NIMAL HUSBANDRY AND FISHERIES
RESOURCES DEPARTMENT
GOVT. OF BIHAR

Training Manual

Training Program
"Veterinary Interventions in Goat Productivity and Health Management"

(27 to 29 November, 2025)

Directorate of Extension Education

Bihar Animal Sciences University, Patna-14


प्रसार शिक्षा निदेशालय
बिहार पशु विज्ञान विश्वविद्यालय, पटना
TRAINING PROGRAM
" VETERINARY INTERVENTIONS
IN GOAT PRODUCTIVITY AND
HEALTH MANAGEMENT"
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Sponsored by:

ANIMAL HUSBANDRY AND FISHERIES
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ANIMAL HUSBANDRY AND FISHERIES RESOURCES DEPARTMENT GOVT. OF BIHAR

Organized by:

Directorate of Extension Education
Bihar Animal Sciences University, Patna-14

Editor In-Chief

Dr. J. K. Prasad
I/C, Director Extension Education, BASU, Patna

Editors:

Dr. Y. S. Jadoun
Dr. Mritunjay Kumar
Dr. Anuradha Kumari
Dr. Ravi Kant Nirala
Dr. Saroj Kumar

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CORE TEAM MEMBERS OF THE TRAINING

Course Director

Dr. J. K. Prasad
I/C, Director Extension Education, BASU, Patna

Course Convenors

Dr. Y. S. Jadoun
Associate Professor & Head
Department of Diary Extension Education
Sanjay Gandhi Institute of Diary Technology (SGIDT)
Bihar Animal Sciences University (BASU), Patna.

Dr. Mritunjay Kumar
Associate Professor
Department of Veterinary Medicine
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna.

Course Coordinators

Dr. Ravi Kant Nirala
Associate Professor
Department of Livestock Production Management
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna.

Dr. Saroj Kumar
Associate Professor & Head
Department of Veterinary & Animal Husbandry Extension Education
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna.

.

Course Co-coordinators

Dr. Anuradha Kumari
Assistant Professor
Department of Dairy Chemistry
Sanjay Gandhi Institute of Diary Technology (SGIDT)
Bihar Animal Sciences University (BASU), Patna.

Dr. P. K. Singh
Assistant Professor
Department of Veterinary & Animal Husbandry Extension Education
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna.

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Extension Services of BASU to the Livestock Farmers of Bihar

Y.S. Jadoun and Nirmal Singh Dahiya
Directorate of Extension Education (DEE)
Bihar Animal Sciences University (BASU), Patna-14

The Directorate of Extension Education (DEE), Bihar Animal Sciences University (BASU) plays a vital role in strengthening the livestock sector of Bihar by providing a wide range of extension and outreach services to farmers, rural youth, and field-level stakeholders. These services aim to transfer scientific knowledge, advanced farming practices, and skill-based training from laboratories and classrooms directly to the livestock keepers of the state. Through its constituent colleges, veterinary clinical complexes, Krishi Vigyan Kendras (KVKs), and research stations, BASU ensures that farmers receive timely guidance, practical demonstrations, and access to innovations that can significantly improve productivity and livelihoods.

The core mandate of the DEE is to ensure the effective dissemination of validated knowledge and technologies related to livestock health, breeding, nutrition, and management. To achieve this, the Directorate conducts a wide range of farmer-oriented extension activities. These includes; capacity-building programs, on-farm demonstrations, village adoption initiatives, mobile advisory services, the ***BASU Krishi Gyan Vahan***, awareness campaigns, and digital outreach efforts.

These initiatives are designed to promote scientific best practices in areas such as:

- Livestock health and disease prevention
- Breeding and reproductive management
- Nutrition and fodder cultivation
- Clean milk production
- Value-added animal products

By leveraging both traditional and digital platforms, the Directorate ensures that the latest scientific innovations reach livestock owners at the grassroots level. This approach contributes significantly to enhancing animal productivity, welfare, and the

economic well-being of rural communities.

Key Extension Activities

1. Farmer Training Programs

Regular training sessions are organized both on-campus and off-campus for a diverse group of stakeholders, including farmers, livestock keepers, veterinary officers, dairy professionals, livestock assistants, and rural youth. Major training themes include:

- Scientific dairy farming and milk processing
- Veterinary diagnostic and therapeutic techniques
- Goat and poultry farming management
- Fodder production and silage preparation
- Clean milk production practices
- Animal health management and vaccination protocols

2. Field-Level Demonstrations and Farmer Interface

a) Establishment of KVK- Jamui

Directorate of Extension Education (DEE) at **Bihar Animal Sciences University (BASU), Patna** is instrumental in establishing KVK, extending the university's presence and outreach in tribal and underdeveloped regions.

b) FLDs and OFTs

Frontline Demonstrations (FLDs) and On-Farm Trials (OFTs) to evaluate and popularize livestock technologies across farming systems.

c) Demonstration Units at KVK, Jamui

The Directorate of Extension Education (DEE), Bihar Animal Sciences University (BASU), Patna, has taken a significant step towards strengthening practical agricultural education and skill development by establishing multiple demonstration units at the newly established Krishi Vigyan Kendra (KVK) in Jamui. These include dedicated units f**or goat, poultry, pig, and cattle rearing, offering vital hands-on training and experiential learning** opportunities to farmers, students, and extension workers.

In addition to livestock units, DEE has also developed essential infrastructure to support comprehensive agricultural extension activities. A nursery demonstration unit has been set up to promote horticultural practices and plant

propagation techniques. Two functional borewells have been installed to ensure a reliable water supply for farm operations and irrigation needs. Furthermore, a farm implement shed has been constructed to house agricultural tools and machinery, enabling mechanized demonstrations and equipment familiarization.

To provide continuous support and advisory services to the farming community, a **Kisan Paramarsh Kendra (Farmers' Advisory Center)** has been established. This center serves as a hub for information dissemination, farmer-scientist interactions, and on-the-spot solutions to agricultural challenges. Moreover, a seed production unit has been initiated to facilitate the production and distribution of quality seeds, contributing to improved crop productivity and sustainability in the region.

These developments at KVK Jamui underscore BASU's commitment to integrated, field-livestock based agricultural education and its vision of empowering rural communities through science-led integrated farming practices.

3. Animal Health and Awareness Camps: Organizes **free veterinary health camps** in remote and rural areas.

- Services include:
    - Deworming
    - Disease diagnosis and treatment
    - Infertility and reproductive disorder treatments
- Also conducts awareness campaigns on zoonotic diseases and hygienic livestock practices.

4. Farmer-Scientist Interaction Programs: Arranges interactive sessions between university experts and local farmers.

- Aims to:
    - Solve field-level livestock problems
    - Collect feedback for research and extension improvements
    - Promote collaborative learning and experience sharing

5. Collaboration and Networking

Directorate of Extension Education, Bihar Animal Sciences University (BASU), Patna have strong collaboration, linkages and networking with; BAMETI, Animal and Fisheries Resources Department (AFRD), NABARD, COMFED, JEEViKA,

Bihar Livestock Development Agency (BLDA), ICAR-RCER & ICAR-ATARI, National Commission for Women (NCW), New Delhi, Dairy Development Department, Bihar.

These linkages have facilitated joint training programs, funding, innovation dissemination, and field demonstrations.

6. Information, Education, and Communication (IEC) Activities

- **Publication and Distribution of Extension Literature**
  - Publishes leaflets, booklets, manuals, and newsletters in regional languages for easy understanding.
  - Topics include disease management, fodder production, breeding techniques, and value-added dairy products.
- **Audio-Visual Aids**
  - Produces educational videos and slide presentations on animal husbandry practices.
  - Broadcasts programs through Doordarshan, All India Radio, and local cable networks.
- **Use of ICT Tools**
  - Provides information through mobile apps, SMS services, and WhatsApp groups.
  - Maintains an online knowledge updates on livestock management at University website

7. Organization of Exhibitions, Fairs, and Events;

- **Livestock and Agriculture Fairs (Pashu Melas)**
  - Hosts exhibitions to showcase latest technologies, breeds, and innovations.
  - Offers platform for farmers to interact with scientists and companies.
- **World Veterinary Day, World Milk Day, and Other Celebrations**
  - Organizes events to spread awareness on livestock health, nutrition, and productivity.
  - Involves school children, farmers, and stakeholders for community participation.

- **Participation in State/National Exhibitions**
    - Represents BASU in regional and national agri expos and fairs.
    - Demonstrates university innovations and farmer success stories.

8. Flagship Programs and Initiatives Directorate of Extension Education

Directorate of Extension Education (DEE) at **Bihar Animal Sciences University (BASU), Patna**, implemented numerous innovative extension programs aimed at bridging the gap between research and client system of livestock farmers of the state.

a) Cattle Expo-2023

Organized Bihar's landmark Cattle Expo, promoting livestock technologies, breed improvement, and farmer-scientist interaction.

b) Pashupalan Darshika – Hindi Magazine

To strengthen knowledge dissemination among livestock farmers and rural communities, a Hindi magazine titled **'Pashupalan Darshika'** has been launched as a **quarterly** publication. This magazine is specifically designed to cater to the informational needs of Bihar's rural population, with a focus on promoting best practices in animal husbandry, veterinary care, livestock management, and allied agricultural activities.

'Pashupalan Darshika' serves as an accessible and practical resource, offering expert insights, success stories, seasonal advisories, and scientific recommendations in a language that is both familiar and easy to understand for farmers. The publication aims to bridge the gap between research institutions and the grassroots level by translating technical knowledge into actionable guidance. By empowering farmers with up-to-date and relevant information, the magazine contributes significantly to improving livestock productivity, health, and income generation in rural Bihar.

This initiative reflects a broader commitment to inclusive extension services and the use of regional languages as a medium to enhance outreach and impact across farming communities.

c) e-Kisan Samadhan

A digital initiative leveraging WhatsApp groups for quick advisory delivery, real-time interaction with farmers, and dissemination of weather, disease alerts.

e-Kisan Samadhan is a digital extension initiative launched by the

Directorate of Extension Education, Bihar Animal Sciences University (BASU), Patna, designed to provide real-time, science-based livestock advisory services to farmers through modern communication tools. The program primarily operates through **WhatsApp groups**, making it easily accessible even to farmers in remote and rural areas. It leverages **live interactive webinars**, expert-led audio-visual sessions, and regular **video uploads** on dedicated platforms to disseminate practical knowledge related to **animal health care, nutrition, breeding, disease prevention, and scientific livestock management**.

Through this initiative, farmers receive timely solutions to their field-level challenges directly from veterinary and animal husbandry experts. The platform also facilitates two-way communication, allowing farmers to ask questions, share field observations, and adopt improved practices based on expert feedback. By combining digital technology with expert outreach, **e-Kisan Samadhan** plays a vital role in **empowering livestock farmers and rural youth**, enhancing productivity, and promoting sustainable livestock-based livelihoods. It stands as a model for **inclusive, ICT-driven agricultural extension**, effectively bridging the gap between research institutions and grassroots communities.

d) BASU Krishi Gyan Vahan: A Mobile Knowledge Dissemination Initiative

Directorate of Extension Education (DEE), Bihar Animal Sciences University (BASU), Patna has started a unique initiative **"Krishi Gyan Vahan"**, under 4th Krishi Road Map, Govt. of Bihar, a mobile extension, and outreach service aimed at bridging the knowledge gap between researchers, extension personnel, and farmers across Bihar. This initiative plays a crucial role in technology dissemination, awareness creation, and capacity building among livestock and crop farmers, particularly in remote and underserved regions.

The **Krishi Gyan Vahan** is a well-equipped vehicle carrying:

- Audio-visual aids (TV, PA system, projector)
- Training materials, leaflets, and brochures
- Models and samples for demonstration
- Veterinary medicines and diagnostic kits

Teams comprising **BASU scientists**, **veterinary officers**, and **subject matter**

specialists (SMSs) from **KVKs** accompany the van during field visits. The Vahan follows a pre-determined schedule covering different blocks and panchayats, in collaboration with the **AFRD**, **KVKs and ATMA**, and other allied departments.

e) Village Adoption Program

Adopted Dariyapur Village of Naubatpur block Patna under a participatory rural extension model focused on dairy and poultry development, with the objective of transforming it into a model village. The initiative aimed at holistic livestock development, creating a cascading impact in nearby areas by enhancing income levels and generating employment opportunities.

Farmer FIRST Project BASU

Farmer FIRST Project BASU Strengthens Rural Livelihoods Through Integrated Crop-Livestock Development Approach. The **Farmer FIRST Project**, operating under the **Directorate of Extension Education, Bihar Animal Sciences University (BASU), Patna**, is making significant strides in enhancing rural livelihood security through an integrated crop-livestock development approach. As part of the ongoing outreach, two villages—**Sidhauli and Senduari in Hajipur Block, Vaishali Distric**t have been adopted under the project.

Conclusion:

The extension services of Bihar Animal Sciences University (BASU) play a pivotal role in strengthening the livestock sector across the state. By integrating scientific research with field-level outreach, BASU ensures that modern and practical knowledge reaches livestock farmers in an accessible and farmer-friendly manner. Through its extensive network of veterinary colleges, clinical complexes, training centres, and collaborative programs, BASU equips farmers with improved skills, updated technologies, and reliable advisory support. These efforts not only enhance livestock health and productivity but also promote sustainable livelihoods, rural entrepreneurship, and economic growth in Bihar. Ultimately, BASU's extension initiatives bridge the gap between innovation and practice, empowering livestock farmers to adopt better management strategies and secure a more prosperous future.

Routine Scientific Goat Farm Management Practices

R. K. Nirala
Department of Livestock Production Management
Bihar Veterinary College,
Bihar Animal Sciences University Patna-14

Goat is good converter of herbs, shrubs, trees, thorny grasses, garbages, and farm with kitchen wastes. It is a vertical browser and five star animals with an excellent biological converter of unused products of human into milk, meat, hides, fibers and manures. It play a vital role in the economy, nutrition, livelihood, and sustainability of farming systems, especially in developing countries. Goats are important because they offer economic returns & livelihood support, nutritious milk and meat, adaptability to tough climates, high reproductive efficiency, low input requirements and contribution to sustainable farming systems. It is fastidious in food habit, mobile upper lips helps to graze wide varieties of herbs, shrubs and grasses. It has very good feed conversion efficiency about 48% feed is converted into their metabolic activities in comparison to 35% of cows. It takes dry matter even 11% of their body weight however, cattle takes 2.5% of their body weight. Goat is poor's man cow, because of well adaptation and good yield in low inputs. It is a poor man's cow. Goat utility comprises hair, Meat and Dairy products. Its hair is used for rope making, skins are in great demand for leather for gloves & shoes, mohair from Angora goats and Pashmina from Kashmiri goats are greatly prized for the manufacture of high-class dress fabrics shawls. The intestines of goats & sheep are used to make "Catgut“. Goat milk naturally has small, fine (2 micron) fat globules, well-emulsified, which means the cream remains suspended in the milk, instead of rising to the top, as in raw cow milk; therefore, it does not need to be homogenized that contains essential amino acids and digestibility coefficient of protein of goat is 85%. It Has 9 minerals more in number than any other milk and biological value of goat milk protein is about 67.5%. It is rich in natural antibiotics because it graze and browse wide range of vegetation's, not horizontally, but vertically hence have immense therapeutic value for people suffering from dyspepsia, Dengue, pyloric stenosis, peptic ulcers, liver dysfunction, Jaundice, Insomnia, Biliary disorders and ultimately enhances

immunity. The importance of goat can be understood under the following headings:
The goat keeping has following advantages:

1. Financial investment is small. Goat gives more production per capital investment. The money required to purchase a doe is relatively small. A good doe is expected to milk for six to ten years. At the end of this she may be sold for full salvage value.
2. The building and equipment needs are less. The goat is small animal and can be housed in an inexpensive house, hut or verandah. In our country, the goat requires shelter from rain and hot sun. A wooden box or an old bucket can be used as manger.
3. Returns start earlier. Markets for goat meat are well established and no religious taboo. A doeling can be bred at the age of 12 months, i.e. when it weighs 35 kgs. The income from milk starts at about 16 to 18 months.
4. Goats are prolific. Exotic goats are fairly prolific. Twins are common on an average an exotic doe produces 1.6 to 2.0 kids. The tropical goats like those of India produce triplets and quadruplets. The sexes are equally distributed.
5. Goats require less feed. A doe will consume about one-fifth as much feed as a cow. In case of buffalo, it may be one-sixth to one-eight.
6. Goat milk is easily digested. Compared to the milk of other animals, goats milk approaches nearest to human milk in fat and protein. The fat globules of goat's milk are small and it makes soft curd which is easily digested. The milk is recommended for infants, invalids and convalescents. Especially given to T. B. patients. Its milk being alkaline has medicinal value and recommended for patients suffering from pyloric stenosis, alyspepsia, Peptic ulcers, allergic eczema and infertile diarrhea. Its milk is also preferred in liver dysfunction, jaundice, biliary disorders, acidosis or insomnia.
7. Goats help in solving unemployment. The village women and children can easily manage goats, which are docile by nature. So the family members who are not employed can earn by goat keeping.
8. Goat provides stable income. Goat provides a daily stable income, which is useful for the family.
9. Goat manure increases crops. IT also contributes 85 thousand MT manure

per year, which is rich in N & P than cow. Goat manure maintains and builds up soil fertility. Goat manure is turned back to soil, as it is never used for fuel.

10. No prejudices against slaughter. In India, there are no prejudice against goat slaughter. As such, males and uneconomic females can be easily disposed off. Moreover, there are usually no intermediaries for marketing. Hence, better price is realized.

11. The pashmina production ranges from 100 to 450 gm / goat. IT is sold between 180 to 500 dollars / kg. Kashemere carpets are magnificant and may cost 3000 dollars / sq. meter. The annnual production of pashmina is more than 80 MT.

12. Goat is more tolerant to hot climate than other farm animals.

13. They have got increased digestibility of crude fibre with poor quality roughages.

14. Hairs of goats are used for rugs, rope, and hide for leather products.

15. Goats forms an excellant experimental animals for physiological and biochemical research. FAO, 1997

Disadvantages of goat production :

1. Goats destroy plant life. Goat is a browsing animal. As such it nibbles or eats tender leaves of shrubs trees and grassland. When not confined, goats destroy forest. Stall feeding is recommended.

2. Palatability of goats milk. Goat's milk may have peculiar flavour - goatee odour - which is not liked by people. The buck is chief responsible agent for this odour. This is avoided by keeping buck for away from milking barn and maintaining hygienic conditions during milking. The milk should be removed to a cool room immediately after milking.

3. Labour requirement is more. Dairying is a full time job. It require more labour to manage, feed and milk does as five does are equal to one cow. Small quantities of milk are to be marketed. (Labour may not be a problem in India).

4. Milk customers are temporary. The consumers of goat milk may purchase it for short time. The demand may be temporary. Mostly cow's milk is consumed on medical advice and customer may not purchase as soon as recovers from the ailments. The goat milk producer has to search customers every now and then.


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Importance of goats

✅ **1. Economic Importance**

- Goats require **low initial investment** and generate **quick returns**, making them ideal for small and marginal farmers.
- Income from sale of **milk, meat, kids, manure, skin**, and breeding stock.
- High demand for goat meat (**chevon**) ensures stable market prices.
- Goat farming supports **rural employment** and livelihood security.

✅ **2. Nutritional Importance**

- Goat milk is highly nutritious, rich in **calcium, protein, vitamins (A, B, D)**, and minerals.
- Easier to digest and suitable for people with **cow milk intolerance**.
- Goat meat is lean, high-protein, and low in cholesterol—considered a **healthy red meat**.

✅ **3. Livelihood Security for Poor Farmers**

- Goats act as a **"poor man's cow"**, providing continuous income even in drought and hardship.
- Ideal for **landless, marginal, and women farmers** due to easy handling.
- A reliable source of **financial resilience** in difficult times.

✅ **4. Adaptability & Climate Resilience**

- Goats survive well in **harsh climates**—drought, heat, hills, semi-arid regions.
- Can consume **low-quality forage**, shrubs, and tree leaves.
- More **disease resistant** than large livestock.

✅ **5. Role in Farming System**

- Goats help in **weed control** and bush management during grazing.
- Goat manure is excellent organic fertilizer: rich in **nitrogen, phosphorus, potassium**.
- They help in **crop-livestock integration**, improving farm sustainability.

✅ **6. Reproductive Efficiency**

- Short gestation period (150 days)
- Possibility of **twins or triplets**, increasing herd size quickly
- Early maturity and faster turnover make goat farming highly profitable.

☑ 7. Cultural & Social Importance

- Goats have cultural significance in festivals and traditional ceremonies.

The scientific management is an act of regulating and supervising or directing of an enterprise/business by an effective utilization and coordination of resources such as capital, plant, materials, and labor to achieve defined objectives with maximum efficiency.

Management

The management of goat mainly comprises-Feeding, Breeding, Heeding, Housing, protecting kids and health management.

1. Housing Management

- Provide well-ventilated, dry, and raised housing to avoid dampness and diseases.
- Maintain 1.2–1.5 sq. m space per adult goat.
- Use slatted floors or raised bamboo floors to reduce parasite load.
- Ensure proper drainage and sunlight exposure.
- Separate housing for kids, does, bucks, pregnant and sick animals.

2. Feeding & Nutrition

Balanced Diet

- Offer a diet containing green fodder (60%), dry fodder (20%), concentrates (20%).
- Provide good quality leguminous fodder (berseem, Lucerne, cowpea).
- Allow daily browsing/grazing for 4–5 hours if possible.

Minerals & Supplements

- Provide mineral mixture (10–15 g per goat/day).
- Add common salt (5 g/day).
- Ensure continuous clean drinking water.

Special Feeding

- Pregnant does: extra concentrates 200–300 g/day.
- Lactating does: extra 300–500 g/day.
- Kids: creep feed from 15 days of age.

REQUIRMENTS……

Animal	Protein	Energy
• Bucks	11% CP	60% TDN
• Dry doe	10% CP	55% TDN
• Late gestation	11% CP	60% TDN
• Lactation (avg. milk)	11% CP	60% TDN
• Lactation (high milk)	14% CP	65% TDN
• Kid	14% CP	68% TDN
• Yearlings	12% CP	65% TDN

3. Breeding Management

- Follow scientific breeding plan:
  - Breeding age:
    - Does: 12–15 months
    - Bucks: 10–12 months
  - Breeding season: avoid peak summer for better conception.
- Maintain 1 buck for 20–25 does.
- Practice record keeping for heat symptoms, pregnancy, and kidding.
- Avoid inbreeding.

4. Health & Disease Management

Regular Vaccination

- **PPR:** at 3 months; booster yearly
- **Enterotoxaemia (ET):** at 3 months; booster annually
- **Goatpox:** at 3 months; booster every 2–3 years
- **FMD:** twice yearly
- **HS (Haemorrhagic Septicaemia):** once yearly

Deworming

- Deworm **every 3–4 months** depending on season.

- Rotate dewormers to prevent resistance.
- Do **faecal examination** periodically.

Routine Check-Ups:-

- Weekly body inspection (coat, hooves, injuries).
- Hoof trimming every 3–4 months.
- Quarantine new or sick animals for **14 days**.

5. Kid Management:-

- Ensure **colostrum feeding within 1 hour** of birth.
- Maintain warm, clean bedding for kids.
- Navel dipping with tincture iodine.
- Vaccinate kids as per schedule.
- Weaning age: **3 months**.
- Take care of new born kids by providing guard rails.
- Treat / disinfect the naval cord with tincture of iodine as soon as it is cut with a sharp knife.
- Protect the kids from extreme weather conditions, particularly during the first two months.
- Dehorn the kids during first two weeks of age
- Male kids should be castrated for better quality meat production.
- Vaccinate the kids as per the recommended schedule
- Wean the kids at the age of 8 weeks.
- Proper selection of kids on the basis of initial body weight and weaning weight should be initiated by maintaining appropriate records for replacing the culled adult stock as breeders.
- Additional feed requirements of lactating does must be ensured for proper nursing of all the piglets born.

CARE AND MANAGEMENT OF KIDS

Rearing of kids :

1. Cleaning of Mucus : The mucus from the nostrils and body of kids be cleaned by means of a soft cloth just after kidding.

2. Colostrum feeding within an hour of birth is essential.

The kids are usually hand reared when the goat is to supply the family milk. Kids may be allowed with their dam until they are four days old and then should be removed from her sight and sound. The kids must be fed the recommended amount of milk three to four times a day up to 2-3 weeks of age. The milk should be warmed 95 F to 100 F. The kids take 1 ½ to 2 pints of milk per day @ of $1/5^{th}$ to $1/10^{th}$ of their body weight. They may be fed cow milk if goat milk is not available. Milk substitutes can be used after 8-10 days of their birth when kids start consuming relatively large portions of the meals. Milk feeding can be reduced to twice a day and green hay may be offered. Milk can be discontinued at 3 to 4 months of age. The males should be separated at this age and castrated.

3. **Disbudding / Dehorning :**

Removing the horn buds from kids is a common practice and should be done when the kid is 2 to 5 days old. First, hair from the area of the horn buds are clipped and surrounding area is covered with petroleum jelly to protect it from caustic soda or potash, that is thoroughly rubbed on the bud until the horn button is well blistered.

Mature goats may be dehorned by sawing the horns close to the head with a meat saw. This should be done during cool weather and wounds should be coated with pine tar or other disinfectant repellent.

The other methods are :

1. Dehorning iron method by hot red iron.
2. Dehorning colloidin method : dehorning outfit with colloidin.
3. Electric dehorner.
4. **Removal of off-flavour producing gland :**

Usually male goats emit a smell which develops in them at puberty and normally remains with the animal for life. It is more strong in breeding season. It is reduced, if the animal is castrated at an early age. It is thought to be originating from fatty glands (musk gland) which enlarge during the breeding season., This smell may be accentuated by the males 'objectionable' habits of frequently spraying urine and sperm over the head, chest and forelegs. These 'musk gland' situated immediately behind and towards the inside of the horns of corresponding bumps on a hornless goat, can be destroyed at birth by applying red hot iron at the time of disbudding.

Subsequently, only little smell develops.

5. **Tattooing :**

The number is tattooed on ears of kids and later on the inside of the skin flap of goat tail. Branding on thigh, and ear or neck tags may also be used depending on the convenience or the management.

6. **Hoof trimming :** Goats seldom get sufficient exercise on hard surfaces to keep down the horny growth covering the sides of the hooves. A sharp knife is the best to cut these in a month. The heel may also need trimming.

7. **Grooming :**

Grooming is done with stiff dandy brush and a fine toothed steel comb. This helps to eliminate the scrub which is often prevalent when the old coat is being shed in the spring. In winter and autumn wash-leather rubbing is better as extensive grooming removes the developing woolly under-coat.

8. **Castration of male kids :**

At the age of about 2 to 4 weeks, male kids are castrated by close method.

Purpose of castration :

1. Prevents indiscriminate breeding
2. Makes kid more docile
3. Male kids can be raised together with female kids
4. Produces more desirable edible chevon
5. Rapid gain in weight
6. Makes skin of superior quality
7. Profit / goat is more.

9. **Deworming of kids :**

Age	Drug	Dose
10 days	Binminth	Half tablet
1 Month	Piperazine	5 gm in two day
1.5 Month	Bnminth	1 tablet
2 month	Phenovis	5 g in two days

Feeding growing kids :

From 3 months onwards, kids be fed leguminous roughages to supply enough nutrients for their normal growth. Low quality roughages should be supplemented

with concentrate mixture of 12 to 14 % DCP and 62 to 65 % TDN and fed @ 350 to 400 g daily. Over feeding to fatten should be avoided. Growing kids should be given following concentrate mix :

Maize	-	20 parts
Gram	-	32 parts
Wheat bran	-	30 parts
Ground nut cake	-	15 parts
Mineral mix	-	2.5 parts
Common salt	-	0.5 parts

6. Record Keeping: Scientific records help in selecting high-performance animals. Maintain records for:

- Breeding
- Kidding
- Health & vaccination
- Growth weight
- Feed consumption
- Mortality and sales

.7. Biosecurity Practices

- Restrict farm visitors.
- Footbath at entry point.
- Clean feeders and waterers daily.
- Dispose of dead animals scientifically.
- Maintain proper hygiene and waste management.

8. Marketing & Financial Management

- Sell goats at **optimal body weight and market demand** periods.
- Maintain cost and profit analysis.
- Build tie-ups with traders and local markets.

Goat classified based on utility like meat, milk and fibers.

Management of buck :

The buck must be kept away from the others. It should be given enough of exercise to kept the animal in active condition. Regular grooming must be carried. The buck

usually consume more feed than a doe. Balanced concentrate and good fodder should be provided. During breeding season, it is necessary to feed more concentrate.

FEEDS AND FEEDING OF GOATS :

Goat is a ruminant, but its feeding is quite dissimilar from sheep and cows. For its size, a goat can consume substantially more than either cow or sheep, can viz. 6.5 to 11.0 per cent of her body weight in dry matter compared to 2.5 to 3.0 percent in case of cattle and sheep. This means that goats can satisfy their maintenance and production requirement on good fodder and pasture. It is interesting to note that each 100 kg body weight goat require 1.5 times as much feed per day for maintenance as a 100 kg cow. For every 140 pounds (63.5 kg) of common concentrate mixture a goat produced 2 gallon (9.1 litres) more milk than a cow. The goat, should not be fed more than 50 per cent of dry matter as concentrate. The remainder of the ration should be roughages supplied as hay, silage, or roots. Good quality Lucerne (*alfa-alfa*) or berseem hay is more desirable for milking animals.

Certain aspects of Breeding, Feeding and Selection of bucks, Care of repeat breeder and pregnancy diagnosis :

- ✓ **Breeding :**
- ✓ Check the tattoo or tag number of the individual animal to facilitate better recording.
- ✓ Provide best grazing facilities to the breeding stock.
- ✓ Improve the physical condition of the flock (flushing) at least 4 weeks before tupping. It will increase the chances of implantation / conception.
- ✓ Remove the hair around the vulva for easy mating
- ✓ Check the breeding records before starting the mating.
- ✓ Extra growth of hooves to be trimmed.
- ✓ Selection of foundation stock is very important.
- ✓ Cull out uneconomical.
- ✓ If horned bucks insist on spending their energy in fighting discourage them by rubbing a little kerosene or other foul smelling agent along the nose, head and back.
- ✓ Observe heat detection. Properly by use of teaser / apronised or vasectomised

buck

- ✓ Age at puberty is 7 months to 1 year.
- ✓ Save the buck from summer sterility.
- ✓ Daily exercise is must essential for the breeding buck.
- ✓ Buck may be used for mating when attains maturity at about 15 months age.
- ✓ Use always a pure bred buck on the farm.
- ✓ Best time for breeding Indian goat is May - June. So that goats will kid during October - November.
- ✓ Bucks of 18 to 24 months age may be used to serve 25 - 30 does / breeding season. When attains full maturity at 2 or 2 ½ years of age may be allowed to serve 50 - 60 does / breeding season.
- ✓ Doeling will kid for the first time at the age of 17 to 18 months.
- ✓ Buck should not allowed to serve a doe more than once at a time.
- ✓ Duration of oestrous and oestrous cycle is 36 hrs and 19 days.
- ✓ The gestation period is of 145 - 150 days.
- ✓ Signs of heat are Swelling & redness of genital opening, shaking tail, restless, loss of appetite, bleat.
- ✓ August - November is the best time for kidding.
- ✓ The average life span of goat is 12 years.
- ✓ Buck should not be housed with does.
- ✓ Bringing the teaser buck near the females for a short time every morning is generally helpful in picking up the doe in heat / silent heat / shy breeders.
- ✓ In exotic goats the breeding season is from September - February.

Signs of heat :

1. A doe in heat becomes uneasy and shakes its tail frequently.
2. A doe in heat seeks the company of the buck.
3. Little mucous may also flow from it's vagina.
4. A doe in heat urinates frequently and bleats restlessly.

Care of repeat breeder :

- ✓ Change the buck and observe the number of non return.
- ✓ Examine the semen and genital organs and check the quality.

- ✓ Give high phosphate cereals like wheat bran, iodized salt in drinking water.
- ✓ Add vitamin supplement like Rovimix in concentrate mixture.
- ✓ Examine blood glucose level of repeat breeders.
- ✓ Continue the treatment of antibiotics for 3 day

Pregnancy diagnosis :

1. Cessation of heat.
2. Ballooning of belly from three months onward.
3. Docile in behaviour.
4. Enlargement of abdomen.
5. Chemical test : 5 ml urine sample + 5 ml Barium chloride solution (1 %) taken which shows turbidity due to precipitation noted, it means pregnant. Clear solution indicates non pregnant.

Kidding:

1. First sign of kidding is uneasiness, including restlessness, sitting down and getting up and smelling the ground. When this happens, kidding can be expected to occur within 1 - 2 hours.
2. Appearance of the water bag.
3. Onset of contraction.
4. Appearance of part of the kid.

Marketing :-

The marketing of goats and goat products in the Topics is very variable, and depends on location and prevailing production conditions. Primitive production trends tend to be associated with primitive marketing conditions. Whereas, a highly organized goat enterprise will have regular marketing channels and markets which will help recover the production investment. Additionally, these aspects are complicated in the Tropics by the presence of middle men or dealers.

Recent Advances in Goat and Sheep Managemental Practices in Bihar

D. N. Singh, Ranjana Sinha, Suchit Kumar, Manmohan Kumar and Dushyant Yadav
Department of Livestock Farm Complex, Bihar Veterinary College,
Bihar Animal Sciences University (BASU), Patna-14

The livestock sector has a significant potential for round the year employment generation particularly in rural areas. This provides subsidiary source of livelihood to the people living below the poverty line due to lack of sufficient agricultural land to sustain, particularly in the draught prone, hilly, tribal and other remote areas where crop production on its own may not be capable of engaging them fully.

Goat and Sheep play an important role in Indian economy and are a source of livelihood and employment to millions of rural households. It contributes around 8.5% to the total value of output from livestock sector at current prices. At the national level, small ruminants account for 14% of the meat output, 4% of the milk output and 15% of hides and skin production in the country. But it receives only about 2.5% of the public spending on livestock sector, which is much less than the share of small ruminants in the value of output of the livestock sector. Sheep and goats in India are predominantly maintained on natural vegetation on common grazing lands, wastelands and uncultivated (fallow) lands, stubbles of cultivated crops and top feeds. Small ruminant production is important due to the fact that sheep and goats are easily managed, require a relatively small initial investment and their short generation interval lends itself to a fast return on investment.

Status of Goat and Sheep population in Bihar

Being the 5th largest goat population state, Bihar contributes about 7.63% of India's total goat population. The state is also a habitat of 42.6% people below poverty line and hence there is a tremendous scope of goat farming to meet up the large gap between demand and supply of meat. In context of Bihar, goat herd size is generally 1-3 goats per family depending on availability of surplus labour in the family. Village goats are mostly non-descript Black Bengal breed type. However, crosses with other breeds like Jamunapari, Barbari, Sirohi and Jakharana are also available. The state occupies a vast area under rainfed system with regular

occurrence of either flood or draught. Hence, there is tremendous scope of goat farming that can meet up the large gap between demand and supply of meat in the state. The advantages of goat rearing are: The initial investment needed for sheep & goat rearing is low. Due to small body size and docile nature, housing requirements and management problems with sheep & goats are less. The adoption of good management practices of sheep & goat rearing along with value chain development can transform small goat rearers / village women into established micro-entrepreneurs and accelerate development of the weaker sections.

Bihar has been divided into two halves by the river Ganges namely North and south Bihar. On the basis of agro-ecosystem and crop production system, the state can be divided into two parts i.e. Irrigated and Rain-fed agro-ecosystem. According to criteria, the districts of Araria, Bhagalpur, Darbhanga, East Champaran, Jamui, Katihar, Kishanganj, Madhubani, Muzaffarpur, Purnia, Saharsha, Samastipur, Seohar, Sitamarhi, Supaul, Vaishali and West Champaran may be classified under rainfed agro-ecosystem as less than 40% of area of these districts are covered by irrigation.

Table 1. Goat production as per agro-ecosystem in Bihar (DAHD, Bihar).

Parameters	**Irrigated agro-ecosystem**	**Rain-fed agro-ecosystem**
Geographical Area, %	50.61	49.39
Production system	Rice-wheat based	Rice based
Goat population, %	40.22	59.78
Density of goat population	80.10	121.98

Shahabadi sheep is only recognised breed of sheep of Bihar among 46 recognized breeds of India. Shahabadi animals are being maintained by the farmers in villages purely for mutton production. Shahabadi sheep is found in Shahabad region particularly Patna, Gaya, Ara, Rohtas, Kaimur, Buxar region of Bihar. These are medium sized and leggy animals. The fleece colour is mostly grey, sometimes with black spots. Tail is extremely long and thin. Both sexes are polled. Fleece is coarse hairy and open. Legs and belly are devoid of wool. Total Sheep Population in Bihar is about 2,13,377 including exotic/crossbred and indigenous Shahabadi Sheep population is about 71,278 (approx.).

Advances in Management of Sheep & Goat

Livestock management, as a science, has far less recognition than the other disciplines of animal production. While the importance of skills related to the successful sheep & goat husbandry is often enunciated by the specialists, the farmers are inclined heavily on the wisdom gained over generations as a family trade. The worth of rich experience in the management of flocks is seldom transcended by any mode of learning; yet the managers miserably wane in the documentation of their experiences that might have been acquired progressively over the years.

The science and art of sheep & goat management, like any livestock management, incorporates the management of breeding behaviour and reproductivity, feed habits and feeding, disease surveillance and prevention, perinatal prudence of does and neo-natal kid care, besides management of personnel, shelter and other infrastructures at the farm complex.

A. System of Rearing:

i. Traditional system

Sheep & Goat raising is mainly in the hands of the weaker sections of the community which either do not possess land or their landholdings are so small that crop cultivation does not provide remunerative employment all the year round. Due to lack of education these sheep & goat owners are not able to appreciate and adopt improved goat husbandry practices brought to them by extension workers. Sheep & Goat management has thus remained in a neglected state. Migration and grazing practices have an impact on the present status of goat husbandry in the country.

ii. Extensive system

This is the cheapest system of rearing and practiced over all parts of India where grazing land is available. This is also practiced by nomadic tribes who move for pasture to pasture along with the season with their herds. The nomads keep watch dogs with their herds to protect them and to prevent them trespassing in unwanted areas. Advantages of this system are that it is cheap and provides the production and disposal process simultaneously. The disadvantages are mainly that the animals raised on the system are poor producers besides having poor genetic capabilities, and are exposed to continuous stress.

iii. Semi intensive system

This system is widely practiced by small and marginal farmers and village poor. The nature and extent of this system depends on the type of crops grown and their suitability to sheep & goats. Goats are left to graze/browse on the crop residue when the same has been harvested, this will be further utilized by sheep. The advantages of this system are increased fertility of the land by droppings and urine of these animals, control of wasteful habits, good growth rate, easier management and possible increased crop yields.

A modified form of this system is tethering, where the animal is held by a rope about 2-3 meters long, and other end being tied to a tree or post. The animal grazes and browses in the area accessible through the length of the rope. This system is popular with farmers who keep only a few goats. It permits utilization of grass, fodder and bushes in a limited area and keeps a control on the animal and saves labour.

iv. Intensive system It is characterized by high input and high output and usually practiced for high potential animals. It is associated with high investment on housing, veterinary care, housing, feed resources, labour and other infrastructure etc. It involves cultivation of fodder with zero grazing, usually low forage and high plane of concentrate diet. This system is very less practiced in India and mostly undertaken at institutional flocks and few commercial sheep and goat farmers. In semi intensive and intensive production system the selection of ram or buck can be done on the basis of their pedigree family if proper record is available or on the basis of phenotypic performance. Selective breeding plan should be conducted to take good results for improvement of breed. Breeding buck or ram should be replaced from the flock in every year to avoid adverse effect of inbreeding.

Management Strategies for Goat & Sheep

1. Feeding management

A dairy goat may be considered a miniature cow, so the feeding of a doe is similar to feeding a cow. Feeds suitable for one are suitable for the other. It has been

estimated that a goat will consume 1/5th to 1/8th as much feed as a large cow. To be conservative it is usually claimed that they consume 1/5th as much feed. To get high production from a goat it is important that she be fed a good ration, much better than the buffalo or cow receives in most instances in the Indian village. Similarly, the lactating ewe will have required proper feeding with balanced nutrients. Repeatedly it has been stressed that well-cured legume hay such as lucerne or berseem are the best and cheapest sources of nutrition for sheep & goat. Cut the grass while it is in the early bloom stage and cure it during sunny weather because rain-soaked hay loses considerable food value.

The bucks/Rams should have the same feed as the does but they consume more forage because they are larger. During the mating season, it is necessary to feed more concentrate. An exercise pen is important for a buck because he must have exercise. This helps to keep him in good physical condition for breeding.

For sheep & goat we should adopt four grazing and feeding systems for proper growth and production.

a. Rotational Grazing

b. Silvipasture Grazing

c. Supplementary Feeding

d. Fattening of kids

2. Breeding Management

Sheep and Goats are bred either by natural mating or through artificial breeding. Rams/Bucks of the indigenous breeds donate good quality semen under proper management conditions throughout the year. However, the bucks of temperate breeds if not protected from high temperature, high humidity and high solar radiation will not produce good quality semen during hot dry and hot humid seasons. Females of tropical breeds cycle throughout the year. Temperate breeds which are affected by hours of day light and breed with declining day length. They come in heat in autumn from August to November, although some may breed up to February.

a. Natural Breeding (Individual, Pen and Flock Mating)

b. Artificial Insemination Method

c. ETT-IVF method

Heat detection methods

Visual signs of approaching estrous are, a swelling and redness of the vulva and restlessness or nervousness indicating a desire for company, but the most obvious sign is ridding and in turn being ridden. The breeding occurs only during estrous although the buck is capable of breeding at any time.

3. Health management

Good health management is to ensure timely vaccination according to schedule to all members of the flock. Routine dipping will indeed render the flock free of ectoparasites. The administration of anthelmintic drugs before and after monsoon is always advisable. Trimming of hoofs are absolutely essential for those goats which do not undertake long walking/grazing on the hard and rocky terrains. Even with the best health care and management, a few animals in the flock may develop illness at any time and a good manager will not fail to detect the unhealthy behaviour of these animals. Isolation of these animals in the sick shed and prompt treatment by a competent veterinarian is obligatory. Routine testing of the flock for Brucellosis and Johne's disease should under no circumstances be deferred to as precipitation of these diseases in the flock will be highly derrogatory in future. Vaccination of pregnant ewes & does against FMD and colibacillosis and antibiotic administration to control insidious mycoplasmal infection should receive imminent priority. The kids are highly susceptible to PPR, enterotoxaemia, FMD, colibacillosis and coccidiosis for which preventive vaccination and administration of drugs are necessary.

4. Housing Management

There are no serious problems as far as housing of sheep &goats is concerned. It is to provide dry, comfortable, safe and secure place free from worms and against extreme heat and on weather. Dairy goats and Sheep do not require very costly housing, however, for more economic returns, proper housing system will be required. They require very little extra investments for housing and equipment. A separate building can be constructed at low cost out of bricks and thatched root. A room of size 3 x 1.5 meters is quite sufficient for a doe/ewe, but some space of daily exercise is also needed. Hence a coral adjoining the goat house is sufficient to a allow daily exercise.

They are usually kept in Katcha' thatched sheds with an open enclosure of thorny bushes. However, they need to be protected against inclement weather, wild animals and predators. Sheep & goats are generally susceptible to cold and need to be kept in a comparable and warm place especially during winter months. The shed should have proper drainage. Lambs & kids should be housed in a warm place and buck should be kept away from lactating ewe & goats.

i. Orientation of Sheds

Sheds with long axis running East-West provide a cooler environment underneath than the one with a North-South orientation. The latter, however, keeps the shed dry and promotes sanitation (because of the sun rays falling inside for a longer period) though this orientation may impose a greater stress on animals, if left underneath during the daytime in hot-arid climate. A North-East to South-West orientation of the shed is expected to provide the maximum benefit from the morning sun and the cooler microenvironment within tile sheds in the hot-arid environment. Like the latter orientation, East to West and North-West to South-East oriented sheds provide more opportunity for radiation exchange with cooler North sky at night. One slope of the roof is shaded by the roof line of 'A' shaped sheds in such orientations for a greater part of the day, resulting in lower floor temperature. Thus these orientations favour heat loss from animal body to environment both by radiation and conduction. Paddocks on North side of the shed in hot regions and on South side in temperate climates are recommended for better comfort.

ii. Ventilation

The efficiency of ventilation is greatly affected by the summer and winter directions of the prevailing wind at any place. The air in-lets should, therefore, be provided at the height of the sheep & goat breeds to prevent the drought. An attempt to cover sheds from all sides to protect the animals from low air temperatures may result in an increase of humidity up to 90% and ammonia concentration to 20 p.p.m. Good ventilation in the sheds is very important in hot-dry and warm-humid climate to promote the heat loss from animals with increased convection and radiation.

iii. Roofing Material

Roofing material in the goat shed is an important factor which determines the cost of construction and micro-environment within the shed. A wide range of roofing materials is available in different climates which differ to a great extent in their thermal characteristics. The worth of over 50 materials were tested for use as roofing material in California, ranging from hay or straw, galvanized steel and plywood to several types of plastics. On a summer day, the difference in the radiant heat load, under sheds covered with strawversus galvanized iron or plastics, was of the order of 163 Kcal/ h/m2 of the animals surface. Different roofing materials commonly used in India were tested and they can be graded as, the most to least effective in that order, improved thatch, thatch, asbestos, liter roof with top surface painted white and non-painted liter roof.

iv. Height and shape of roof

The height at centre in _A' shaped roof is suggested to vary between 3 to 3.5 m. A height of less than 3 m interferes with the proper ventilation resulting in reduced convective heat loss from animals. In temperate and hot-humid climate, where more height does not provide any additional benefit, a height of 3 m is expected to suffice. The heat loss through radiation from goats to cool sky is curtailed in low roof sheds. The shadow size is not affected by height, since higher the shed the faster the shadow moves. In hot-dry environment, radiant heat load plays a vital role. Within the boundaries of the shed, the radiant load on goats comes from the atmosphere, the roof, the shaded ground and sunny ground. The heat load on goats will be minimum within the shed when the distance from the roof is maximum.

Double roof with both roofs of some or different materials are effective in reducing the heating of shed in hot weather conditions. The additional cost of construction in double roof, however, restricts its use to very high producing animals.

v. Floor type and space

The surface upon which an animal lies may potentially be a source of thermal and physical discomfort, injury and infectious diseases. Deep, clean, dry straw can

provide an ideal bed for weaners and growers during the cool period, but a thin layer of straw is likely to be more suitable during warm or hot weather conditions. Perforated or slatted floors are mostly drier and more hygienic than solid floors with limited bedding and thus more suitable for humid and high rainfall areas. The type of floor which provides both comfort and cleanliness with minimal risk of injury should be given preference.

vi. Shelter Surroundings

Surfaces around the shelter are very important in view of the radiation exchange between surrounding surface and the shelter. The temperature of different surfaces varies significantly at the same air temperature. It is well known that the green surface do not heat up as much as other surface like gravel or lose loam. It should be possible to maintain the green vegetation adjacent to the goat shelters except the paddock.

vii. Optimum floor space requirement

The floor space for different age groups should be slightly more in hot weather conditions in comparison to cool weather. This helps in radiant heat losses and convective removal of heat and water from the animal body. In tropical climates, huddling is disadvantageous for health of the animals and their productivity. The optimum floor space requirement to provide healthy and clean micro-environment have been recommended later on the basis of scattered information.

Floor space requirements for Sheep & Goat at their different stages of life

S.N.	Type of animals	Floor space requirement (m^2)
1.	Adult ewe/goats	1.25 to 1.5
2.	Lactating and pregnant ewe/does	2.0-2.25
3.	Rams/Bucks	2.0-2.25
4.	Lambs/kids	
a.	7 to 90 days	0.5 to 0.6
b.	3 to 6 months	0.7 to 0.9
c.	6 to 12 months	1.0-1.25

Primary Housing structure in Sheep & Goat

i. Lambing/Kidding Pens

Individual spacious pens are essential to house does in late pregnancy. Movable hurdles can also be used for preparing lambing/kidding pens. Individual lambing/kidding pens are contaminated very quickly, and need frequent cleaning and disinfection. Otherwise, they may constitute an important source of naval infection to lambs & kids.

Rearing of young kids needs special attention while planning housing and a fly proof shed for kids up to 3 months of age will prove worthy. The pens for kidding should be at the warmest part of the goat-house complex if the kidding is expected in cool weather. The protection of new-born kids from low ambient temperatures is essential to reduce the kid mortality.

ii. Ram/Buck housing

The ram & buck should be housed separately. A single stall measuring 2.5 m x 2.0 m with the usual fittings for feed and water could be quite suitable. Only one ram/buck should be kept separately to avoid fighting during breeding season.

iii. Housing for pregnant does and kids

A separate enclosure must be required for keeping pregnant ewes/does.

iv. Housing for adult sheep & goat

v. Quarantine/Segregation shed

A small Quarantine/segregation shed of 3.6 m x 5 m is essential when the herd size is large. It should be constructed in the farther corner of the farm and provided with a well fenced yard. It should be divided into 2 or 3 sections. Each stall and the yard should have a separate watering arrangement.

vi. Exercising yard for stall-fed goats

A yard measuring 12 m x 18 m is adequate for 100 to 125 sheep & goats. Such a yard should be well fenced with strong woven wires which should be quite close to bottom. The exercise paddock/yard should be made bigger than the enclosures and

should have same shade trees if the stock in to be maintained constantly in confinement.

Care and Management of Sheep & Goat

1. Kidding does/Lambing ewes

The doe/ewe should be put in the pen a few hours before parturition. She becomes fussy about 2 or 3 hours before actual kidding/lambing. The udder becomes engorged with milk, the belly appears shrunk and the flanks appear rather hollow. The tail head is raised higher than usual as the ligaments of either side relax. There is thick, white, starchy discharge which soon changes to a more opaque substance. The water-bag appears first. Soon afterwards, within 15 minutes, it breaks and the feet of the kid appear with the head resting on them Since the doe is fussier and noisier than any other domestic animal during kidding, it is not necessary to care for her unless she is obviously in trouble. In case of undue delay in the appearance of the kid/lamb after the bursting of the water-bag, the position of the kid/lamb may have to be adjusted. If twins or triplets are to be born there is usually a short period of rest between the appearance of kids.

2. Kids/lambs

The first few days of life of kids/lambs are rather vital in their management. With multiple births weaker kids/lambs often require special attention particularly at the time of suckling. It is a good practice to clean the udder with $KMnO_4$ solution each time, prior to suckling. Overfeeding and underfeeding are both deleterious to the health of the kid(s). It becomes essential to detect and isolate the kid/lambs suffering from diarrhea or other ailment and to place the cases under the attending veterinarian. Healthy kids/lambs become playful within 72 hours after birth and they require soft bedding and clean grassy paddocks. The kids/lambs are very susceptible to cold and special attention is required to monitor the shed temperature with simple Maximum–Minimum thermometer and to impose correction of ambient temperature to about $18^{\circ}C$ in winter.

Immediately after birth, the nose of the kid should be cleared of nay entangling membranes or mucus to prevent suffocation, and the navel swabbed with tincture of iodine. The lambs & kid, if healthy and strong, would stand on its legs and

make for its mother's teats. Failure to reach the teats, however, is of no consequence. The kid should be taken away from its mother in birth. Colostrum should be the first food to be given to kids; it clears the stomach and develops immunity in them. The lams/kids should be placed on either pan or bottle-feeding. Use of baby bottles and nipples or baby feeders that lessen air swallowing would be better. Nipples and bottles should be kept thoroughly cleaned. Pan-feeding is fast and efficient. Lukewarm milk (95°F/36°C) should be placed in a shallow pan and the lip of the kid slowly dipped into it. Bottle feeding may cause distension of the abdomen, and pan-feeding distension of the abdomen and scouring. During the first 2 or 3 weeks lambs/kids should be given 0.9 to 1 litre of milk 3 times a day.

3. Pregnant does

A temporary increase in milk yield after mating is considered to be an indication of pregnancy, but the first sign that a doe/ewe is in-kid/lamb is the cessation of the periodical return of oestrus. During pregnancy period we should provide additional pregnancy allowances to ewe/doe for proper growth & development of fetus in the womb. During advance stage of gestation, provide ample quantity of concentrates about not less than 400g per day for optimization of growth of fetus, colostrum/milk production as well as to reduce the embryonic or lambs/kids mortality.

4. Dry does

Extra care will be required for these animals, if these are pregnant. No extra care is required, if non-pregnant. Regular grazing for 8 to 10 hours on a good pasture is sufficient to maintain their weight/condition.

Flushing is conditioning of does/ewes for breeding. If the does/ewes are in low plane of nutrition prior to breeding, additional supplementation for about one month has beneficial effect in bringing the does into oestrus. Even without additional supplementation when there is lush green pasture, there is flushing effect. Supplementation of about 250-400g of concentrate could bring about flushing of does quite well. If the plane of nutrition of the animal is good prior to breeding, flushing is not at all required.

5. Weaning and Fattening stock

Complete separation of kids/lambs from their mothers is called weaning. The practices and problems of weaning and care of weaners vary from place to place. The management of weaners play an important part in good goat husbandry because these weaners will be the future breedable animals. The following steps will greatly help in proper care and management of weaners.

i. Weaning should preferably be done at 90 days.

ii. Avoid malnutrition, as it will result in stunted growth and susceptibility to worm infestation.

iii. Provide supplementary feeding and good clean pastures.

iv. Drench them regularly against various gastro-intestinal parasites as these are very prone to worm infestation.

v. Vaccinate them against enterotoxaemia, struck and black-quarter diseases.

vi. Do not graze weaners in burry and seedy type of pastures which may cause skin irritation to lambs, damage to wool and cause ophthalmic diseases.

vii. Provide them shelter against vagaries of climate and predation.

viii. They should have easy access to fresh and clean water and nutritious green pastures.

Post-weaning growth is primarily affected by hereditary factors, plane of nutrition, prevailing meteorological conditions, animal's ability to adapt to the environment and managemental stresses. In agriculturally advanced countries post-weaning phase of growth is mainly used for fattening and finishing purpose, whereas, in our intensive meat production strategies, the active growth is completed by 5 to 6 months of age depending on the weaning age of lambs/kids.

6. Teaser Bucks/Rams

The number of vasectomized bucks used is 1% of the original number of does/ewes *i.e.* for 5,000 does/ewes 50 teasers and even when there are only 1,000 does/ewes left in the flock, 50 teasers should still be used. All vasectomised bucks are tested for brucelosis.

7. Breeding Bucks/Rams

Buck kids and Ram lambs, unless from highly pedigreed does/ewes or from does/ewes with good performance records are rarely worth retaining. They should be castrated shortly after birth or within 2 weeks. Male goats are fertile when quite young and if left with young females are capable of breeding and causing early kidding. Goats for slaughter should be raised on milk for the first 6 weeks. They can be sold or slaughtered when 3 months old for meat, which is considered excellent.

The rams & buck, to be in good condition and well suited for breeding, should be kept on range, and made to cover 3 to 4 km each day. Rams/Bucks often become sluggish and slow breeders for lack of adequate exercise, because they are kept confined in small enclosures. For giving exercise, they may be yoked to small carriages used for hauling light loads. A ram/buck should be very active during the breeding season. The rams/buck's hooves should be regularly attended to as otherwise foot-rot or lameness may develop. Rams & Bucks should always be kept separate from the ewes/does. They become unduly restive or excited and waste more energy when kept with does.

Grazing schedule and supplementary feeding

Goats normally enjoy grazing and foraging to their choice, except in very intensive system of management, tight scheduling of time and grazing area is obligatory. Depending on the nutrient potential of the grazing area at a particular season, supplementary feeding with concentrate mixture, particularly to lactating/pregnant does and growing kids, are necessary. With extensive grazing in the good pasture and in migratory flocks, such supplementation may not be necessary though graziers prefer to carry ground seeds/cereals and salt for feeding in adversities. A good feeding management is rested on storage of feed and hay and the efficiency of management is soon reflected in the general health of the flock.

Conclusions

Recent advancements in goat and sheep management practices in Bihar indicate a major shift towards scientific, technology-based, and market-oriented livestock production. Improved breeding strategies—such as selective breeding of

Black Bengal goats and Shahabadi sheep, artificial insemination programmes, and the promotion of superior germplasm will be helping to enhance growth, productivity and reproductive efficiency. Modern feeding interventions, including balanced ration formulation, urea-treated straw, mineral mixture supplementation and community fodder banks, have contributed to better growth rates and reduced nutritional stress, especially during the dry season. Health management has also improved through routine vaccination drives, regular deworming, mobile veterinary services and digital disease-surveillance systems, resulting in lower mortality and better flock performance. Additionally, innovations such as low-cost housing, climate-resilient shelters, semi-intensive rearing systems and improved grazing management have further supported animal welfare and productivity.

Feeding Management of Goats

Dharmendra Kumar, Surabhi Kumari and Akriti Rani
Department of Animal Nutrition,
Bihar Veterinary College,
Bihar Animal Sciences University (BASU), Patna-14

Feeding different age groups of goats

A. Feeding does in different stages

1. Feeding of breeding does

- If the availability of pasture is good there is no need to supplement concentrate mixture.
- In poor grazing condition animals may be supplemented with concentrate mixture @150 – 350 g of concentrate / animal/day depending up on the age
- The digestible crude protein level of concentrate mixture used in the adult feed is 12 per cent.

2. Feeding does during the first four months of pregnancy:

- Pregnant animals should be allowed in good quality pasture 4-5 hours per day.
- Their ration must be supplemented with available green fodder at the rate of 5 kg per head per day.

3. Feeding does during the last one month of pregnancy:

- In this period fetal growth increases 60 – 80 per cent until parturition and lack of enough energy in the feed can cause pregnancy toxaemia in does. So during this period animals should be allowed in very good quality pasture 4-5 hours per day.
- In addition to grazing, animals should be fed with concentrate mixture @ 250 –350 g/animal/day.
- Their ration should be supplemented with available green fodder at the

rate of 7 kg per head per day.

4. Feeding does at kidding time

- As kidding time approaches or immediately after kidding the grain allowance should be reduced but good quality dry roughage is fed free choice.
- It is usually preferable to feed lightly on the day of parturition, but allow plenty of clean, cool water.
- Soon after kidding the doe must be given just enough of slightly warm water.
- After parturition the ration of the doe may be gradually increased so that she receives the full ration in divided doses six to seven times in a day.
- Bulky and laxative feedstuffs may be included in the ration during the first few days.
- A mixture of wheat bran and barely or oats or maize at 1: 1 proportion is excellent.

5. Feeding lactating does

The following rations may be recommended

- 6-8 hours grazing + 10 kg cultivated green fodder/day
- 6-8 hours grazing + 400 g of concentrate mixture/day
- 6-8 hours grazing + 800 g of good quality legume hay/day

Doe Body weight (kg)	Milk yield (Kg)	Concentrate (g/d)
20	0.5	300
	1	400
25	0.5	350
	1	450
30	0.5	400
	1	500
35	0.5	400
	1	550
40	0.5	450
	1	550
45	0.5	500
	1	550
50	0.5	500
	1	600

6. Feeding non pregnant does

- If the availability of pasture is good no need to supplement with concentrate mixture
- In poor grazing condition animals may be supplemented with 150 – 200 g of concentrate / animal/day.

B. Feeding bucks for breeding

- The common practice is allowing the bucks to graze with does.
- Under such conditions the bucks will get the same ration as the does
- Usually, it will meet the nutritional requirements of the buck.
- Where there are facilities for separate feeding of the buck, it may be given half a kilogram of a concentrate mixture consisting of three parts oats or barley, one part maize and one part wheat per day.

C. Feeding kids

1. Feeding from birth to three months of age

- Immediately after birth feed the young ones with colostrum.
- Up to 3 days of birth keep dam and young ones together for 2-3 days for frequent access of milk.
- After 3 days and up to weaning feed the kids with milk at 2 to 3 times a day.
- At about 2 weeks of age the young ones should be trained to eat green roughages.
- At one month of age the young ones should be provided with the concentrate mixture (Creep feed).

1.1 Colostrum feeding of kids

- The kid should be allowed to suck its dam for the first three or four days so that they can get good amount of colostrum.
- Colostrum feeding is a main factor in limiting kid losses.
- Cow colostrum is also efficient for kids.
- Colostrum is given at the rate of 100 ml per kg live weight.
- Colostrum can be preserved with 1-1.5% (vol/wt) propionic acid or 0.1% formaldehyde. Propionic acid is preferred for preservation as it keeps the pH value low.

- The chemically treated colostrum is kept at cool place to ensure better quality.

1.2 Creep feeding for kids

- This creep feed may be started from one month of age and up to 2-3 months of age
- The main purpose of creep feeding is to give more nutrients for their rapid growth.
- The general quantity to be given to the kids is 50 – 100 gm/animal/day.
- This should contain 22 per cent protein.
- Antibiotics like oxytetracycline or chlortetracycline may be mixed at the rate of 15 to 25 mg/kg of feed.

1.3 Composition of ideal creep feed

- Maize - 40%
- Ground nut cake -30 %
- Wheat bran – 10 %
- Deoiled rice bran- 13 %
- Molasses – 5%
- Mineral mixture- 2%
- Salt – 1% fortified with vitamins A, B2 and D3 and antibiotic feed supplements.

Sl. No.	Ingredients	Quantity Kg (%)	Available CP (%)	Available TDN (%)
1	Maize crushed	37	2.96	28
2	GNC	35	15.75	25
3	WB	13	1.56	9.9
4	DORB	12	1.92	6.5
5	Mineral	2	-	-
6	Salt	1	-	-
7	**Total**	**100**	**22.19**	**69**

1.4 Feeding schedule for a kid from birth to 90 days:

Age of kids	Dam's milk or cow milk (ml)	Creep feed (grams)	Forage, green/day (gm)
1-3 days	Colostrum-300 ml, 3 feedings	-	-
4-14days	350 ml, 3 feedings	-	-
15-30 days	350 ml, 3 feedings	A little	A little
31-60 days	400 ml, 2 feedings	100-150	Free choice
61-90 days	200 ml, 2 feedings	200-250	Free choice

2. Feeding after three months to twelve months of age

- Grazing in the pasture for about 8 hours per day.
- Supplementation of concentrate mixture @ 100 – 200 g/animal/day with protein of 16-18 per cent.
- Dry fodder during night in summer months and during rainy days.

Feeding Management

1. Extensive Grazing

- Grazing the sheep and goat in the entire pasture and leaving them there for the whole season is the extensive system of rearing.
- In this method feed cost is very much reduced.

- It is not conducive to making the best use of the whole grasses. So we can preferably practice the **rotational grazing method.**

Rotational grazing method

- Rotational grazing should be practiced under which the pasture land should be divided by temporary fences into several sections.
- The animals are then moved from one section to another section. By the time the entire pasture is grazed, the first section will have sufficient grass cover to provide second grazing.
- Parasitic infestations can be controlled to a great extent.
- Further, it helps to provide quality fodder (immature) for most part of the year.
- Under this system, it is advisable to graze the kids first on a section and then bring in Goats to finish up the feed left by the kids.

2. Semi-intensive

- Semi-intensive system of goat production is an intermediate compromise between extensive and intensive system followed in some flocks having limited grazing.
- It involves extensive management but usually with controlled grazing of fenced pasture.
- It consists of provision of stall feeding, shelter at night under shed and 3 to

5 hour daily grazing and browsing on pasture and range.

- In this method the feed cost somewhat increased.

This system has the advantage of

- Meeting the nutrient requirement both from grazing and stall feeding.
- Managing medium to large flock of 50 to 350 heads and above.
- Utilizing cultivated forage during lean period.
- Harvesting good crop of kids both for meat and milk.
- Making a profitable gain due to less labour input.

3. Intensive system-zero grazing-system

- It is a system in which goats are continuously kept under housing in confinement with limited access to land or otherwise so called zero grazing system of goat production in which they are stall fed.
- It implies a system where goats are not left to fend for themselves with only minimum care.
- Intensive operation of medium sized herd of 50 to 250 heads or more oriented towards commercial milk production goes well with this system particularly of dairy goats.
- It merits exploitation of the system of feeding agro-industrial by products as on pangola grass (Digitaria Decumbens) with carrying capacity of 37 to

45 goats per hectare.

- This system of management requires more labour and high cash input.
- However, this has the advantage of close supervision and control over the animals.
- In this method the dung is collected in one place and used as a good fertilizer.
- Less space is sufficient for more number of animals.

Clinical Services and Facilities of Veterinary Clinical Complex at Bihar Veterinary College for the Goat Farmers

Ravi Shankar Kumar Mandal and Mritunjay Kumar
Department of Veterinary Medicine,
Bihar Veterinary College,
Bihar Animal Sciences University (BASU), Patna-14

Introduction

Goat farming is one of the most important livelihood-supporting activities for rural communities across Bihar. With increasing demand for chevon and goat-based products, scientific goat production and timely veterinary interventions are essential for improving productivity, reducing mortality, and ensuring economic sustainability. The Veterinary Clinical Complex (VCC) at Bihar Veterinary College, Patna, plays a pivotal role by offering advanced clinical services and diagnostic support specifically tailored to the needs of goat farmers.

1. OPD Services for Goat Farmers

Veterinary Clinical Complex at Bihar Veterinary College has 3 Outpatient Department (OPD) - Veterinary Medicine, Veterianry Surgery and Radiology and Veterinary Gynaecology and Obstetrics. The OPD provides daily clinical examination of goats brought by farmers.

1.1.1 Veterinary Medicine OPD

The Veterinary Medicine OPD is the primary point of contact for goat farmers seeking medical care for their animals. It provides systematic diagnosis, medical treatment, disease prevention advisory, and herd-health–oriented services suited to small ruminants. The following are the major facilities and farmer-support services offered by the Medicine OPD:

- General health check-up
- Detailed physical examination
- Assessment of feeding and management practices
- Identification of common ailments such as pyrexia, pneumonia, diarrhoea, parasitic infestations, mastitis
- Information regarding routine vaccination schedule against PPR, Enterotoxaemia, FMD, Goat Pox, HS, and other regional diseases

- Vaccination against Rabies
- Deworming
- External parasite control (ticks, lice, fleas) with guidance on acaricide use
- Vitamin-mineral supplementation strategies
- Herd history collection and interpretation

1.1.2 Emergency Medical Services

The Medicine OPD provides prompt attention to emergencies such as:

- Severe diarrhoea and dehydration
- High fever and septicaemia
- Respiratory distress
- Toxicity and poisoning
- Heat stroke
- Shock and collapse

1.2 Veterinary Surgery and Radiology OPD

Veterinary Surgery and Radiology OPD following services are provided to goat farmers

1.2.1 Outpatient Surgical Examination and Case Handling

- Detailed clinical examination of goats presenting with lameness, wounds, swelling, fracture, hernia, or abdominal distension.
- Assessment of hoof condition, limb deformities, joint diseases, and musculoskeletal injuries.
- Triage and prioritizing emergency surgical cases such as bloat, deep wounds, impaction and fractures

1.2.2 Radiology (X-ray) Services

Digital radiography is a major asset for accurate surgical diagnosis. The OPD provides:

- Limb X-rays to detect fractures, dislocations, joint diseases
- Chest radiography for pneumonia, thoracic trauma, mediastinal abnormalities
- Abdominal radiographs for rumen disorders, urinary calculi, foreign bodies
- Skull and horn radiography for sinus and horn pathologies

1.2.3 Ultrasonography Services

Veterinary ultrasonography is used widely for:

- Pregnancy diagnosis and foetal viability assessment
- Abdominal disorders (intussusception, fluid accumulation, liver/kidney abnormalities)
- Urinary obstruction/urinary bladder evaluation
- Guided aspiration of abscesses or cysts

1.2.4 Physiotherapy services

Physiotherapy unit provides specialized rehabilitation services that improve movement, reduce pain, and enhance recovery in goats.

1.3 Veterinary Gynaecology and Obstetrics

The Veterinary Gynaecology & Obstetrics (VGO) OPD plays a crucial role in improving reproductive efficiency, kidding rate, and overall productivity of goat herds. Goat farming is highly dependent on effective breeding management, timely pregnancy diagnosis, and expert handling of obstetrical emergencies. VGO OPD at Veterinary Clinical Complex provides specialized reproductive healthcare tailored to the needs of goat farmers.

1.3.1 Reproductive Examination and Consultation

- Examination of history of heat cycles, mating, or AI
- Physical and genital examination of does with infertility or breeding issues
- Pregnancy Diagnosis: Ultrasonographic pregnancy confirmation with fetal viability assessment

1.3.2 Obstetrical Emergency Services

- Dystocia (difficulty in kidding) – manual correction of malpresentation or malposition
- Assisted kidding using lubrication, gentle traction, and obstetric manoeuvres
- Cesarean section (C-section) for non-responsive dystocia cases
- Management of retained placenta
- Treatment of vaginal or uterine prolapse
- Post-partum haemorrhage and shock management

2. Advanced Diagnostic Facilities

Quality diagnosis is essential for accurate treatment. VCC offers comprehensive laboratory and imaging services:

2.1 Clinical Pathology Laboratory

The laboratory performs:

- Haematological tests (Complete blood count (CBC): Hb, PCV, TLC, DLC, ESR)
- Blood biochemical profile (serum calcium, phosphorus, liver function tests, kidney function tests, glucose)
- Faecal examination
- Routine urine examination

These services are crucial for managing metabolic diseases, parasitism, infectious diseases, and nutritional disorders in goats.

2.2 Microbiology Support

- Bacterial culture and antibiotic sensitivity: helps in guiding rational antibiotic use and controlling antimicrobial resistance.

2.3 Parasitology support

- Parasitic screening for endoparasites and ectoparasites
- Blood smear examination for haemoprotozoans

2.4 Radiology and Ultrasonography

The VCC is equipped with digital X-ray and ultrasound machines:

- X-ray helps diagnose fractures, thoracic conditions, foreign body ingestion, and skeletal abnormalities.
- Ultrasonography is widely used for pregnancy diagnosis, reproductive disorders, abdominal conditions, urinary problems, and guided fluid aspiration.

Conclusion

The Veterinary Clinical Complex at Bihar Veterinary College acts as a knowledge resource unit and premier treatment facility for goat health management in the state. Its comprehensive services—clinical, diagnostic, reproductive, surgical, and extension—greatly benefit goat farmers by improving productivity, reducing economic losses, and ensuring scientific management.

Non-Conventional Green Fodder and Their Importance in Goat Feeding

Kaushalendra Kumar

Department of Animal Nutrition, Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

Goat rearing is a critical component of India's livestock sector, especially for small and marginal farmers in rainfed and resource-poor regions. India has one of the largest goat populations in the world and remains the world's top producer of goat meat (chevon). According to the 20th Livestock Census (2019) and DAHD estimates (2023–24), the goat population of country is 148.88 million (second-largest species after cattle), which contributes ~27% of India's total livestock population. Goat meat production is ~1.57 million tonnes annually and India ranks 1st globally. Goat milk production is ~6.2 million tonnes (approx. 3–4% of total milk pool). The major goat-producing states are Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Maharashtra. India holds 34 registered goat breeds (ICAR–NBAGR). Goats provide regular income through milk, meat, manure and sale of young stock, making feed security essential for sustaining livelihoods. Non-conventional fodders help reduce feed costs, which typically account for 70% of total goat rearing expenditure. However, the productivity of goats is highly constrained by year-round fodder scarcity, particularly during summer and drought periods when conventional forages (maize, sorghum, cowpea, Napier) become limited. To bridge this gap, non-conventional green fodders, particularly tree leaves, aquatic plants, cactus species, and crop by-products, play a vital role in low-cost, sustainable, and climate-resilient goat feeding systems across India.

India faces chronic seasonal shortages of conventional green fodder and concentrates for small ruminants. Non-conventional (alternative or unconventional) green fodders, including certain tree/shrub leaves, aquatic macrophytes, succulent cacti, green crop residues and by-products can fill feed gaps, improve nutrient supply (especially protein), reduce feeding cost and increase resilience of goat production systems in arid, semi-arid and peri-urban areas (ICAR-IGFRI, 2019). This write-up describes the major non-conventional green fodder options, their nutritional value,

practical uses, benefits and constraints for goat feeding in the Indian context.

What is meant by "non-conventional green fodder"?

Non-conventional green fodders are forage resources not normally included as mainstream cultivated fodder (e.g., sorghum, maize fodder, Napier). They include tree and shrub leaves (browse), succulent plants (cactus/Opuntia), tree leaves (jack fruit, banyan, mulberry, plum, etc), fast-growing tree fodders (moringa, sesbania, leucaena), aquatic macrophytes (azolla, duckweed), crop residues used green or as cut-and-carry, and agro-industrial green by-products. These resources are often locally available, require low input, and can be especially valuable in feed-scarce seasons.

Major Non-Conventional Green Fodders Used for Goats in India:

1. Fodder Tree Leaves (Browse Species)

Tree leaves are a natural component of goat diets due to their browsing behaviour. Many indigenous trees produce biomass even during dry months, making them ideal emergency and supplemental fodder.

Jamun (*Syzygium cumini*) Leaves

- Nutritional Profile: Moderate crude protein (12–16% DM), good fiber, rich in minerals (Ca, P, Fe), and beneficial phytochemicals.
- Benefits: Highly palatable; supports rumen health; useful during dry seasons due to evergreen nature.
- Usage: Fed fresh; can be lopped lightly from farm bunds and homestead trees.

Jackfruit (*Artocarpus heterophyllus*) Leaves

- Nutritional Profile: Good CP content (14–18% DM), digestible fiber, and high palatability for goats.
- Benefits: Commonly used in eastern and southern India; improves growth and supports milk production when used as supplement.
- Usage: Fresh or slightly wilted; abundant availability from homestead orchards.

Banyan (*Ficus benghalensis*) Leaves

- Nutritional Profile: Moderate CP (~12% DM), high fiber, good mineral profile.

- Benefits: Evergreen; provides green fodder throughout the year; widely available along roadsides and farm bunds.
- Limitation: Latex content requires gradual introduction.
- Evidence: Ficus species are well-documented browse trees in arid and semi-arid goat diets, improving fiber intake and rumen activity.

Mulberry (*Morus alba*) Leaves

- Nutritional Profile: High CP (18–28%), good amino acids, high digestibility (55–70%).
- Benefits: Excellent protein supplement; improves growth rate and feed conversion; suitable for cut-and-carry systems; supports milk yield.
- Usage: Fresh leaves or leaf meal; grown as hedge or silvopasture.

Babool (*Vachellia nilotica / Acacia nilotica*) Leaves

- Nutritional Profile: Rich in CP (12–18%), minerals, and tannins.
- Benefits: Excellent drought-hardy fodder; readily available in arid and semi-arid regions; goats tolerate tannins better than cattle.
- Limitation: High tannins at excessive levels may reduce digestibility; mix with other fodders.

Kikar (*Acacia karroo / Acacia spp.*) Leaves

- Nutritional Profile: Moderate to high protein (14–20%) depending on species.
- Benefits: Highly drought-resistant; good emergency green fodder; supports basal roughages.
- Limitation: Tannins require balanced inclusion.

2. Other Common Fodder Trees

Opuntia (Cactus pear / prickly pear)

- Description & use: Succulent cladodes (pads) of Opuntia spp. are drought-tolerant, can be produced on marginal lands and fed fresh or ensiled to small ruminants. They supply water and fermentable carbohydrate but are low in protein and fiber (variable), so need protein supplementation.
- Benefits: Excellent drought-season green feed and water source; reduces seasonal weight loss; suitable for arid/semi-arid goat systems.

- Limitation: Low crude protein must be supplemented; spines require de-spining or use of spineless cultivars; high moisture can limit dry matter intake if fed alone (Pastorelli et al., 2022).

Moringa (*Moringa oleifera*)

- Description & use: Leaves are high in crude protein, vitamins and minerals and can be fed fresh, dried (leaf meal) or as silage. Integration around homesteads or on farm bunds is common.
- Benefits: High CP (often ~20–30% on DM basis), good amino-acid profile, improves milk yield and quality in lactating goats when used as supplement; suitable for cut-and-carry systems.
- Limitation: Leaves are best used as a supplement (not sole feed) due to potential anti-nutritional factors at very high inclusion rates; drying or silaging reduces handling constraints (Leitanthem et al., 2022).

Azolla (free-floating aquatic fern)

- Description & use: Azolla pinnata and related species are fast-growing, protein-rich aquatic ferns that can be cultivated in small shallow ponds and harvested frequently. They can be fed fresh or sun-dried and mixed into total mixed rations.
- Benefits: Very rapid biomass production, high crude protein (20-30% on DM), minerals and vitamins; can replace part of concentrates and reduce feed cost; suitable for smallholders with limited land.
- Limitation: Requires water and simple management (pH, nutrient input); potential microbial contamination if not managed hygienically; best used as partial replacement rather than sole feed (Chekola et al., 2024).

Duckweed (Lemna / Wolffia)

- Description & use: Duckweed species are tiny, fast-multiplying aquatic plants with high crude protein (often 20–40% on DM) and can be grown on small wastewater or nutrient-enriched ponds and fed fresh or dried.
- Benefits: Excellent protein supplement, high productivity per unit area, useful in peri-urban and integrated systems (wastewater nutrient recycling). Studies indicate improvements in growth and rumen parameters when used as supplement.

- Limitation: Need controlled production to avoid contamination and balance diets; palatability varies and may require gradual introduction (Sosa et al., 2024).

Prosopis juliflora (mesquite) - pods and leaves

- Description & use: Prosopis is an invasive shrub/tree common in arid regions of India. Pods (and to some extent leaves) have been used as emergency feed (pods are sweet and energy-rich). Farmers sometimes use pods as a supplement in dry seasons (Sirohi et al., 2014).
- Benefits: Readily available in arid zones; pods are palatable and can partially replace concentrates in dry periods.
- Limitation & caution: Prosopis is an invasive species with ecological costs; some reports indicate variable effects on animal health and needs careful processing (pods may require grinding or mixing); long-term ecological management considerations are important.

Leucaena, Sesbania, Glyricidia and other tree/shrub fodders

- Description & use: Fast-growing leguminous trees/shrubs (e.g., Leucaena leucocephala, Sesbania grandiflora, Glyricidia sepium) are used as cut-and-carry protein fodders. They are widely advocated in agroforestry and silvopastoral systems. High-protein (23–28% CP) fodder tree; excellent growth booster; contains mimosine—safe for goats at moderate inclusion.
- Benefits: High protein, good forages when used as supplements; improve nitrogen in diets and allow reduced concentrate use; integrate with cropping systems to provide year-round supply.
- Limitation: Some (e.g., Leucaena) contain secondary compounds (mimosine) though goats are generally tolerant; tolerance varies by species and inclusion level — appropriate feeding strategies and, where necessary, detoxification practices are required. Research supports their utility but urges managed use. (ResearchGate)

3. Crop-byproducts and other green wastes (banana pseudo-stem, sweet potato vines, vegetable residues)

- Description & use: Many horticultural residues and vegetable trimmings are fed as fresh green fodder in peri-urban systems (banana pseudo-stem, sweet potato vines, sugarcane tops, vegetable market wastes).

- Benefits: Reduce waste, supply bulk and some nutrients, low cost. Useful in mixed feeding systems and for smallholders near markets.
- Limitation**:** Nutrient composition is variable; risk of foreign material or pesticide residues; require processing and care to avoid mycotoxins or spoilage.

Importance of Non-conventional Green Fodder in Goat Production Systems:

- Seasonal buffering: Non-conventional fodders provide green feed during lean seasons (summer/dry period), reducing body-weight loss and mortality.
- Cost reduction: High-protein, low-cost options (azolla, duckweed, Moringa, tree leaves) can reduce concentrate dependence and improve profitability.
- Resource efficiency & sustainability: Many options use marginal lands, homestead spaces or wastewater nutrients (duckweed), contributing to circular resource use.
- Adaptation to climate variability: Drought-tolerant options (Opuntia, Prosopis) improve feed security in arid and semi-arid zones.
- Smallholder applicability: Low input, locally producible fodders are accessible to resource-poor farmers and fit cut-and-carry systems favored by goat keepers.

Practical Feeding Considerations:

Fodder Type	**Suggested Inclusion**	**Remarks**
Mulberry leaves	15–30% of diet DM	High protein; improves growth
Jackfruit leaves	15–25%	Good digestibility
Jamun leaves	10–20%	Evergreen; mix with other fodders
Babool/kikar leaves	10–15%	Tannin content; use moderately
Banyan leaves	10–20%	Introduce gradually due to latex
Opuntia pads	Up to 20% DM	Add protein source
Moringa leaves	10–20%	Rich CP; excellent supplement
Azolla/Duckweed	5–15%	Mix with concentrate

Note:

- Values indicative; adjust based on availability and animal response.)
- Introduce latex-containing leaves (banyan, peepal) gradually.
- Mix tannin-rich leaves (babool, kikar) with other fodders.
- Opuntia requires de-spining or feeding spineless varieties.
- Aquatic fodders must be produced hygienically to avoid contamination.
- Combine multiple species for balanced nutrition.

Practical Recommendations for Adoption in India:

- Use as supplements, not sole feeds. Many non-conventional fodders are best used to partially replace concentrates or to add protein and minerals to basal roughages. Always balance for protein and energy.
- On-farm production: Promote homestead planting of Moringa, Sesbania and Leucaena and small ponds for Azolla/duckweed near livestock units. These fit small landholdings and reduce transport costs.
- Processing and quality control: Drying, ensiling or mixing with other feeds can reduce anti-nutritional factors and extend shelf life. De-spining and chopping increase intake and safety (Opuntia).
- Hygiene & safety: Monitor aquatic fodders for contamination; avoid plant parts from pesticide-sprayed fields; introduce new feeds gradually.
- Extension & farmer training: Demonstrations, simple extension manuals and local trials will increase farmer confidence and correct usage (optimal inclusion rates, combinations).
- Ecology & policy caution: While Prosopis pods are useful locally, large-scale encouragement of invasive species is not advised—use existing stands cautiously and pair with restoration plans.

Limitations and Research Needs:

- Standardized feeding recommendations: More region-specific dose/response studies on inclusion levels for goats (growth, reproduction, milk) are needed.
- Anti-nutritional management: Research into simple, low-cost treatments to detoxify problematic species or to reduce secondary compounds.

- Economics and scaling: Studies on cost-benefit and supply chains for peri-urban production systems (azolla/duckweed production enterprises) would help adoption.
- Environmental impacts: Evaluate large-scale use of invasive species and water demands of aquatic systems in water-scarce regions.

Conclusion:

India's large goat population and the rising demand for goat meat and milk require nutritionally secure and cost-effective feeding systems. Non-conventional green fodders including mulberry, jackfruit, jamun, banyan, babool, kikar, subabul, sesbania, opuntia, azolla, duckweed, and horticultural residues play a crucial role in bridging the fodder deficit, ensuring resilience during lean seasons, and sustaining productivity. Their availability, adaptability, and nutritional richness make them indispensable to the future of goat farming and rural livelihoods in India. Integrating these fodders into feeding strategies will significantly enhance goat productivity while reducing dependence on commercial concentrates, leading to sustainable, low-cost and climate-resilient goat production systems.

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Pregnancy Diagnosis, Nutritional Needs During Gestation and Difficult Birth in Goats

S K Sheetal
Department of Veterinary Gynaecology and Obstetrics, Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

Pregnancy diagnosis

Pregnancy in does is most commonly diagnosed using real-time ultrasonography, which allows visualization of the embryo/fetus and placentomes within the uterus. Transabdominal ultrasonography is fast, reliable, and can detect pregnancy as early as 30 days, with optimal accuracy after 45 days of gestation. Fasting the doe for 12 hours (feed) and 4 hours (water) can improve examination efficiency in large herds. Transrectal ultrasonography, though more technically difficult and time-consuming, can identify pregnancy as early as 20 days. Fetal counting is most accurate up to 85 days of gestation and is useful for managing does at risk of pregnancy toxemia. Experienced ultrasonographers may perform fetal sexing between 55 and 70 days, with higher accuracy in single pregnancies. Radiography can confirm pregnancy with 100% accuracy after day 70 and reliably determine fetal number after day 75, but its routine use is limited due to cost and practicality.

Progesterone levels can be evaluated in milk or serum, but samples must be collected exactly one estrous cycle (19–24 days) after breeding. Low progesterone confirms that a doe is not pregnant, but high progesterone cannot confirm pregnancy because it does not distinguish between normal diestrus, true pregnancy, or pseudopregnancy. Early in gestation, progesterone levels also cannot reliably assess fetal viability or determine fetal number. However, after three months of gestation, does carrying triplets tend to have higher progesterone concentrations than those carrying twins or singles?

Estrone sulfate measurement in plasma or urine is another method of pregnancy detection. Estrone sulfate, a conjugated estrogen produced by the conceptus, rises markedly between 15 and 20 days after conception and remains

elevated throughout pregnancy. For best accuracy in does, most diagnostic laboratories recommend testing at 50–60 days of gestation. Higher estrone sulfate levels have been observed in does carrying multiple fetuses. Because estrone sulfate declines with abortion, fetal death, or embryonic resorption, this test also provides useful information on conceptus viability.

Hydrometra, or pseudopregnancy, is a well-recognized condition in goats, though its exact cause remains unclear. It is characterized by the accumulation of sterile fluid in the uterus and persistently elevated progesterone levels caused by failure of luteolysis. Up to 50% of pseudopregnancies may result from early embryonic loss occurring at ≤40 days of gestation. Another contributing factor is spontaneous persistence of the corpus luteum, which is more common in older does, in those bred outside the normal breeding season, or following induced ovulation. Diagnosis is based on ruling out true pregnancy and identifying compatible clinical signs. Treatment involves administration of prostaglandin to induce luteolysis, and does may return to fertility if the condition is identified and managed early. However, prolonged or recurrent cases carry a reduced chance of future conception and such animals are candidates for culling. Other causes of hydrometra in older does include cervical adhesions following dystocia, which block normal uterine drainage, or uterine neoplasia. These conditions do not respond to prostaglandin therapy and have a poor reproductive prognosis.

Nutritional needs during gestation

During gestation, proper nutrition in goats is essential to support healthy fetal development and maintain the doe's productivity. Early to mid-gestation (30–90 days) is crucial for placental growth, and both underfeeding and overfeeding can impair this process, resulting in low birth weights. Does should be maintained at a body condition score of around 3 to ensure optimal nutrient balance. Energy and protein requirements gradually increase as gestation advances, especially during the last 6–8 weeks when fetal growth is most rapid. Providing good-quality forage, adequate minerals—particularly calcium and phosphorus—and access to clean water helps ensure successful pregnancy outcomes.

Early to Mid-Gestation

- ❖ Placental development occurs between 30 and 90 days of pregnancy.
- ❖ Poor placental development leads to low birth weights, even if nutrition improves later in gestation.
- ❖ Severe underfeeding for 21 days or moderate underfeeding for 80 days can impair placental growth.
- ❖ Avoid both overfeeding and underfeeding; does should maintain a body condition score (BCS) of 3–3.5.
- ❖ Nutrient requirements during this period are only slightly higher than maintenance.

Late Gestation

- ❖ Proper nutrition during late gestation is essential for a successful kidding season.
- ❖ Seventy percent of fetal growth occurs during the last 4–6 weeks of pregnancy.
- ❖ The doe's mammary gland is developing, and her rumen capacity decreases, limiting feed intake.
- ❖ Energy becomes the most critical nutrient and is the one most likely to be deficient.
- ❖ Protein requirements increase only moderately.
- ❖ Calcium needs nearly double, and adequate selenium and vitamin E are also essential.
- ❖ Nutritional needs vary depending on the doe's size, age, and number of fetuses she carries.
- ❖ To meet energy demands, grain supplementation is generally required.
- ❖ If forage quality is poor, additional protein and/or calcium supplementation

may be necessary.

- ❖ Extra nutrition is needed to support rapid fetal growth, mammary gland development and prevent pregnancy toxemia (ketosis) and milk fever. It also ensures kids are born strong and healthy with appropriate birth weights.

Managing Difficult birth in goats

Managing a difficult birth, or dystocia, in goats requires timely recognition, calm handling, and systematic intervention to protect both the doe and her kids. The first step is close observation during late gestation and early labor, especially in does carrying multiple fetuses or those with a history of birthing complications. Normal labor progresses in three stages, and any delay—such as prolonged restlessness, straining without delivering, or the absence of the normal "nose and two feet" presentation—should raise concern. Once dystocia is suspected, the doe should be gently restrained in a clean, well-lit area. Proper hygiene is critical; hands and arms must be thoroughly cleaned and lubricated before any internal examination. A sterile obstetrical lubricant greatly reduces trauma to the birth canal. On vaginal examination, the position, presentation, and posture of the fetus should be assessed. Many dystocias in goats result from malpresentation—such as a head turned back, limbs retained, or breech position—and careful repositioning, known as mutation, is necessary.

If the fetus is too large or the birth canal not sufficiently dilated, gentle manipulation should be attempted slowly and patiently, never using excessive force. Traction should only be applied when the fetus is correctly aligned, always pulling in synchronization with the doe's contractions and directed slightly downward toward her hocks. If multiple fetuses are present, it may be necessary to identify and deliver one at a time by repelling (pushing back) the second fetus to create room. Good communication and teamwork are extremely helpful during difficult deliveries, especially when additional assistance is needed. Throughout the process, it is essential to monitor the doe for signs of exhaustion or shock. If progress cannot be made within 20–30 minutes, or if the fetus is dead, extremely large, or tightly wedged, veterinary assistance should be sought immediately. In some cases, a

caesarean section may be the safest option to save the doe and any remaining kids.

After the birth, both doe and kids require close attention. The doe should be checked for retained placentas, internal tears, or excessive bleeding. Administering antibiotics is often recommended following extensive manipulation to prevent infections such as metritis. Pain relief, hydration, and nutritional support hasten recovery. The kids must be dried immediately, stimulated to breathe, and cleared of any mucous in the mouth or nostrils. Ensuring they receive colostrum within the first one to two hours is vital for immunity and survival. Observing the doe for proper bonding and nursing behavior is equally important, as stress from a difficult birth can sometimes interfere with maternal instincts. By combining prompt recognition, skilled intervention, and diligent postnatal care, most cases of dystocia in goats can be managed successfully, safeguarding the health and productivity of the herd.

Nutritional Deficiency Diseases and Metabolic Disorders in Goats and their Management

Bipin Kumar
Department of Veterinary Medicine
Bihar Veterinary College,
Bihar Animal Sciences University (BASU), Patna-14

Nutritional deficiency diseases and metabolic disorders in goats are primarily caused by an imbalance between the animal's nutrient requirements and its dietary intake, with factors such as high production demands, poor quality forage, or incorrect feed management playing a key role. In simple language it can be said that if there is imbalance between nutritional input and output, the deficiency diseases occurs. As far as metabolic disorders is concerned, these occurs due to stress of overproduction even in nutritionally deficient animals. Effective management focuses on proper feeding, balanced mineral supplementation, and prompt veterinary intervention when necessary.

COMMON NUTRITIONAL DEFICIENCY DISEASES

Nutritional deficiencies in goats can lead to significant health issues affecting growth, reproduction, and overall vitality. These diseases can discourage the overall goat farming by significantly reducing the profit to the farmers by reduced production, cost of treatment and death of animals.

WHITE MUSCLE DISEASE (Nutritional Myodegeneration)

This disease is associated with muscle mass which is main source of productivity in goat in general and caused by a deficiency in **selenium** and **vitamin E**, which work as antioxidants to protect muscle cells.

Symptoms: The following important signs are visible in the affected goat, stiffness (especially in hindquarters), tucked-up rear flanks, arched back, pneumonia, and sudden death in young, rapidly growing kids. Necropsy reveals white striations in affected skeletal and cardiac muscles.

Management: Treatment is generally ineffective in severe cases. Prevention involves providing sufficient dietary selenium (0.2–0.3 mg/kg dry matter) and vitamin E supplementation, particularly in areas with known selenium-deficient

soils.

COPPER DEFICIENCY

Goats have a higher copper requirement than sheep but are susceptible to deficiency due to inadequate intake or interactions with other minerals (e.g., molybdenum, sulfur, iron) that decrease bioavailability.

- **Symptoms:** Anemia, poor hair color (achromotrichia) or quality, stunted growth, infertility, and in severe cases, neurological signs like incoordination.
- **Management:** Ensure mineral mixes are specifically formulated for goats, not sheep (which require much lower copper levels). A dietary copper: molybdenum ratio of 6:1 to 10:1 is recommended. Liver biopsies are the most accurate diagnostic method.

GOITER (IODINE DEFICIENCY)

It is a deficiency disease of goat caused by insufficient iodine in the diet, which can result from iodine-deficient forages or the consumption of goitrogenic plants.

- **Symptoms:** These are the important clinical signs of goiter such as enlarged thyroid glands (goiter), poor growth, weak or stillborn kids subsequently leads to less growth and fecundity in the suffering animals.
- **Management:** It can be managed by providing a stabilized iodine source in mineral supplements. The recommended dietary concentration is 0.5 mg/kg dry matter.

POLIOENCEPHALOMALACIA (PEM)

It is a neurological disease primarily resulting from **thiamine (vitamin B1) deficiency**. This often occurs in goats on high-grain, low-forage diets or those with high dietary sulfur intake, which disrupts thiamine production in the rumen.

- **Symptoms:** Disorientation, aimless wandering, loss of appetite, circling, blindness, head pressing, and recumbency.
- **Management:** Prompt treatment with thiamine injections is critical. Prevention involves increasing forage intake, avoiding sudden diet changes,

and ensuring proper fiber levels in the diet.

COMMON METABOLIC DISORDERS

Metabolic disorders generally result from the body's inability to manage nutrient demands, especially during key physiological stages like late pregnancy or peak lactation. The following are the metabolic disorder of goat;

PREGNANCY TOXEMIA (KETOSIS)

An energy imbalance in late gestation, particularly in does carrying multiple fetuses or that are excessively thin or fat. The doe cannot consume enough glucose to meet fetal demands, leading to the mobilization of body fat and the production of toxic ketone bodies.

- **Symptoms:** Separation from the herd, depression, reduced appetite, staggering (ataxia), recumbency, and sweet-smelling breath.
- **Management:** Early intervention is key. Treatment includes oral administration of propylene glycol or glycerol and intravenous dextrose solutions. Prevention requires monitoring body condition and providing adequate, energy-dense nutrition in late pregnancy.

HYPOCALCEMIA (MILK FEVER)

A disruption in calcium homeostasis most common in late-pregnant or lactating does.

- **Symptoms:** Depression, decreased appetite, mobility impairment ranging from ataxia to recumbency, and lack of urination or defecation.
- **Management:** Slow intravenous administration of a calcium borogluconate solution by a veterinarian. Prevention involves ensuring adequate dietary calcium during late gestation and avoiding an imbalance with phosphorus.

UROLITHIASIS (URINARY CALCULI)

Mineral crystals (struvite, calcium carbonate) form in the urinary tract, most commonly obstructing the long, narrow urethra of male and castrated male goats. It is often linked to high-concentrate diets with an imbalanced calcium-to-phosphorus

ratio (should be >2:1).

- **Symptoms:** Painful and difficult urination (straining), kicking at the abdomen, blood in urine, and potentially a ruptured bladder (water belly).
- **Management:** Treatment often requires surgical intervention. Prevention is achieved by providing a proper Ca:P ratio in the diet, ensuring constant access to fresh water, adding salt to encourage drinking, and potentially adding urinary acidifiers like ammonium chloride to the feed.

RUMINAL ACIDOSIS (GRAIN OVERLOAD)

Caused by the rapid consumption of large amounts of fermentable carbohydrates (grains), leading to a quick drop in ruminal pH.

- **Symptoms:** Depression, bloat, dehydration, and possibly diarrhea. It can lead to secondary complications like enterotoxemia or laminitis (founder).
- **Management:** Focus on prevention by introducing grains gradually, feeding smaller, more frequent concentrate meals, and ensuring sufficient roughage in the diet.

GENERAL MANAGEMENT AND PREVENTION

The cornerstone of preventing these disorders is sound nutritional management:

➢ **Balanced Rations:** Diets should be tailored to the goat's physiological stage (maintenance, growth, gestation, lactation) to meet specific energy, protein, mineral, and vitamin requirements.

➢ **Quality Forage:** High-quality forage (grasses, legumes, browse) should form the bulk of the diet to ensure adequate fiber intake, which is essential for healthy rumen function.

➢ **Mineral/Vitamin Supplementation:** Provide free-choice access to a complete mineral supplement specifically designed for goats to address regional deficiencies. Soil and forage analysis can help identify local deficiencies or toxicities.

➢ **Constant Fresh Water:** Ensure constant access to clean water to promote overall health and prevent issues like urolithiasis.

➢ **Body Condition Scoring:** Regularly monitor the body condition score (BCS) of

the herd (optimal range 2.5–3.0) to assess energy intake and adjust feeding programs accordingly.

- **Minimize Stress:** Avoid sudden changes in diet or environment, as stress can precipitate metabolic disorders.
- **Consult a Veterinarian/Nutritionist:** Seek professional advice for accurate diagnosis, tailored feeding programs, and the development of a comprehensive herd health plan.

Reproductive Disorders and their Management in Goats

Dushyant Yadav[1], Bhavna[2], D.N. Singh[3], Ranjana Sinha[3], Manmohan Kumar[3] and Suchit Kumar [3]

[1] Department of LFC (Veterinary Gynaecology & Obstetrics), [2] Department of VCC (Veterinary Gynaecology & Obstetrics), [3] Department of Livestock Farm Complex
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

The reproductive failure has more impact on economics of goat farming and it is a big challenge to goat producers. Meat goat producers whose herds exhibit poor reproductive success earn less and have higher costs of production per kid produced than those whose herds reproduce successfully. Increase in dry periods resulted in to higher feed costs because of increased periods of feeding without production in return. The reproductive system of the goat is complex, but having a basic understanding of it will help you better manage the reproductive success of your goats.

Basic Cause of Reproductive Failures in Goats-

- Identification marks/tags- most of the no any provision
- No written reproductive record with owner
- No observation details with owner
- Wet, moist, soiled, unhygienic byres
- Failure of balanced feeding
- Unavailability of provision of Area Sp. Minerals
- No any control or monitoring on breeding/AI
- No any investigation of case by vets
- No follow up till confirmation of etiology
- Attitude to dispose infertile animal etc.

Types of Infertility /subfertility in female goats -

Structural and functional abnormalities- like aplasia of ovaries, utrine unicornish, pelvic deformaties, segmental aplasia of oviducts etc.

Managemental and deficiency disorders-

o Mis-managed sheds/shelters home/labour/breeding plan etc. resulted into abortion, early/late embryonic death, non-return of estrus, missed estrus etc.

o Deficiency disorders- due to of low/high vitamins and mineral resulted in to anoestrus/subestrus, fertilization failure and death of fetus etc.

Non-specific infections- Generalized infection caused by different micro-organism

Specific infectious diseases- Specific infectious diseases like brucellosis etc.

➢ **Brucellosis**- Infertility, abortion, milk loss, zoonotic, financial loss of total production system, weak new-borns

➢ **Q fever**- In chronic high death rate, productivity loss, costly vaccination, abortion, stillbirth, public health issue

➢ **Trypanosomiosis**- Abortion, repeat estrous, repeat breeding, retained placenta, delay uterine involution, infertility, mortality, sterility

➢ **Compylobacteriosis**- Abortion, infertility, late pregnancy, stillbirth

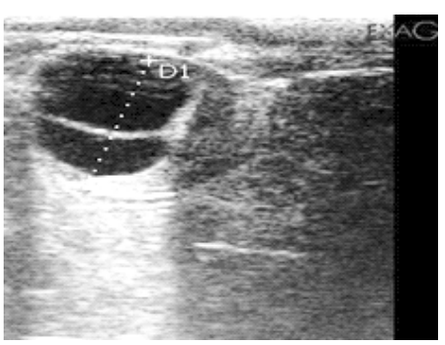
➢ **Listeriosis**- Abortion, septicemia

➢ **Leptospirosis**- Infertility, stillbirth, abortion

➢ **Toxoplasmosis**- Meat loss due to infection, infertility, abortion

Common Reproductive Diseases/Disorders of Goats-

- Anoestrus
- Cystic ovary (Luteal and Follicular)
- Cystic ovary with mucometra
- Ovarian tumors
- Segmental aplasia
- Ovarobursal adhesion
- Pyometra
- Mucometra
- Metritis/Endometritis/Subclinical endometritis
- Mummified fetus
- Maceration
- Emphysemated fetus



Follicular Cyst of Ovary in Goa

- Abortion

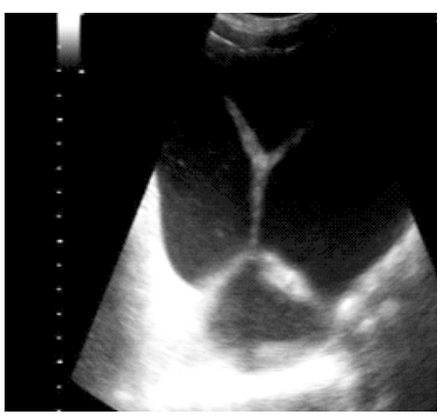
Post -partum diseases and complication-

- Fetal membrane dropsy

(Hydroallantois, hydroamnion, fetal ascitis)

- Dystocia* (ICD, Uterine torsion, mal-dispositions)
- Total Uterine Prolapse
- Retention of Fetal membranes (RFM)
- Septic metritis
- Endometritis
- Uterine rupture
- Paralysis of different nerves
- Adhesion of uterus etc.

Total Uterine Prolapse in Goat



Mucometra in Goat

Diagnosis of Diseases-

Diagnosis should be done based on the following points -

- Reproductive history

Handling of Dystocia in Goat

- Samples :

  Oestrual mucus
- Blood (Haemogram/Blood smear)
- Vaginal swab

Mummified Fetus in Goat

- Endometrial content- (White Side test, PMN cell count etc.)
- USG scanning
- X-ray
- Disease specific tests

Advance Way of Diagnosis of Reproductive Disorders-

- Advance Radiography CT scan, MRI etc.
- Color Doppler's Ultrasound
- Physiological markers
- Biochemical Markers
- Enzymatic assay/ enzymatic markers eg. ELISA
- Antigen-antibody interaction based techniques like FAT
- Immunological Assay like RIA
- Staining/Biopsy/Histology/immune-histochemistry
- PCR
- Nucleotide (genomics)/proteomics /Epigenetic markers etc.

Monitoring of Reproductive Health-

Starting with the premise that production is equal to reproduction and keep the following points in your mind-

Carefully watching for first estrus, or puberty

Be aware of weather extremes

Monitor body condition

Nutritional status

- Walking and standing position
- Vagina and rectum
- Milk production
- Feed, water and milk intake
- Check the record daily (sick animal register) etc.

Estrous Cycle, Signs of Estrus and Artificial Insemination in Goats

Bhavna, Dushyant Yadav and Sonam Bhatt[1]
Department of Veterinary Gynaecology & Obstetrics, [1]Department of Veterinary Medicine
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

Reproductive efficiency in goats plays a central role in improving herd productivity, achieving planned breeding, and optimizing genetic progress. A comprehensive understanding of the estrous cycle, its behavioural and physiological manifestations, and proper timing and technique of artificial insemination (AI) is essential for veterinarians, animal scientists, and progressive farmers.

Estrous Cycle in Goats

Goats are seasonally polyestrous, with most breeds cycling during the short-day season (post-monsoon to winter). However, many tropical and Indian breeds exhibit year-round cyclicity under favourable nutritional and environmental conditions.

The estrous cycle typically lasts 18–21 days, with acceptable variation between 16 and 24 days. It comprises four distinct phases:

1. **Proestrus (24–36 hours)**

- Characterized by follicular growth under increasing estrogen influence.
- Vulva becomes slightly edematous; behavioural changes begin.s
- Doe may show restlessness but will not stand for mating.

2. **Estrus (Heat Period, 24 to 48 hours)**

- Period of maximum estrogen secretion.
- Doe exhibits strong behavioural estrus and stands for mating.
- Ovulation occurs 2-36 hours after the onset of estrus, highlighting the importance of accurate breeding timing.

3. **Metestrus (2–3 days)**

- Characterized by the formation of the corpus luteum (CL).
- Progesterone begins to rise; doe returns to calmer behaviour.

4. Diestrus (12–14 days)

- Dominated by high progesterone secretion from a fully functional CL.
- Doe shows no interest in males.
- If pregnancy does not occur, luteolysis by uterine $PGF_{2\alpha}$ initiates the next cycle.

Signs of Estrus in Goats

Estrus detection is a critical determinant of reproductive success, especially in AI programs where timing must coincide with ovulation. Estrus behaviour has two phases: (1) proreceptivity in which the doe seeks out and stimulates the male; and (2) receptivity in which the doe will express an immobilisation reflex to the male that involves nudges and standing for mating. The detection of estrus in a doe is difficult in the absence of a male goat.

Behavioural Signs

- Restlessness and vocalization (bleating)
- Frequent tail wagging ("flagging") from side to side and up and down, most reliable sign
- Mounting other does or allowing mounts
- Seeking the buck's company and reduced fear response
- Decreased appetite or slight drop in milk yield (in lactating does)

Physical Signs

- Vulvar swelling, moistness, and hyperaemia
- Clear, watery, or stringy cervical mucus
- Frequent urination
- Arched-back stance in presence of a male

Buck Indicators

- When a teaser or intact buck is nearby:
    - Doe stands willingly for mounting (most reliable sign).
- The buck exhibits flehmen response and persistent courtship behaviour.
- Use of a vasectomized or apron-fitted teaser buck, introduced twice daily, significantly enhances estrus detection accuracy in large flocks.

Right Timing for Artificial Insemination

1. **Physiological Basis**

Since goats ovulate towards the end of estrus or shortly after, semen deposition should be timed to ensure:

a. Viable sperm are present in the oviduct at the time of ovulation.
b. Cervical barriers are most relaxed (during mid–late estrus).

2. **Recommended Timing**

The optimal timing varies with semen type due to differences in sperm lifespan.

A. Fresh or Liquid Semen

- Inseminate 12–18 hours after onset of estrus.
- Can be repeated once after 12 hours if estrus detection is uncertain.

B. Frozen–Thawed Semen

- Frozen semen has a shorter lifespan; hence precise timing is crucial.
- Inseminate 18–20 hours after onset of estrus.
- A single insemination in this window often yields the highest conception rate.

C. If Exact Onset of Estrus is Uncertain

- Use double insemination:
- First AI: At detection of estrus
- Second AI: 12 hours later
- This compensates for variation in estrus detection.

Technique of Artificial Insemination in Goats

Restraint and Preparation

- Restrain the doe in standing position—using a breeding stand or by an assistant.
- Elevate hindquarters slightly (optional but helpful for visualization).
- Clean the vulvar region using sterile saline or mild antiseptic solution.
- Use a clean speculum (glass, metal, or illuminated plastic).

Equipment Required

- Sterile doe speculum
- Light source (penlight or integrated speculum light)
- AI gun or pipette
- Straw cutter and sheath (for frozen semen)

- Semen thawing unit (37°C water bath)
- Lubricant (non-spermicidal)

Step-by-Step Procedure

a. Visualizing the Cervix

- Introduce the lubricated speculum gently into the vagina.
- Use the light source to visualize the cervix:
- Cervical os appears pinkish, moist.
- Cervical mucus may be present and is typically clear during estrus.

Handling Semen

For frozen semen:

- Thaw the straw at 37°C for 30–60 seconds.
- Dry and load into the AI gun immediately.
- Maintain semen temperature and avoid exposure to sunlight or cold surfaces.

Insemination

- Advance the insemination pipette into the first few cervical folds; deep penetration into the cervix may not be possible due to its spiral shape.
- Deposit semen slowly at the external cervical os or in the first ring.
- Withdraw the pipette gently, followed by the speculum.

Post-Insemination Care

- Allow the doe to remain quiet for 15–20 minutes.
- Avoid stress, fighting, transportation, or exposure to cold immediately after AI.

Following information should be recorded:

- Date and time of estrus
- Time and type of semen used
- Technician's name
- Doe identification number

Factors Affecting Success of AI in Goats:

a. Accuracy of estrus detection
b. Timing of insemination
c. Quality and handling of semen

d. Technician skill
e. Doe fertility status
f. Stress, nutrition, and ambient temperature
g. Breed differences in cervical anatomy (e.g., smaller cervix in dwarf breeds)

Conclusion

An in-depth understanding of the estrous cycle, recognition of estrus signs, and precise AI timing are essential pillars of reproductive management in goats. While natural mating remains efficient for smallholder systems, AI offers unmatched advantages for genetic improvement and disease control, provided it is performed with sound technique and proper management. Integrating accurate estrus monitoring with skilled insemination practices significantly enhances conception outcomes and overall reproductive efficiency in goat herds.

External and Internal Parasites of Goats and its Control Measures

Shyma K.P.
Department of Veterinary Parasitology
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

Parasites continue to be among the most significant constraints in goat production worldwide, particularly in tropical and subtropical regions where climatic conditions support year-round parasite survival. In goats, parasitism leads to reduced productivity, poor growth, anemia, weight loss, compromised immune status, mortality in severe cases, and considerable economic losses to farmers. Parasitic diseases of goats are broadly categorized into external parasites, which infest the skin and appendages, and internal parasites, which inhabit the gastrointestinal tract, respiratory tract, liver, and blood. Understanding the biology, pathogenesis, clinical manifestations, diagnosis, and control strategies of major parasites is fundamental to designing sustainable parasite management programs in goat production systems. This write-up provides a comprehensive overview of major external and internal parasites affecting goats along with their preventive and control measures.

External Parasites of Goats

External parasites, also known as ectoparasites, include ticks, mites, lice, fleas, keds, and flies. These parasites damage the skin, suck blood, irritate the host, and often transmit important vector-borne diseases. Ectoparasitic infestations are influenced by environmental temperature, humidity, management practices, and hygiene.

Ticks

Ticks are among the most important ectoparasites in goats. Hard ticks of the genera *Rhipicephalus*, *Haemaphysalis* and *Hyalomma* commonly infest goats in India. Ticks damage the skin by feeding on blood and lymph, cause irritation and hypersensitivity, and transmit pathogens such as *Anaplasma*, *Theileria*, and *Ehrlichia*. Severe tick infestation leads to weakness, anemia, reduced milk yield, and

poor weight gain. The control of ticks relies on regular inspection, strategic use of acaricides, rotational grazing, and management of the environment to reduce tick habitats. Acaricide resistance is emerging as a major challenge, necessitating integrated tick management that combines chemical, biological, and environmental approaches.

Economic and veterinary importance of ticks

The medical and economic importance of ticks had long been recognized due to their ability to transmit disease to humans and animals in several ways and parasitize a wide range of vertebrate hosts, and transmit a wide variety of pathogenic agents than any other group of arthropods They play a major role of vector in spreading different diseases of livestock and humans such as babesiosis, theileriosis, anaplasmosis and many rickettsial and viral diseases. In addition, direct losses due to their being ectoparasites includes blood loss, irritations that result in “tick worry” and interrupt the grazing habits of the host. Damage and loss of udders are also caused by the attachment and feeding activities of ticks, which provide portals of entry for secondary bacterial infections and induce myiasis and tick paralysis due to the toxins they secrete in to the blood. The secreted toxins may evenly disseminate to the respiratory organs and cause death of the animal. Their attachment and feeding also down grade hides and skins and reduce milk and wool production. Reduce productivity and increase susceptibility to other disease

Mites

Mange mites, including *Sarcoptes scabiei*, *Psoroptes*, *Chorioptes*, *Demodex*, and *Otodectes*, cause mange in goats. Sarcoptic mange is the most severe form, characterized by intense pruritus, alopecia, thickened and crusty skin, and emaciation in chronic cases. Demodectic mange occurs in hair follicles and sebaceous glands and results in nodular lesions along the face, neck, and forelimbs. Mite infestations spread rapidly in overcrowded, unhygienic conditions and during winter months. Control involves the use of acaricidal dips, sprays, or systemic macrocyclic lactones, combined with improved sanitation and isolation of affected animals.

Lice

Both biting lice (*Damalinia caprae*) and sucking lice (*Linognathus stenopsis*, *L. pedalis*) affect goats. Lice infestation, or pediculosis, leads to intense itching, restlessness, rough coat, weight loss, and in heavy infestations, anemia. Kids and weak animals are more severely affected. Lice are transmitted primarily through direct contact. Treatment includes topical pyrethroids, organophosphates, or systemic ivermectin. All in-contact animals should be treated simultaneously to prevent re-infestation.

Keds

Goat keds (*Melophagus ovinus*) or sheep ked infestation may occur in mixed farming systems. These wingless flies suck blood and cause irritation, anemia, and damage to the fleece in wool-producing goats. Control is similar to lice management and includes application of insecticidal sprays and maintenance of hygiene.

Fleas and Flies

Flea infestation in goats, although less common than in dogs and cats, can occur when goats share premises with other domestic animals. Fleas cause severe itching and transmit pathogens. Biting flies such as *Stomoxys* and *Tabanus* cause blood loss, irritation, and may transmit diseases. Myiasis, produced by larvae of blowflies, can occur in wounds or soiled wool. Flies are managed by proper sanitation, manure disposal, insecticidal sprays, and fly traps.

Control Measures for External Parasites

Effective ectoparasite control requires an integrated approach combining chemical, environmental, and biological strategies. The judicious use of acaricides or insecticides such as pyrethroids, organophosphates, amitraz, and macrocyclic lactones remains central to control. However, reliance solely on chemicals has led to the development of resistance in ticks and lice. Rotational use of acaricides with different modes of action, proper dosing, and ensuring full coverage of the body are essential for effective treatment. Environmental management involves regular cleaning of sheds, removal of manure, trimming of bushes around goat houses, prevention of overcrowding, and maintenance of dry bedding to minimize parasite breeding. Biological control methods such as entomopathogenic fungi offer

promising eco-friendly alternatives for tick and fly control. Ensuring good nutrition improves the animal's resilience to ectoparasites. Regular monitoring of herd infestation status helps design timely interventions and prevents outbreaks.

Internal Parasites of Goats

Internal parasites, also referred to as endoparasites, are a major constraint in goat farming. Goats are more susceptible than sheep to gastrointestinal nematodes due to their browsing nature and lower innate immunity against parasites. Internal parasites cause chronic ill-health, weight loss, diarrhea, poor growth, reproductive failures, and occasionally death. The major groups include gastrointestinal nematodes, tapeworms, trematodes, coccidia, and blood parasites.

Gastrointestinal Nematodes

Gastrointestinal nematodes (GINs) are the most common and economically important parasites of goats. Species such as *Haemonchus contortus*, *Trichostrongylus*, *Ostertagia*, *Oesophagostomum*, and *Cooperia* inhabit various parts of the gastrointestinal tract. Among these, *H. contortus*, commonly known as the barber pole worm, is highly pathogenic, causing severe anemia, bottle jaw, and sudden death in heavily infested goats. The life cycle involves development of infective L3 larvae on pasture, and goats ingest them during grazing. Warm, humid environments favour larval development and survival.

Clinical signs of GIN infestation vary depending on worm burden and include anemia, dullness, rough hair coat, weight loss, submandibular edema, reduced milk yield, and occasionally diarrhea. Diagnosis is based on clinical signs, faecal egg count, larval culture, and identification of parasites at necropsy.

Control relies on targeted selective treatment, often guided by FAMACHA scoring to identify anaemic animals, rotational grazing to reduce pasture contamination, and provision of browse species that reduce worm intake. Anthelmintics such as benzimidazoles, levamisole, macrocyclic lactones, and monepantel are used to treat GINs. However, anthelmintic resistance is widespread in goats, particularly against benzimidazoles and ivermectin, necessitating rational use. Combination treatment, maintaining adequate dosage based on body weight, avoiding underdosing, and strategic deworming during peri-parturient rise are important in delaying resistance.

Tapeworms

Tapeworms or cestodes such as *Moniezia expansa* and *Moniezia benedeni* frequently infect goats, especially young animals. Goats become infected by ingesting oribatid mites on pasture, which act as intermediate hosts. Infected animals may show unthriftiness, poor growth, diarrhea, and proglottids in feces. Though tapeworms are often less pathogenic than nematodes, heavy burdens can cause intestinal blockage. Control involves pasture management, rotational grazing, and treatment with praziquantel or niclosamide. Breaking the life cycle by reducing exposure to intermediate hosts is an effective measure.

Trematodes

Trematode infections such as fasciolosis and amphistomosis occur in goats grazing in wet, marshy areas. *Fasciola gigantica* and *Fasciola hepatica* affect the liver and bile ducts, leading to chronic liver damage, anemia, bottle jaw, reduced weight gain, and decreased productivity. Amphistomes such as *Paramphistomum*, *Gastrothylax*, and *Cotylophoron* infect the rumen and reticulum; acute infection with immature amphistomes in the duodenum causes severe diarrhea and dehydration. Snails serve as intermediate hosts for trematodes, and their population peaks during monsoon and post-monsoon seasons. Control includes strategic deworming with flukicides like triclabendazole or oxyclozanide, snail control, fencing of marshy areas, and improved drainage.

Coccidia

Coccidiosis is a significant protozoan disease in kids aged 1–6 months. *Eimeria arloingi*, *Eimeria ninakohlyakimovae*, and other *Eimeria* species cause damage to the intestinal epithelial cells, resulting in diarrhea, dehydration, weight loss, poor feed conversion, and occasionally nervous signs due to hypocalcemia. Stress factors such as overcrowding, poor hygiene, sudden dietary changes, and weaning predispose kids to coccidiosis. Diagnosis is based on clinical signs and detection of coccidian oocysts in feces. Management involves improving hygiene, reducing stocking density, and prophylactic use of anticoccidials such as toltrazuril or decoquinate. Good nutrition and minimized stress enhance resistance to coccidiosis.

Lungworms

Lungworm infections in goats are caused by *Dictyocaulus filaria*, *Muellerius capillaris*, and *Protostrongylus rufescens*. These parasites inhabit the airways and lung parenchyma and are more common in goats kept in humid environments. Clinical signs include coughing, nasal discharge, dyspnea, reduced weight gain, and secondary bacterial pneumonia. Diagnosis is made by Baermann technique for detecting larvae in feces. Deworming with ivermectin or benzimidazoles is effective, and pasture management plays an important role in reducing infection levels.

Blood Parasites

Blood parasites such as *Trypanosoma evansi*, *Babesia*, *Theileria*, and *Anaplasma* infect goats in many parts of India. These parasites cause fever, anemia, lymphadenopathy, jaundice, and lethargy. Vectors include biting flies, ticks, and other hematophagous insects. Diagnosis relies on blood smear examination, serology, or molecular techniques. Control focuses on vector management, chemotherapeutic agents such as diminazene aceturate for trypanosomosis, and supportive therapy.

Integrated Control Measures for Internal Parasites

Internal parasite control in goats is most effective when integrated approaches are adopted. Strategic deworming programs should be based on seasonal parasite dynamics, age of the animals, and local epidemiology. Blanket deworming without assessment promotes resistance; therefore, targeted selective treatment using FAMACHA scoring, body condition scoring, and faecal egg count monitoring is recommended. Rotational grazing helps reduce pasture contamination, while mixed grazing with cattle or horses dilutes parasite populations and lowers infection pressure.

Providing browse species such as *Leucaena leucocephala* or tannin-rich plants can naturally reduce worm load. Ensuring adequate nutrition, especially protein supplementation, enhances immunity and helps goats cope better with parasitism. Kids should be housed in clean, dry conditions with adequate space to prevent heavy coccidial contamination. Proper disposal of manure, maintenance of hygiene in kidding pens, and clean water supply significantly reduce infection pressure.

Preventing overcrowding, minimizing stress, and practicing all-in all-out rearing

systems help break the parasite transmission cycle. Regular surveillance, proper record-keeping, and routine parasitological examinations allow early detection of rising parasite burdens and inform timely interventions.

Conclusion

Parasitism remains one of the most important health problems in goat production, especially in tropical regions where environmental conditions support continuous parasite survival. External parasites such as ticks, mites, lice, keds, fleas, and flies cause irritation, blood loss, skin damage, and vector-borne diseases, whereas internal parasites such as gastrointestinal nematodes, tapeworms, trematodes, coccidia, lungworms, and blood parasites significantly impair growth, productivity, and overall health. Sustainable parasite control in goats requires a comprehensive and integrated strategy that combines judicious use of antiparasitic drugs, improved management practices, environmental hygiene, nutrition, pasture management, and regular monitoring. Rational use of drugs, understanding local parasite epidemiology, and educating farmers about parasite risks are critical for reducing parasitic diseases and improving the productivity and welfare of goats.

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Common Viral Diseases in Goats and their Control Strategies

Mritunjay Kumar and Ravi Shanker Kumar Mondal
Department of Veterinary Medicine
Bihar Veterinary College
Bihar Animal Sciences University, Patna-14

Goat production is an important source of meat, milk and livelihoods worldwide. Viral diseases cause substantial production losses through mortality, reduced growth, decreased milk yield, and trade restrictions. Effective control requires integrating disease-specific measures (vaccination, therapeutics, surveillance) with herd-level management, biosecurity, and public-health awareness (for zoonoses). This document summarizes the most important viral diseases of goats, their clinical features, diagnostics, and practical control strategies. Key diseases covered: Peste des petits ruminants (PPR), capripox (goat pox), contagious ecthyma (orf), caprine arthritis-encephalitis virus (CAEV), bluetongue, and foot-and-mouth disease (FMD).

1. Pestes Des Petits Ruminants (PPR)

PPR is an acute and highly contagious viral disease of goats and sheep with very high mortality in susceptible populations. The causative agent is PPR virus, a Morbillivirus belonging to the family Paramyxoviridae. The disease is widely prevalent in Asia, Middle East and Africa. Goats are more susceptible than sheep, and severe disease is commonly noticed in young animals aged 4 to 12 months. The virus is transmitted primarily through aerosol and direct contact with nasal and ocular secretions of infected animals. Fomites such as feed troughs, water utensils and bedding material also play an important role in mechanical transmission during outbreaks.

The virus initially replicates in the lymphoid tissues and subsequently targets the respiratory tract and intestinal epithelium. This induces necrotizing stomatitis, erosive enteritis and pneumonia. The incubation period ranges from 2 to 6 days. The onset of disease is marked by sudden high fever, dullness, anorexia, matting of

eyelids, excessive ocular and nasal discharges, erosive lesions in the oral cavity, foul breath, diarrhoea and severe dehydration. Advanced cases show dyspnoea and coughing due to secondary bacterial pneumonia. Mortality varies from 10% to 100% depending on immunity status and secondary infections.

Diagnosis is mainly based on clinical signs and epidemiology. Laboratory confirmation is done using antigen detection tests like CIE, AGID and ELISA, while virus isolation is performed in Vero cells. Supportive therapy is the mainstay of treatment because no specific antiviral drug is available. Broad-spectrum antibiotics, antihistamines, fluid therapy, oral rehydration solutions and intestinal astringents are used to prevent secondary infection and dehydration. Control strategies include isolation of infected animals and strict sanitation. Mass vaccination with the live attenuated PPR vaccine at 3 to 4 months of age provides long-term immunity (up to three years) and plays a key role in eradication programs.

2. Contagious Ecthyma (Orf)

Contagious Ecthyma, also called Orf, is a viral skin disease of goats and sheep characterized by proliferative dermatitis and crust formation, particularly around the mouth and nostrils. It is caused by Orf virus, a Parapoxvirus belonging to the family Poxviridae. The virus is highly resilient and can survive for years in dried scabs, contributing to its persistence on endemic farms. The disease mainly affects kids aged 3 to 6 months and is associated with high morbidity and moderate mortality. Importantly, Orf is zoonotic and may produce lesions on the hands and arms of animal handlers.

Transmission occurs by direct contact with infected animals or indirectly through contaminated feed, pasture or equipment. Minor skin abrasions facilitate viral entry. The pathogenesis involves viral replication in keratinocytes, leading to papules, vesicles, pustules and thick brown crusts around the lips and muzzle. The lesions are painful and interfere with feeding, resulting in weight loss and poor growth. In severe cases, lesions may extend to the udder, teats, ears and genitalia.

Diagnosis is based on typical skin lesions and laboratory techniques including AGPT, CFT, electron microscopy and histopathology showing intracytoplasmic

inclusion bodies. There is no specific antiviral therapy; treatment is symptomatic. Local application of povidone iodine, antiseptic ointments or 5% copper sulphate helps in healing. Broad-spectrum antibiotics reduce secondary bacterial infections. Vaccination using live scab vaccine applied on scarified skin provides immunity for up to two years and is recommended in endemic regions. Isolation of affected animals and proper disposal of scabs are essential for prevention.

3. Goat Pox

Goat Pox is a systemic viral disease of goats characterized by generalized pock lesions on the skin and mucous membranes. It is caused by Goat Pox virus, a Capripoxvirus belonging to the family Poxviridae. The disease is prevalent in many Asian and African countries and causes significant economic loss due to mortality in kids, reduced growth rate and hide value deterioration. The virus spreads through direct contact, aerosol, and contaminated fomites, while wounds and abrasions facilitate viral entry.

The incubation period ranges from 4 to 15 days. Clinical signs begin with high fever, depression and reduction in feed intake, followed by the appearance of cutaneous papules, vesicles, pustules and scabs over the body, especially head, ears, udder, perineum and limbs. Conjunctivitis, nasal discharge and respiratory distress occur in severe cases. Pregnant goats may abort during infection. Necropsy reveals pock lesions on the skin and internal organs, pneumonic changes, enlarged lymph nodes and intracytoplasmic inclusion bodies.

Diagnosis is made based on clinical signs and confirmed by serological tests such as SNT, AGPT, ELISA and virus isolation. No specific antiviral drug is available; treatment is symptomatic and includes anti-inflammatory drugs, antibiotics and wound dressing. Prevention is mainly through vaccination using live Goat Pox vaccine (Uttarkashi strain), administered once at 3 months of age with revaccination every two years. Segregation of sick animals, strict disinfection and restriction of animal movement are essential to control outbreaks.

4. Foot And Mouth Disease (FMD)

Foot and Mouth Disease (FMD) is a highly contagious viral disease of goats and other cloven-hoofed animals, producing painful vesicular lesions in the mouth and feet, resulting in heavy production losses due to reduced feed intake, lameness, poor growth and decline in milk yield. The disease is caused by Foot and Mouth Disease Virus (FMDV), a small, non-enveloped, positive-sense RNA virus belonging to the genus Aphthovirus under the family Picornaviridae. Seven immunologically distinct serotypes are recognised—O, A, C, Asia-1, SAT-1, SAT-2 and SAT-3—and immunity is strictly serotype-specific. In India, serotypes O, A and Asia-1 are most frequently associated with outbreaks.FMD is widespread globally and remains endemic in many Asian and African countries. Goats and sheep often develop mild or sub-clinical infection, making them silent carriers that spread the virus to cattle and buffalo. The virus transmits rapidly through aerosol inhalation, direct contact with clinically affected or carrier animals, contaminated feed, water and fomites, as well as during transportation and livestock trading. Stress factors such as overcrowding, long travel, unhygienic environments and introduction of new animals into a flock further increase disease incidence. Kids may suffer the most severe form of disease and mortality in this age group may be high. Following entry, FMDV replicates initially in the pharyngeal epithelium and later spreads through the bloodstream producing viraemia. Vesicular lesions arise due to degeneration of stratified epithelial layers, primarily in the oral cavity, interdigital space, coronary band, udder and teats. Vesicles rupture and form raw ulcers that are extremely painful, interfering with feeding and locomotion. Secondary bacterial infections worsen the condition and animals that recover may remain pharyngeal carriers for several months. The incubation period is generally 2–14 days. The early stage is characterised by high fever, dullness, teeth grinding, excessive salivation and drooling of frothy saliva. Vesicles appear on the tongue, gums, inner lips and dental pad and rapidly rupture to create raw red ulcerated patches. Goats show difficulty in chewing and swallowing, resulting in sudden anorexia. Vesicles also form on the limbs including coronary band and interdigital space, leading to severe lameness and reluctance to walk. There is marked reduction in milk yield in lactating animals. Kids may develop

myocarditis, often dying suddenly without visible oral lesions. Mortality is generally low in adults but may be high in young animals. Typical lesions and herd history are suggestive, but laboratory confirmation is essential. Diagnostic techniques include ELISA, virus neutralization test, complement fixation test, competitive ELISA, RT-PCR and virus isolation in cell culture. Suitable samples include vesicular fluid, epithelial tissue and probang samples. Differential diagnosis should consider bluetongue, peste des petits ruminants (PPR), vesicular stomatitis and contagious ecthyma.There is no specific antiviral drug available for FMD and therapy is only supportive. Oral lesions should be cleaned with antiseptic solutions such as potassium permanganate, boroglycerine or povidone iodine to promote healing. Broad-spectrum antibiotics help prevent secondary bacterial infections. Anti-inflammatory agents and analgesics alleviate pain and encourage feed intake. Foot lesions require antiseptic dressing and animals should be kept on soft bedding. Nutritional support, electrolyte supplementation and soft diets aid recovery. The major strategy for FMD control in goats is systematic vaccination combined with strict biosecurity measures. In endemic regions, goats should be vaccinated at 4–5 months of age, revaccinated after 6 months and subsequently every 6 months using an inactivated trivalent FMD vaccine containing serotypes O, A and Asia-1. During outbreaks, immediate isolation of sick animals, disinfection of sheds using strong alkalis such as sodium hydroxide or soda ash or iodophor disinfectants, and restriction of animal movement are essential to prevent spread. Newly purchased animals must undergo at least 21 days of quarantine before herd introduction. Hygienic housing, controlled grazing, avoidance of overcrowding and prohibition of inter-farm animal exchange during disease season significantly reduce risk.

5. Caprine Arthritis–Encephalitis Virus (CAEV)

Caprine Arthritis–Encephalitis Virus (CAEV) is a chronic, debilitating viral disease of goats characterised primarily by progressive arthritis in adults and encephalitis in kids, leading to lifelong infection and major economic losses in dairy goat farming. CAEV is caused by a lentivirus belonging to the family Retroviridae, similar to Maedi–Visna virus of sheep. It is an enveloped RNA virus that integrates into host

cell DNA, establishing lifelong persistent infection. The virus shows tropism for monocytes/macrophages and induces chronic inflammatory lesions in joints and central nervous system. CAEV occurs worldwide, particularly in dairy breeds such as Saanen, Alpine and Toggenburg, with infection rates as high as 60–80% in intensive farms if control measures are not applied. Transmission occurs mainly through ingestion of infected colostrum and milk by kids, but direct contact via body secretions, shared equipment, blood-contaminated needles, and semen from infected bucks also plays a role. Vertical transmission in utero and through embryo transfer can occur. Latently infected animals without symptoms serve as reservoirs, contributing to silent spread within herds. Once infected, goats remain lifelong carriers. After entry, CAEV replicates in monocytes, which later differentiate into macrophages where active viral replication begins. This results in chronic inflammatory responses mediated by immune cells, cytokines and immune complexes. In adults, inflammatory lesions predominantly affect synovial membranes, cartilage and periarticular tissues, leading to arthritis. In kids, the virus invades the central nervous system, causing demyelination and perivascular mononuclear infiltration. Over time, progressive tissue damage results in irreversible clinical disease. The incubation period varies from months to years. In adult goats, the most common manifestation is chronic arthritis, especially affecting the carpal joints. Clinical signs include progressive joint swelling, lameness, pain during locomotion, stiff gait, poor body condition and eventual inability to move normally. In kids between 2 and 6 months of age, a leukoencephalomyelitis form develops, characterised by neurological signs such as hind limb ataxia, weakness, paralysis and difficulty standing or walking, while maintaining alertness. Other manifestations include hard-udder syndrome in lactating goats due to indurative mastitis, leading to reduced milk yield, and interstitial pneumonia with chronic coughing and exercise intolerance. Mortality is usually low in adults but may be high in severely affected kids. Clinical signs alone are not sufficient because many infected goats remain asymptomatic. Laboratory confirmation is done by serology using AGID (agar gel immunodiffusion) or ELISA, which are most widely used for herd screening. PCR and virus isolation from blood leukocytes, joint fluid, milk, or CNS tissue are

confirmatory tests. Histopathology of affected tissues reveals chronic lymphocytic synovitis, demyelination or mononuclear encephalomyelitis. Differential diagnoses include Mycoplasma arthritis, bacterial meningitis, listeriosis and spinal injuries. There is no cure for CAEV because of lifelong viral integration in host cells. Treatment is supportive, aimed at relieving symptoms and slowing progression. NSAIDs help reduce joint pain and inflammation, and physiotherapy or controlled exercise may improve mobility. Severely debilitated animals may require humane culling. Antibiotics are ineffective because CAEV is viral but may be used to treat secondary bacterial infections. Good nutrition and management can improve comfort but do not eliminate the virus. Since no vaccine or antiviral treatment exists, the most effective control strategy is prevention of infection in newborn kids and progressive elimination of the virus from the herd. CAEV-free herds are established by removing kids at birth and feeding them heat-treated colostrum and pasteurized milk or milk replacer from uninfected donors. Whole-herd serological testing should be performed regularly and seropositive animals should be segregated or culled depending on farm policy. Needles and surgical equipment must not be reused across animals, and natural mating or artificial insemination with semen from infected bucks must be avoided. Maintaining a closed herd system, enforcing strict biosecurity, and preventing the introduction of untested animals are critical for long-term control.

Conclusion

Viral diseases constitute a major threat to goat farming by causing high morbidity, mortality, production losses and treatment costs. PPR, Contagious Ecthyma and Goat Pox remain the most economically important viral infections of goats. Although specific antiviral drugs are not available, effective control can be achieved through strict biosecurity, early diagnosis, isolation of infected animals, supportive therapy and above all regular vaccination. Ensuring high herd immunity through systematic vaccination and educating farmers about disease management are essential for minimizing the economic loss and improving goat health and productivity.

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Common Bacterial Diseases of Goats and their Control Strategies

Pallav Shekhar and Mritunjay Kumar
Department of Veterinary Medicine
Bihar Veterinary College
Bihar Animal Sciences University, Patna-14

Important bacterial diseases such as Enterotoxemia, Tetanus, Pasteurellosis, and Brucellosis significantly impact goat production by causing high mortality, reduced productivity, and serious reproductive losses, ultimately threatening the economic stability and livelihood of farmers who depend on small ruminant farming. Enterotoxemia and tetanus often lead to sudden deaths in healthy, fast-growing goats, resulting in immediate financial losses, while pasteurellosis reduces growth rates, milk yield, and survival due to severe respiratory infections. Brucellosis, one of the most devastating reproductive diseases, causes widespread abortions, infertility, and decreased kid crop, undermining herd expansion and milk production, and it also poses a major public health risk that affects rural communities relying on goats for income, nutrition, and trade. Together, these bacterial diseases burden smallholder farmers through increased treatment costs, loss of animals, reduced market value, and restrictions on animal movement, making effective prevention and control essential for protecting livelihoods and sustaining the profitability of goat farming.

Enterotoxemia: Enterotoxemia, often called "overeating disease" or "pulpy kidney disease," is an acute and frequently fatal condition of goats caused by toxins produced by Clostridium perfringens* types C and D. These bacteria normally exist in low numbers within the intestinal tract, but under certain conditions they multiply rapidly and release potent toxins that lead to severe intestinal and systemic damage. The disease is seen in all ages but is especially common in young, fast-growing kids and in animals exposed to sudden dietary changes. Enterotoxemia is caused by Clostridium perfringens, a spore-forming, anaerobic bacterium.

Type C produces beta toxin, which causes severe hemorrhagic enteritis and primarily affects newborn and very young kids, particularly those with inadequate colostral

immunity.

Type D produces epsilon toxin, which becomes activated in the intestines and leads to increased vascular permeability, neurological signs, and sudden death. This form commonly affects rapidly growing kids on high-energy diets or goats that experience sudden increases in carbohydrate intake (e.g., grain, lush pasture, milk replacer). Environmental or dietary conditions that slow gut motility or introduce excess fermentable carbohydrates favor the rapid bacterial proliferation that triggers toxin production.

Clinical Signs:

The disease can be peracute, acute, or subacute depending on toxin type and age of the goat. In Peracute signs there is sudden death with little or no preceding signs. Kids often found dead after a heavy feeding episode. Acute/subacute signs is characterized by severe abdominal pain (kicking at belly, vocalization). There may be Profuse watery or bloody diarrhea (especially type C infections), Bloat and distended abdomen may be seen. There may be Incoordination, tremors, opisthotonos (neurological signs). Mortality is typically high, especially in unvaccinated herds.

Diagnosis:

Diagnosis is based on a combination of history, clinical signs, and laboratory confirmation.

History of high-energy feeding, sudden dietary change, or rapid kid growth. Post-mortem findings such as fluid-filled intestines, hemorrhagic enteritis (type C), or “pulpy kidneys” due to autolysis (type D) helps in diagnosis. Diagnosis often relies on toxin detection combined with suggestive clinical and necropsy findings.

Prevention

Prevention revolves around vaccination and proper management of diet.

1. Vaccination: Use a Clostridium perfringens type C & D toxoid (usually combined with tetanus toxoid as CD&T). Following dose should be followed:

Pregnant does: Vaccinate 4–6 weeks before kidding to ensure strong colostral immunity.

Kids: Vaccination should be started at 6–8 weeks of age, with a booster 3–4 weeks later.

Adults: Annual booster is recommended.

2. Dietary management:

Avoid sudden changes in feed, especially increases in grain or lush pasture. Concentrates feed should be gradually introduced and feeding should be done in controlled manner. Adequate roughage to maintain normal gut motility. Adequate colostrum intake for newborns must be insured in kids and over crowding should be avoided.

Tetanus:

Tetanus in goats is an acute, often fatal neurological disease caused by the bacterium *Clostridium tetani*, which is widely present in soil, manure, and the environment. The organism enters the goat's body through wounds that create anaerobic conditions, such as those resulting from castration, dehorning, kidding injuries, tail docking, hoof trimming accidents, or puncture wounds from sharp objects. Once inside the tissue, the spores germinate and multiply, producing a powerful neurotoxin called tetanospasmin. This toxin travels along the nerves to the central nervous system, where it blocks inhibitory neurotransmitters, leading to the characteristic rigid paralysis seen in affected animals.

Clinically, goats with tetanus first show stiffness in their gait and difficulty moving, often progressing to a characteristic “sawhorse stance.” The muscles of the neck and face become rigid, resulting in erect ears, an anxious facial expression, and partial lockjaw that interferes with normal eating and chewing. A classic sign is the protrusion of the third eyelid when the head is elevated. As the disease progresses, the animal becomes extremely sensitive to touch, noise, or light, which can trigger violent muscle spasms. Body temperature may rise due to continuous muscle contractions. Affected goats often experience difficulty swallowing, resulting in

drooling and bloat, and in advanced stages they may become recumbent, suffer convulsions, and eventually die due to respiratory failure caused by paralysis of the breathing muscles.

Diagnosis of tetanus is usually based on the history and clinical signs rather than laboratory testing, since *C. tetani*is difficult to isolate. A recent wound combined with progressive muscle stiffness, third-eyelid prolapse, and exaggerated responses to external stimuli strongly suggests tetanus. Although laboratory confirmation is possible, it is rarely necessary, as the classical presentation is typically sufficient for diagnosis.

Treatment requires rapid and aggressive intervention. The administration of tetanus antitoxin is crucial, as it neutralizes circulating toxin that has not yet bound to the nervous system. Antibiotics, particularly penicillin, are given to eliminate the bacteria at the site of infection. The wound must be thoroughly cleaned, opened, and debrided to remove necrotic tissue and improve oxygenation, thereby inhibiting further bacterial growth. Supportive therapy is equally important; muscle relaxants such as diazepam, sedatives, and keeping the goat in a quiet, dark environment help to reduce spasms. Nutritional support, fluid therapy, and careful nursing are often necessary because affected goats may be unable to eat or drink. Despite intensive treatment, the prognosis remains guarded, especially once the animal becomes recumbent or experiences severe spasms.

Prevention of tetanus in goats relies heavily on effective vaccination and proper wound management. The tetanus toxoid vaccine, commonly administered as part of the CD&T vaccine, is the best method of protection. Pregnant does should be vaccinated four to six weeks before kidding to provide passive immunity to newborn kids through colostrum, while kids should receive their first vaccination at six to eight weeks of age followed by a booster a few weeks later. Annual boosters for adult goats are recommended. In high-risk procedures such as castration or dehorning, the use of tetanus antitoxin offers temporary protection. Alongside vaccination, strict hygiene during surgical procedures, quick treatment of wounds, and maintaining clean living environments significantly reduce the risk of infection. With proper preventive measures, tetanus is largely avoidable, even though it remains one of the

most dangerous clostridial diseases affecting goats.

Pasteurellosis / Pneumonia

Pasteurellosis in goats is an important respiratory disease characterized by sudden onset pneumonia and high morbidity, especially in young or stressed animals. It is commonly associated with stressful conditions such as transportation, overcrowding, abrupt weather changes, poor ventilation, and concurrent infections that weaken the immune system. The disease is primarily caused by Pasteurella multocida and Mannheimia haemolytica, both of which are normal inhabitants of the upper respiratory tract but can invade the lungs when host immunity is compromised. Once these bacteria multiply in the lower respiratory passages, they produce toxins and cause severe inflammation of the lung tissues, leading to acute respiratory distress.

Clinically, affected goats may show fever, loss of appetite, nasal discharge, coughing, and rapid, labored breathing. Harsh lung sounds, depression, reluctance to move, and frothy nasal discharge can occur in advanced cases. In young kids, the disease may progress rapidly, sometimes causing sudden death without obvious preceding symptoms. Environmental stress and nutritional deficiencies often exacerbate the severity of clinical signs.

Diagnosis of pasteurellosis is based on the history of stress or sudden weather changes, clinical presentation, and physical examination. Lung sounds, nasal exudate, and fever support the diagnosis, while laboratory confirmation can be obtained through bacterial culture and sensitivity from nasal swabs or lung tissue. Radiographic or post-mortem findings showing consolidation and fibrinous pneumonia provide additional confirmation.

Treatment involves the early use of effective antibiotics such as oxytetracycline, penicillin-streptomycin combinations, or ceftiofur, depending on local availability and veterinary advice. Supportive therapy, including anti-inflammatory drugs, good hydration, and improved ventilation, greatly enhances recovery. Severely affected animals may require isolation, warmth, and easily digestible feed to reduce metabolic stress.

Prevention focuses on reducing predisposing factors and strengthening the animal's immunity. Vaccination with pasteurella vaccines can significantly decrease the incidence and severity of the disease. Proper management practices such as avoiding overcrowding, ensuring adequate ventilation, minimizing sudden climatic stress, and maintaining good nutrition are essential. Quarantine of newly purchased animals and prompt treatment of any respiratory signs help prevent spread within the herd. With consistent preventive measures, pasteurellosis can be effectively controlled in goat populations.

Brucellosis (Brucella melitensis, Brucella abortus)

Brucellosis in goats is a contagious bacterial disease that primarily affects the reproductive system, leading to significant economic losses due to abortions, infertility, reduced milk production, and weak newborns. It is particularly important in regions where small ruminant farming is widespread. The disease is caused mainly by Brucella melitensis in goats, although Brucella abortus, typically associated with cattle, can also infect goats. Brucellosis spreads easily within herds through aborted fetuses, placentas, vaginal discharges, milk, and contaminated environments, and it poses a serious public health concern due to its zoonotic nature.

The etiology of the disease involves infection by gram-negative, intracellular bacteria of the genus Brucella. Brucella melitensis is highly pathogenic and is the most common species responsible for caprine brucellosis, causing severe reproductive disturbances. Brucella abortus, although less common in goats, can be transmitted through close contact with infected cattle or contaminated environments. These organisms have the ability to survive inside macrophages, making the infection chronic and difficult to eliminate. Routes of transmission include ingestion of contaminated materials, inhalation of aerosols, and entry through mucous membranes or skin abrasions.

Clinical signs in goats are mainly reproductive in nature. The most characteristic sign is late-term abortion, usually occurring in the last trimester of pregnancy. Infected females may show retained placenta, metritis, and reduced fertility in subsequent breeding seasons. Other signs include stillbirths, weak kids, decreased milk yield,

and swollen joints or orchitis in bucks due to inflammation of the testes and epididymis. Although adult goats may appear clinically normal between reproductive events, they continue to shed the organism, contributing to ongoing transmission.

Brucellosis has major zoonotic importance, especially Brucella melitensis, which is considered the most pathogenic species for humans. People can become infected through consumption of unpasteurized milk or dairy products, handling of aborted fetuses or placentas, and contact with contaminated secretions. In humans, the disease presents as undulating fever, joint pain, weakness, and chronic health complications if left untreated. The zoonotic potential makes brucellosis not only an animal health problem but also a significant public health threat.

Diagnosis is based on clinical history, reproductive records, and laboratory testing. Serological tests such as the Rose Bengal Test (RBT), Complement Fixation Test (CFT), ELISA, and milk ring test are commonly used for screening and confirmation. Bacterial isolation from aborted materials or tissues provides definitive diagnosis, although it requires specialized laboratory facilities due to the risk of human infection. Molecular techniques like PCR can also aid in rapid and sensitive detection.

Prevention of brucellosis in goats depends on strict herd management and biosecurity. Vaccination using suitable Brucella vaccines, such as Rev.1 for B. melitensis, is an effective preventive measure in endemic areas. Farmers should avoid introducing infected animals into healthy herds and should quarantine all new additions. Proper disposal of aborted fetuses, placentas, and contaminated bedding is essential, along with thorough disinfection of facilities. Consumption of raw milk and unpasteurized dairy products should be discouraged to prevent zoonotic transmission. Regular herd testing, culling of positive animals, and strict adherence to sanitary practices are crucial steps in controlling and ultimately eradicating brucellosis in goat populations.

Advancing Goat Production Through Artificial Insemination: Improved Genetics, Better Health and a Sustainable Future

Alok Kumar[1] and J. K. Prasad[2]
[1]Department of Gynecology, [2] Dean
Bihar Veterinary College
Bihar Animal Sciences University, Patna-14

1. Introduction

Goat farming is deeply integrated into India's rural ecosystem and plays a vital role in supporting small and marginal farmers. Goats require minimal resources, are highly adaptable, and reproduce rapidly compared to other livestock species. Traditional goat breeding depends solely on natural mating, where one buck serves many does, often without any selection based on genetic merit. This limits genetic improvement and increases the risk of spreading reproductive diseases. Artificial Insemination (AI), therefore, emerges as a scientifically superior alternative for enhancing productivity. AI involves depositing semen collected from a genetically elite buck directly into the reproductive tract of a doe, eliminating the dependence on natural mating. Although widely practiced in cattle and buffalo for decades, goat AI has expanded slowly due to anatomical challenges, the need for specialized equipment and trained manpower. However, the benefits in terms of genetic gain, improved reproductive efficiency, reduced disease risks and enhanced flock uniformity are significant. When systematically implemented, AI can transform goat production systems and build a stronger foundation for sustainable rural livelihoods.

2. Need for AI in the Indian Context with special reference to BIHAR

India's goat sector is predominantly unorganized, and most farmers own only a few animals with limited access to quality breeding bucks. This results in slow genetic progress, low body weight gain, poor milk yield and compromised resilience against diseases. Artificial Insemination provides an opportunity to bridge this gap by enabling access to high-quality semen from elite bucks located anywhere in the country. Instead of purchasing costly breeding males, farmers can inseminate their does with frozen semen at a fraction of the cost. More importantly, semen from a

superior buck can be used to inseminate thousands of does, ensuring rapid dissemination of desirable traits across regions. AI also reduces the spread of sexually transmitted reproductive diseases, offering a safer alternative to natural mating. In states like Bihar, where goat husbandry is central to rural livelihoods, AI technology has the potential to significantly enhance productivity, ensure uniformity in the flock and support socio-economic development among resource-poor families.

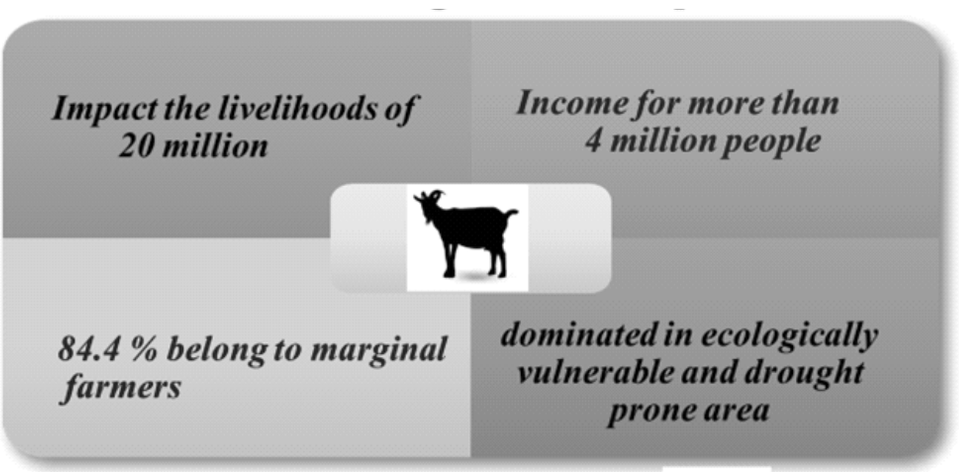

Figure:1. Impact of goat rearing on socio-economic condition of farmers

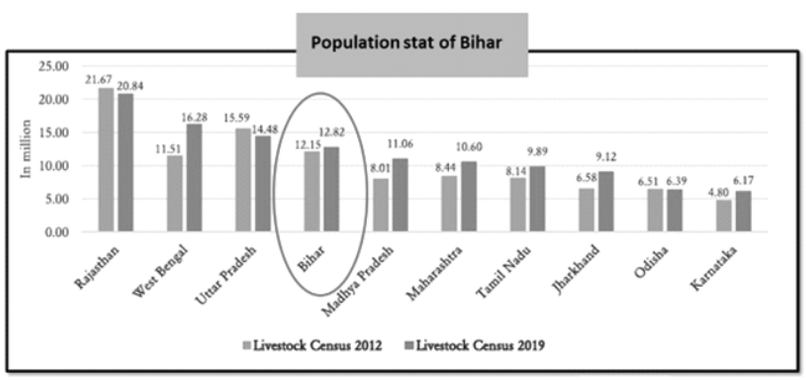

Figure:2. Goat population statistics in Indian states. Bihar stands 4th in goat population

3. Major Advantages of Artificial Insemination in Goats

Artificial Insemination offers several advantages that directly impact productivity, health and genetic improvement in goats.

A) Rapid Genetic Progress

Rapid genetic progress through artificial insemination occurs because semen from a single, superior buck can be disseminated to a very large population of does across different regions, multiplying his genetic influence exponentially. Unlike natural mating, where one male's contribution remains limited to the number of females he can physically mate with, AI enables thousands of inseminations from the same buck through semen processing and cryopreservation. This accelerates the spread of desirable traits—such as higher milk yield, better growth rate, enhanced fertility and improved disease resistance—across entire goat populations within a short time. Through continuous selection of top-performing males and systematic use of their semen, AI ensures sustained genetic improvement, uniformity in flock performance and long-term productivity enhancement for farmers.

B) Efficient Use of Elite Bucks

Efficient use of elite bucks is one of the most significant advantages of artificial insemination, as it allows a single genetically superior male to contribute far more extensively to the breeding population than is possible through natural mating. Through semen dilution, extension and cryopreservation, one ejaculate can be processed into multiple insemination doses, enabling hundreds or even thousands of does to benefit from the same elite genetics. This not only maximizes the reproductive output of valuable bucks but also reduces the need for farmers to maintain multiple males, lowering feeding and management expenses. Moreover, by concentrating breeding efforts on a few high-quality males, AI programs promote rapid dissemination of superior traits and help build a more uniform, productive and genetically refined goat population over generations.

C) Access to Superior Breeds Nationwide

Access to superior breeds nationwide is greatly enhanced through artificial

insemination, as frozen semen can be transported safely and efficiently across long distances without requiring the physical movement of live animals. This enables farmers in remote or underserved areas to utilize the genetics of highly valued breeds such as Jamunapari, Sirohi or Black Bengal, even if these breeds are not locally available. By using cryopreserved semen from elite bucks maintained at national or state-level semen banks, it becomes possible to introduce superior growth, higher milk yield and improved reproductive traits into local goat populations. This approach eliminates the cost, risk and logistical challenges associated with transporting breeding males, and ensures that even small-scale farmers have equitable access to high-quality germplasm. Consequently, AI helps bridge regional genetic gaps and promotes nationwide improvement in goat productivity and breed diversity.

D) Reduced Disease Transmission

Artificial insemination significantly lowers the risk of spreading reproductive and venereal diseases within goat populations because it eliminates direct physical contact between bucks and does. In natural mating systems, sexually transmitted infections such as contagious agalactia, brucellosis and other reproductive tract pathogens can easily pass from infected males to multiple females, creating large-scale health and productivity losses. AI prevents this by ensuring that semen is collected, processed and stored under strict hygienic and laboratory-controlled conditions, where each ejaculate undergoes thorough evaluation and, when required, disease screening. Furthermore, semen extenders often contain antibiotics that add an additional layer of protection. By minimizing the movement of breeding bucks between farms and eliminating uncontrolled mating behavior, AI helps maintain flock health, reduces treatment costs, and supports more stable reproductive performances across herds. This disease-preventive advantage is especially crucial in dense goat-farming regions, where even a minor infection can spread rapidly and cause significant economic damage.

E) Safer Flock Management

Artificial insemination also contributes substantially to safer and more controlled flock management by reducing the need for maintaining adult breeding bucks within the herd. Bucks are often aggressive, particularly during the breeding season, and their presence may cause stress, injury or unnecessary disturbance to does and younger animals. Natural mating can also lead to accidents, rough mounting and physical trauma, especially in small-bodied breeds like Black Bengal. With AI, these risks are minimized because the breeding process is performed under supervision by trained personnel, eliminating uncontrolled mating behavior. Farmers are relieved from the burden of managing multiple bucks or handling their unpredictable temperament. Additionally, AI prevents dominance-related conflicts among males, reduces the chances of inbreeding and enables better reproductive planning. Overall flock safety improves, animal welfare is enhanced and the environment becomes more organized and peaceful, which ultimately supports improved productivity and reduces avoidable economic losses.

F) Synchronized Breeding and Efficient Management

Synchronized breeding through artificial insemination provides a powerful tool for improving management efficiency in goat production systems. By using hormonal protocols or controlled exposure to bucks, large groups of does can be brought into heat at the same time, allowing AI to be performed in a highly organized and coordinated manner. This results in synchronized kidding, where kids are born within a short, predictable window. Such uniformity greatly simplifies critical management tasks, including vaccination schedules, deworming, kid creep-feeding, and overall herd health monitoring. Farmers can allocate labor more efficiently, plan feed resources effectively, and reduce the scattered workload associated with year-round kidding. Group kidding also improves kid survivability because adequate human supervision can be ensured during the critical neonatal period. Additionally, synchronized breeding helps create uniform batches of market-ready animals, which is highly advantageous for commercial goat meat and breeding enterprises. Overall, synchronization combined with AI leads to streamlined operations, better record-

keeping, and improved farm profitability.

4. Limitations and Challenges of AI in Goats Despite its significant potential, artificial insemination in goats faces several limitations that restrict its widespread adoption, particularly in developing regions. One of the primary challenges is the anatomical complexity of the goat cervix, which requires highly skilled technicians capable of performing insemination accurately. Unfortunately, trained manpower remains limited, especially in remote rural areas. The availability of specialized AI equipment—such as semen straws, AI guns, thawing units and liquid nitrogen storage containers—is also inconsistent and often inadequate. Incorrect heat detection by farmers further reduces conception rates, as AI must be performed within a narrow window for optimal results. Additionally, the cost of establishing semen banks, storage facilities and field-level service delivery systems may pose financial constraints to institutions and smallholder farmers. Poor hygiene, improper semen handling or inadequate thawing techniques may lead to uterine infections or unsuccessful inseminations. Therefore, expanding AI in goats requires comprehensive training programs, improved infrastructure, awareness campaigns and continued field support.

5. Signs of Heat (Estrus) in Goats Accurate estrus detection is the key determinant of AI success in goats. A doe generally cycles every 20–21 days, though stress, malnutrition, illness or recent kidding may delay estrus expression. Observable behavioral and physical changes help identify heat. The doe becomes restless, bleats frequently and wags her tail continuously. The vulva becomes swollen, moist and reddish, accompanied by a clear, stringy mucus discharge—one of the most reliable signs. The doe shows a strong response to the scent or presence of a buck, often presenting herself for mounting. Increased urination, reduced appetite and mild nervousness are also common. Some does may stand still when touched near the tail head—a sign known as the standing reflex. Recognizing these indications and timing AI within the first 10 hours of heat substantially increases conception rates. Proper training of farmers and field workers in estrus detection is essential for maximizing

the benefits of AI.

6. Semen Collection Using the Artificial Vagina Method

The Artificial Vagina (AV) method is internationally recognized as the most hygienic, safe and reliable technique for semen collection in bucks. The AV consists of a rubber cylinder lined internally and filled with warm water (around 42°C) to mimic the natural vaginal environment. Prior to collection, the buck is stimulated by bringing it in close contact with a doe in heat or using a well-designed dummy doe. When the buck attempts to mount, the technician positions the AV carefully over the penis at an appropriate angle, ensuring natural ejaculation into a sterile attached container. The collected semen is immediately transferred to a laboratory where parameters such as motility, concentration, viability and morphology are assessed using standard protocols. High-quality semen is then diluted with appropriate extenders, packed into straws and frozen in liquid nitrogen at –196°C. The AV method reduces the risk of contamination, eliminates the need for natural mating and ensures consistent, high-quality semen for AI programs.

7. Artificial Insemination Procedure in Does

AI in does requires precision, cleanliness and understanding of the female reproductive anatomy. Once estrus is confirmed, all equipment—including AI guns, sheaths, gloves, thermos flasks and thawing jars—are sterilized and arranged. Semen straws stored in liquid nitrogen are carefully retrieved and thawed in 37°C warm water for 30–40 seconds. The straw is cut and loaded

Figure:3. Procedure of AI in Doe (Demo purpose)

into the AI gun with a sterile sheath. The doe is gently restrained, her tail lifted, and the vulva is disinfected using 70% alcohol or a safe antiseptic to prevent infection. The AI gun is inserted slowly at an upward angle to navigate the vaginal folds and reach the cervical opening. Semen is deposited at or near the cervix to maximize sperm transport. After insemination, the gun is withdrawn gently and all waste materials are disposed of safely. The doe should rest for 20–30 minutes to prevent backflow of semen. Successful AI depends on correct timing, hygiene, gentle technique and proper handling of semen.

8. Bihar: Importance and Future Potential of AI in Goats

Bihar holds a unique and strategically significant position in India's goat production landscape, with goat farming serving as a major livelihood source for millions of

Figure:4. Goat Semen Biology Lab at Bihar Veterinary College, Bihar Animal Sciences University, Patna.

rural households. The state has a very high population density and widespread land fragmentation, making goat rearing a suitable enterprise even for families with

minimal land resources. Women, in particular, constitute a large percentage of goat keepers in Bihar, and therefore any improvement in productivity directly enhances their socio-economic empowerment. In this context, Artificial Insemination (AI) emerges as a transformative intervention capable of elevating both productivity and profitability in goat husbandry across the state. The primary importance of AI in Bihar stems from its ability to introduce rapid genetic improvement within local goat populations—especially the economically important Black Bengal breed. This breed is well known for exceptional meat quality, prolificacy and adaptability, but its productivity has been limited by poor selection and unrestricted mating. Through AI, farmers can now access semen from elite, genetically superior bucks that have been evaluated scientifically, enabling marked improvement in growth performance, reproductive traits and overall flock health within a few generations.

The future of AI in Bihar is very promising, especially because of institutional support from Bihar Animal Sciences University and Bihar Veterinary College. Initiatives such as mobile AI units, village-level AI delivery services, synchronized breeding programmes and doorstep semen distribution models are being developed. These efforts, combined with government-funded research and extension projects, are preparing the state for large-scale deployment of AI in goats. If implemented systematically, AI can revolutionize goat production in Bihar by increasing household income, reducing disease risks, ensuring genetic conservation, and establishing Bihar as a national leader in scientific goat breeding.

Role and Contribution of the Goat Semen Biology Laboratory, Bihar Veterinary College.

The Goat Semen Biology Laboratory at Bihar Veterinary College (BVC), under Bihar Animal Sciences University (BASU), has emerged as a pivotal institution in advancing scientific goat breeding and Artificial Insemination (AI) in the state. Established with the vision of improving genetic potential in local goat breeds—especially the Black Bengal—this laboratory has taken the lead in semen technology research, training, and field implementation. One of its most significant

contributions lies in developing region-specific protocols for semen collection, evaluation, dilution, cooling and cryopreservation suited to Bihar's climatic conditions. These protocols ensure that semen maintains high post-thaw motility, viability and fertilizing ability, which are essential for improving conception rates under field conditions.

The laboratory routinely collects semen from elite bucks selected on the basis of growth rate, body conformation, reproductive health and genetic merit. Each ejaculate undergoes rigorous microscopic and biochemical assessment before being approved for dilution or freezing. Advanced research is being conducted on antioxidant supplementation, extender composition, cryo-protectant optimization and semen longevity to enhance fertility outcomes.

Beyond laboratory work, the unit plays a crucial extension role by supplying high-quality frozen semen to rural AI service providers and conducting hands-on training for veterinarians, para-vets and field workers. Through government-funded projects, it is actively engaged in establishing an efficient semen distribution network to ensure that even marginalized farmers in remote areas can benefit from superior germplasm. By integrating research, training and field implementation, the Goat Semen Biology Lab has become the backbone of goat AI development in Bihar and stands as a model for other states seeking to modernize their goat breeding programs.

Conclusion

Artificial insemination represents a transformative opportunity for strengthening the goat production sector in India, particularly in states like Bihar, where goats form the backbone of rural livelihoods. As a reproductive technology, AI offers far more than a modern alternative to natural mating—it provides a structured pathway for scientific breeding, rapid genetic enhancement and long-term economic upliftment of small and marginal farmers. Through the use of carefully selected elite bucks, AI accelerates the dissemination of superior traits such as improved growth rate, higher milk yield, enhanced fertility, disease resistance and adaptability. This enables the formation of healthier, more productive and genetically uniform goat populations, which in turn contributes to more predictable and profitable farm performance. Despite certain limitations—such as the need for skilled technicians,

specialized equipment and accurate estrus detection—the overall potential of AI remains substantial. With coordinated efforts in farmer training, infrastructure development, extension support and institutional research, these challenges can be systematically overcome. The active involvement of organizations like Bihar Veterinary College and the Goat Semen Biology Laboratory further strengthens this foundation by providing high-quality semen, region-specific protocols, and scientific guidance to field-level practitioners.

As awareness grows and access to AI services expands, goat farmers will increasingly adopt this technology as a reliable tool for upgrading their flocks. The future of goat husbandry in India hinges on efficiency, genetic merit and disease control—all of which are directly supported by AI. Therefore, artificial insemination stands not only as a scientific milestone but also as a catalyst for sustainable rural development, income enhancement and the overall modernization of goat farming in the years to come.

बिहार पशु विज्ञान विश्वविद्यालय
पटना–800014, बिहार

नामांकन नोटिस

बिहार पशु विज्ञान विश्वविद्यालय, पटना के अधीन बिहार पशु चिकित्सा महाविद्यालय,पटना एवं संजय गाँधी गव्य प्रौद्योगिकी संस्थान, पटना में शैक्षणिक सत्र 2025–2026 में नये पाठ्यक्रम शुरू किए जा रहा है, नामांकन हेतु विवरणी निम्नवत् है:–

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कोर्स का नाम	अवधि
बी.एस.सी. (पोल्ट्री प्रोडक्शन)	3 वर्ष (6 सेमेस्टर)

पैरा वेटरनरी साइंसेज

कोर्स का नाम	अवधि
डिप्लोमा इन वेटरनरी एंड लाइवस्टॉक डेवलपमेंट (डी.वी.एल.डी.)	2 वर्ष (4 सेमेस्टर)
डिप्लोमा इन वेटरनरी लेबोरेटरी टेक्नोलॉजी (डी. वी. एल. टी.)	2 वर्ष (4 सेमेस्टर)
सर्टिफिकेट कोर्स इन आर्टिफिशियल इन्सेमिनेशन	3 माह

पोस्ट ग्रेजुएट डिप्लोमा

ऑनलाईन – वेटरनरी होम्योपैथी, एथ्नोवेटरनरी मेडिसिन, वन हेल्थ, ऑफलाईन – बोवाइन क्लिनिकल प्रैक्टिस, कैनाइन एंड फेलाइन क्लिनिकल प्रैक्टिस ।
एडवांस ट्रेनिंग कोर्स ऑन इम्पोर्टेंट वेटरनरी क्लिनिकल प्रोसीजर अवधि: 3 सप्ताह, प्रवेश क्षमता: 6

सर्टिफिकेट कोर्स

वेटरनरी फॉरेंसिक साइंस, सीमन हैंडलिंग एवं आर्टिफिशियल इन्सेमिनेशन, मॉलिक्यूलर डायग्नोसिस ऑफ इन्फेक्शस डिजीजेस, वेटरनरी डायग्नॉस्टिक इमेजिंग, एम्ब्रायो ट्रांसफर टेक्नोलॉजी (आईवीएफ) इन बोवाइन।

ऑनलाइन पाठ्यक्रम

फीड एवं फॉडर टेक्नोलॉजी पर ऑनलाइन शार्ट कोर्स
प्रसार एवं उद्यमिता विकास पर ऑनलाइन शार्ट कोर्स

संजय गाँधी गव्य प्रौद्योगिकी संस्थान, पटना

कोर्स का नाम	अवधि
बी.टेक. (एफ.टी.)	4 वर्ष (8 सेमेस्टर)

प्रवेश क्षमता, अवधि एवं सभी कोर्स की विस्तृत जानकारी हेतु विश्वविद्यालय की वेबसाइट www. basu.org.in पर अपलोड किए गए विवरण पुस्तिका को देखें।

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