for its milk potential averaging a daily yield between 2 to 5 litres. The milk has a relatively higher fat content (5.06 %), SNF (8.60 %) and protein (3.70%). Average adult weight of male and female is 50-55 kg and 35-40 kg. These goats show good prolificacy and the kidding percentage is 90. Kidding takes place twice a year with a twinning percentage of 80 – 90 %.

Jamunapari

Jamunapari- The Pride Goat of India, is large dual purpose breed commonly found in UP in between Jamuna, Ganga and Chambal river. According to the 18th Livestock Census 2007, the number of Jamunapari goats in the country is 10, 56,633. The National Bureau of Animal Genetic Resources has put the Jamunapari goat breed on the 'endangered species list'.

It is predominantly white in colour with long and pendulous ear, Roman nose and tuff hairy buttock. They are considered the largest and most elegant of the long legged goats of India. Both sexes are horned with short and thin tail. The breed has well developed udder round in shape with large conical teats.

Average adult weight of male and female is 45-50 kg and 40-45 kg respectively. Average milk yield is 1.50 – 2.00 kg / day with a total lactation yield of 280 kg in a lactation period of 270 days. The fat content of milk ranges from 5.2 to 7.8 percent. Average growth was recorded to be 70 -75 g / day. Single birth is very common and twin birth is less observed. Litter size at birth is single 70 % while twins 30 %. They kid twice in a period of 18 months.

Jamunapari (40) goats were maintained in goat farm of ICAR Research Complex for Eastern Region, Patna. Goats were reared in semi intensive system of Management. Goats were being fed concentrate mash feed besides grazing. Highest growth was observed in the 1 st week i.e. 134.07 g / day with an overall mean of 79.19 g / day (Das et al, 2010).

Beetal

The Beetal is native to the districts of Gurdaspur, Amritsar and Ferozepur in Punjab. As per the 18th Livestock Census 2007, there are 3, 04,223 Beetal goats distributed across the states of Punjab, Haryana, Jharkhand, Assam and Himachal Pradesh.

The breed is a good dairy type, second to Jamunapari in size but is superior to it in respect to proliferation and adaptability to various agro climatic zones and also to stall feeding. It is well known for milk production and has largely been used in cross-breeding and other goat improvement programmes. The goat resembles

Jamunapari goat but smaller in size and weight .Coat colour is predominantly black (90 %) or brown (10 %) with white patches; long and flat ear; udder large and well developed. Both sexes have thick, medium-sized horns, carried horizontally with a slight twist directed backward and upward and Roman nose. Male possesses marked beard while females are beardless.

Average adult weight of male and female is 50 - 55 kg and 35 - 40 kg. Average milk yield is 1.50 – 2.00 kg / day. The average milk yield per lactation is 288 kg. In addition to being considered a good dairy breed, the Beetal is also known for its good quality meat and skin. Unlike Jamunapari twins are common in Beetal. The litter size is single 41 %, twins 53 % and triplets 6 %.

Barbari

The Barbari breed has mainly evolved and adapted in the north western arid and semi-arid regions, and more specifically in the Etah, Etawah, Hathras, Mathura, Agra and Aligarh districts of Uttar Pradesh. According to the 18th Livestock Census 2007, the number of Barbari goats in the country is 31,55,723 fairly widely distributed across the states of Uttar Pradesh, Uttarakhand, Madhya Pradesh, Punjab, Haryana, Jharkhand with a few found in Delhi.

The Barbari is a dual purpose (milk and meat) goat breed and are maintained on browsing and grazing. In addition to being a good milkier it is highly prolific and generally gives birth to twin and triplets. It is dwarf breed highly suited for stall-feeding conditions and hence generally found in the cities. They are white in colour with tan spots having short ears and short legs.

This breed is prolific. The adult body weight in male and female is 40 and 25 kg. Average milk yield is 0.750 – 1.00 kg / day. Average lactation yield is 130 - 200 kg of milk in a lactation length of 150 days with a fat percentage of about 5 %. It

kids twice in a period of 12 - 15 months. Twin and triplate is very common like Bengal breed. Litter size at birth is generally, single 25 %, twins 65 %, and triplets 10 %.

Osmanabadi

Osmanabadi goats are native to the Latur, Tuljapur and Udgir taluks of Osmanabad district of Maharashtra, from where they derive their name. They are also fairly widespread in Karnataka and the Nizamabad district of Andhra Pradesh. According to the 18th Livestock Census 2007, the number of Osmanabadi goats in the country is 15, 53,208.

The breed is reared, bred and well adapted throughout the Maharashtra state (Sahare et al, 2009). The goats are large in size. The colour of the coat varies, but is mostly black (73 %), with the rest being white, brown or spotted. Ninety per cent males are horned; females may be horned or polled.

The breed is considered useful both for meat and milk. Average daily milk yield varies from 0.5 to 1.5 kg for a lactation length of about 4 months. The adult body weight in male and female is 35 and 30 kg respectively. In favourable conditions they breed regularly twice a year and twinning is common.

Konkan Kanyal -

Konkan Kanyal goat is meat type breed adapted to high rainfall and hot and humid climate of Konkan region of Maharasthra. Konkan Kanyal goats were registered as a distinct breed by the National Bureau of Animal Genetic Resources in May 2012. They are native to the Konkan region of Maharashtra and are reared mostly by the Dhangar and Maratha communities for meat.

These goats are mainly black with a white marking in a specific pattern. Animals have typical white bands on black face and black ear with white margin. The ventral surface of the body

and the legs are white mostly. Konkan Kanyal goats have bilateral white strips from nostrils to ears; a flat and broad forehead; flat, long drooping ears; backward, straight, pointed, cylindrical horns; white muzzle and long legs, laterally black, medially white from knee to the fetlock joint.

The body weight of adult bucks and does averages 35 and 30 kg respectively. Konkan Kanyal goats are regular breeders and breed round the year, with a twinning percentage of about 66 %.

Malabari / Tellicherry –

Malabari also known as Tellicherry are native to Kerala. Malabari goats are reared for milk and meat and their skin is popular in the tanning industry. According to the 18th Livestock Census 2007, the number of Malabari goats in the country is 7, 10,523.

The animals are medium in size. They have no uniform colour and the coat varies from completely white to black. All males and a small number of females are bearded. They have a medium sized head with a flat and occasionally a roman nose with medium sized ears directed outward and downward. Malabari goats are reared under a semi-intensive management system, with 4 to 6 hours of grazing supplemented with stall feeding in the evening.

The breed is quite prolific and has a 50 % twinning, 25 % triplets and 5 % quadruplets kidding percentage. The milk yield ranges from 0.5 to 1.5 kg / day with an average of 90 kg in a lactation period of 150 days. The adult weight of male and female is 40 and 35 kg respectively.

Sirohi

It is distributed in Sirohi and Udaipur districts of Rajasthan, Gujarat and Karnataka. According to the 18th Livestock Census 2007, the number of Sirohi goats in the country is 29, 09,286.

It is compact medium-sized animals. Coat color predominantly brown with light or dark brown patches, a very few individuals are completely white. The body is covered fairly densely with hair which is short and coarse. Ears are flat and leaf

like, medium sized and drooping. Both sexes have small horns, curved upward and backward.

The adult weight of male and female is 40 - 45 and 35 - 40 kg respectively. The age at first kidding is 19 - 20 months and the litter size is one kid per birth. The breed is well suited to stall feeding. The breed is used mainly for meat. The milk yield is relatively small, about 0.4 to 0.5 kg / day, with an average milk yield of 65 kg over a 145 day lactation period. Usually doe kids twice a year, giving birth to single in 40 % while twins in 60 % cases. They kid twice a year. On average, the birth weight is about 2.0 kg.

As an indicative of stressful condition of goat under certain housing and environment, sweating rate of this breed was determined. It was observed that it varied from 74.57 g / m 2 / h at neck region to 59.37 g / m 2/ h at sacrum. Higher sweating rate would be due to larger size of the sweat gland and higher concentration of sweat gland at neck region (Das, 1995).

Marwari

The native tract of the Marwari goat breed is western Rajasthan – the districts of Barmer, Jaisalmer, Bikaner, Jodhpur, Jalore, Pali and Nagaur. According to the 18th Livestock Census 2007, the number of Marwari goats in the country is 75, 74,632.

This is a dual purpose breed, reared for both meat and milk and is well adapted to the harsh environment of the Thar desert. The Marwari goat is a medium sized animal, predominantly black in colour. The hair covering is lustrous and prominent and grows at the rate of about 10-12 cm annually. The thick hair protects the animal from the extremes of temperature found in this region. The hair is used to weave traditional harnesses for camels, and also carpets and bags, the latter used by potters. The male has a thick beard. The ears are small and flat, carried on a small head. Both sexes have short pointed horns, directed upward and backward. The tail is small and thin. The udders

are fairly well developed but small and round with small teats placed laterally.

The adult weight of male and female is 35 - 40 and 30 - 35 kg respectively. The milk yield varies from 0.5 to 1 kg when reared on grazing and from 2 to 3 kg under stall fed conditions. Kidding is primarily single births, with a twinning percentage of around 10 %.

Kutchi or Kathiawari

The Kutchi or Kathiawari, is an important dual-purpose (meat and milk) goat breed, native to the Kutch district of Gujarat. According to the 18th Livestock Census 2007, the number of Kutchi goats in the country is 6, 61,496.

They are medium-sized animals. The coat is predominantly black, but a few white spotted animals are also found. Ears are medium in size, floppy and drooping with typical white markings. The coat is shaggy and dull in appearance with medium to long coarse hair. Both sexes have short, thick horns pointed upward.

The adult weight of male and female is 45 and 40 kg respectively. Average milk yield is around 2 kg / day under stall fed conditions and 0.5 to 1 kg on grazing resources. The lactation length is about 6 to 7 months. Generally there is one kidding annually with a twinning percentage of 11.

C. Environment

Goat is basically animal of arid and semi-arid region. They prefer hot, dry climate. The climate of Goa is hot and humid. Air temperature ranges from 25 - 35 0 C. Humidity ranges from 80 % to 99 %. So from climatic and topographical point of view Goa is not very suitable for goat rearing. However, breeds suitable to hot hunid climate like Konkon Kanyal and Osmanabadi was tried to maintain at Goa.

Temperature

The comfort zone for dairy goats is between 55 and 70 degrees Fahrenheit. Non-sweating animals are much less sensitive to declining temperatures than to rising temperatures. Milk production, feed consumption and comfort are not affected by temperatures between 0 and 55 degrees Fahrenheit, but temperatures over 80 degrees Fahrenheit seriously reduce feed intake and milk output. Therefore, the object is not how to keep the goats warm in winter, but how to keep them cool in summer.

Ventilation

The movement of air, either by mechanical or natural means, to remove heat, moisture and odors is a necessary part of a housing plan. Most pneumonia problems with dairy goats can be traced to inadequate ventilation. Wet walls and ceilings are the result of improper ventilation, poor insulation or a combination of the two. The rate of air movement is influenced by the amount of animal heat produced and the temperature need to maintain in the building. Additional heat and insulation may be required to keep the stable air fresh and to prevent water pipes from freezing in the winter. An air inlet system also must be provided for good air distribution. Ventilation entails more than installing a fan to move some air. Proper ventilation during the summer may require moving 150 to 200 cubic feet of air / minute. Winter weather may reduce the amount of air to be exhausted to as little as 20 cubic feet / minute. With proper ventilation, health of the animals and the longevity of the building are maintained.

Light

Windows are essential in a closed barn. They permit sunlight for warmth and drying and provide a source of vitamin D for the animals. Well-lighted barns usually are kept cleaner. In summer, open windows are important for air movement.

It was found that live weight; weight gain and average daily gain were significantly correlated with maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and solar radiation, but non - significantly correlated with wind speed and rainfall. Weekly live weight of Jamunapari goat decreased significantly by 180 g per % rise of evening relative humidity. Average daily gain in grower and finisher goat were reduced by 46.11 g / d and 24.14 g / d respectively per 0 C rise of effective temperature (Das et al, 2010).

The mean rectal temperature (0C), respiration rate (number / minute) and pulse rate (number / minute) of adult Black Bengal goats maintained on deep litter system of management were 39.14 $\pm$ 0.15, 30.67 $\pm$ 0.36 and 77.77 $\pm$ 0.88 in summer; 38.45 $\pm$ 0.16, 29.29 $\pm$ 0.31 and 77.08 $\pm$ 0.81 in monsoon and 38.01 0.12, 27.30 $\pm$ 0.32 and 75.56 $\pm$ 0.76 in winter respectively. All the values were within normal range. So, complete confinement on deep litter did not alter the physiological responses indicating their adaptability on deep litter system of housing and management. However, highly positive correlation was found between these physiological responses of the goats and climatic component (Das et al, 2006).

D. Housing of Goat

In India in village condition goat does not need any special shelter and are usually kept in katcha house with thatched roof. Goats however need to be protected from drastic weather during pick summer, rainy and winter. Goats are susceptible to cold hence should be kept in warm places.

Houses should be well ventilated with free access of sunlight particularly during winter. Proper ventilation and good drainage is another important criteria for housing of goats. The purpose of ventilation is to provide the desired amount of fresh air, without drafts, to all parts of the shelter; to maintain temperatures within desired limits; and to maintain ammonia levels below specified levels. Ventilation is of utmost importance to maintain a desirable interior temperature of 28 to 30°C. If the animals cannot get rid of heat because the surrounding temperature is too high (above 30°C), they eat less and therefore produce less. It is, therefore, necessary to make the shed sufficiently high and make sure, there are openings for ventilation in the roof or walls. Hence height of roof of the goat shed should be 3 m at the periphery and 3.5 m at the center for proper ventilation.

The orientation of the shed is another important factor depending on the climate. In dry arid region one can prevent the entry of sunlight inside the shed for preventing heating up of stall too much by placing the longitudinal axis of the goat shed east – west. On the contrary in humid and high rainfall area, if one wants to keep floor of the shed dry and disease free, he would construct goat shed with long axis in north - south direction for allowing of sunlight to enter inside the shed sufficiently to keep the house warm and dry.

The roof provides protection from sun and rain and can be of a shed, gable or modified gable style. Slope is important in removing rain and thatched roofs need a greater slope than iron sheeting. A greater slope is also beneficial in areas with high rainfall. The roof should be light, waterproof with sufficient overhang to prevent rain from blowing in. A high roof encourages air movement but is more likely to be damaged by strong winds. A roof vent can assist in proper ventilation. Roofs can be constructed by GI sheet, asbestos, tiles, grass/bushes, wood depending on production system, material availability and climate.

The floor could either be packed earth, concrete or slatted. Packed earth or concrete floors should have a slope of about 5 % for good drainage. Raised platforms where goats can lie above the floor and away from manure and urine are beneficial. Slatted floors should be raised about 1-1.5 meters above ground level to facilitate easy cleaning and collecting of dung and urine. The gap between the slats should be 1.4 to 1.6 cm to allow easy passage of fecal material and guarantee safe footing for the animals. Newborn and young should not be put on slatted floors. A raised, slatted floor in tropical and subtropical areas has the following advantages:

- No need of bedding
- Allows manure, urine and debris to drop through the slatted floor, thus removing a major source of disease and parasite infestation
- Requires less labor to clean and maintain
- Remains relatively dry and clean
- Reduced space requirements
- Manure is easily collected for fertilizer use or for sale
- Allows air to pass through the slats increasing ventilation and comfort in hot weather.

The main disadvantage of raised, slatted floors is the high expense of construction. Other concerns with slatted floors are leg and foot problems from too wide a gap or poor maintenance of existing slatted floors.

Regular disposal of dung and urine is very essential to keep animal house hygienic. Preference of floor type and material was studied due to the reason, it determines the conductive heat loss from the animal which is very important factor to keep animal warm during winter season, simultaneously it would help to disseminate heat load during summer. So idea on floor type and floor material is of immense helpful during construction of goat shed in different agro climatic condition as well as in different seasons. The study revealed that Sirohi goat would prefer most slatted wooden floor followed by slatted plastic floor (Das, 2003).

Goats like to see each other, even if penned separately, so provision needs to be made for this in the type of partitions / gates used. Pen and door heights vary according to breed and 1 to 1.25 m. height is recommended for most of the breeds of goats.

The buck should be housed separately. A single stall measuring 2•5 m x 2•0 m with the usual fittings for food and water would be suitable for the bucks. Two

bucks should not be kept together, particularly during the breeding season, because they might fight.

Pregnant goats should be maintained individually to avoid fighting between themselves, as it may lead to abortion. So, a pen of 2.5 x 2 m is sufficient to house a pregnant doe.

Kids should be kept in warm houses, especially in chilly and wet weather. There should have proper drainage facility. Generally goats are allowed for grazing during daytime and stall fed during night.

Adequate space should be given to each goat if maintained individually or group of two or three in pen for proper growth and production. Floor space requirement for breeding buck / pregnant doe, breeding doe, adult buck / doe, finisher and grower is 5 m 2 / head, 4 m 2 / head, 3 m 2 / head, 2 m 2 / head and 1 m 2 / head respectively. Overcrowding should be avoided for proper growth and production. If the goats are housed in a group in the same area a minimum of 2 m 2 / goat needs to be provided. Although more than this minimum is recommended if fighting is to be avoided.

Das et al (1999) reported a floor space requirement of 2.14 m 2 / head was most suitable for optimum growth and feed conversion efficiency for grower to finisher Black Bengal goats on deep litter system of management.

In the tropics because of high temperature, heavy rainfall and the susceptibility of goats to parasitism, the most practical goat houses are those which are raised above the ground level, are well ventilated, and have long eaves to prevent heavy rain showers to splash in from the sides. The floor must be strong (wooden strips with small slits in between) and the roof material should provide effective insulation from the solar radiation. The roofing material would be made of bamboo or tree leaves or earthen tiles which are cheap and practical. Provision must be made for collection of dung and urine periodically.

In a study of Das et al (2006) it was reported that while Black Bengal goats were housed on deep litter for a period of two years under humid tropics with Para grass and concentrate feed block, the growth and feed efficiency was optimum. Different physiological responses and disease occurrences were studied. No apparent adverse effect on health of the goats was noticed. Hematological observations were within normal limit. Goats reproduced throughout the year indicating unaltered reproductive pattern in confinement on deep litter.

An enclosure measuring 20 m x 10 m is adequate as paddock for stall fed goats of 100 numbers for roaming and exercise. Such an enclosure or exercise paddock should be well fenced with strong woven wires. The exercise paddocks should be made bigger than the enclosures and should have some shade trees if the stock is to be maintained constantly in confinement. Barbed wire should not be used so as to avoid injury to the udder and teats.

In housing, bedding must be available to animals at all times. Bedding must be clean, dry, mold-free and replenished as needed. Bedding must not cause discomfort or harm to the animals. Bedding with straw or sawdust preferred. There must be enough bedding to ensure the comfort of all animals. In cold temperatures heat must be provided as necessary to keep animals comfortable.

E. Feed and Feeding of Goat

Herbivorous animals may be classified into two broad categories i.e., the first preferring grasses e.g. cattle, sheep etc. and second preferring woody plants and pods with supplementations of grasses and herbages e.g. goat. Therefore, it is desirable that a balance between browsers and graziers be maintained for foolproof soil, plant, animal's ecosystem. As the goats are browser in feeding habit they prefer shrubs and tree leaves to grasses and pasture (Skerman, 1977). On an average goat receive mixture of grasses, shrubs, weeds, thorny plants, pods, tree leaves etc.

The DM requirement of goat is much higher than cattle and sheep due to higher BMR and thyroxine production in goat. Dry matter requirement of meat breed, dual purpose breed and milch breed of goat is 4 %, 5 % and 6 % respectively. Goat is also very efficient in digesting crude protein, crude fiber and NFE in comparison to sheep, cattle and buffalo. The superior digestive efficiency, especially of crude fibre in goats can be attributed to their slower rate of passage of digesta. It was reported that the goats are more efficient in the digestion of lignin than the buffaloes, cattle and sheep. Hence tree leaves and shrubs contribute about 60 % of diets of goats.

There are many indigenous and exotic shrubs and tree leaves in India than can be successfully propagated in either silvi-pastoral system or agro-forestry systems for better production of tree leaves. The most promising fodder trees and shrubs are Leucaena leucocephala, Acacia tortilis, Albizia amora, Ficus religiosa, Ficus glomerata, Sesbania sesban, Dichrostachys mutans, Pittosporum phillyraesides, Atriplex spp., Azarachta indica, Melia azedarach, Ailanthus excels would be produced and fed to the goats.

There are forests by products such as banana leaves, banana stem, pine apple leaves, wild roots and tubers; leaves of jackfruit, tapioca would be used for feeding goats. Banana leaves are rich in riboflavin and vitamin A, but poor in sodium so after adding common salt it could be utilized for feeding goat. Water hyacinth is a weed commonly available in Eastern and North Eastern region of India. It would be used for feeding goats. Pine apple leaves and needles are excellent vitamin source and would be utilized for feeding goats (Verma et al, 1982).

If sufficient browsing materials and tree leaves are not available cultivated fodders such as Paragrass, Guinea grass, Barseem, Lucern, Hybrid Napier, Maize may be given for maintenance and production. Cowpea, Rice bean and Stylo are the promising leguminous fodder would be grown for feeding goats. Das and Satapaty (2006) reported that absolute weight gain and average daily gain of Black Bengal goats were higher in 70 % roughage feeding than sole roughing feeding, on both Congosignal and Guinea grass feeding while maintained in Integrated Farming System .

In the absence of good quality green fodder concentrate mixture should be given to goats for maintaining production and health. Concentrate supplement for grower, finisher, adult and breeder should be @ 100 g / d, 150 g / d, 200 g / d and 250 g / d respectively. The concentrate requirement for nursing doe should be 300 g / d. The BMR of goat is high and the mineral content of goat milk is higher than any milk. Therefore mineral requirement of goat is high. Hence mineral mixture should be added to the ration of goat @ 2 %.

Some golden rules of feeding are as follows:-

- The aim should be to keep every goat in the herd in good bodily condition, not too thin and not too fat, all the year round.
- Food must be stored properly prior to feeding, to protect it from damp, contamination and vermin. Food must be hygienically presented to the herd with an understanding of goat behaviour so that each animal gets its share.
- Good hay is the single most important item of the diet. At least half the diet (on a dry weight basis) should consist of forage.
- Green food, concentrates, minerals, vitamins and water are also important, and a balanced and adequate diet is crucial to success. Any change to the diet fed must be made gradually to enable the population of rumen bacteria to adjust.

Double sided feeder for goat

Single sided feeder for goat

- Kids must receive colostrum immediately after their birth, followed by a sufficient milk diet leading up to weaning.
- Drinking water must be clean, fresh and always available. In a study on effect of water restriction for goat on thermoregulatory responses it was revealed that goat would overcome the adverse effect of water restriction by its adaptive mechanism ie reducing sweating rate and respiration rate (Das et al, 1994). They would be maintained on once daily watering for a period of 15 m in dry arid region where water is a limiting factor in summer and winter.

F. Reproduction of Goat

Selection of buck and doe is important for selective breeding and obtaining maximum efficiency. Buck and doe should have strong, well-developed frame, good conformation and breed characters. Legs should be straight and well placed under the body.

Goats should be healthy and free from external and internal parasites. They should be chosen from good milking strain and should be the progeny of dams having good performance records.

The skin of a good doe should be loose, pliable and free from dryness. Poor condition of flesh is an indication of good milker and vice versa. The udder of a good milch goat should be soft and pliable rather than meaty. The teats should be pointed straightforward.

Study of sexual behavior in Black Bengal goat revealed that courtship in the form of sniffing urine and flefihmen exhibited in the form of extending neck and head upwards with lips in curled, nosing, licking the external genitalia of oestrous doe are the most prominent symptoms of potent buck ready for breeding. Average duration of courtship was found to be 1-10 m in most of the cases (Das et al, 1991).

Avoid the kidding during peak period of summer and winter to avoid stress. Does are to be bred at the interval of 7 - 8 months for maximum productivity. Cull the old unproductive animals at the age of 6 years and above.

Doe lings reach puberty by 6 to 8 months of age and are usually bred at 7 to 10 months of age. At the time of breeding they should weigh about 30 - 40 kg ie 60 % of adult weight. If the doe lings are not at an optimum weight, breeding should be delayed since puberty is more dependent on body size rather than age. However, delaying breeding much after 10 months of age decreases the reproductive performance. Growth rates of replacements should be monitored and their nutrition adjusted accordingly.

For two to three weeks prior to the breeding season does and doe lings should be gaining weight. This is achieved by increasing the amount of energy being fed. Does managed in this manner will have an increased number of ovulations.

Estrus is the period when the doe will receive the buck. Usually this period will last from a few hours to 2-3 days and is characterized by frequent and insistent "talking", tail wagging, and pink color as well as swelling in the external genital region, sometimes with a discharge. In a study of Das et al (1991) regarding sexual behavior of Black Bengal goat it was observed that watery mucous discharge from vulva was the most common and prominent symptoms of oestrous doe. A lactating doe will usually drop in her milk production. The period between oestrous is from 17-21 days. To achieve the highest conception rate, it is best to breed the doe on day two of her oestrous period.

The doe should be bred to freshen once each year with a dry period of about two months. The dry period allows the mammary system time to repair and regenerate for the next lactation. The greater her production the more likely that her body has been depleted of the nutrients used in milk secretion and the longer the dry period required to replenish the losses and store adequate reserves for the next lactation. Does which are not given a normal dry period usually produce only 65 to 75 % as much milk in the subsequent lactation as does given a dry period. The gestation period in goats is 148 to 150 days.

G. General Management for Goat Production

Management of doe

- Regular detection of heat is necessary by potent buck; swelling and redness of vulva, mucous discharge from vulva are common signs of heat.
- Breed the doe 12 hours after the onset of symptoms of oestrous for maximum conception. Unbreedable doe should be examined thoroughly to find out the causes for anoestrous. If repeat breeding condition occurs and does not response to treatment it is better to cull the doe as soon as possible.
- Feeding schedule should be as regular as possible.
- Regular cleaning of house, feeder and water pot is very important.
- Hooves of doe should be checked regularly for foot rot and lameness.
- Does should be dewormed before breeding.
- Clipping of hair from reproductive organs is necessary before breeding.
- Does should be kept in separate pen for any sickness, to avoid disease transmission.

Management of pregnant doe

- They should be kept individually to avoid fighting.
- They should not be allowed to jump to avoid chance of abortion.
- They should not be allowed for too long march, particularly during hot part of the day to avoid chance of abortion.
- Supply of balanced and adequate quantity of feed at least before two months of kidding is necessary to reduce doe and kid mortality.
- Any drastic change of feed should be avoided during pregnancy.
- Water, mineral and vitamin mixture should be given in sufficient quantity.

Care and management of kids

- Immediately after kidding the strong and healthy kid should stand on their legs and make attempt for suckling doe. It should be ensured that weak one

should get sufficient milk from its mother in case of twin and triplet. Suckling behavior is associated with milk yield of doe, growth and mortality of kid. So, in a study of suckling behavior of Black Bengal kid, it was observed that overall mean duration of suckling and amount of milk consumption per suckling bout were 2.54 m and 100.85 g respectively. The positive correlation coefficient (r = 0.24) between suckling rate and butting frequency is an indication of joy and satisfaction of kids (Das and Pan, 1990).

- Kids should be fed colostrums at least for seven days for the development of natural immunity.
- Protect kids from extreme cold and hot during the first two months of their age.
- At the age of 14 – 21 days sufficient green and fresh soft grasses should be available to the kids.
- Horn development is a recessive trait of goats and is found in most breeds. For safety purposes, remove the horns while the animals are young, between 7 to 14 days of age. There are several ways to dehorn goats, by chemical method using caustic compounds, physically by applying burning irons.
- Bucks develop musk glands when they reach puberty. These glands emit an objectionable odor that often taints the taste and odor of the meat. At the age of 30 days male kids should be castrated by close method with the help of burdizzo castrator for better quality meat production and reducing the objectionable odour in the meat, keeping few good healthy kids for breeding.
- Weaning should be done at the age of 45 days to make habit on taking solid food. After weaning kids should be given identification number by ear notching or tattooing or neck tagging for keeping records etc.
- Growth of kids should be recorded for selection and breeding purpose. Stunted one should be culled from the stock.

H. Health Management of Goat

Common Diseases of Goat

A number of diseases occur in goats. When a problem occurs in the herd, veterinarian should be consulted to treat and control the disease immediately. The most important diseases are overeating disease, bloat, tetanus, mastitis, parasitic infestation, edema, foot rot etc

- **Overeating disease (enterotoxemia)** generally results in death and seldom exhibits symptoms. This disease is caused by a Clostridial organism that is normally in the intestine of most goats. Goats that have their feeding schedules abruptly changed or consume large amounts of grain are the most susceptible to overeating disease. These changes cause the Clostridial organism to grow rapidly and to produce a powerful toxin that causes death within a few hours. The two types of enterotoxemia are C and D. Vaccinate all your goats with the combination C and D vaccine; multiple vaccinations are recommended.

- **Bloat** is the accumulation of an excessive amount of gas in the rumen. This may result from overeating tender, young, high protein legumes or other green forages still wet with dew. Symptoms of bloated goats include the animal's lying down and getting up at frequent intervals, kicking at the abdomen, making loud grunting noises, or otherwise showing distress. Prevention includes making sure the animals have a good fill of dry hay before turning them onto moist pasture. Animals can die suddenly with bloat; therefore, immediate calling the veterinarian is advisable. Treatment includes trocarisation for removing gas followed by oral administration of anti bloat medicine and antihistaminic.

- **Tetanus (lock jaw)** is a disease usually resulting from a wound infection. The disease is caused by a powerful toxin produced by a bacterium that grows in the absence of oxygen. The first sign of tetanus is stiffness about the goat's head; the animal often chews slowly and weakly and swallows awkwardly. Also, the goat's third or inner eyelids protrude over the forward surface of the eyeballs. The animal shows violent spasmotic reactions with the slightest movement or noise and usually remains standing until close to death. All ages are susceptible, but kids weakened due to castration or dehorning are more

susceptible to tetanus. Tetanus is hard to treat, and death occurs in more than 50 percent of the cases. Contact your veterinarian immediately; keep infected goats as quiet as possible. Tetanus antitoxin might help if administered early, but prevention is the best policy. Reduce the incidence of wounds, apply sanitary and proper wound treatments, and vaccinate with tetanus toxoid immediately after dehorning or castration surgery.

- **Parasitic infestation** The roundworm, stomach worm and coccidia are the most significant internal parasites that affect goats. Animals become infested by grazing on pastures contaminated with droppings from other infested goats. Use several pastures in rotation because parasite carryover can be markedly reduced by resting pastures for 30 to 60 days between grazing. In a study of Das et al (1994), it was observed that if goats are maintained under confinement on deep litter infestation of amphistome, tapeworm, hookworm and strongyle would be minimized significantly in comparison to goats maintained on pasture in semi intensive system in tropic humid condition in Black Bengal goat. So, newly purchased animals would be treated for internal parasites.

  Coccidiosis can cause severe problems in goats, especially those managed in confined or dry lot conditions. Goats managed under these conditions should receive a coccidostat regularly in their feed. Symptoms of parasite infestation include general unthriftiness, a rundown condition, rough hair coat, loss of weight, poor appetite, diarrhea and anemia. If goats are infested with internal parasites, fecal samples should be collected for examination which will determine the type of parasite, degree of infestation and recommended treatment. External parasites including lice, ticks, mites, horn flies, stable flies, horse flies and mosquitoes might present serious problems. These pests are most prevalent in the spring, summer, and fall but can be a problem throughout the year.

- **Mastitis** is an inflammation of the udder. It may be acute or chronic. Most cases are caused by streptococcus or staphylococcus organisms. The udder may appear hot, painful, tense and hard. A broad spectrum antibiotic may be needed or simply strepto - penicillin may be effective. The disease can be cured if treated early. Sanitation during milking is important in the control of mastitis and the making of a clean wholesome dairy product. Many mastitis-causing organisms are present in the environment and can find their way into the udder and milk pail if good sanitation is not maintained. Manure should be removed from the milking areas as frequently as needed. If milking machines

are used, the teat cups should be kept clean and dipped into clean water and then a sanitizing solution such as 5 % potassium permanganate. Machines should be properly cleaned, sanitized, and stored after each milking. Clean equipment will reduce chances of mastitis and lower bacteria counts in milk.

- **Udder edema and congestion** is commonly observed in high producing dairy goats during the late dry period and after parturition. While the problem cannot be totally controlled, limiting the use of sodium (salt) and potassium (good sources are molasses) as well as high energy feedstuffs in the dry period is helpful. The total ration dry matter should contain about 0.2 to 0.3 % sodium and 0.7 % potassium. While a lower energy and higher fiber ration is needed for the dry does, lactating does need higher energy feedstuffs in their ration with adequate amounts of good quality forages.

- **Foot rot** is not often seen in goats, but it may occur if animals spend considerable time in wet, unsanitary yards or barns. The first symptom is lameness, followed by a swelling of the foot that becomes hot to the touch. Carefully trim the rotten area away and the foot treated with a 10 – 20 % copper sulfate solution or 5 % Potassium permanganate solution followed by local application of anti-infective ointment and parental injection of antibiotic is advocated.

- **Abscesses** are a common chronic disease of adult goats where abscesses arise from the lymph nodes, particularly about the head, neck and shoulder. This disease may eventually cause emaciation and death of the affected animal due to internal abscesses interfering with vital organs. The abscesses should be lanced after becoming sufficiently organized near the surface of the skin and the pus carefully collected and disposed of. Cleaning the wound with an antiseptic solution followed by parental injection of broad spectrum antibiotic until healed should be followed. During treatment, the animal should be isolated and the area around the wound washed and dried before returning her to the herd.

- **Skin infections** such as ring worm require treatment. Treatment includes using a solution of glycerine or tincture of iodine. The antifungal activity of thiabendazole may provide a useful treatment.

So following measures should be taken :-

- Deworming of animal should be done regularly at four months interval with broad spectrum anthelmentic ie thrice a year. Time to time faecal examination is also needed for identification of internal parasite.

- Provision of clean drinking water and uncontaminated feed is essential to reduce health disorder. Mold infested feed should never be fed to the goats to avoid aflatoxicosis.

- Keeping house hygienic is another way to keep diseases at bay.

- Routine vaccination schedule should be followed. Goats should be vaccinated against FMD, PPR and CCPP etc. In case of outbreak quarantine measure should be followed.

I. Economics of goat Production

Assumptions:-

- Entrepreneur has land for constructing goat shed and for fodder cultivation / grazing for 60 goats (50 females and 10 males).
- Konkan Kanyal / Osmanabadi are considered as parental stock. Cost of buck and doe was considered as Rs. 2000 and Rs.1500 respectively. Goat will be purchased at the age of 9 - 10 months and after rearing 3 - 4 m selective mating will be practiced.
- Semi intensive system will be practiced i.e. goat will be allowed for grazing for 5 – 6 hours and will be sheltered in house during night time.
- Labour will be paid by farmer himself for daily routine work, so labour cost was not considered for the calculation
- Concentrate feed @ 100, 150 and 200 g will be given to grower, adult and nursing mother daily. The cost was considered @ Rs 2000 / Qt.
- Locally available materials are used to construct shed and rate was considered @ Rs 50 / ft 2. Space requirement for adult was considered @ 20 ft 2 and for growers @ 10 ft 2 . So, total space requirement is 2700 ft 2.
- Fertility rate is considered 90 %. It is assumed that 50 % doe deliver single and 50 % doe deliver twin .
- Mortality is considered as 5 %,
- Cost of feeder / waterer is @ Rs 20 each
- Insurance premium @ 4 % of animal cost.
- Selling price of parental stock @ 1500 per goat, adult goat of 16 m old @ 2000 per goat and grower goat of 8 m old @ Rs 1200.and weaner kit @ Rs 500 each

Non recurring Expenditure :-

1.	Cost of animal	10 males x Rs 2000/-	= Rs	20,000/-
		50 females x 1500	= Rs	75,000/-
2.	Cost of Housing	2700 ft2 x Rs 50 / ft2	= Rs	1,35,000/-
			TOTAL	2, 30,000/-

Recurring Expenditure

1.	Feed 140 Qt x Rs 2000/- per Qt	=	Rs	2,80,000/-
2.	Medicine	=	Rs	10,000/-
4.	Feeder and waterer 200 x Rs 20/- each	=	Rs	4,000/-
6.	Insurance premium 4 % x Rs 95,000/-	=	Rs	3,800/-
7.	Interest of loan Rs 2,30,000/- x 12 % x 1 yr	=	Rs	27,600/-
			TOTAL	3, 25,400/-

Income :

1.	Sale of parental stock 57 no x Rs 2500/-	=	Rs	1, 42,500/-
2.	Sale of goat of 12 m old 65no x Rs 2000/-	=	Rs	1, 30,000/-
3.	Sale of goat of 6 m old 65no x Rs 1200/-	=	Rs	78,000/-
4.	Sale of weaner of 2-3 m old 65 no x Rs 500/-	=	Rs	32,500/-
4.	Sale of gunny bag	=	Rs	2,000/-
5.	Sale of goat litter (150 Qt x Rs 200 / Qt)	=	Rs	30,000/-
			TOTAL	4,15,000/-

Net Profit in 2 years from 60 goats (4, 15,000 – 3, 25,400)	=	Rs.	89,600/-
Net Profit / goat / year	=	Rs.	747/-

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