PACKAGE OF PRACTICES

for

"Successful and Sustainable Cattle Farming"



Compiled & Edited by:

Rajiv Ranjan Kumar, Naresh Prasad, Ajayvir Singh Sirohi,
Sumit Mahajan and Sonam Dwivedi

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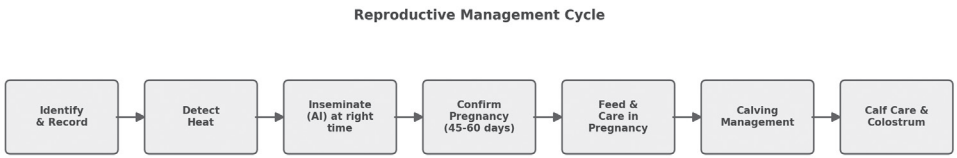
ICAR-Central Institute for Research on Cattle

Grass Farm Road, Meerut Cantt.
Meerut, Uttar Pradesh – 250001

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Breeding • Feeding • Reproductive & Health Management • Milk Handling and Processing

A Field Reference and Policy Guidance Document for Farmers, Livestock Keepers, Extension Functionaries, Cooperatives and Dairy Sector Stakeholders

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Foreword



India's dairy sector stands as a vibrant beacon of agrarian growth, rural economic resilience, and food security. As the home to a vast cattle population exceeding 193 million animals and the world's leading milk producer accounting for over 247 million tonnes of annual production with a per capita availability of 471 grams per day, our livestock sector directly sustains the livelihoods of millions of smallholder, marginal, and landless farming families across the nation. Despite this remarkable scale, the average productivity of our individual dairy cattle presents a critical growth frontier. Bridging this productivity gap requires a paradigm shift—moving from traditional husbandry practices toward precision-oriented, evidence-based, and scientifically validated management.

It gives me immense pride to present this publication, ***"Package of Practices for Successful and Sustainable Cattle Farming,"*** brought out by ICAR-CIRC, Meerut. Optimizing dairy productivity requires an integrated approach combining high genetic potential, balanced nutrition, meticulous reproductive management, biosecurity, and hygienic post-harvest handling. Addressing bottlenecks like delayed puberty, silent heat, extended days open, repeat breeding, thermal stress, and the conservation of indigenous germplasm is essential for profitability and sustainability.

This comprehensive field reference and policy guidance document has been Crafted to bridge the gap between frontline scientific innovations and practical field execution, this comprehensive document provides step-by-step guidance across the cattle lifecycle. It covers genetic selection, precision heat detection (AM-PM rule), timely artificial insemination, pregnancy diagnosis, and management of repeat breeding. It further details stage-specific challenge feeding, bypass nutrients, mineral supplementation, fodder conservation (silage/hay), heifer rearing, immunizations, deworming, and hygienic milk handling. The ultimate goal is to empower farmers, extension workers, veterinarians, and dairy cooperatives to cut input costs, enhance milk yields, shorten calving intervals, and boost lifetime productivity.

I extend my deep appreciation to the scientific team at ICAR-CIRC for their dedication and to the Indian Council of Agricultural Research (ICAR) for its guidance and support. I trust this manual will serve as an indispensable reference driving the sustainable transformation of Indian cattle farming.

"Jai Hind!"

Dr. A. K. Mohanty
Director

Preface

India holds the world's largest bovine population and dairying is a principal source of livelihood for millions of small, marginal and landless farm families. Despite this scale, the average productivity of Indian cattle remains well below global benchmarks, largely on account of sub-optimal breeding practices, imbalanced feeding, weak reproductive management and gaps in animal health and biosecurity.

This Package of Practices (PoP) consolidates scientifically validated and field-tested recommendations covering the entire production cycle of cattle — from breeding and reproduction, through calf rearing, nutrition and health management, to milk handling and hygiene. It is intended to serve as a single, ready-reference policy document that can be circulated to farmers, field functionaries, dairy cooperatives, veterinary institutions and extension workers across the country.

Recommendations in this document are presented sequence-wise, as numbered, actionable steps, supported by illustrations, tables of indicative parameters, and clear Do's and Don'ts, so that they may be readily adopted at the farm level and used for training and extension purposes.

(Editors)

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Introduction and Objectives

Reproductive efficiency, balanced nutrition and sound health management together determine the profitability of a dairy enterprise. The ultimate objective of cattle husbandry is to obtain a healthy calf at regular intervals while sustaining optimum milk production, health and longevity of the breeding animal. Failure to conceive at the appropriate time results in extended calving intervals, increased feeding and management costs, reduced lifetime productivity and avoidable economic losses. Reproductive and productive efficiency are governed jointly by genetic and non-genetic factors — breed, nutrition, climate, health, reproductive management and the farm environment. Improving cattle productivity therefore requires an integrated approach spanning genetic improvement, scientific breeding, accurate estrus detection, timely artificial insemination (AI), reproductive health management, balanced nutrition and systematic performance recording.

Objectives of this Package of Practices

1. Improve the genetic potential of cattle for milk production and other economically important traits.
2. Improve reproductive efficiency and conception rate.
3. Reduce age at first calving and calving interval.
4. Promote timely and effective use of artificial insemination.
5. Improve estrus detection, particularly of silent/weak heat.
6. Reduce repeat breeding and postpartum reproductive disorders.
7. Promote scientific selection and culling of breeding animals.
8. Ensure proper management and utilization of genetically superior bulls and semen.
9. Improve calf and heifer survival and future reproductive performance.
10. Increase lifetime productivity and profitability of cattle farming.
11. Promote conservation and genetic improvement of indigenous cattle breeds.
12. Integrate breeding, nutrition, health and management for sustainable productivity enhancement.

2. Guiding Principles of Cattle Breeding and Productivity Enhancement

2.1 Five Core Principles

Principle	Explanation
Breed according to the production objective	Define the breeding objective clearly before selecting animals or germplasm — milk yield, milk fat/quality, reproductive efficiency, adaptability, disease resistance, longevity, feed efficiency or overall economic performance.
Use superior germplasm	Prefer genetically superior, evaluated bulls for natural service or AI. Use breed-specific germplasm for conservation and improvement of indigenous breeds.
Keep the best, cull the poorest	Select animals that should contribute to the next generation; cull animals with undesirable production, reproductive, health or hereditary traits.
Record before selecting	Base selection on reliable performance and pedigree records rather than appearance alone.
Give equal importance to reproduction and production	A high-yielding animal that repeatedly fails to conceive may be less profitable overall than a moderate yielder with good fertility and longevity.

3. Selection of Breeding Animals and Selection Methods

3.1 Desirable Traits in Breeding Females

- Desirable breed characteristics
- Good growth and body development
- Normal reproductive organs and regular estrous cycles
- Good conception history
- Sound udder and functional teats
- Good milk production performance
- Good health and disease resistance
- Good adaptability to the local environment
- No known serious hereditary defects

3.2 Selecting Breeding Bulls

A single superior bull, especially through AI, can influence a very large number of offspring making bull selection one of the highest-leverage decisions in a breeding programme. Bulls should be selected based on:

- Pedigree, dam and relatives' performance
- Individual performance and genetic evaluation
- Progeny performance where available
- Reproductive soundness and semen quality/fertility
- Breed characteristics
- Health status and freedom from transmissible diseases

3.3 Selection Methods — Comparison

Method	How it Works	Advantages / Limitations
Performance testing	Measures the phenotypic performance of an individual as an estimate of genetic merit under standardized management.	Simple, practical, shorter generation interval; accuracy depends on minimizing environmental variation.
Pedigree selection	Uses information on an animal's ancestors, especially before individual records exist.	Useful for early selection and sex-limited traits (e.g., milk yield); less accurate than direct performance data.
Progeny testing	Assesses breeding value from the performance of offspring.	High accuracy with adequate progeny numbers; longer generation interval and greater resource need.
Conformation-based selection	Uses functional body type as an indirect indicator.	Useful as a supplement; direct selection on performance traits is generally more reliable.

3.4 Choice of Traits for Selection

1. Objective of the breeding programme
2. Heritability of the trait
3. Economic importance of the trait
4. Available genetic variation
5. Correlation with other economically important traits
6. Cost and practicality of recording and selection

3.5 Breeding Systems

System	Description	Caution
Inbreeding	Mating between related animals (e.g., sire × daughter, dam × son, full siblings) to increase homozygosity.	Should never be undertaken indiscriminately due to risks of inbreeding depression and hereditary defects.
Outbreeding	Mating of unrelated animals for breed improvement.	Preferred as the general strategy to avoid excessive relatedness in the herd/population.

4. Reproductive Parameters and Breeding Systems

The following indicative reproductive parameters should be interpreted according to breed, physiological status, nutrition and management conditions.

Parameter	Indigenous Cattle	Exotic / Crossbred Cattle
Age at puberty	~24 months	12–15 months
Age at first mating	~30 months	18–20 months
Optimum weight at first mating	~250 kg	180–275 kg
Estrous cycle length	17–24 days	21 ± 3 days
Duration of estrus	12–18 hours	12–18 hours
Gestation period	280–290 days	280–290 days
Calving to first heat	~40 days	~40 days
Calving to first service	60 days or less	60 days or less

5. Estrus Detection and Timing of Artificial Insemination

5.1 Signs of Estrus

Standing to be mounted ("standing heat") is the single most reliable behavioural sign of estrus. Other supporting signs include:

- Restlessness and increased activity
- Mounting other animals / seeking the bull
- Frequent bellowing
- Reduced feed intake and a temporary decline in milk yield
- Frequent urination
- Clear mucus discharge; swelling and increased moisture of the vulva

Note: *Observe cows at least twice daily, preferably during the cooler hours of morning and evening, and maintain individual breeding records to predict the likely date of the next estrus.*

5.2 Supplementary Methods of Heat Detection

- Teaser/vasectomized bull
- Tail-mounted estrus detection devices
- Mounting-activity indicators / pedometers
- Cervical mucus crystallization
- Electronic/automated heat detection systems

For smallholder farmers, careful twice-daily observation of standing heat remains the most practical and dependable method.

5.3 Correct Timing of Insemination

Because sperm and ova have limited viable periods and sperm require time for capacitation, insemination should be performed around mid-estrus to the latter part of heat. The practical AM–PM rule is as follows:

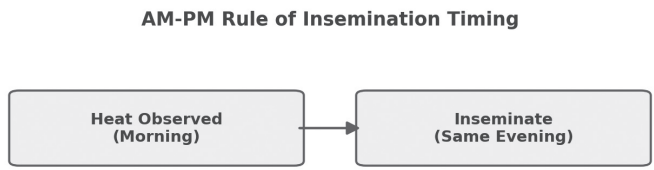


Figure 1: AM–PM rule for timing of artificial insemination.

Heat First Observed	Recommended Time of AI
Morning	Same evening
Evening	Following morning

5.4 Precautions during Artificial Insemination

✓ ***DO***
- *Use good-quality, properly stored semen*
- *Follow correct semen thawing and handling procedures*
- *Use a hygienic AI technique performed by a trained technician*
- *Record bull/semen identification and date/time of insemination*

× ***DON'T***
- *Do not use semen that has been improperly stored or thawed*
- *Do not allow untrained personnel to perform AI*
- *Do not skip identification/record entries after insemination*
- *Do not inseminate outside the recommended heat window*

6. Post-Insemination Management, Pregnancy Diagnosis and Record Keeping

6.1 Steps Following Artificial Insemination

1. Avoid unnecessary stress to the animal
2. Maintain adequate, consistent nutrition
3. Avoid sudden changes in feed
4. Observe the animal for return to estrus and record any subsequent heat
5. Undertake pregnancy diagnosis approximately 45–60 days after breeding

Early identification of non-pregnant animals allows timely rebreeding and reduces the number of "days open," directly improving herd reproductive efficiency.

6.2 Reproductive Records to be Maintained

- Animal identification and date of birth
- Breed and pedigree
- Dates of observed estrus
- Date and time of AI; bull/semen identification
- Pregnancy diagnosis result
- Date of calving and calving interval
- Number of services per conception
- History of reproductive disorders
- Milk production records
- Treatment history

7. Management of Repeat Breeding and Silent Heat

7.1 Postpartum Reproductive Management

Cows normally show first heat approximately 30–40 days after calving under good conditions. Animals failing to show heat beyond the expected period should be examined for the following possible causes:

- Inadequate nutrition / negative energy balance
- Uterine infection
- Persistent corpus luteum
- Ovarian dysfunction
- Poor body condition
- Lactational anestrus
- Genetic or developmental abnormalities

7.2 Repeat Breeding — Recommended Approach

A cow failing to conceive after repeated services should never simply be re-inseminated without investigation. Veterinary examination is recommended when females fail to settle after three services. The following should be checked:

- Estrus detection accuracy and AI timing
- Semen quality and AI technique
- Nutritional status and body condition
- Uterine infection or ovarian abnormalities
- Hormonal/reproductive disorders

Field Illustration: Managing Repeat-Breeding Cows

In a documented field case, four crossbred cows with non-infectious repeat breeding were treated with nutritional intervention (bypass fat) from the detected estrus, followed by AI in the subsequent cycle, with hCG administered on day 7 post-insemination. Three of the four cows conceived (a 75% pregnancy rate), and the farm also reported improved milk production and lower feeding costs. This illustrates that repeat breeding should be addressed through diagnosis-based intervention under veterinary guidance — not repeated insemination alone. This case is presented as an illustrative field experience, not a universal treatment protocol.

7.3 Management of Silent (Weak) Heat

Silent estrus — where ovarian activity and ovulation occur but behavioural signs are weak — is particularly common in buffaloes, high-yielding animals, animals under nutritional or heat stress, and certain heifers and postpartum animals. Useful measures include:

- Improved nutrition and adequate mineral supplementation
- Better summer/heat-stress management
- More frequent observation and activity monitoring
- Use of a teaser bull on organized farms

8. Management of Pregnant Animals and Calving

8.1 Care of Pregnant Animals

1. Provide adequate nutrition for fetal growth and the coming lactation
2. Maintain appropriate body condition
3. Separate advanced-pregnancy animals from the general herd where feasible

4. Provide a clean, comfortable calving area with adequate bedding
5. Ensure a non-slippery floor and clean drinking water
6. Closely observe animals as calving approaches

8.2 Signs of Approaching Parturition

- Separation from the herd
- Restlessness and reduced appetite
- Udder and teat distension; milk leakage
- Relaxation of pelvic ligaments; raised tail head
- Enlargement and relaxation of the vulva

Note: *Parturition consists of preparatory, active expulsive and fetal membrane-expulsion stages. Prolonged or abnormal labour warrants immediate veterinary assistance.*

8.3 Calving Management Sequence

Stage	Key Actions
Before calving	Move to clean calving area • Provide bedding, space and ventilation • Keep clean equipment ready • Minimize stress and handling.
During calving	Allow normal calving to proceed without unnecessary interference • Observe closely • Seek veterinary help if labour is prolonged or abnormal.
After calving	Monitor expulsion of fetal membranes • Watch for postpartum complications • Ensure early calf access to colostrum • Record calving date and calf details.

9. Care and Management of the Newborn Calf

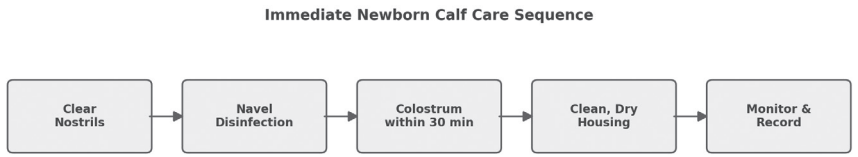


Figure 2: Immediate care sequence for the newborn calf.

9.1 Immediate Care after Birth

1. Clear mucus from the nostrils
2. Allow the dam to lick the calf where possible

3. Maintain a calm environment
4. Disinfect the navel with an appropriate antiseptic
5. Ensure early and adequate colostrum intake
6. Provide clean, dry and comfortable housing
7. Protect calves from cold stress and maintain good ventilation/hygiene
8. Avoid unnecessary exposure of young calves to adult animals

9.2 Colostrum Feeding — Why It Matters

Colostrum is highly fortified — containing roughly seven times the protein and twice the total solids of normal milk — and is rich in immunoglobulins that provide the calf's early passive immunity, since negligible antibody transfer occurs across the placenta before birth. Colostrum quality is highest immediately after calving and declines rapidly with time and volume; absorption efficiency by the calf's gut also falls sharply within the first day of life.

Constituent (%)	Colostrum — Cow	Colostrum — Buffalo	Normal Milk
Total solids	28.30	31.0	12.86
Fat	0.15–1.2	4.0	4.0
Lactose	2.5	2.2	4.8
Total protein	21.32	23.8	3.34

9.3 Colostrum Feeding Schedule

1. Feed colostrum within the first 15–30 minutes of life, followed by a second feed about 10–12 hours later.
2. From half an hour to 12 hours of age, feed colostrum equal to 5–8% of body weight.
3. On the 2nd and 3rd day, feed at about 10% of body weight.
4. If the calf does not suckle, provide colostrum via an esophageal feeder.
5. Store any surplus colostrum by refrigeration/freezing (up to about one year frozen) for use with other or orphan calves; thaw gradually in a warm-water bath, never rapidly.

9.4 Weaning

Early, planned weaning with separate housing and a scientific feeding schedule is now recommended over natural suckling. Weaned calves should be trained to drink from a pail/nipple pail, weighed weekly, and their milk allowance adjusted accordingly.

10. Calf and Heifer Rearing for Early, Efficient Breeding

The future productivity of the herd depends directly on how well replacement heifers are raised. Raising heifers typically accounts for 15–20% of total dairy farm expenses, making efficient, well-timed growth an important economic objective. The optimal age at first calving is generally 22–24 months.

10.1 Key Recommendations

- Provide adequate colostrum/milk during early life
- Introduce a highly palatable calf-starter grain early to promote rumen development
- Provide good-quality forage once starter intake is established
- Maintain adequate protein and energy supply appropriate to growth stage
- Provide minerals and clean, free-choice water at all times
- Monitor body weight and growth regularly (weigh tape or scale)
- Control internal and external parasites and infectious disease
- Avoid both underfeeding and excessive fattening
- Breed only after the animal reaches the appropriate body weight and development, not by age alone

Note: *Free-choice water is essential alongside milk feeding — calves deprived of water have been observed to consume substantially less starter and gain significantly less weight.*

10.2 Growth Targets for Heifers

Heifers should reach about 55% of their eventual calving weight by breeding age (13–15 months) and about 82–85% of mature weight at calving (22–24 months). Taller heifers at calving tend to produce more milk, so monitoring wither height alongside weight is useful where scales are unavailable.

11. Management of Breeding Bulls

11.1 General Care

- Genetically superior and healthy
- Maintained in good, not excessive, body condition
- Given regular exercise
- Free from reproductive abnormalities
- Housed appropriately, separate from the general herd in organized programmes

Young bulls should be accustomed to handling and leading from an early age. Regular exercise prevents excessive fat deposition and supports sound locomotion and libido; over-conditioning adversely affects both fertility and leg/foot health.

11.2 Factors that Reduce Bull Libido

- Inadequate nutrition or obesity/poor body condition
- Extreme age or inexperience
- Injury; leg, back or penile abnormalities
- Unfamiliar surroundings and poor handling
- Heat stress

11.3 Indicative Feeding Guideline for Mature Bulls

A general rule of thumb is approximately 1 kg hay and 0.5 kg concentrate per 100 kg body weight per day (e.g., a 400 kg bull would receive roughly 4 kg hay and 2 kg concentrate), adjusted for body condition, workload and professional nutritional advice.

12. Feeding Management — Principles, Ingredients and Nutrient Sources

Feed alone constitutes about 60% of the production cost of milk, making feeding management central to farm economics. Nutrient requirements must be worked out for maintenance, milk production (including fat percentage) and gestation, and rations computed accordingly. As a general rule, dry matter from roughage should be between 1% and 2% of the cow's live body weight.

12.1 Commonly Available Feed Ingredient Groups

Category	Common Ingredients	Key Notes
Cereal grains	Maize, bajra, sorghum, rice, oats, barley, wheat	Maize is energy-dense (TDN ~85%) but prone to aflatoxin if stored moist; finely ground wheat is unpalatable and should be avoided.
Vegetable protein sources	Groundnut cake, soybean meal, sunflower cake, cottonseed meal, coconut meal, linseed meal, mustard cake, sesame meal	Watch for toxic factors: aflatoxin (groundnut cake), gossypol (cottonseed), cyanogenic glycosides (raw linseed).
Milling by-products	Rice bran, wheat bran, rice polish, molasses	Rice bran/polish are prone to rancidity due to fat content; molasses up to 15% aids palatability and pelleting.
Animal & vegetable fats	Tallow, lard, corn/groundnut/sunflower oil, rumen-protected (bypass) fat	Fat gives 2.25× the energy of carbohydrate/protein; useful for high yielders and heat-stressed animals.

12.2 Ingredient Cautions — Do's and Don'ts

✓ *DO*	× *DON'T*
• *Store cereal grains and oilcakes dry to prevent aflatoxin (Aspergillus) contamination*	• *Do not feed finely ground wheat — it forms a pasty mass and causes digestive upset*
• *Restrict sunflower cake to about 20% of ration and avoid feeding it to calves*	• *Do not feed rancid, high-oil-content meals (e.g., old rice polish, high-oil coconut meal)*
• *Use decorticated cottonseed products where possible to limit gossypol*	• *Do not exceed recommended inclusion levels for oilcakes with anti-nutritional factors*
• *Soak/process linseed properly to reduce cyanogenic glycoside risk*	• *Do not feed improperly stored, moisture-affected grain*

13. Feeding Cattle at Different Physiological Stages

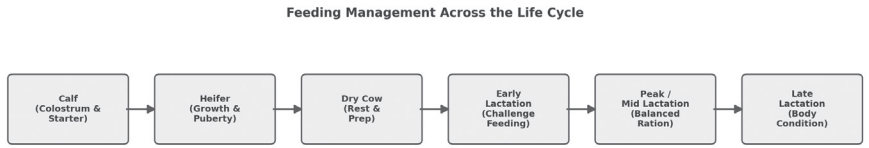


Figure 3: Feeding management across the cattle life cycle.

13.1 Indicative Daily Feeding Allowances

Animal / Stage	Green Fodder (kg/day)	Dry Fodder (kg/day)	Concentrate (kg/day)
Cow, milk yield 5 L/day (avg 250 kg)	15	5.0	2.0
Cow, milk yield 5–10 L/day	17.5	5.5	3.0
Cow, milk yield 10–15 L/day	20.0	6.0	4.0
Cow in gestation (dry)	15.0	5.0	1.5
Buffalo, milk yield 5 L/day (avg 400 kg)	15.0	5.0	2.5
Buffalo, milk yield 5–10 L/day	20.0	6.0	4.0
Buffalo, milk yield >10 L/day	25.0	7.0	5.0
Bull, working days (avg 300 kg)	20.0	7.0	2.0
Bull, non-working days	15.0	5.5	1.0

13.2 Challenge Feeding of the High-Yielding Cow

Challenge feeding conditions the digestive system ahead of peak lactation demand and should begin about two weeks before the expected calving date:

Period	Concentrate Allowance
Last 2 weeks before calving	Start at 500 g/day; increase by 300–400 g daily until the cow eats 500–1000 g per 100 kg body weight.
First 2 weeks of lactation	Increase by 500 g/day up to free-choice level.
2nd week to peak yield (test day)	Feed free choice.
From test day onward	Adjust per production, e.g., 1 kg concentrate for every 2.5 kg milk produced.
Remaining lactation	Adjust concentrate to monthly milk-test results Feed green and dry fodder adequately throughout.

13.3 Feeding by Lactation Stage

Stage	Key Feeding Considerations
Early lactation	Intake capacity often lags behind milk-production demand; the cow draws on body reserves — plan reserves ahead through late-gestation and challenge feeding.
Mid lactation	A relatively stable period; feed a well-balanced ration matched to yield and milk fat percentage; body weight remains fairly stable.
Late lactation	Intake ability can exceed nutrient needs; extra allowance (1–2 kg concentrate) from month 7½–10 helps replenish body condition lost earlier.
Dry period	High-forage diet; concentrate increased in the last 3–5 weeks pre-calving to prepare rumen microbiota and the digestive tract for the next lactation.

13.4 High Producers — Rumen Health Considerations

- Maintain a minimum of 20–25% crude fibre in the ration to sustain acetic-acid fermentation and normal milk fat
- Divide the daily ration into 3–4 feedings to improve digestibility and reduce acidosis risk
- Feed concentrates and roughages together (complete/TMR-style feeding) for more stable rumen fermentation
- Avoid excessive grain proportions, which depress fibre digestibility and can cause acidosis

14. Feeding Strategies for Heat Stress and Climate Resilience

Heat stress reduces dry matter intake by up to 50% relative to thermoneutral conditions, and can depress milk yield by 10–25% along with milk fat percentage, fertility and immune function. A combination of feeding strategies helps offset these losses.

14.1 Key Interventions

Intervention	Rationale / Effect
Ensure abundant, fresh water, especially near feeding areas	Water intake is highly correlated with both DMI (0.94) and milk yield (0.96); intake needs rise sharply with temperature.
Feed highly palatable, high-quality, low-fiber (but adequate fibre) forage	Reduces heat increment from digestion while maintaining normal rumen function.
Include fat as an energy source (up to ~5–8% of DM, prefer bypass/rumen-protected fat in high yielders)	Fat produces less metabolic heat than fibre/NFC digestion, sustaining energy intake without added heat load.
Balance crude protein — avoid both deficiency and excess, particularly excess degradable protein	Both extremes raise body heat production, e.g., through excess ammonia detoxification.
Supplement potassium (≥1.2% DM) and sodium (≥0.45% DM)	Heat-stressed cows lose potassium rapidly (up to 5× more without shade); adequate Na/K supports water balance and can raise DMI and yield.
Feed in the cooler parts of the day; feed frequently (3–4 times/day); push up feed regularly	Encourages intake when animals are less heat-loaded and reduces selective feeding.
Use rumen buffers (sodium bicarbonate, magnesium oxide) and yeast/fungal cultures where appropriate	Helps prevent metabolic acidosis and supports rumen fermentation under stress.

15. Mineral and Vitamin Nutrition

Mineral and vitamin supplementation should be incorporated according to physiological stage, production level, feed resources and local conditions, with particular attention to growing heifers, pregnant cows, recently calved cows, high producers and animals with reproductive problems. A quality-assured, scientifically formulated mineral mixture should be used.

15.1 Key Minerals — Roles and Deficiency Signs

Mineral	Key Role	Deficiency Signs
Calcium	Bone/teeth structure, nerve and muscle function, blood clotting	Rickets (young), osteomalacia (adult), milk fever around calving
Phosphorus	Energy metabolism (ATP), bone structure, enzyme systems	Rickets/osteomalacia, depraved appetite (pica), poor fertility
Magnesium	Enzyme activation, bone structure	Hypomagnesaemic tetany (grass staggers)
Sodium / Potassium / Chlorine	Acid-base balance, osmotic pressure, nerve/muscle transmission	Poor growth, pica (Na); weakness/ tetany (K); alkalosis (Cl)
Copper	Enzyme component, iron absorption, pigmentation	Anaemia, poor growth, infertility, swayback in young stock
Zinc	Enzyme component, skin/hoof integrity	Poor growth, reproductive disorders, parakeratosis
Manganese	Enzyme activation, bone matrix formation	Retarded growth, skeletal abnormalities, delayed/depressed oestrus
Cobalt	Vitamin B12 synthesis by rumen microbes	Wasting disease, poor growth
Selenium	Antioxidant enzyme (with Vitamin E)	White muscle disease; retained placenta, cystic ovaries
Iodine	Thyroid hormone synthesis	Goitre; weak/hairless calves; reproductive abnormalities

15.2 Key Vitamins — Roles and Deficiency Signs

Vitamin	Key Role	Deficiency Signs
Vitamin A	Epithelial integrity, vision, reproduction, bone formation	Night blindness, infertility, abortion, poor calf development
Vitamin D	Calcium/phosphorus absorption and bone mineralization	Rickets, osteomalacia
Vitamin E	Antioxidant (with Selenium), immune function	Nutritional myopathy / white muscle disease
Vitamin K	Blood clotting (prothrombin synthesis)	Haemorrhagic conditions

16. Fodder Conservation — Hay Making and Silage Making

16.1 Silage Making

Silage is the fermented product of green forage, preserved by the acids produced through anaerobic fermentation of sugars. Well-made silage preserves about 85% of forage energy, compared with 50–80% for hay depending on conditions.

Steps to Good Silage

1. Use crops with adequate sugar content (maize, sorghum, meadow fescue); avoid heavy legume content or immature, low-sugar crops; add molasses if the crop is sugar-deficient.
2. Avoid excessive moisture — wilt if necessary to 25–30% dry matter; avoid cutting rain-soaked crops.
3. Exclude air — fill rapidly, chop/lacerate the forage, and consolidate thoroughly (e.g., tractor compaction).
4. Seal the silo immediately after filling to exclude air and prevent water ingress.
5. Use additives (molasses, organic acids, lactobacilli cultures) for problem crops — high moisture, high nitrogen or low sugar (e.g., legumes).
6. Expose the minimum silage face when feeding out — remove at least ~15 cm/day to limit mould growth and wastage.

Silage Quality Grades

Grade	pH	Ammonia-N (% of total N)	Notes
Very good	3.7–4.2	<10%	Good smell; no butyric acid or mould.
Good	4.2–4.5	10–15%	Satisfactory smell; least butyric acid.
Fair	4.5–4.8	15–20%	Slightly bad odour; some butyric acid.
Bad	above 4.8	>20%	Bad smell; high butyric acid — avoid feeding if possible.

16.2 Hay Making

The objective of haymaking is to reduce moisture sufficiently to prevent fermentation and mould growth while preserving the maximum nutrients. Cutting stage is critical earlier cutting gives higher nutritive value but lower yield.

Properties of Good Hay

- Cut at the proper stage of maturity, before stems become woody/lignified
- Retains a high proportion of leaves (leaves are far richer in protein and carotene than stems)
- Green in colour, indicating minimal bleaching/fermentation loss
- Made from thin-stemmed crops, soft and palatable
- Free from weeds and poisonous plants
- Stored at not more than 20–23% moisture to avoid spontaneous heating
- Free from dust and mould, with a pleasant aroma

Note: *Two quick field checks for cure: the scrape test (bark should not peel easily from the stem) and the twist test (a twisted handful should show no moisture and only slight stem breakage).*

17. Animal Identification, Castration, Dehorning and Handling

17.1 Methods of Animal Identification

Method	Nature	Typical Use
Ear tagging	Semi-permanent; most widely used	General herd identification
Ear tattooing	Permanent	Registered/pedigreed animals
Branding (hot iron / freeze)	Permanent	Herd or ownership marking
Ear notching	Permanent	Common in pigs and beef cattle
Neck chain/rope, ankle band, tags	Temporary	Short-term/individual tracking

17.2 Castration

Castration renders draught/work animals more docile, improves growth and meat quality, and controls indiscriminate breeding. It should be performed in the cool season (never during the rainy season, due to fly risk), with the animal rested afterward in a clean, comfortable pen.

Method	Description	Optimum Age
Burdizzo (bloodless)	Crushes the spermatic cord to stop blood supply to the testes, causing atrophy without an open wound.	Young: within 3 months; Adult: within 1 year
Open/surgical method	Scrotum opened and testicles surgically removed; wound treated with antiseptic.	Any age, under veterinary supervision
Rubber ring (elastrator)	A tight rubber ring cuts off circulation to the testicles, which subsequently atrophy.	Below 3 months

17.3 Dehorning / Disbudding

Disbudding at 15–20 days of age (when the horn root is still a bud) reduces injury risk to other animals and handlers, saves shed space, and prevents horn cancer.

- Hot iron method — a heated electric dehorner applied for about 10 seconds; bloodless.
- Elastrator — a tight rubber ring at the horn base; slower (weeks) and more painful; used for horns already 5–10 cm.
- Chemical method — caustic potash/soda paste applied to the bud (with eye protection).
- Saw/clippers — used for older cattle; the main horn artery should be tied off to control bleeding.

18. Transport of Cattle and Buffaloes

18.1 General Conditions

- Only healthy animals, certified by a qualified veterinarian, should be transported
- Young animals should be separated from adults; advanced-pregnancy animals separated from others
- Complete required vaccinations at least 14 days before transport
- Ensure sufficient feed, fodder and water are carried for the journey
- Vehicles must be clean, structurally safe (no sharp edges/nails), and disinfected before loading
- Provide bedding material at least 5 cm thick to prevent injury
- Never tie animals by the leg during transport
- Attach a label with animal count/type, consignor/consignee details and feeding instructions

Note: *For journeys exceeding 12 hours, an attendant must remain with the animals at all times; cattle should be unloaded and watered at least every 8 hours.*

18.2 Mode-Specific Notes

Mode	Key Requirements
Rail	Minimum ~2 m² space per animal; adequate bedding/padding; ventilation via partially open, mesh-protected upper doors; at least one attendant per wagon.
Road/Truck	Anti-slip flooring; no more than 6 cattle per goods vehicle; one attendant per vehicle; do not mix with other cargo; face animals toward the direction of travel where practical.

Mode	Key Requirements
Sea/Air (specialized cases)	Requires certified vessel/aircraft fitting inspection, adequate ventilation, secure standings/pens, veterinary attendance and first-aid provision.

19. Health, Biosecurity, Vaccination and Deworming

19.1 General Biosecurity Measures

- Routine vaccination as per the applicable veterinary programme
- Disease surveillance and prompt treatment of reproductive/other infections
- Quarantine and health assessment of newly introduced animals (minimum 30–40 days; up to 6 months for diseases such as rabies)
- Clean housing, sanitation and clean calving areas
- Safe handling of semen and reproductive equipment
- Control of vectors and external/internal parasites

19.2 Indicative Vaccination Schedule

Animal Group	Vaccine	Timing
Calves	Foot-and-Mouth Disease (FMD)	First dose at 4 months; booster 2–4 months later; then twice yearly
Calves	Brucellosis	4–8 months of age (only female calves)
Calves	Black Quarter (1st dose)	8 weeks before weaning
Calves	Anthrax, Black Quarter (2nd dose), Haemorrhagic Septicaemia	Around 6 months
Adults	FMD	November-December and May–June (twice yearly)
Adults	Anthrax	April–May (Annually)
Adults	Black Quarter	May-June (before monsoon)
Adults	Haemorrhagic Septicaemia	May-June (before monsoon)

Note: *Vaccination should be carried out by a qualified veterinarian using vaccine within its expiry date and maintained in a proper cold chain.*

19.3 Deworming

- Begin deworming from the first week of life (e.g., a single oral dose of piperazine

adepate is commonly recommended for neonatal ascariasis, particularly in buffalo calves)

- Deworming every three months upto 1 years of age then one every 6 months thereafter.
- Always follow veterinary advice on drug choice and dosage — avoid both over- and under-dosing

19.4 Quarantine and Isolation

Quarantine applies to apparently healthy animals newly introduced to a herd, to observe them for a period corresponding to the incubation period of relevant diseases (commonly 30–40 days). Isolation applies to animals already showing signs of a contagious disease, or those in contact with them, and requires separate housing, dedicated equipment/attendants where possible, and strict hygiene by handlers moving between isolated and healthy stock.

20. Milk Production, Hygiene and Handling

20.1 Hygienic Milking Practices

- Clean and sanitize udders and teats before and after milking
- Thoroughly sterilize all milking equipment between uses
- Ensure milkers observe good personal hygiene
- Milk at consistent times daily to support both yield and cow comfort
- Complete milk removal at each milking to reduce mastitis and infection risk

Note: *Mastitis remains one of the most economically damaging and common dairy diseases; hygienic milking is the single most effective preventive measure.*

20.2 Milk Handling after Milking

- Cool and transport milk promptly to minimize bacterial growth
- Use clean, food-grade containers for storage and transport
- Avoid contamination from dust, water or unclean surfaces
- Follow prescribed withdrawal periods for any treated animal before its milk is used, to avoid drug residues
- Maintain milk records (yield, fat %, and any quality tests) for both farm management and buyer transactions

20.3 Economic Significance of Balanced Feeding on Milk Yield

Field evidence consistently shows that balanced nutrition mineral mixtures, vitamins, deworming and proper green/dry fodder mixing can raise milk yield meaningfully within weeks, while also reducing veterinary costs and improving reproductive performance and calf survival, thereby strengthening farm household income and financial stability.

21. Genetic Improvement Infrastructure and Institutional Support

Genetic improvement is permanent and cumulative its benefit persists across the animal's life and compounds across generations. Sustained genetic improvement, as demonstrated internationally, depends on building infrastructure for performance recording, genetic evaluation and wide dissemination of superior genetics.

21.1 Core Activities for Genetic Improvement

1. Setting breeding goals through consultation across the dairy value chain
2. Deciding appropriate breeding designs (progeny testing, pedigree selection)
3. Performance recording of individual animals for various traits
4. Genotyping of recorded animals
5. Estimating breeding values
6. Disseminating genetics of the best-selected animals through AI

21.2 Supporting National Systems

- Unique 12-digit animal identification (as recommended by DADH), coordinated nationally
- The INAPH information system for recording breeding, health and nutrition data at farmers' doorstep
- A Breeding Value Estimation Committee coordinating genetic evaluation across recorded breeds
- Genomic evaluation using SNP chips, improving accuracy of young-bull selection
- Certified semen stations and regulatory oversight of AI service quality

Farmers and cooperatives are encouraged to participate in milk recording, AI programmes and ration-balancing advisory services offered through these national systems, as participation directly improves both individual animal management and the accuracy of genetic evaluation for the wider population.

22. Farm Records, Daily Routine and Monitoring Indicators

22.1 Indicative Daily Farm Routine

Time	Activity
03:00–05:00	Cleaning/brushing of milch animals; feeding half the concentrate ration; morning milking
05:00–08:00	Milk dispatch; shed cleaning; fodder feeding; isolation of sick/in-heat animals
08:00–12:00	Calf/dry-stock/bull shed cleaning; concentrate feeding; bull exercise; sick-animal treatment; breeding of in-heat cows; fodder harvesting and feeding
12:00–13:00	Rest period
13:00–15:00	Miscellaneous farm jobs — identification, vaccination, ration preparation, equipment repair, hay/silage making, deworming, grooming, sale/purchase administration
14:30–17:00	Evening washing/feeding/milking cycle mirroring the morning routine
17:00–18:30	Final shed cleaning and fodder feeding
18:30–03:00	Night watch

22.2 Herd-Level Monitoring Indicators

Indicator	Purpose
Age at puberty / first service / first calving	Assess heifer development and replacement efficiency
Estrus detection rate	Assess quality of heat detection
Conception rate / services per conception	Assess breeding efficiency
Days open / calving interval	Assess postpartum reproductive performance
Repeat breeding rate / pregnancy rate	Identify reproductive problems and herd status
Lactation yield / lactation length	Assess productive performance and persistence
Calf survival / culling rate	Assess replacement efficiency and herd sustainability
Lifetime productivity	Assess overall genetic and management success

23. Consolidated Do's and Don'ts

✓ *DO*	× *DON'T*
• Use superior and appropriate germplasm; maintain complete breeding records • Observe animals regularly for heat, with special attention to silent heat • Follow correct AI timing using trained personnel; confirm pregnancy at 45–60 days • Provide balanced nutrition and proper mineral supplementation at every stage • Maintain clean, hygienic calving facilities and milking practices • Seek veterinary advice promptly for repeat breeders and sick animals • Keep breeding bulls in sound physical and reproductive condition • Select replacement heifers systematically and cull poor performers on objective criteria	• Do not breed animals solely on physical appearance • Do not use genetically inferior or untested bulls indiscriminately • Do not ignore weak or silent heat • Do not repeatedly inseminate non-conceiving animals without diagnosis • Do not compromise semen handling and storage • Do not allow excessive inbreeding • Do not neglect nutrition during pregnancy and early lactation • Do not overlook reproductive disease prevention, sanitation and heat-stress management

24. Key Recommendations, Expected Outcomes and Core Message

24.1 Ten-Step Summary for Farmers

1. **IDENTIFY EVERY ANIMAL**
2. **RECORD ALL BREEDING AND HEALTH EVENTS**
3. **DETECT HEAT ACCURATELY**
4. **BREED AT THE RIGHT TIME**
5. **CONFIRM PREGNANCY**
6. **FEED A BALANCED RATION AT EVERY STAGE**
7. **MANAGE CALVING CAREFULLY**
8. **CARE FOR THE NEWBORN CALF AND COLOSTRUM FEEDING**
9. **RECORD ONGOING PERFORMANCE**
10. **SELECT THE BEST ANIMALS AND CULL THE POOREST**

24.2 Expected Outcomes

- Improved genetic potential and better estrus detection
- Higher AI efficiency and improved conception rate
- Reduction in repeat breeding and reduced days open
- Improved calving interval and earlier replacement of inferior animals
- Better calf survival and heifer development
- Improved milk production and increased lifetime productivity
- Reduced avoidable feeding and reproductive-management costs
- Improved profitability of dairy farming and sustainable improvement of indigenous and crossbred cattle

24.3 Core Message

"Breed the best, detect heat correctly, inseminate at the right time, nourish the animal adequately, maintain reproductive health, record performance and retain only superior animals."

24.4 Cattle Productivity Enhancement Formula

Superior Genetics + Accurate Heat Detection + Timely AI + Balanced Nutrition + Reproductive Health + Proper Calf & Heifer Management + Sound Bull Management + Performance Recording = Improved Reproductive Efficiency + Higher Productivity + Greater Farmer Profitability.

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