

Applied Zoology

Goatry

Dr. B.L. Saraswat

Reader
Deptt. Of Animal Husbandry and Dairying,
Udai Pratap Autonomous College,
Varanasi 221 002 [India]

15th February 2006

Keywords: Goat, Production, Economics, Milk, Meat

Introduction:

The goat-a-mini cow or known as poor man's cow, is a multipurpose animal, which provides meat, milk, hide, hair and manure. The economic returns from goat keeping is high as compared to other livestock farming. The world's goat population has been estimated to be around 696 millions (FAO 1988). The goat population in our country is estimated to be around 128 millions forming 23% of total livestock population (1999-2000). In India, 480 million kg meat (37% of total meat production), 1900 million kg milk (3% of total milk production), 100.9 million kg skin, 30 metric tons Pashmina and around 85000 metric tons manure are produced by goats annually. Goats contribution to national economy is Rs. 2444.3 crore per annum, which forms 3.5 per cent of total income accrued from livestock sector (MOA,1991)

In the prevailing socio-economic conditions in India where per capita holding is hardly 0.2 ha, goat rearing becomes a counterpart of mixed farming system. Goat rearing has been recommended as the best choice for the poor rural people in developing countries because of their low investment, high fertility and fecundity, low feed and management needs, high feed conversion efficiency, quick pay off and low risk involved. Due to these positive parameters, goat rearing is the backbone of economy of small and landless farmers in India. Goat plays an important role in income generation, capital storage, employment generation and improving nutrition. Being smaller in size they are easier to manage, require less space and can be easily handled by women and children.

Goat Production:

Related Terminology:

<i>Term</i>	<i>Meaning</i>
<i>Abattoir</i>	A slaughter house
<i>Ablactate</i>	To wean
<i>Additive</i>	An ingredient added to the feed mixture to produce more desirable product.
<i>ADG</i>	Average daily gain
<i>Adipose</i>	A part of the body where fat is stored
<i>Billy goats</i>	Buck (male goat)
<i>Buck</i>	Male goat (adult)
<i>Bleating</i>	Sound produced by goat.
<i>Buckling</i>	Young male goat (between 1 to 2 year age)
<i>Caprine</i>	Pertaining to goat genera

Carcass	The major portion of a meat animal remaining after slaughter
Chevon	Meat of goat
Creep feeding	System of feeding young animals prior to weaning. It is designed to exclude mature animals.
Doe	Female goat (adult)
Doeling	A female kid from the first day to birth until first parturition.
Flock	A group of goat.
Food conversion ratio	The number of Kg of food consumed by an animal required to produce a live weight gain of 1 kg.
Goatling	Young female goat (between 1 to 2 years age)
Kid	Newly born youngones of goat of either sex upto 1 year age.
Kidding	Act of Parturition in goat.
Mating	The act of joining buck with doe.
Mohair	The covering of the Angora goat.
Nanny	A young female goat
Serving	Act of mating in goat.
Spayed	Castrated male goat
Suckling	Female goat with their off springs.

Goat Breeds

S.No.	Breed	Home Tract	Utility
A. Indian breeds of Goat			
(i) Himalayan Region			
1.	Kashmiri or Pashmina	H.P., J&K and Laddakh	Less yie1d of milk, meat and draft purposes, pashmina production max. 200g/year/goat.
2.	Changthang	Laddakh, Lahul Valley	Sofest fibre production (Pashmina) 25-50g/goat/year.
3.	Chegu	Kashmir, Lahul, Sipti, Yaksar	Pashmina yield

			110g/goat/year, small amount of milk/day.
4.	Gaddi	Kangra, Kullu ratio alley, Simla, Sirmur, Chamba in H.P.	Yield of fleece per clip 1/2 to 1 kg milk yield 500 g/day, Buck used for transport and meat purposes.
(ii) Northern Region			
1.	Jamunapari	Etawah (Between Jamuna & Chambal rivers)	Dual purpose (for milk and meat) milk 2.5-3 Kg/day containing 4-5% fat.
2.	Barbari	Agra, Mathura, Etah, Etawah, Aligarh etc.	Twins/Kidding is common. Suitable for stall feeding, Milk 1-1.5 kg/day.
3.	Beetal	Sialkot, Jhelum, Gurdaspur, Amritsar (Punjab)	Dual purpose (Milk and meat), milk 1.5 to 2 kg/day. Milk yield 200 kg in 220 days.
(iii) Central Region			
1.	Marwari	Marwar area of Rajasthan	Triple purpose breed (Meat, milk and hairs), Av. Milk yield 900 ml/day.
2.	Sirohi	Rajasthan and Gujarat	For meat purpose mainly, Av. milk yield 800ml/day.
3.	Mehsana	Gujarat	Well developed udder, good milk yielder 1.5-2 kg/day.
4.	Zalawari	Zalwad of Kathiawar and west Mehsana	One Kidding/year, good milker 1 Kg/day.
5.	Berari	Nagpur, Wardha, Nimar (M.P.)	Poor milk yielder
6.	Kutchi	Kutch, Rajasthan	Reared for milk, meat and hairs, Av. milk yield 1.3 Kg/day.
(IV) Southern Region			
1	Surti	Surat, Nasik (Maharastra)	Milk production 1.2 Kg/day
2	Osmanabadi	Osmanabad (Maharastra)	Mostly reared for meat, Poor milk yielder.

3	Malawari	Calicut, Malapuram and Cannanore (Kerala)	Milk yield 400-450 ml/day.
(V) Eastern Region			
1	Black Bengal	West Bengal	Produces good quality meat, milk yield 0.4 kg/day.
2	Ganjam	Orissa, Coastal, A.P. & South M.P.	Reared for meat, Poor milker (400ml/ day)
3	Assam Hill	Khasi, Nagar Wahai hills	Kidding twice a year, twins common, useful for meat only, Poor milk yielder.
B. Exotic Breeds of Goat			
1	Alpine	France	Milk yield 1.0-1.3 kg/day
2	Nubian	Sudan	Milk yield 0.8-1.2 kg/day.
3	Saanen	Switzerland	Av. Milk yield 2.3 kg/day
4	Toggenberg	Switzerland	Av. Milk yield 1 kg/day

Feeding and Management:

Popularity of goat husbandry is increasing day by day in tropical countries with the recognition of its significant contribution for improving the socio-economic conditions of the rural poor and landless labourers. Goat and its multi-profit has paramount importance in tropical countries.

Proper feeding of goats is much important as feeding of any other farm animals. Lack of attention in feeding may lead to its poor performance. The ultimate performance of a goat depends on , how a goat is fed during its growth, pregnancy, lactation and dry periods. Therefore, a scientific feeding programme of goats must be followed.

- 1) Goats are very efficient ruminants which take about 80% of their nutrient requirements through grazing and browsing.
- 2) They require higher DM (3-4% of live weight) as compared to large animals.
- 3) A little higher level of protein is also required by goat for their meat production .
- 4) They like tree leaves and bushes and also dry green feeds.

- 5) They have higher metabolic rate than cattle ,therefore, their maintenance need is comparatively higher.
- 6) They require little amount of concentrate mixture if enough forage is available.
- 7) On an average a milch goat requires 3.5 to 5.0 Kg of fodder per day. Out of which 1 Kg should be dry fodder like dry Arhar leaves or Pea or gram bhusa or legume hay.
- 8) Due to smaller stomach capacity, feed may be offered to them 3-4 times a day.
- 9) Immediately after birth, kids must receive colostrum and thereafter kids up to 2 months must be fed milk @ 1/10 of their body weight.
- 10) The kids from 2 to 4 months of age should get creep feed @ 450 g daily alongwith green grass, water etc.
- 11) Four months of refreshing and dry pregnant goats should be given concentrate mixture @ 450 g with 14 to 16 per cent crude protein and green grass *ad-libitum*.
- 12) The milking doe should be provided concentrate mixture @ 350 g for each litre of milk.
- 13) During breeding season, the buck should be given concentrate mixture @ 400 g daily with green pasture.
- 14) Water should be provided *ad-libitum*.

To produce more milk and of high quality meat, the goats should be provided leguminous fodders and concentrate mixture in their diet. A balanced leguminous ration with a minimum level of 6 % total protein and adequate energy, minerals such as calcium, phosphorous etc. and vitamins need to be provided to ensure the optimum production.

Nutrients requirement for goats (percent or per kg feed) (NRC recommendations)

Growing -finishing Kids

A. Small breeds (slaughter weight 20-25 kg)

Body wt. (mg)	DM(kg)	DCP(%)	TDN (%)	Ca(%)	P(%)	Carotene
5	0.20	12	70	0.23	0.21	1.0
10	0.45	10	65	0.23	0.21	1.0
15	0.60	7	65	0.21	0.20	1.0
20	0.80	6	60	0.20	0.19	1.0
25	1.00	5.5	60	0.20	0.19	1.0

B. Large breeds (slaughter weight 30 to 35 kg)

Body wt. (mg)	DM(kg)	DCP(%)	TDN (%)	Ca(%)	P(%)	Carotene
10	0.40	12	70	0.23	0.21	1.0
15	0.68	10	65	0.21	0.20	1.0
20	0.88	7	65	0.20	0.19	1.0
25	1.10	6	60	0.20	0.19	1.0
30	1.20	5.5	60	0.19	0.18	1.0
35	1.40	5.0	55	0.19	0.18	1.0

Doe- Non-lactating and pregnant (first 15 weeks of gestation)

Body wt. (mg)	DM(kg)	DCP(%)	TDN (%)	Ca(%)	P(%)	Carotene
25	0.75	4.5	50	0.30	0.23	1.5
30	0.90	4.5	50	0.27	0.21	1.5
40	1.00	4.5	50	0.27	0.21	1.5
50	1.25	4.5	50	0.24	0.19	1.5
60	1.50	4.5	50	0.22	0.17	1.5

Doe- Non-lactating pregnant (last 6 weeks of gestation)

Body wt. (mg)	DM(kg)	DCP(%)	TDN (%)	Ca(%)	P(%)	Carotene
25	1.07	5.0	55	0.27	0.21	3.3
30	1.20	5.0	55	0.24	0.20	3.3
40	1.60	5.0	55	0.23	0.17	3.3
50	1.75	4.5	53	0.22	0.16	3.5
60	2.10	4.5	53	0.22	0.16	3.7

Doe-lactating (first half of lactation period)

Body wt. (mg)	DM(kg)	DCP(%)	TDN (%)	Ca(%)	P(%)	Carotene
25	1.0	5.0	65	0.30	0.22	2.7
30	1.20	6.0	62	0.29	0.21	2.8
40	1.60	5.0	60	0.28	0.20	3.0
50	2.00	5.0	60	0.27	0.20	3.1
60	2.40	4.5	60	0.27	0.20	3.3

Doe-lactating (later half of lactation period)

Body wt. (mg)	DM(kg)	DCP(%)	TDN (%)	Ca(%)	P(%)	Carotene
25	1.00	5.5	60	0.30	0.22	2.7
30	1.20	5.5	60	0.28	0.20	2.9
40	1.60	5.0	55	0.27	0.19	3.1
50	1.75	4.5	55	0.25	0.18	3.3
60	2.10	4.5	55	0.24	0.17	3.3

Bucks- (Breeding adult and yearling)

Body wt. (mg)	DM(kg)	DCP(%)	TDN (%)	Ca(%)	P(%)	Carotene
30	1.20	6.0	65	0.20	0.18	1.5
40	1.50	5.0	64	0.20	0.18	1.5
50	1.70	5.0	60	0.18	0.16	1.5
60	2.00	4.5	50	0.14	0.15	1.8
70	2.10	4.0	50	0.16	0.14	2.0
80	2.40	4.0	50	0.15	0.13	2.2

Cheap concentrate mixture (in percentage)

Ingredients	Mix-1	Mix-2	Mix-3	Mix-4	Mix-5
Maize (crushed)	30	20	25	-	30
Wheat bran	20	20	25	25	20
Barley	-	10	5	20	10
Oats	10	10	10	25	-
Gram(Crushed)	10	10	15	10	20
Groundnut cake	20	20	10	10	10
Gram/Arhar chuni	10	10	5	10	10
Molasses	2	2	2	2	2
Common salt	0.3	0.3	0.3	0.3	0.3
Vit-A(g)	0.3	0.3	0.3	0.3	0.3
Vit-B ₂ (g)	0.3	0.3	0.3	0.3	0.3
Vit-D ₃ (g)	0.5	0.5	0.5	0.5	0.5
Magnesium Sulphate	0.5	0.5	0.5	0.5	0.5
Phosphorus	2.4	2.4	2.4	2.4	2.4
T.M-5 (g)	0.5	0.5	0.5	0.5	0.5

*Source: Dairy Hand Book (production) 1979, NDRI, Karnal.

Mineral mixture for Goats

Bone meal sterilized	- 42 per cent
Ground lime stone/ chalk	- 30 per cent
Common salt	- 20 per cent
Sulphur	- 5 per cent
Ferrous Sulphate	- 3 per cent
Rate of mixing in concentrate mixture	- 2 per cent

Creep feeding:

The size of adult goat varies and it ranges from 25 kg to 50 kg according to breed. Therefore, a wide variation in the birth weight of kids is recorded. Depending upon the breed and the nutritional status of the pregnant doe, birth weight of kid ranges from 1 to 5 kg. Thus, to spare the goat milk for human consumption and to get a faster gain in kids it is required to provide them balanced starter feed, known as creep ration upto 10 weeks of age.

After feeding colostrum and milk to the kids for 6-7 days, they should be separated from their dams and kept away on starter ration. They should be allowed restricted suckling 2-3 times a day. For kids, free choice legume hay, mineral and drinking water should be made available along with the starter ration. Starter /creep rations should supply about 12 to 18 per cent DCP and 70 to 78% TDN to the kids. Few examples of such rations are below:-

Starter/ creep rations :-

Ingredients	Examp1	Examp2	Examp3	Examp4	Examp5
Maize	60	40	20	15	-
Barley/Oat	-	23	45	40	40
GN Cake	20	20	20	20	22
Fish meal	10	10	10	10	10
Molasses	-	-	-	10	20
Wheat bran	7	7	2	3	5
Mineral mixture	2	2	2	2	2
Common salt	1	1	1	1	1
DCP	18	17	17	17	17
TDN	78	77	75	71	70

Note:

1. Add 150g TM-5/Aurofac.
2. Add 25g vitablend/Rovimix or 1 tea spoonful of shark liver oil.

3. Linseed cake, sesame cake, kusum cake or mustard cake may be used to replace GNC.
4. Jowar, bajra and ragi may be used to substitute 1/3 cereal grains.
5. Rice bran, small millets, may be used to replace wheat bran on weight basis.

Following are the essential and non-essential minerals of goat nutrition:-

Essential minerals		Non-essential minerals
Major	Minor	
Calcium	Iron	Chromium
Phosphorus	Copper	Fluorine
Magnesium	Zinc	Molybdenum
Sodium	Cobalt	Nickel
Potassium	Iodine	Silicon
Sulphur	Manganese	Tin
Chlorine	Selenium	Vanadium
		Arsenic

Feeding of dry goats:

Dry goats should be fed enough to rebuild their lost body reserves. Good leguminous fodder can meet their maintenance and other needs. If good fodder is not available then the goat should be fed with 400 g concentrate mixture twice a day, i.e. in the morning and evening.

Feeding of growing kids:

After weaning of growing kids, a complete ration providing 9-10% DCP and 60 to 65% TDN with 20 to 25% DM from good quality roughage will meet the requirements. Fodders containing less protein and energy should be balanced with the concentrate mixture.

Feeding of pregnant goats:

The pregnant goat should be fed nutritious food just to bear the burden of pregnancy and to rebuild the lost body reserves. For these purposes, the pregnant dry goat should be fed leguminous fodder *ad-libitum* and concentrate at a level of 0.5 to 0.7 kg/day.

Feeding of lactating goats:

While formulating the ration for lactating goats many factors should be taken into consideration like body weight of goat, milk yield, fat% in milk, stage of lactation, weather conditions, availability of forages and cost of feed ingredients. In general, 1 kg concentrate mixture over the maintenance will be sufficient for every 3 kg of milk production. The amount of concentrate should be given two times i.e. in morning and evening. If green fodder is not available, the goat should be fed good quality leguminous hay. Few examples of concentrate mixtures for lactating goats are given below:

Example	Ingredient	Per cent in feed
I	Gram	15.0
	Maize	37.0
	G N Cake	25.0
	Wheat bran	20.0
	Mineral mixture	2.5
	Common salt	0.5
	Total	100
II	Maize	37.0
	Oat	37.0
	Wheat bran	16.0
	Soyabean meal	9.0
	Common salt	1.0
	Total	100

Feeding of Breeding Bucks:-

Breeding bucks should be fed at rate of 3.0-3.5 per cent of live weight and ration providing 4-6 per cent DCP and 50-60 per cent TDN with sufficient minerals and vitamins, to maintain normal health and fertility. Good pasture alone will maintain the buck in good health. If pasture is not available, feed good quality hay and concentrate upto 0.7 kg/day.

Nutrients requirement of goats for general feeding practice

	Nutrients	Requirement
1	Dry matter	- For meat type goat 3-4% - For lactating goat 5-7%
2	Protein	
	I. For maintenance II. For growth	45-65g DCP/100 kg live weight 70 g DCP/litre milk
3	Energy	
	I. For maintenance II. For growth III. For milk production	725.8g SE/100kg body wt/d 3.0g SE/g live weight gain 300g SE/kg milk
4	Water	450-700 ml/d for a goat weighing 18-20kg

5	DM intake	Total water intake ratio 1:4
6	Minerals	
	I. Calcium	147 mg/kg live weight
	II. Phosphorus	72 mg/kg live weight

Management Practices for goats: -

Heanlein (1978) has recognized the following four types of management for goats:-

1. Freely grazing goats
2. Herded goats
3. Tethered goats
4. Stabled goats

For the management of goats following practices are generally followed:

(i) Tethering: -

When grazing facilities are limited and one or two goats are to be kept then tethering is followed. In this method, the animal is tied with a rope of 3 to 5 m length with a slip knot to a peg of 35 to 50 cm long. Peg is driven into the ground over a grazing area which permit the goat to brows over a limited area depending upon the length of rope, so that whole grass is utilized properly.

(ii) Determination of age of goats: -

Age of goat is judged from the incisors which are found in lower jaw only. The eruption of permanent incisors are as follows: -

<i>Pair of incisors</i>	<i>Age of kid in months</i>
First – central	12-14 months
Second-middle	24-26 months
Third-lateral	36-38 months
Fourth-corner	48-50 months

(iii) Disbudding: -

To rear the goats under group management in loose housing system the horns of goats are nuisance, therefore, disbudding of kids is an essential practice. In male kids disbudding is performed at the age of 4 to 5 days and in female kids it is done at the age of 10-12 days. Disbudding is generally performed with the help of caustic potash stick.

(iv) Castration: -

All male kids except those to be kept for breeding purposes in future must be castrated by Burdizzo's castrator at an age of 2-4 weeks. As a result of castration, the male kids gain weight rapidly, produces more desirable meat and increases profit per unit.

(v) Deworming of kids: -

Kids are more susceptible to endoparasites than adult animals, therefore, a regular deworming schedule should be followed as below:-

Age	Drug	Dose
10 days	Binminth	half tablet
1 month	Piprazine	5 g in two days
1.5 months	Binminth	1 tablet
2 months	Phenovis	5 g in two days

(vi) Hoof Trimming: -

The trimming is essential to prevent over growth of the hoof which keeps the animal fit for walk and prevents weakness of leg. It is performed with the help of sharp hoof knife 3 to 4 times in a year.

(vii) Determining Physiological norms: -

To know the state of health and diagnose the disease physiological norms should be determined at a suitable interval. In case of goats normal physiological norms are as below: -

Body temperature	=	39 to 40 ⁰ C (102-104 ⁰ F)
Respiration rate/minute	=	12 to 20
Pulse rate/minute	=	70 to 80

Body temperature may be recorded with the help of clinical thermometer by placing it in anus. Respiration rate may be recorded with the movement of flank. Pulse rate may be recorded by placing the fingers on a artery lying near the surface of lower jaw or by placing the hand over the heart.

(viii) Culling the animals: -

To raise the profit, less productive animals should be culled time to time. Following category of the goat must be culled:

1. Undesirable animals
2. Low producers
3. Repeat breeders
4. Animal with stunted growth
5. All males except future breeding bucks at 16-18 kg wt. in 4 to 5 months
6. Low prolificacy animal

7. Problem breeders
8. Does of longer inter kidding period
9. Does of longer dry period
10. Paralysis affected animals
11. Goats suffering from incurable disease
12. Goats with lame or deformed bone, fractures
13. History of abortion, distocia and other kidding problems
14. Goats suffering from contagious disease.

(ix) Protection from cold draught: -

Kids are highly susceptible to cold. They usually suffer from fatal pneumonia, enteritis under cold and wet housing conditions.

Cold winds are very injurious to general health of goats. Give protection by providing covering of a coarse cloth on body, bedding material on floor, planting wind breakers, exposure to sunlight, etc.

(x) Care of lactating goats: -

1. Provide good quality greens and concentrate mixture for feeding.
2. Wash the udder with 5 per cent dettol solution.
3. Milk the doe completely with dry hand.
4. Clip off the hairs from hindquarters.
5. Carryout measures of clean milking.
6. Daily grooming of milking doe makes them docile, clean the body and make close observations of body.

Housing Requirement:

House for goat must be safe, dry, well ventilated and free from parasites. House should be able to provide protection from rain, cold, direct sunshine and winds. It should also provide protection from wild animals and theft. It must be on higher level for easy drainage. Temperature in house should remain between 15° C to 25° C.

Advantages of adequate housing

1. Increased production of milk
2. Better utilization of labour
3. Production of high quality milk and milk products.
4. Proper disease control
5. Better care and supervision
6. Decrease in mortality rate of kids.
7. Proper and controlled feeding of goats.
8. Better production and reproductive efficiency of goat.

Space requirement for different categories of goat:

Type	Floor space (m ²)	Maximum animals/pen	Feeding space/animal (cm)	Water space/animal (cm)
Kid	0.5-1	20-25	30-35	3-5
Adult female	1-1.5	60	40-50	4-5
Pregnant and Lactating doe	2	8-10	40-50	4-5
Adult male	2	1	40-50	4-5

Records to be maintained on a goat farm:-

The registers for maintaining records on a goat farm are listed below:-

1. Buck history sheet
2. Record of fertility
3. Health Veterinary history
4. Doe history sheet
5. Deworming register
6. Disease and treatment record
7. Goat breeding record
8. Goat history and performance record
9. Daily milk record
10. Daily milk disposal register
11. Milk quality register
12. Kidding register
13. Kids and their growth record
14. Monthly feed register
15. Fodder crop register

Common diseases of goats:

It is better to have prevention against the ailments and diseases than to treat them. Therefore, goats must be vaccinated and dewormed from time to time.

Regarding abnormalities and ill health of goats following observations have to be made:

1. Loss of body weight or condition
2. Emaciation, dullness
3. Skin infection, external practices
4. Wound and other physical injuries
5. Lameness
6. Difficult breathing
7. Scratching, biting, rubbing
8. Unusual discharge from mouth, eye, nose, vagina
9. Abnormal faces, discolouration (white/yellow), diarrhoea, dysentery, presence of blood mucus, etc.
10. Rise in body temperature (fever), increased pulse.
11. Anaemia; pale colouration of lining of eye lids.
12. Run down condition, shedding of hair coat.
13. Reduced or no feed intake, no rumination, etc.

Some common diseases of goats:

S.NO.	NAME OF DISEASE	CAUSE	SYMPTOMS
1.	Rinderpest	Virus	High fever, bran like ulcers in mouth and lips, blood stained, shooting foul smelling diarrhoea.
2.	Foot and Mouth Disease	Virus	Salivation, sores on feet and tongue, ulcers, lameness.
3.	Anthrax	<i>Basillus anthracis</i>	Sudden death, very high fever, blood tinged, foamy discharge from mouth and nose on death.
4.	Black Quarter	<i>Clostridium chauvoei</i>	Gas gangrene, death before 48 hours.
5.	Haemorrhagic septecemia	<i>Pasturella multocida</i>	High fever swelling in the neck region, laboured breathing. Eyes swollen and tounge enlarged, difficult swallowing , death in 24 hours.
6.	Pneumonia	<i>Mycoplasma</i> sp.	Fever (104-107 °F), nasal discharge.
7.	Goat Pox	Virus	High fever, discharge from eyes and

			nose, lesions on the skin.
8.	Brucellosis	Brucella abortus	Expulsion of foetus, uneasiness before abortion, secretion of colostrum in milk.
9.	Diarrhoea and scours	Due to liver fluke	Loose water motion, condition depressed, dislike feed, dehydration, dullness and temperature sub-normal.
10.	Coccidiosis	Emeri arunibacillus	Animal attempts to lick the feet, Loose motion and fixed with blood, anemia, loss in appetite and body weight, slight fever and rough hair coat.

Control measures of diseases:-

To control the diseases in goats following measures should be followed:-

1. Segregation of sick animals
2. Change of pasture
3. Vaccination of healthy animals
4. Disinfection of shed
5. Affected animals be slaughtered and buried 6' deep with lime under ground
6. Proper disposal of litter material
7. Use anti- serum in affected animals
8. Quarantine
9. Use of foot bath
10. Timely treatment and visits to goat shed

Vaccination:-

As a routine prophylactic measure follow vaccination schedule as below:-

Vaccination schedule for goats:-

Month	Vaccine	Adult Goat	Young one
January	Contagious pleuro pneumonia	0.2 ml l/dermal	0.2 ml l/dermal
March	H.S. Vaccine	5ml S/C	2.5 ml S/C
April	Goat pox vaccine	By scraching	By scraching
May	Entero toxaemia vaccine	5ml S/ C	2.5ml S/ C
	FMD Vaccine	5ml S/ C	5ml S/ C
June	Rinderpest vaccine	1ml S/ C	1ml S/ C
July	Black Quarter vaccine	5ml S/ C	2.5ml S/ C
August	FMD vaccine	5ml S/ C	0.5ml S/ C
September	Entero toxaemia vaccine	5ml S/ C	2.5ml S/ C

Salient Points Related to Goat Production:

1. Gestation period of goat is 145-150 days.
2. For meat purpose the bucks are castrated at the age of 1-2 months:
3. Age of puberty attainment in does is about 1 year.
4. Oestrus cycle is repeated every 17 to 21 days and female remains in heat for 18-30 hours.
5. Time of ovulation is 12 hours before the end of heat.
6. Karnataka is the state, which has no goat.
7. Goat has no teeth in upper jaw and for determining its age the teeth of lower jaw are counted.
8. India has first rank in the world's in goat skin production and India has second place after Africa so far as population of goat is concerned.
9. Respiration rate of goat is 14-22 per minute.
10. In India, Barbari is a best milch breed of goat.
11. Maximum number of goats are reared in Rajasthan and Uttar Pradesh.
12. Due to small fat-globules and low fat content, goat milk is easily digestible.
13. Pashmina (Kashmiri) is a breed of goat, which provides high quality wool.
14. Buck starts mating at the age of 15 months and attains full maturity at the age of 2-2.5 years. A buck may be allowed to serve 50 to 60 does in breeding season.
15. Buck is sexually more active in winter and spring but most of the does come in heat in September and March.
16. Does may be bred again 45 days after normal kidding.
17. The average life span of a goat is 12 years.

Modern reproductive tools to enhance goat production

Beside scientific feeding, management, selective breeding and disease control, the improvement in reproductive efficiency would also ensure economic viability of goat enterprise. The reproductive efficiency depends on the length of breeding season, frequency of oestrus, number of ovulations, fertilization rate, duration of pregnancy, litter size, embryo/foetal development, growth of new born, suckling period, puberty age and duration of reproductive life. These processes can be controlled by using modern reproductive tools with an aim to achieve more kidding per year, more kids per kidding, more kids in life time, efficient use of genetically superior bucks and does. Some of the modern reproductive tools to improve reproductive efficiency are described below:

(1) Synchronization of oestrus:-

Synchronization of oestrus is a technique which is used to bring large number of animals in a flock into heat at the predetermined time. The main benefits of heat synchronization in goats are as under: -

- (i) To reduce the time needed for detection of oestrus.
- (ii) To facilitate the use of artificial insemination.
- (iii) To control the time of ovulation and to permit insemination on a predetermined schedule.
- (iv) To shorten the duration of kidding in a flock.
- (v) To reduce mortality to a great extent at the time of kidding.
- (vi) To permit supervision of birth in order to reduce neonatal mortality.
- (vii) To facilitate use of technique of embryo transfer.
- (viii) After successful control of breeding to permit weaning, fattening and marketing of uniform group of animals.
- (ix) To enable the feeding of goats in uniform groups.
- (x) As a general management aid, it helps to make best use of labour, building and other farm resources.

Agents used for Synchronization of oestrus:-

Several agents have been tried for synchronization of Oestrus in goats. Progestrogen + Gonadotropins in combination have been used in goats. More recently Prostaglandins and its analogues have been found very effective in synchronization of oestrous. Several preparations of gonadotropins and steroid hormones available in the market can also be used effectively.

(2) Superovulation:-

Prolificacy in domestic animals, particularly of meat animals is a most important factor determining economy of production. Goat is the main source of meat and more than 30% of the meat produced in our country comes from it. To attain maximum increase in the number of kids, super ovulation becomes a necessity.

The objective of super ovulation is to increase the yield of viable ova which may lead to an increased litter size. This technique also gives an opportunity to provide large number of embryos from genetically valuable donors in embryo transplantation studies. These are three main methods which are used for inducing super ovulation in goats:-

Practice of flushing for some weeks before mating

Selection based on litter size and

Use of Hormones

The use of hormones have been the most successful and accurate method. The gonadotropins of pituitary gland (FSH and LH) are mostly used as superovulating

hormones. Gonadotropins in combination with progesteron and/or prostaglandins have also been successfully used for induction of superovulation in goats.

(3) Artificial Insemination:-

The importance of artificial insemination for improving productivity of native goat in our country has been well documented by the scientists. It is most useful to utilize outstanding bucks over larger population and through this technique about 400-600 goats could be covered by one buck in one breeding season (40-60 days).

It has been accepted well that artificial insemination is a successful technique in goat production but its fruitful exploitation depends upon a number of factors such as selection of buck, method of semen collection, frequency of semen collection, semen evaluation, diluents, dilution rates, number of live and normal spermatozoa per inseminating dose, oestrus behaviour, stage of heat and insemination technique.

(4) Embryo Transplantation:

Artificial insemination has provided the considerable opportunity to improve genetic potential of the goat by using semen from proven males. Embryo transfer, a term most commonly used in animals is more or less similar to the 'Test-tube baby technique' in case of human beings. It refers to a technique by which embryos are collected from a female called the donor and then transferred, for development, to another female known as the recipient. The technique permits exploitation of superior female genotype giving more offspring from the same genetic donor than would arise under normal conditions of breeding. It has also an advantage of using the genetically poor females as faster another to carry genetically valuable embryos to full term and, therefore, has a control on the production of offspring of poor genetic makeup.

Pregnancy diagnosis:-

The technique of early detection of pregnancy is very important, because it is not necessary that an animal bred or inseminated may become pregnant. Lack of information in confirming the pregnancy of an animal may result in economic loss in the form of abortion and/or unnecessary feeding of non- pregnant animal. A farmer can select pregnant animals and can give better attention to pregnant animals by providing them additional nutrients for higher economic gains.

Pregnancy diagnosis method in goats should be such, that can detect pregnancy within 3 months of mating at one hand and must be cheap, harmless and easily applicable. Ultrasonic method of pregnancy diagnosis which works on 'Doppler principle' has successfully been tried at Central Institute of Research on Goats, Farah, Mathura (U.P.). It was possible to diagnose pregnancy with 60-100% accuracy after 30-60 days post conception with the application of ultrasonic equipment. This technique is very simple and can be used under field conditions at very nominal price. It needs little or no appliance/ electricity and takes very little time. "Enzyme Linked Immunossorbent Assay" (ELISA) can also help in to detecting early pregnancy in goats. The idea is to develop a "do it yourself pregnancy detection kit" for the farmers.

Induction of Parturition:-

Birth for the new-born or parturition for the mother are two main objectives for induction of parturition. It should be compatible with the survival and normal development of new born without deleterious effect on lactation and on maternal behavior. Various agents have been used for the induction of parturition in goats.

Some commonly used agents are cortico- steroids, oestrogens and prostaglandins. Vetesterol alone, vetesterol+oxytoxin, dexamethasone alone and dexamethasone + vetesterol are used at full term as well as 3-4 days before the term in goats which causes induction of parturition within 15 to 35 hours of administration.

Infertility problems:-

The success of any breeding programme depends on the increased fertility by producing live young or on results which reduces reproductive wastage and problem of infertility. Infertility problems in goats are uncommon as compared to other domestic animals.

Infertility in males:-

Infertility in males is mainly due to abnormalities of testes. If the buck is suspected for any abnormality, it should be immediately culled from the general flock and replaced by another buck of known fertility.

Genital tract of a male is infected with a number of different bacterial, viral and chlamydial agents. Brucellosis is one of the major bacterial infection which causes infertility in male and this disease is transmitted from one male to another male through copulation with female previously served by infected male. Animal suffering from such disease should be segregated immediately.

Sometimes nutritional deficiency like protein, phosphorus, copper, iodine and vitamin A leads to retarded sexual development, delayed puberty and low level of semen production resulting in infertility. Care should be taken that the males are not underfed. Feed should contain all the essential requirements of minerals to reduce the chances of infertility problems.

Infertility in females:-

In females, common problems of infertility are discussed below:-

Anoestrus:-

When a female does not exhibit heat, the condition is known as anoestrus. It may be due to seasonal changes in environment, nutritional deficiency, lactational stress and age. Seasonal anoestrus has been observed specially in Jamunapari goats. Low level of energy, minerals (Phosphorus and manganese) and Vitamin. A or E deficiencies lead to anoestrus conditions. Old age has also been reported to be one of the cause of anoestrus.

Repeat breeder:-

Repeat breeder is one which returns to service repeatedly after being bred to a fertile male. There are mainly two reasons for this purpose i. e. fertilization failure and early embryonic mortality. This may due to genital tract abnormalities, infections, hormonal imbalances, hereditary and managerial factors.

Brucellosis:-

It is the common cause of abortion in goats which leads to infertility. The infection may lead to high incidence of abortion. In Brucellosis, abortion takes place between third and fourth month of pregnancy.

Salmonellosis:-

It is an acute contagious disease, characterized by metritis and abortion. Abortions occur during the third trimester of pregnancy.

Foot and mouth disease:-

This infection in goats occur as a symptomatic infection. The infection of foetus with virus, results in death of foetus and animal becomes infertile.

Chlamydial abortion:-

Among the pregnant animals, it causes abortion. Sometimes in such cases placenta is retained which causes metritis resulting in infertility.

Mycoplasmosis:-

Mycoplasma infections also cause abortions leading to infertility.

Nutritional deficiency:-

Sometimes lack of protein, minerals specially phosphorus, cobalt and copper causes infertility problems. Manganese deficiency has also been reported to be the cause of silent heat, delayed conception and high culling rate because of breeding difficulties, repeat breeding and high abortion rate.

Economics of Goat Production

To make goat enterprise economically sound, it is advisable to maintain them in rural areas on grazing. For economics of goat farming, following points must be considered: -

As far as possible pregnant does should be purchased so that all of them should kid within 2 to 3 months of their purchase.

Mortality of kids should not be more than 10 per cent.

The goat unit becomes productive from second year onwards when first crop of kids is ready for sale.

Breeding life of foundation stock is 8 years with an annual mortality of 10%.

The lactation length is expected to be 150 days.

There shall be at least one kidding per year with an average of 1.5 kidding.

Grazing lands should be available in adjacent areas.

Example:

Number of animals= 100 she goats, followers and bucks

(A) Expenditure:-

Fixed expenditure:

Land:

(i) Covered area:

(a) For 100 goats (@ 12Sqft/goat)	= 1200 Sq ft
(b) For 40 kids (@ 4Sqft/kid)	= 160 Sq ft
(c) For 3 bucks (@ 25Sqft/buck)	= 75 Sq ft
(d) For 1 store cum milk room/ office	= 400 Sq ft
<u>Total covered area</u>	<u>= 1835 Sq ft</u>

(ii) Uncovered area :

(a) For 100 goats (@ 20Sqft/goat)	= 2000 Sq ft
(b) For 40 kids (@ 10Sqft/kid)	= 400 Sq ft
(c) For 3 bucks (@ 50Sqft/buck)	= 150 Sq ft
Total uncovered area	= 2550 Sq ft

Total land area required = covered area+ Uncovered area + 10% extra for path ways etc. = 1835 + 2550 + 438= 4823 Sq ft.

Buildings:

(a) Covered area (@ Rs 100/Sq ft) = 100x1835	= Rs 1,83,500.00
(b) Uncovered area (@ Rs 40/Sqft) =40x2550	= Rs 1,02,000.00
Total cost	= Rs 2,85,500.00

Livestock :

(a) Purchase of 100 she goats (@ Rs 1200/-each)	= Rs 1,20,000.00
(b) Purchase of 3 bucks (@ Rs 1500/- each)	= Rs 4,500.00
Total cost	= Rs 1,24,500.00

Equipments :-

(a) Grinder – One	= Rs 18,000.00
(b) Feeder – Four	= Rs 8, 000.00
(c) milk cans – Four	= Rs 4,000.00
(d) Manure cart – Two	= Rs 5,000.00
(e) Wheat barrow – Two	= Rs. 2,400.00
(f) Miscellaneous	= Rs. 3,000.00
Total Cost	= Rs. 40, 400.00

Total Fixed Cost = 2,85,500+1,24,500+40,400 = Rs. 4,50,400.00

II.Recurring Expenditure: -

1. Feed and fodders: -

(a) Greed feed (@ 1kg/goat/day) and dry feed (@ 0.5 kg/goat/day)

For kids (@ 0.4 kg/day) = 1 x 40 x 365 x 0.4 = Rs. 82, 500.00

(In general, all goats graze pasture)

(b) Concentrates: - @ 1kg/3kg milk

Total milk production/year = 30,600 kg.

Total concentrate required = $30,600/3 = 10,220$ Kg

Total Cost (@Rs. 8/kg) = $8 \times 10,220 = \text{Rs. } 81,760.00$

2. Labour: -

(i) Supervisor – One (@Rs 3000P.M.) for 1 year
= Rs. 36,000.00

(ii) Milkers - Two (@ Rs. 18,00 P.M.) for 1 year
= Rs. 43,200.00

(iii) Goat boy Three (@Rs. 1000 P.M.) for 1 year
= Rs. 36,000.00

Total Labour Cost - = Rs. 1,15,200.00

3. Water and Electricity charges and repairing = Rs. 5000.00

4. Depreciation on

(a) Covered area (@10%) = Rs 18,350.00

(b) Uncovered area (@10%) = Rs. 10,200.00

(c) Equipments (@20%) = Rs. 8,080.00

Total depreciation = **Rs. 36,630.00**

5. Interest on Capital (@10% on 4,50,400) = Rs. 450,40.00

Total recurring expenditure = $85,500 + 81,760 + 1,15,200 + 5000 = \text{Rs. } 2,84,460.00$

Note: - 1. Balance value of stock has not been accounted.

2. Depreciation on stock is not taken into account due to replacement by followers.

(B) Income: -

1. Sale of milk (Assuming 70 goats in milk and producing 1.5 kg milk/day/goat)

Fore one year = $70 \times 1.5 \times 365 = 37,800$ litres

Price of milk (@Rs. 10/litres) = Rs. 3, 78,000.00

2. Sale of male kids (Assuming 1:1 ratio of male and female and 10% mortality)

Therefore cost of 45 kids (@Rs. 600 each) = Rs. 27,000.00

(3) Sale of culled goats, 30 goats (@Rs. 800 each) =Rs. 24,000.00

(4) Sale of nannies ($45 - 30 = 15$) @ Rs. 600 each = Rs.9,000.00

(5) Sale of manure (18 tons @Rs. 250/ton)	= Rs. 4,500.00
(6) Sale of gunny bags (120 bags @Rs. 10 each)	= Rs. 1,200.00
Gross Return	= Rs. 4,43,700.00
Gross income	= 4,43,700 – 2,84,460 = Rs. 1,59,240.00
Net income	= 1,59,240 – 81,670 =Rs77,570.00 /year
Per month net income	=77570/12 = Rs 6464.00

Goat Milk:

Characteristics of goat milk: -

1. Acidity of fresh goat milk is 0.152 per cent and specific gravity ranges from 1.026 to 1.028.
2. Digestibility coefficient of goat milk protein is 85 per cent and its B.V. is 67.5 per cent.
3. Fat globules are smaller and fine (2 microns) than the cow milk fat hence it is easily assimilated.
4. Goat milk is rich in antibiotics and hence considered to have therapeutic value for people.
5. Goat milk is easily digestible, therefore, it is considered best food for children, patients and persons of old age.
6. Goat milk does not have gamma-globulin factor.
7. Goat milk has 9 minerals more in number than any other milk used for human consumption.
8. Goat milk protein contains all the essential amino-acids.
9. Goat milk is almost similar in composition (except lactose content) to human milk in comparison to the milk of other dairy animals, therefore, it makes an excellent food for infant.
10. Goat milk is free from TB germs as goat never suffer from this disease.
11. Goat milk is frequently used for the preparation of curd or soft cheese.
12. Fresh raw milk of healthy goats contains comparatively low number of total bacteria.
13. Goat milk is sweet, nourishing and medicinal.
14. Goat milk has an objectionable goaty flavour which can easily be overcome if the goats are kept under clean and hygienic conditions and away from the buck.

Yield and composition of goat milk

The average milk yield of deshi doe per lactation is about 60 litres and in improved breeds like Barbari it may go to 100 litres and in breeds like Jamunapari and Beetal it may go upto 150 litres in the lactation of 120 days. The milk yield of Indian goat ranges from 0.5 to 5.0 kg. The average milk production of a good grade, healthy, properly fed and kept goat should yield about 2.5 litres/day over a lactation period of 7 to 10 months. Amongst Indian goat breeds, Beetal, Jamunapari, Barbari and Surti are known to be good milk yielders. In a study, it was reported that mean lactation milk yield of the important indigenous breeds maintained in the institutional farms ranges lowest from 90 $\pm$ 4.1 kg in Malabari to highest 225.9 $\pm$ 17.4 kg in Beetal.

Composition of goat milk

Constituents	Amount (in 100 ml. of milk)
Water	86.8 g
Fat	4.5 g
Protein	3.3 g
Lactose	4.6 g
Ash	0.8 g
SNF	8.7 g
Total Solids	13.2 g
Energy	72 Kcal
Calcium	170mg
Phosphorus	120mg
Iron	0.3mg
Vita.A	182 IU
Vita. B1	0.05mg
Vita.B2	0.04mg
Niacin	0.3mg
Vita C	1mg

Physico-chemical properties of goat milk fat: -

Richert Meissel Value	25.81
Polenske Value	5.85
Butyro Refractometer reading	37.35
Saponification Value	227
Iodine Value	28-95

Goat Meat (Chevon)

‘Meat’ may be defined as animal flesh or tissues which are suitable for use as food.

Desirable characteristics of Chevon: -

1. A good quality tender meat is obtained from goats of 6-8 months age.
2. Chevon is pinkish red in colour, coarse textured and has a characteristics goatly odour.
3. The fat in carcass is yellowish in colour.
4. The digestibility coefficient and biological value of dried goat meat are 95.2 and 60.4 per cent respectively.
5. Black Bengal and Angora chevon is considered more delicious than meat of others, therefore, it fetches more price.
6. Its meat has no religious taboo and liked by all class of people.
7. Goat meat has less fat, liked by many due to activeness of animal.
8. Markets for chivon are very well established in our country.

Chevon Production: -

In India, Goats are main source of meat accounting for about 26 per cent of total meat production (FAO, 1990). Goat meat production was increased by 48% during 9 years (1981-90). It has about 15-20% of good quality protein and the percentage is higher in lean meat (20-22%). Guts from goats are used for casings in sausage making.

Composition of Goat Meat:-

The male kids intended for slaughter are usually castrated. The results have shown that castration improves the body weight as well as lean production by reducing bone percentage in the carcass.

Average composition of goat meat and offal: -

Constituents	Meat	Heart	Liver
Moisture(%)	74.6-77.6	76.8- 79.6	64.6-74.3
Fat (%)	1.0-2.8	3.3-5.8	3.2-13.8
Protein(%)	18.8-20.1	11.6-17.2	18.5-21.3
Mineral matter (%)	0.66-1.15	0.72-0.97	0.98-1.70
Calorific value (Cal/100g)	90-108	93-120	108-205
Total iron (mg/1	6.6-12.0	13.7-15.8	18.7-39.1
Ionisable iron (mg/100g)00g)	10.2-23.0	6.9-25.1	18.7-39.1
Phosphorus (mg/100g)	190-270	170-270	
Thiamine (mg/100g)	63.6-148.4	-	-
Nicotinic acid (mg/100g)	0.43-0.98	-	-
Ascorbic acid (mg/100g)	0	-	-

	Lungs	Kidney	Brain
Moisture(%)	77.8-79.7	77.6- 79.7	73.8-77.1
Fat (%)	1.5-2.7	1.8-3.1	9.3-12.5
Protein(%)	11.6-17.3	15.5-16.6	9.6-12.5
Mineral matter (%)	1.11-1.46	0.95-1.41	0.76-1.57
Calorific value (Cal/100g)	79-95	82-98	135-152
Total iron (mg/100g)	16.7-21.8	13.3-21.1	6.4-10.2
Ionisable iron	1.02-1.12	2.3-2.59	0.43-0.53

(mg/100g)			
Calcium (mg/100g)	8.6-18.3	18.3	9.1-200
Phosphorus (mg/100g)	200-250	230-250	210-380
Thiamine (mg/100g)	-	-	-
Nicotinic acid (mg/100g)	-	-	-
Ascorbic acid (mg/100g)	8.80-9.89	-	10.12-10.61

In addition to milk and meat, some breeds of goat also produce most valuable fibres like Mohair and Pashmina.

Mohair Production: -

Mohair is a fine goat fibre produced from the Angora goats. Most of the Indian goats are non-hairy. A crossbreeding experiment was conducted at Rahuri (Maharashtra) Centre for introducing Mohair in a virtually non-hairy goat of the deccan plateau. The results have shown that this valuable goat fibre can be produced from the Indian goats also.

Mohair yield and quality of Angora and its crosses with local goats.

S.No.	Character	Angora	Angora(75%)	Angora(75%)
1	Annual Mohair yield (kg)	3.06	1.07	1.72
2	Clean yield (%)	83.02	84.19	85.85
3	Staple length (cm)	6.93	7.81	7.35
4	Fibre diameter (micron)	21.25	24.32	23.35
5	Medullation (%)	2.61	11.98	6.57

Results showed that crossbred with 87.5% Angora genes were found to be the most ideal for Indian conditions so far as Mohair production is concerned.

Pashmina Production:

Pashmina is a fine goat fibre produced by the Chanthangi goats found in Ladakh at high altitudes. This precious genetic material can be an economic boon to the farmers because of its high market value. The average annual yield of Pashmina in this breed was found to be 214 gm. The staple length and fibre diameter were 5 cm and 12.4 microns, respectively.

Another goat breed which produces Pashmina is Chegu. These goats are found in the areas bordering Tibet. The average Pashmina yield of Chegu is 131.7 gm. The staple length and fibre diameter are 6.8 cm and 12.1 microns respectively. The Pashmina goats in India produce the finest Mohair fibres in the world but the average yield is low and needs improvement either through selection or cross breeding with the soviet Pashmina goats.

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