Scientific Dairy Farming Practices for the Semi-Arid Tropics

Compiled by

Prakashkumar Rathod

ICRISAT
INTERNATIONAL CROPS RESEARCH
INSTITUTE FOR THE SEMI-ARID TROPICS

Citation: Rathod P. (2019). Scientific Dairy Farming Practices for the Semi-Arid Tropics. Patancheru 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. 32 pp.

Cover photo:
Sahiwal cow: Dr Vivek Patil, LRIC (Deoni), KVAFSU, Bidar

Back cover photo:
Deoni cow: L Manjunath, Veterinary College, Hassan

Contents page photo:
Rathi cow: Dr Vivek Patil, LRIC (Deoni), KVAFSU, Bidar

Scientific Dairy Farming Practices for the Semi-Arid Tropics

Compiled by

Prakashkumar Rathod

ICRISAT
INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

IDC ICRISAT DEVELOPMENT CENTER

About the author

Dr Prakashkumar Rathod - Visiting Scientist, ICRISAT Development Center, Asia program, ICRISAT, Patancheru 502 324, Telangana, India.

Acknowledgements

We thank Dr Sariput Landge, Maharashtra Animal and Fisheries Science University, Nagpur (Maharashtra) and Dr Siddaling Swamy Hiremath, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar (Karnataka) for their valuable inputs.

Edited by: Smitha Sitaraman; *Design:* SK Meeravali

CONTENTS

Introduction

The livestock sector is one of the fastest growing agricultural sub-sectors in India. It is a rich source of high quality products such as milk, meat and eggs and a source of income and employment to millions of rural farmers, particularly women. According to the reports of Central Statistics Office, the value of outputs from the livestock sector at current prices was about ₹811,847 crores during 2015-16, which is about 28.6% of the value of outputs from the agricultural and allied sectors. Within this sector, dairying is a livelihood option for many rural poor, especially the landless, marginal and small farmers in India. It serves as an effective tool for rural development, employment and sustained income and as an insurance against several odds. Milk production in India during 2015-16 and 2016-17 was 155.5 million tonnes and 165.4 million tonnes respectively, showing an annual growth of 6.37%.

Dairy farming in semi-arid India is mainly taken up by smallholders who rear animals on crop residues and common property resources. They are handicapped by low capital and lack of resources and training. Lately, dwindling common property resources are driving farmers to take up intensive systems. The dairy scene in India is undergoing changes with newer technologies in breeding, feeding, management and disease control, underlining the need to adopt scientific dairy farming methods. The profitability and sustainability of dairy farming in the semi-arid tropics hinges on increased production and efficiency through the adoption of improved practices that enhance nutrition and livelihood security.

Choosing the Right Breed

India has about 40 breeds of cattle and 13 breeds of buffaloes that are distributed across the country and agro-climatic conditions. While there is no 'ideal breed', choices are specific to the purpose they serve and to the farming environment, production system, breeding system and market requirements, and most importantly, the socio-economic status of the farmer. What purpose will the breed serve? Broadly, the purpose of rearing dairy animals is for milk, draught (work) or for both (dual purpose). Dairy animals are also reared for dung (as manure), urine, etc. While choosing a breed, it is best to buy those from the home tracts or local farmers rearing that breed rather than bringing in a breed from afar. In general, cattle from drier regions are well built while those from heavy rainfall, coastal and hilly regions are smaller in build.

Sahiwal cow

Photo: Dr Vivek Patil, LRIC (Deoni), KVAFSU, Bidar

Tharparkar cow

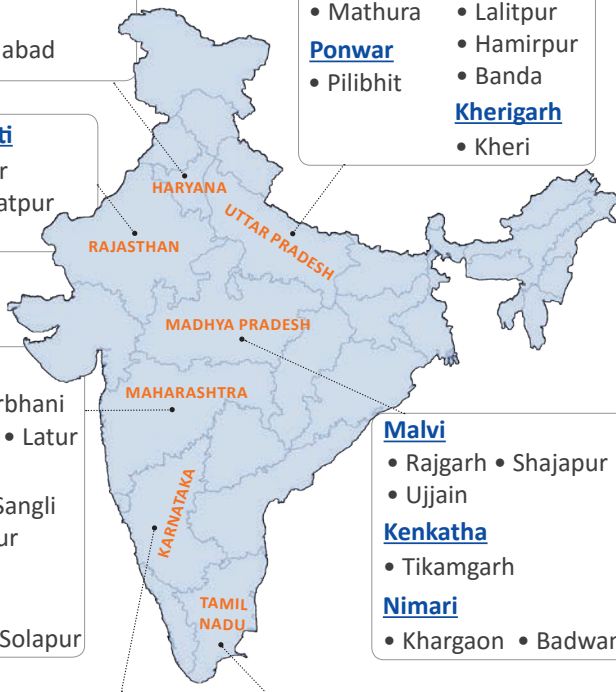
Photo: ICAR-NBAGR, Karnal

Gangatiri cow

Photo: Dr Vivek Patil, LRIC (Deoni), KVAFSU, Bidar

Home tracts of different dairy breeds of cows in the semi-arid tropics of India

■ Draught purpose



Mewati
• Gurgaon • Faridabad

Nagori
• Bikaner
• Jodhpur
• Nagaur

Mewati
• Alwar
• Bharatpur

Mewati
• Mathura

Ponwar
• Pilibhit

Kenkatha
• Lalitpur
• Hamirpur
• Banda

Kherigarh
• Kheri

Red Kandhari
• Ahmadnagar • Parbhani
• Bheed • Nanded • Latur

Khillar
• Pune • Satara • Sangli
• Solapur • Kolhapur
• Osmanabad

Krishna Valley
• Satara • Sangli • Solapur

Malvi
• Rajgarh • Shajapur
• Ujjain

Kenkatha
• Tikamgarh

Nimari
• Khargaon • Badwani

Khillar
• Belgaum • Bijapur • Dharwad
• Gulbarga • Bagalkote

Amritmahal
• Chikmagalur • Chitradurga • Hassan
• Shimoga • Tumkur • Davanagere

Hallikar
• Bengaluru • Chitradurga • Hassan
• Kolar • Mandya • Mysore • Tumkur

Krishna Valley
• Belgaum • Bijapur • Raichur

Pulikulam
• Madurai • Sivaganda
• Virudhunagar

Umblachery
• Nagapatinam • Thiruvarur

Kangayam
• Coimbatore • Erode
• Dindigul • Karur
• Namakkal

Bargur
• Erode

Home tracts of different dairy breeds of cows in the semi-arid tropics of India

■ Milk ■ Dual purpose

Hariana
• Hisar • Rohtak • Sonepat
• Gurgaon • Jind • Jhajjar

Belahi
• Ambala • Panchkula
• Yamunanagar • Chandigarh

Tharparkar
• Barmer • Jaisalmer • Jodhpur

Kankrej
• Barmer • Jodhpur

Sahiwal • Ganganagar

Rathi
• Ganganagar
• Jaisalmer • Bikaner

Dangi • The Dangs

Tharparkar • Kachchh

Gir
• Amreli • Bhavnagar
• Junagadh • Rajkot

Kankrej
• Ahmedabad
• Banaskantha
• Kheda • Mahesana
• Sabarkantha • Kachchh

Dangi
• Thane • Nashik
• Ahmednagar

Deoni
• Parbhani • Latur
• Nanded • Osmanabad

Gaolao
• Wardha • Nagpur

Sahiwal
• Ferozepur
• Amritsar

Gangatiri
• Varanasi • Ballia
• Mirzapur • Ghazipur

PUNJAB
HARYANA
RAJASTHAN
UTTAR PRADESH
BIHAR
GUJARAT
MADHYA PRADESH
MAHARASHTRA
ANDHRA PRADESH
KARNATAKA

Gangatiri
• Bhojpur

Gaolao
• Balaghat
• Chhindwara
• Seoni • Durg
• Rajnandgaon

Ongole
• East Godavari
• Guntur • Prakasam
• Nellore • Kurnool

Punganur
• Chittoor

Deoni
• Bidar

Jaffarabadi buffalo

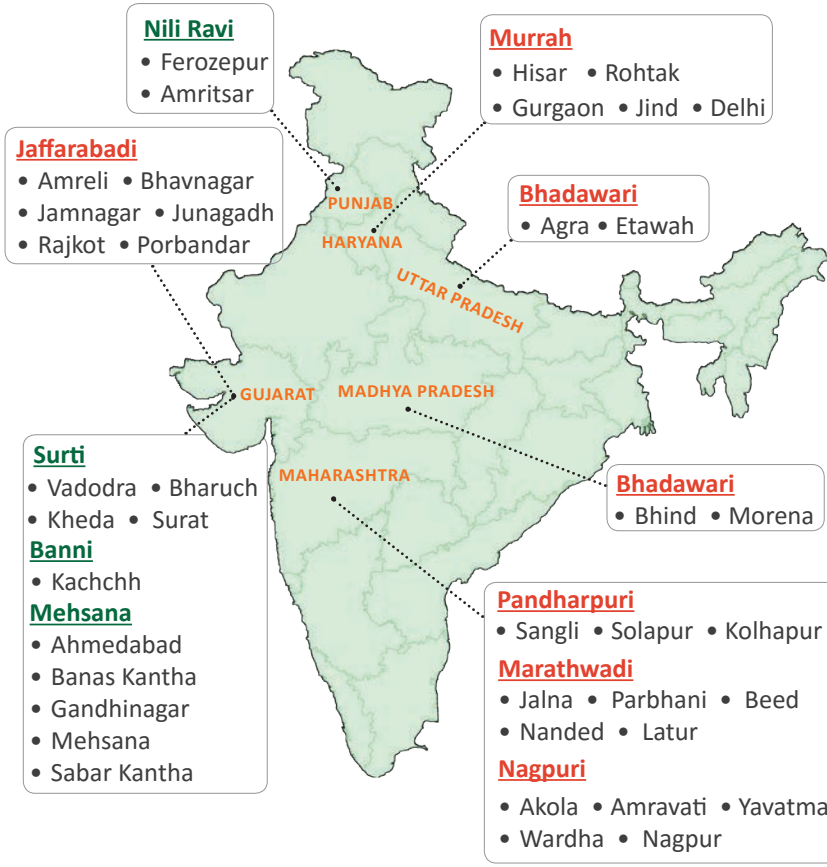
Photo: L Manjunath, Veterinary College, Hassan, Karnataka

Murrah buffalo

Photo: ICAR-NBAGR, Karnal

Home tracts of different breeds of buffaloes in the semi-arid tropics of India

■ Milk ■ Dual purpose



Crossbred Dairy Cattle

Dairy animals can be either indigenous or crossbred. While indigenous cattle attain puberty late, are mostly dual purpose and yield less milk, crossbred ones attain early puberty and are mostly milch breeds with high milk yields. Indigenous breeds have a low feed conversion ratio, require less investment and are more disease resistant while crossbred ones have a high feed conversion ratio, call for high investment, are more susceptible to diseases and require greater scientific management. Indigenous rather than crossbred breeds are preferred for arid and semi-arid regions.

Jersey Crossbred

- Originated in Jersey Island, UK and is the smallest dairy breed
- Acclimatized to India, widely used in upgrading/cross breeding with non-descript/ local cattle
- It is medium sized, reddish fawn with a dished forehead and compact and angular body. It tolerates heat better than other exotic crosses
- Its average milk yield is 3000-4000 kg per lactation, with milk fat ranging from 4-4.5%
- Good management practices can result in a 2 to 3-fold increase in milk yield

Photo: L Manjunath, Veterinary College, Hassan

Holstein Friesian (HF) Crossbred

- Originated in northern Netherlands, especially in the province of Friesland
- Largest dairy breed with mature cows weighing as much as 700 kg
- It has a typical and distinguishable black and white marking
- Average milk yield is 4000-6000 kg per lactation, with low fat content (3-3.50%)
- It is more suited to cooler climate and hilly areas

Photo: L Manjunath, Veterinary College, Hassan

Rearing Systems

Extensive system: Also known as the grazing system, animals are reared on external grazing alone, in which 90% of dry matter fed to them comes from rangelands, pastures, annual forages and purchased feed and less than 10% of the total value of production comes from non-livestock farming activities.

Semi-intensive system: In this system which is most prevalent in India, animals are housed in covered enclosures. They are taken out to graze during the day and provided feed and fodder when they return. Quite often, the system is similar to mixed farming system.

Intensive system: This highly evolved system involves rearing in closed enclosures, where average stocking rates are greater than 10 livestock units per hectare. Common in developed countries like the USA and UK, it is also found in the states of Punjab, Haryana, Western Uttar Pradesh in India.

Housing Management

Among good farming practices, attention to the housing of dairy cattle is important. This is essential to ensure safe and quality milk from healthy animals kept under acceptable conditions, buffering the animals from adverse weather conditions. Care should be taken to provide comfortable spacing, hygiene, durable housing, and arrangements for hygienic milking.

Types of Housing

Dairy cattle may be housed under a wide variety of conditions, ranging from close confinement to little restrictions except at milking time. However, two types of dairy barns are in general use: the loose housing barn in combination with some type of milking barn or parlor and the conventional dairy shed.

Loose Housing

In this economical system of housing, animals are unfettered except during milking and when being treated. It involves low cost of construction with scope for expansion, facilitates detection of animals in heat, and animals get optimum exercise.

Advantages in arid and semi-arid regions

Conventional Shed

Animals in this system are confined together on a platform and secured at the neck by stanchions or neck chains. They are fed as well as milked in the barn, which has a fully covered roof, windows and ventilators. The construction of the shed depends on the class of livestock it is meant for and to what use it is to be put. You could have a cow house, calving box, bull shed, isolation box, etc. Conventional sheds are costly and therefore, becoming less popular.

Floor space (sq. m) for various categories of dairy animals (BIS standards)

50 Cows
maximum

3.5 Covered area
7.0 Open area

50 Buffalo
maximum

4.0 Covered area
8.0 Open area

1 Bull
maximum

12 Covered area
12 Open area

30 Heifers
maximum

2.5 Covered area
5.0 Open area

5–10 Young calves
maximum

1.0 Covered area
2.0 Open area

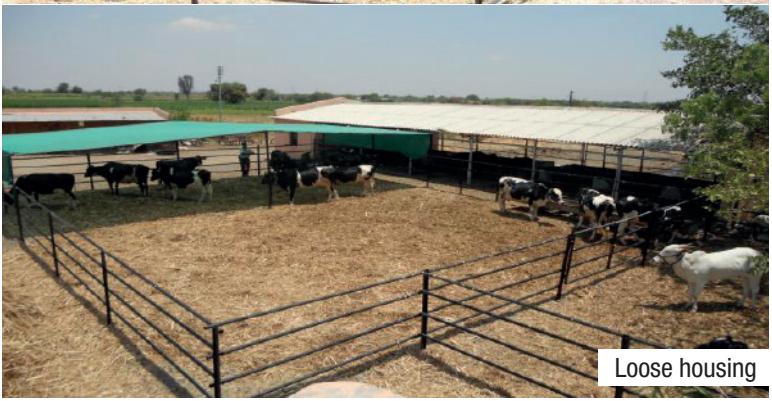
25 Older calves
maximum

1.0 Covered area
4.0 Open area

Height of the sheds at eaves

175 cm in medium and heavy rainfall areas

220 cm in semi-arid and arid areas



Loose housing

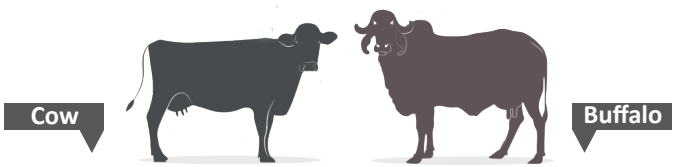
Tail to tail system of housing

The sheds can be either of a single row when animals are fewer or in two rows if more animals are being reared. In double row housing, the arrangement should be such that the cows either face out (tail to tail system) or face in (head to head system). The breadth of the shed should not exceed 10 metres and the distance between animals should be 1.0 to 1.2 metres, with each animal having an individual space of 1.5 to 2.0 metres. The central height of the shed must be 3.5 to 4.0 metres, sloping at the edges. Good ventilation and flooring are essential.

Feeding Practices

A scientific feeding pattern will ensure adequate nutrition and consequently proper growth of the dairy animal. Its diet must comprise approximately 60-70% of green fodder, 20-30% of dry fodder and 5-10% of concentrate/supplementary feed. The diet should provide about 16-20% of Crude Protein (CP) and 65% of Crude Fibre (CF). Additional concentrate/supplementary feeding must be provided to pregnant and lactating animals.

Feeding allowances



Milk yield	Kg/animal/day
<5 Lt/day	15 green fodder 5 dry fodder 2 concentrates
5-10 Lt/day	17.5 green fodder 5.5 dry fodder 3 concentrates
Cow in gestation	15 green fodder 5 dry fodder 1.5 concentrates

Milk yield	Kg/animal/day
<5 Lt/day	15 green fodder 5 dry fodder 2.5 concentrates
5-10 Lt/day	20 green fodder 6 dry fodder 4 concentrates
>10 Lt/day	25 green fodder 7 dry fodder 5 concentrates

Sources of raw material for supplementary feed (concentrate mixture)

Cereals and millets
Pearl millet, maize, sorghum, finger millet, rice, oat, wheat

Oilseed cake
Pearl millet, maize, sorghum, finger millet, rice, oat, wheat

Agro-industrial by-products
Rice and wheat bran, rice polish, de-oiled rice bran, chunnies

Mineral and vitamin mixture
Calcite grit, calcium carbonate, ground limestone, oyster shell, steamed bone meal, monosodium phosphate, dicalcium phosphate, defluorinated rock phosphate, soft rock phosphate

Nutrient composition (%) for every 100 kg of supplementary feed (concentrate mixture) for dairy animals.

Ingredients	Per 100 kg
Maize/ soybean/green gram/cereals (broken/ ground/mashed)	30-40
Any oil cakes	20-30
Husk/bran	30-40
Mineral mixture & salt	1-2
Total	100

Low grade roughage/residues can be used, but have to be treated through physical and mechanical methods (soaking, chopping, grinding, pelleting, steaming and irradiation); chemical methods (sodium hydroxide, urea/ammonia, etc.) and biological methods (fungi).

Classification of Green Fodder Crops

Green fodder crops can be classified based on whether they are annuals that complete their life cycle in one season (fodder maize, cowpea) or perennials that provide fodder more than once per season or year (Guinea grass, lucerne).

They can also be leguminous (guar, berseem, cowpea, Lucerne) or non-leguminous (maize, pearl millet, sorghum, oat). Fodder crops can also be rainfed (fodder pearl millet, Stylosanthes) or irrigated (Hybrid Napier, guinea grass, lucerne). Range species/ grasses (Dharaf grass, marvel grass, setaria grass, anjan grass) are another category of fodder crops.

For more information on green fodder production, go to http://111.93.2.168/idc/wp-content/uploads/2019/01/Final-Green-fodder-production_Booklet.pdf

Photo: LRIC (Deoni) KVAFSU, Bidar

Hybrid Napier

Sesbania

Fodder Chaffing

This is the process of cutting fodder into 1-2 inch pieces so that wastage can be minimized by about 40-50%, ensuring maximum utilization. Not only does it increase feed palatability; it also substantially reduces rumination time and storage space.

Minimizing wastage by chaffing

Silage Making

- Silage comes in handly during times of fodder scarcity.
- Silage can be made with thick stem crops like sorghum, maize, pearl millet, Napier and various legumes. The crop should be harvested at 50% flowering to milk or dough stage for quality silage.
- Ensiling can be done under anaerobic conditions for 45 days in pits, trenches, bunkers and tower silos of different types and sizes. Lately, silo bags of various sizes (100 kg, 200 kg, 500 kg and 1000 kg) are also available.
- Inoculums can be used to enhance ensiling rate.
- A total of 500 kg of green fodder can be ensiled in a 1 cubic metre pit. On an average, 20-25 kg of silage can be fed to an adult cattle/buffalo per day.

Silage to feed dairy animals

- Good silage is golden brown or greenish yellow with a pleasant fruity odor, has no mould growth, is palatable and has a pH of around 4.0-4.5.
- Silage making ensures the regular supply of quality fodder during lean periods and enhances green fodder productivity by improving harvesting intensity.

Hay Making

Hay is stored forage that has low moisture content (less than 15%). Legume hay, non-legume hay and mixed hay are the three major types of hay. Hay making is the most common and easy way of preserving the seasonal excess of green fodder. The herbage's low moisture enables its storage without fermentation or mold formation. For hay making, harvesting must be done after the dew has dried up. The harvested fodder

has to be allowed to cure in the field, and turned every 4-5 hours for 1-2 days, to reduce moisture content to around 20% or less, following which it can be stored. Nutrient loss may occur due to late cutting of hay, shattering of leaves and finer parts especially in legumes, oxidation loss by sun bleaching and leaching leading to loss of protein, resulting in major losses.

Enriching Dry Fodder

Urea enrichment methods (ammoniation and treatment) improve the nutritional composition of crop residues, especially during periods of fodder scarcity. It is suitable for crops with thick stems, like the straw of sorghum, maize, pearl millet, Napier, sugarcane trash, etc.

Urea ammoniation: 3-4% urea with 30-40% moisture level is stored for 21 days under anaerobic conditions. In short, 4 kg urea is mixed in 40-45 liters of water for 100 kg of straw or crop residues. This improves palatability and fiber digestibility, as well as supplies valuable protein in the form of nitrogen.

Urea treatment: 2-3% urea with 20-25% moisture level is fed to animals without any storage or delay.

Improving the nutrition in dry fodder

Azolla Feed

Azolla is a small, aquatic floating fern that lives in symbiosis with nitrogen fixing blue-green algae that grow naturally in stagnant drains, canals, ponds, rivers, etc. Its nutrient composition makes it a highly efficient and easily digestible feed for livestock.

- Azolla doubles its weight in 3-5 days. Its fresh weight can go from 1 t/ha to 15-20 t/ha in about 20 days.
- On dry weight basis, it contains 25-35% protein, 10-15% minerals, 7-10% amino acids, bio-active substances and bio-polymers. It has very low carbohydrate and fat.
- It is one of the most economical feed substitutes, since it can be easily digested by livestock due to its high protein and low lignin content.

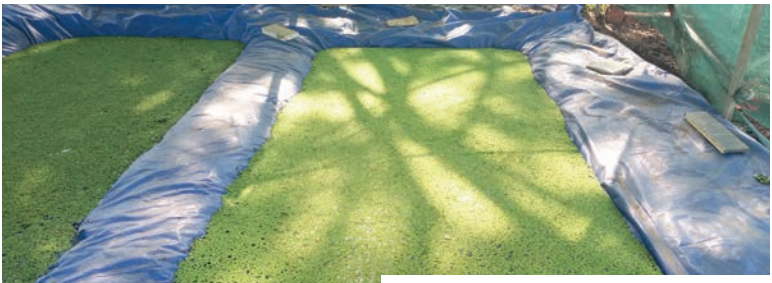


Photo: LRIC (Deoni),KVAFSU, Bidar

Azolla: An economical feed substitute

Area Specific Mineral Mixture (ASMM)

- Feed and fodder fed to dairy animals do not provide all the minerals required. Hence, their diet should be supplemented with adequate amount of good quality mineral mixture.

Supplementary/concentrate feed

Mineral mixture

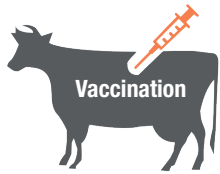
- The major minerals required are calcium, phosphorous, magnesium, potassium, sodium, chlorine and sulphur. The trace minerals required are iron, zinc, manganese, copper, iodine, cobalt and selenium. Mineral mixtures contain these minerals.
- 50-200 g of area specific mineral mixture has to be fed daily depending on the age and condition of the animal.
- Its benefits include swifter growth of calves, reproduction efficiency, efficiency of feed utilization, early puberty, reduced inter-calving period, improved milk production and Solids Not Fat (SNF) content of the milk, and better resistance to diseases.

Health Management

Devastating livestock diseases are endemic in many parts of the world including India, and threats from old and new pathogens continue to emerge due to climate change, agricultural practices and demographic conditions that favour the spread of arthropod-borne diseases to new geographical areas. This has led to national and international trade embargoes.

Farmers should be able to identify sick animals and isolate them. Some of the common signs of illness include weakness, loneliness, lagging behind in the flock, reduced feed and water consumption, etc. Vaccination and deworming are the best options to ensure healthy dairy animals. Hygienic living conditions around the farm are also necessary to keep animals free from infestation by external parasites.

Care During Vaccination



- **Vaccinate** only when the **animal is healthy**
- **Deworm 10-15 days** prior to vaccination
- **Vaccinate during cool hours of the day** (preferably early morning)
- **Make note of the batch number** of the vaccine
- **Vaccinate all the animals** in a farm/village at once.

Vaccination and deworming schedule in cattle and buffaloes

Foot & Mouth Disease (FMD)
At **>4-6** months
Biannually (Feb/March and August/September)

Black Quarter
At **>4-6** months
Once a year (March/April)

Hemorrhagic Septicemia
At **>4-6** months
Once a year (April/May)

Anthrax
At **>6** months
Once a year
(July/August or in affected areas)

Theileriosis
At **>3-4** months
Once in a lifetime

Brucellosis
Females at **>4-6** months
Once in a lifetime

Rabies
At **>3-4** months
Once a year

Deworming

- Within 15 days of birth
- Every month in the first 6 months
- Twice a year at an interval of 6 months
- 12-15 days prior to any vaccination

Photo: K Sindhu, Veterinary College, Gadag, Karnataka

Vaccination by a veterinarian

Calf Management

- Immediately after birth, though the cow licks the calf clean, the extra mucous or phlegm from the calf's nose and mouth can be removed to stimulate breathing and circulation. If cold, keep the calf warm by rubbing and drying the calf with a dry cloth or gunny bag.
- Tie the calf's umbilical cord about 3-5 cm away from its body. Make an incision 1 cm below the ligature and apply tincture of iodine to avoid infection.
- The calf should be fed the cow's colostrum (the milk produced 4-5 days after calving) within 30 minutes to two hours of birth. If the calf isn't getting enough colostrum and later milk, pooled colostrum or milk from other cows can be used. Artificial colostrum can also be procured from markets. However, artificial colostrum can also be prepared using an egg, half liter of fresh warm water, half liter of whole milk, a teaspoon of castor oil and similar amount of cod liver oil.
- Disbudding to remove horn buds should be done 10-15 days after birth with red hot iron or caustic potash stick or by electrical method.
- Start the calf on starter/good quality grain when two weeks old; fresh water should be given from the age of 2-3 weeks.
- Calves should be fed whole milk/milk replacer at least up to 2 months.

Proper feeding and deworming are key to calf health

- House the calves in individual calf pens for 3 months, and then in groups. After 6 months, male and female calves should be housed separately.
- Male calves should be castrated at 8-9 weeks.
- Proper feeding and regular deworming will achieve a growth rate of 10-15 kg/month.
- Strictly follow vaccination and deworming schedules.

Care and Management of Milch Animals

- Milch animals should have a proper and organized feeding regimen to enable maximum lactation.
- Extra concentrate at the rate of 1 kg/2-2.5 liters of milk should be provided. Salt and mineral supplements should be given to maintain lactation.
- Provide water as often as necessary.
- Maintain regularity in milking. Use the full hand method to milk.
- Train cows to lactate without the calf suckling. This will help to wean the calves early.
- In buffaloes, grooming, washing and wallowing must be practiced as required.
- Maintain a 60-day dry period between calving. An insufficient dry period will lead to reduced lactation.

Artificial Insemination: Better Semen for Better Calves

Artificial insemination (AI) is the deposition of semen into the female genital tract by means of instruments. The germplasm of bulls of superior quality can be utilized. AI reduces both genital and non-genital diseases in the farm stock. Non-descript cattle in the semi-arid tropics can be upgraded using exotic/crossbred bulls' semen, which would help in increasing milk production and farmers' income. Sorted sexed semen has become an innovative technology that can produce mostly female calves for breeds of choice.

Artificial insemination by a veterinarian

Symptoms of Heat in Dairy Animals

- The animal is excited, restless and nervous
- Frequent bellowing and reduced feed intake
- Smelling, licking and mounting other animals
- Standing still when being mounted, also known as standing heat
- Frequent micturition or urination
- Clear mucous discharge from the vulva, and sometimes resembling string sticking around the vulva
- Swollen vulva and congestion and hyperemia of membrane
- Raised position of the tail
- Slight decrease in milk production
- On palpation, the uterus will be turgid and the cervix will open.

Care and Management of Pregnant Animals

- Pregnant animals should be watched carefully, particularly during the last stages of pregnancy to avoid abortion due to fights or other physical trauma.
- During the last three months of pregnancy when foetal growth is very rapid, a special allowance of about 1-2 kg of concentrate should be included.
- Feeding trace mineralized salt plus recommended amounts of calcium and phosphorus is essential. Balanced and laxative rations should be fed to maintain the normal tone of the reproductive tract.
- Isolate the pregnant animal 10-15 days before calving is due. Keep it in a clean, well bedded, dry and disinfected maternity pen. Watch the animal every 2-3 hours as calving time approaches.
- Swelling of external genetalia and udder are symptoms of ensuing delivery. Most animals will deliver without any help. In case of any difficulty, provide veterinary help.
- Do not tire the animal by making it move over long distances, especially on uneven surfaces. Ensure it is not fighting with other animals or chased by dogs and other animals.
- Calving problems must be attended to by a veterinarian.
- Placenta is normally expelled 2-6 hours after calving. If this doesn't happen within 12 hours, a veterinarian must be called in to remove it.
- After calving, the animal must be encouraged to move to the manger for feeding, especially on the day of calving and the first two days after calving.
- Provide clean drinking water and protection from thermal stress.

How to Beat the Heat in Summer

During extreme hot and humid or dry weather, the animal's thermoregulatory capacity to dissipate heat by sweating and panting is compromised, causing summer/heat stress. Severe heat stress can raise body temperature, increase the pulse rate and peripheral blood flow, reduce feed intake and increase water intake. Heat stress can lead to loss of productivity, reduce breeding efficiency and even loss of life in extreme cases. Crossbred and exotic breeds of cattle are highly sensitive to heat stress compared to indigenous non-descript animals. Buffaloes are more prone due to their dark skin that absorbs more solar radiation and they have fewer sweat glands.

Keep the Animals Cool!

- Animals must be kept in the shade, especially under trees or a 9-10 foot high thatched roof with good ventilation.
- To provide a cooler ambience, the roof can be thatched with paddy/sorghum straw, sugarcane trash, etc., painted white or a false ceiling insulation provided.
- Create barriers against hot winds using a thatched wall or by hanging wet gunny cloth/bags sprinkled with water.

A well ventilated shed

- Heat stress can be managed by spraying/sprinkling water on the animal for 2-5 minutes at 45-60-minute intervals. Misting/fogging of water in the microenvironment of the animal, fans/blowers too can be used in sheds. Wallowing in ponds is the most effective way of combating heat stress in buffaloes.
- Drinking water should be provided to the animals round the clock and in the shade.
- Feed the animals early in the morning, evening and night. Grazing is preferable early in the morning and late evening to avoid the scorching heat.
- Increase ration density to provide optimum nutrients during heat stress. Low fibre and high fermentable carbohydrate diets have lower dietary heat increment compared to high fibre diets.
- A potassium-rich mineral mixture is preferred to ensure increased mineral supplementation during hot weather to meet the increased demand for minerals.

A wallowing tank for buffaloes

ICRISAT INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

CGIAR ICRISAT is a member of the CGIAR System Organization

We **believe** all **people** have a **right** to **nutritious food** and a **better livelihood.**

ICRISAT works in agricultural research for development across the drylands of Africa and Asia, making farming profitable for smallholder farmers while reducing malnutrition and environmental degradation.

We work across the entire value chain from developing new varieties to agribusiness and linking farmers to markets.

ICRISAT-India (Headquarters)
Patancheru, Telangana, India
icrisat@cgiar.org

ICRISAT-India Liaison Office
New Delhi, India

ICRISAT-Mali (Regional hub WCA)
Bamako, Mali
icrisat-w-mali@cgiar.org

ICRISAT-Niger
Niamey, Niger
icrisatsc@cgiar.org

ICRISAT-Nigeria
Kano, Nigeria
icrisat-kano@cgiar.org

ICRISAT-Kenya (Regional hub ESA)
Nairobi, Kenya
icrisat-nairobi@cgiar.org

ICRISAT-Ethiopia
Addis Ababa, Ethiopia
icrisat-addis@cgiar.org

ICRISAT-Malawi
Lilongwe, Malawi
icrisat-malawi@cgiar.org

ICRISAT-Mozambique
Maputo, Mozambique
icrisatmoz@panintra.com

ICRISAT-Zimbabwe
Bulawayo, Zimbabwe
icrisatzw@cgiar.org

ICRISAT appreciates the support of CGIAR investors to help overcome poverty, malnutrition and environmental degradation in the harshest dryland regions of the world. See http://www.icrisat.org/icrisat-donors.htm for full list of donors.

About ICRISAT: www.icrisat.org

ICRISAT's scientific information: EXPLORE*it*.icrisat.org

/ICRISAT /ICRISAT YouTube /ICRISATco /company/ICRISAT /PHOTOS/ICRISATIMAGES /ICRISATSMCO

20-2019