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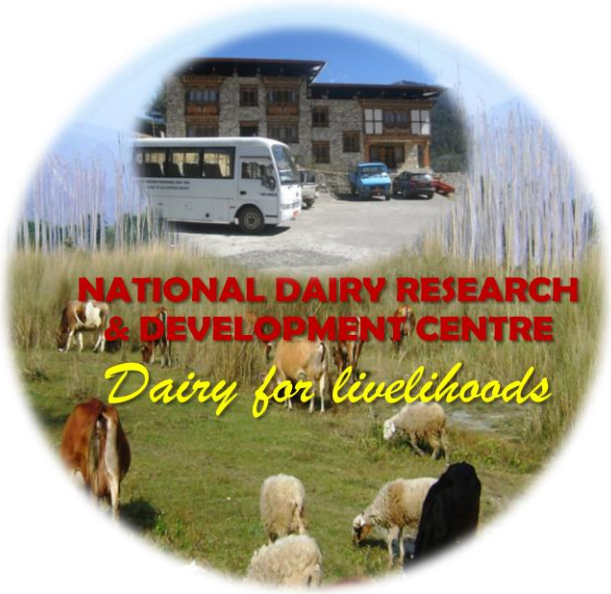
MINISTRY OF AGRICULTURE & FORESTS
DEPARTMENT OF LIVESTOCK
NATIONAL DAIRY RESEARCH AND DEVELOPMENT CENTRE
YUSIPANG, THIMPHU

DAIRY PRODUCTION MANUAL

National Dairy Research & Development Centre, May 2021

Suggested citation: NDRDC (2021): 15; **Dairy Production Manual**



Compiled and edited by:
Dr. Dhan B. Rai, Animal Reproduction Specialist

Cover Design:
Dr. Nar B. Tamang, Specialist Head/Program Director

Contact Address
Specialist Head/Program Director
National Dairy Research & Development Centre,
Yusipang, Department of Livestock
Ministry of Agriculture and Forests

PO Box: 1058
Office Phone: +97517116985, 17116985 (PABX) Lab: 17116986
Email:ndrc17@gmail.com

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Contributing Team Members

1. Dr. Dhan B. Rai, Specialist III, NDRDC Yusipang (Team Leader)
2. Dr. Nar B. Tamang, Specialist Head/Program Director, NDRDC Yusipang
3. Mr. Phuntsho T. Norbu, Principal LPO, NDRDC Yusipang
4. Dr. Dorji, Principal Animal Health Officer, NDRDC Yusipang
5. Mr. Lokey Thapa, Dy. Chief LPO, NDRDC Yusipang
6. Mr. Abi N. Koirala, Sr Livestock supervisor II, NDRDC Yusipang
7. Ms. Deki Choden, Dy. Chief LPO, NDRDC Yusipang
8. Ms. Kinley Choki, Dy. Chief LPO, NDRDC Yusipang
9. Mr. Kanti Ram Chettri, Sr. Pasture Supervisor, NDRDC Yusipang

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DAIRY PRODUCTION MANUAL

1. SCOPE

This manual shall provide overall guidelines for dairy cattle management; proper breeding and reproduction, selection of good quality animals, feeding, housing and health care, under Bhutanese environment. This concise manual is intended for use by dairy farmers and Livestock Extension Agents to enhance dairy productivity and farm income.

2. INTRODUCTION

Dairy farming is one of the most prominent features of livestock-crops system in Bhutan. To boost dairy farming and make it more efficient, Royal Government of Bhutan is providing production support for breed improvement, housing, feed/fodder development and control of economically important livestock diseases. Besides, farmers are assisted to form self help groups, support capacity building, support access to essential infrastructure for products processing and marketing.

Increased demand for fresh milk and milk products is driving the need for improved dairy farms across the country. Thus there is need to further strengthen adoption of modern farming technologies, good practices and building of farmers institutions to make dairy farming a viable enterprise to improve income and livelihoods.

Dairy farming has picked up its pace in the recent years with a steady increase in the total milk production in the country. This is mainly due to the increased number of crossbred cattle with intensification of systematic breeding programs. However it is not able to fulfill the increasing demand for dairy products resultingin the import from other countries.

Though dairy farmers have good quality crossbred cattle, the milk production potential of these breeds remains to be improved, owing to following attributes:

- Inadequate feeding, management and housing facilities that compromise the comfort, welfare and production of animals.
- Poor adoption of good health management practices
- Inadequate uptake of systematic breeding and reproductive management practices

To guide the Livestock Extension Agents and dairy farmers/entrepreneurs, this manual along with relevant good management practices are outlined below.

3. CATTLE BREEDS, BREEDING SYSTEM AND PRODUCTIVITY

3.1 Cattle breeds and Characteristics

The exotic dairy cattle breeds reared in the country are Jersey, Brown Swiss (BS), and Holstein-Frisian (HF). The *Nublang* (male)/ *Thrabam* (female), native to the country, dominates the cattle population and are used as base population for crossbreeding with exotic breeds. Jersey pure and BS pure are available in Govt. nucleus farms (National Jersey Breeding Centre, Samtse and Regional Cattle Breeding Centre, Bumthang), whereas crosses of Jersey, BS, HF are reared by farmers as a result of crossing with the base population.

Native cattle

The native cattle are locally known as *Thrabam* (female) and *Nublang* (male). These local cattle *Nublang/Thrabam* has typical cervical hump of *Bos indicus* type.

The distinguishing features are:

- Long head and face with wide and flat forehead
- Humps are well developed in bulls and prominent in cows
- Legs and feet are long and strong
- Neck is broad and long with a well developed dewlap in the male and prominent in female, extending from mid jaw to brisket

Nublang

Jersey

Jersey breeds originated from British isle of Jersey. They are most often brown or tawny with a light-colored underbelly and dark hooves. Their milk contains higher milk fat than other exotic dairy breeds making it ideal for production of butter and cheese.

The distnguishing features of this breed is dish shaped face, bulging eyes and compact body.

Jersey cross cow

Brown Swiss

This breed is native to Switzerland. Their color varies from light-to-dark brown and sometimes gray, but they are easily recognized by their large furry ears. Brown Swiss is a hardy, dual purpose breed, and is one of the popular cattle breed adopted in dairy farming.

Brown Swiss Cows

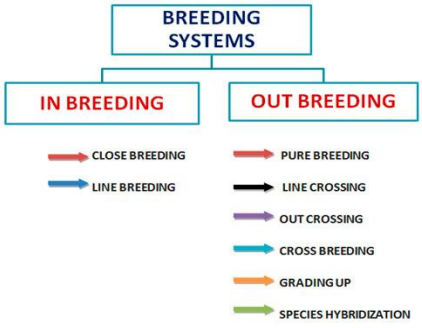
Holstein Friesian

Originally bred in Northern Germany and the North Holland/ Friesland regions of the Netherlands. It is the most popular of all dairy cattle breed in the world. Holstein Friesians are mostly black and white.

Holstein-Friesian cross cow

3.2 Breeding System

Breeding is defined as the crossing of the male and the female parents to get the off spring for the characters desired. The breeding methods are categorized as Inbreeding and Out-breeding.



3.2.1 Inbreeding

Inbreeding is the mating of closely related individuals. The example is the individual having one or more common ancestors or relatives. Inbreeding may be close breeding or line breeding.

a) ***Close inbreeding***

In this type of breeding, mating is done between very closely related individuals, such as full brothers are crossed with full sisters, or off springs are crossed with parents.

b) ***Line breeding***

It is repeated back crossing to one outstanding ancestor, so that its contribution to the progeny is more. In this type of breeding, mating is made to concentrate the inheritance of desired characters of some favored individuals.

Advantages

- It increases homozygosity (similarity) and decreases genetic variance (variations).
- Breaking down of population into different inbreed lines.

Disadvantages

- The progeny becomes more susceptible to diseases
- Breeding problems and reproductive failure usually increases
- Inbreeding has little value in dairy cattle breeding programs due to it detrimental effects

3.2.2 Out breeding

It is the opposite of inbreeding. Mating of unrelated animals is known as out breeding. It is divided into six classes; Pure breeding, Line Crossing (Crossing of inbreed lines), Out Crossing, Cross Breeding, Grading up and Species Hybridization.

a) Pure breeding

It is mating of unrelated male and female belonging to the same breed. The examples of pure breeding are: Native purebred cows (Thrabum) x Native purebred bull (Nublang), Jersey cow x Jersey bull.

Advantage

- Pure breeding improves the quality of animals within the breed.
- It avoids mating of closely related individuals.

b) Line crossing

In this method of breeding closely inbred lines are subject to intensive inbreeding for more than five generations. It is done to develop inbred lines, from unrelated line for the male and for the female. The unrelated inbred line of male is mated to the inbred lines of female and the offspring born out of such mating becomes a hybrid which exhibits heterosis or hybrid vigour.

Advantage

- Heterosis takes place wherein the crosses between inbreed lines are better than two parental populations.

c) Out crossing

It is mating of unrelated pure bred animals in the same breed. The animals do not have common ancestors on either side of their pedigree (parental generations) up to four to six generations.

Advantage

- It is an effective system for genetic improvement if carefully combined with selection.
- It is also pure breeding.

d) Cross breeding

It is mating of animals of different breeds. Cross breeding is followed for breeding animals for milk and meat production. In Bhutan, native breed of cows (*Thrabam*) are crossed with exotic breeds such as Brown Swiss and Jersey bulls or use their semen for artificial breeding to enhance the milk production potential of the progeny. The progeny inherit the desirable characters of the parent: high milk yield, early maturity, higher birth weight of calves, better growth rates, better reproductive efficiency and native parents' characters: disease resistance and ability to thrive on scanty feeding and coarse fodder.

Advantages

- The desirable characters of the exotic parent are transmitted to the progeny which the native parent does not have.
- Results are seen more quickly in characters like milk yield in the crossbred progeny.

Disadvantages

- The breeding merit of cross bred animals may be slightly reduced to that of parents.
- Cross breeding requires maintenance of two or more pure breeds in order to produce the cross breeds.

e) Grading up

Grading up is the practice of breeding in which the sires (male parent) of the exotic breed are mated with the females of same breed/ crossbred and their off-spring from generation to generation. After five or six generations of grading up will result in population resembling the exotic breed. This is the breeding practices that is pursued in Bhutan. Females of less developed breeds are continuously bred with exotic Jersey or Brown Swiss bulls.

Advantages

- After five to six generations of grading up the progeny resembles pure bred animals both for physical appearance and production
- Grading up avoids expenditure of purchasing the exotic females herd of improved animals.
- Farmers can get better price for upgraded animals

Disadvantages

- The graded males are less useful for breeding and draught purpose
- The adaptability to climate and the environment is reduced for upgraded animals

f) Species hybridization

It is mating of male and female belonging to the different species to produce hybrid progeny. Species hybridization is an extreme form of out crossing. The examples of species hybridization are: *Thrabam* – purebred local cows (*Bos indicus*) x Mithun bull (*Bos frontalis*) to produce hybrids *Jatsham* (female) and *Jatsha* (male).

Advantages

- The Hybrid progeny has slightly higher production potential, greater strength for draught work and better environmental adaptability because of new combinations of useful genes.
- The hybrid animals can fetch better price.

Disadvantages

- The males born from such hybridization are sterile and useless for breeding purpose e.g Mithun x *Thrabam* hybridization results in production of sterile first cross male *Jatsha*.
- Farmers have to back cross *Jatsham* with Nublang bull continuously for the next four to five generations to regain the fertility of males.

3.3 Productivity of different breeds

In dairy production, the productivity of an animal is determined primarily by the breed of animal and its quality (purity), level of feeding and health care management. On an average, the productivity of breeds available in the country are presented in table 1, to guide farmers to make an informed choice of breed while starting a dairy farm.

Table 1: Average productivity of dairy cattle in Bhutan

Breed	**Production**	**Evidence**
Jersey pure	10.47 L/day	*Tamang et al*. (2019)
Jersey cross (F1 – F4)	7.8 L/day	*Rai et al*. (2020).
BS pure	9.8 L/day	*Gurung, P.B* (2021) *pers. comm.*
BS cross (F1 – F4)	6.5 L/day	
HF cross (F1 – F3)	10.74 L/day	*Choden et al.* (2020)
Native/ *Thrabam*	2.04 L/day	*Tamang et al*. (2019)

4. MANAGEMENT OF DAIRY CATTLE

4.1 Management of Calves

The profitability and sustainability of a dairy farm depends upon the quality of calves born. Therefore, care and management of the calves should truly begin before they are born (*refer management during pregnancy and parturition below*).

- Immediately after the birth, any membrane or mucus adhering to the mouth, nostrils, eyes and ears of the newborn should be carefully removed and facilitate normal breathing. A dry cloth can be used for cleaning.
- Usually the dam (mother) will lick her calf dry, otherwise sprinkle little common salt on the calves to induce licking. If the calf does not start to breath, artificial breathing needs to be provided by pressing and relaxing alternatively the chest wall or the calf should be held by hind legs upside down and swing several times.

- The umbilical cord should be disinfected using disinfectant (iodine). The navel cord of the calf should be tied 2.5cm away from its body and cut 1cm below the ligature. The stump should be disinfected. A healthy normal calf should get up within 30 minutes. Weaker calves should be given assistance.
- Calf hood is categorized into *Colostrum phase, Pre-ruminant phase* and *Transition phase*.

Colostrum phase

The calves should be fed with colostrum within the first hour of life. Colostrum feeding should continue for the first 3 – 4 days of life. Calves need to be fed with colostrums (10% of their body

weight) daily in three equal feedings. The primary function of colostrum is to fortify the calf's disease resistance due to the presence of maternal antibodies. It also contains minerals and vitamins which acts as laxative and helps in clearing the meconium. Within two hours of suckling, meconium is passed. If the meconium is not passed rectal enema with one teaspoon of soda bi-carb in one litre of lukewarm water should be given. If the colostrum is not available from the dam, colostrum from other cows (if available) could be given or an artificial colostrum can be prepared and fed. Artificial colostrum can be prepared with 2 eggs in 30 ml of castor oil.

Pre-ruminant phase

Fresh warm whole milk is fed to calves @ 10% of its body weight. Milk and milk substitute should not exceed 4.5 kg per day. Green fodder can be given after 15 days onwards. This phase lasts from 5^{th} day to 30 days.

Transition phase

In this phase small quantities of dry meal (calf starter) should be fed to calves. Calves should be liberally fed as they are continuously growing. Over feeding however should be avoided. Calves can be weaned (stop feeding milk) after four months of its age as they can sustain on feeds and fodder. However, practice of weaning may not be feasible with native (*Thrabam*) cattle.

4.2 Management of Heifers

Management of heifers (female cattle of more than one year till calving) in a dairy farm is important as the productive and reproductive performances of dairy herd depend on it.

Rearing period of heifers can be divided into two stages, viz. from weaning to first service and from first service to calving.

Heifers should be provided with the floor space of about 50 – 60 sqft each. The heifers should be fed daily with concentrate up to 1.5kg/ day as a supplement to good quality pasture. Feeding hay/silage with concentrates will be necessary as a supplement when pasture is in short supply.

If underfed, diseased or have parasites, then puberty is delayed. Low energy will lead to ovarian inactivity and low protein will cause irregular or silent heat.

4.3 Management during Pregnancy and Parturition

Pregnant heifers and cows (gestation period 280 to 285 days) must be provided with grain mix, minerals and vitamins to ensure proper development of fetus. During the final three months of pregnancy, heifer and cows will need extra nutrients for growth of developing fetus. Protein rich diet allows heifers and cow to carry her calf to term healthy.

The pregnant animals should be spared from all forms of violent exercises (walk long distances, run fast, chased, frightened or allowed to fight).

Usual signs of pregnancy are cessation of estrus, alteration of temperament, fattening tendency, enlargement of abdomen, engorged mammary gland and increase in weight.

The areas of attention that need to be provided are;

- Pregnant animal ration should contain all the nutrients in adequate quantity so that the animal at the time of calving is healthy with body condition score (BCS) of minimum 3 (Scale of 1 – 5).
- As a preparation to calving, the animals should be moved to a quite, comfortable, hygienic and well bedded place at least one week before calving.
- The advanced pregnant animal should be kept on light, laxative diet and given water adlib. The feed should not be reduced too much before or after calving.

Early signs of calving

Common signs of approaching parturition are swelling of external genitals with a clear mucus discharge, enlargement of udder, engorgement of the teats, relaxation of pelvic ligaments and muscle around the tail head and pin bones. Temperamental changes are also observed.

Care at calving

- The animal should not be disturbed during the time of calving process
- In case of Dystocia (difficulty in parturition) due to unnatural presentation of calves, it should be corrected timely to facilitate normal calving process. Under such situation, farmers should seek for help from animal health service providers
- Animals should not be allowed to eat placenta as it may cause indigestion.
- Normally placenta is expelled within 4 to 8 hours of parturition. In case of retention of placenta (RoP) it should be removed manually within 12 to 18 hours in case the dam is off-feed and has fever and in field situation farmers should seek the aid of animal health service provider
- The cow can be put to regular milking after 4-5 days of parturition

4.4 Management of Lactating cows

Lactating cows require high quality feed and fodder to sustain good milk production. Normally, lactation period lasts for about 10 month, whereas in native cattle it lasts only for 7 – 8 months. Nutritional requirements of cows are dependent on body weight and milk production. For optimum production and subsequent fertility the lactating cows should be adequately fed with balanced ration so that the BCS of 2.5 – 3.5 (scale of 1 – 5) is maintained, which is regarded as best health condition. The cows should not lose body weight more than 0.5 of the standard BCS from calving to next desired insemination.

4.5 Management of Dry cows

This is a "rest" period. Dry cows should be fed with diet of mostly forages, and some grains/ concentrates to ensure the fulfillment of required vitamins, minerals and salt. Cows should not be milked for about 60 days before the nextexpected calving. Cows with no dry period will result in decreased milk production in subsequent lactation and may effects fetal growth.

Therefore, following interventions are required;

- Discontinue milking for 60 days before calving.
- Observe for mastitis after 10 days of dry off period.
- High yielding cow should be milked intermittently in the dry period to avoid mastitis

5. REPRODUCTION MANAGEMENT

The animals are bred either naturally or artificially. Natural breeding is supported in areas where Artificial Insemination (AI) services are not available, owing to its non-feasibility due to various reasons, through supply of pedigree selected breeding bulls of either pureline or its crosses according to choice of farmers. However, tri-hybridization is not supported by Breeding guidelines in Bhutan. Farmers are discouraged to practice Inbreeding and encouraged to practice Outbreeding systems.

5.1 Natural Breeding and Artificial Insemination

The areas not feasible for establishment of AI facility, owing to inaccessibility due to remoteness or less breedable female population, are supported with supply of breeding bulls. In order to ensure procurement and supply of highly fertile breeding bull, the probable bull before selection has to undergo rigorous selection process. A breeding bull selected and placed in an area can remain there for maximum of two years and it has to be exchanged with other certified breeding bull so as to avoid inbreeding.

As AI greatly helps in genetic improvement of the herd the areas accessible by road and feasible for AI centre establishment are supported with AI facilities. With the use of mostly proven sires for A.I, offspring born are genetically superior [Refer to ***Standard Operating Procedure for Bovine AI in Bhutan, NDRDC, Publication 12: 2019***]. However, for establishment of AI centre feasibility study has to be carried out in order to ensure that minimum of 120 inseminations per centre are performed[1] annually on an average so that return of investment is accomplished.

For AI success rate, it is crucial to observe heat signs and follow the insemination procedure.

AI services are catered by Livestock extension staff and Community based AI Technician (CAIT) [Refer to ***Guidelines for selection, training and deployment of CAITs, NDRDC, Publication 14: 2019***].

Similar to placement of bulls, semen of a particular bull can remain in one AI centre for maximum of two years to avoid inbreeding.

5.2 Selection of Breeding bulls

There are a number of considerations when selecting a bull for breeding purposes. The differential emphasis on breeding soundness evaluation (BSE) is dependent upon the needs and opportunities that a producer may experience on their individual operations. Desired characteristics such as growth, locomotor system, external genitalia and testicular size (scrotal circumference) need to be physically observed as a part of BSE, in addition to semen quality assessment, semen freezing test for AI station and diseases screening.

For details on breeding bull selection and management [Refer to ***Bhutan Guidelines for Breeding Bulls Procurement, Placement and Management" (BTS 49: 2018)***].

5.2.1 Physical examination of the locomotors system

Foot and leg problems can be a major herd problem due to reduced performance (weight gain and reproduction) resulting in lower productivity and increased economic losses. Abnormal structure of the hindquarter, shoulders and legs alters weight distribution, leading to stresses,

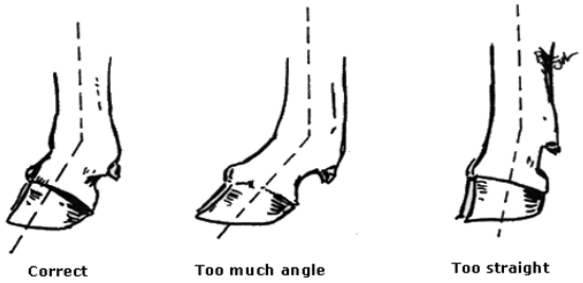
[1] The target for annual AI performance per centre may change with change in time.

inflammation and impaired function such as walking and serving ability (Ashwood, 2011). A structurally correct bull, when walking, will place his hind foot in the mark left by his front foot, and over or under-stepping of the hind feet are an indication of structural leg problems (Raza et al (2013).

Front legs *(Knock-kneed or bow-legged)*

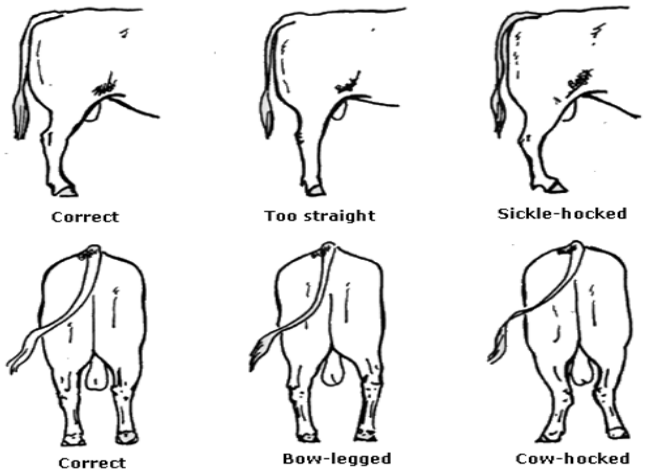
The front legs of the bull should be straight when viewed from in front. On a structurally sound animal, a vertical line may be drawn from the point of the shoulder to the middle of the claw. This line should intersect the knee. A ***'knock-kneed'*** bull will have turned-out front feet (up to 10 degrees is considered normal). On other instance, ***'bow-legged'*** bull will have their knee deviated away from the vertical line, which is also called ***'Valgus Deformity of Forelimbs'.***

The way the claws of the feet grow often indicates structural problems higher up the legs. Long or excessively short even claws may indicate too much or not enough pastern angle, causing both claws of the hoof to grow or wear excessively. Overgrown claws affect the mobility and performance of the animal.



Hind legs *(Straight hock, Sickle hock, Bow legged or Cow hock)*

Hind legs have well-defined angles in the joints at the hip, stifle, hock and pastern joints. The angles are critical, particularly during serving when entire body weight is placed on these joints. Deviations from the correct angles will cause excessive wear and tear on the joints, leading to early breakdown. ***'Straight hock' (Post legged conformation)*** occurs due to hock, stifle or hip joint pathology. The opposite of it is ***'sickle hock'*** that leads to collapsed heels and overgrown claws with a tendency for foot lameness. Thus young bulls with straight and extreme sickle hock should be avoided from selection for breeding.



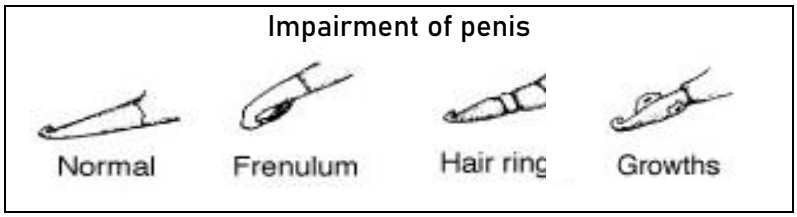
Viewed from the back, the leg should be vertical. Bulls that are wide at the hocks with their feet turned inwards (***bow legged***) and those with their hooves rotated outwards (***cow hocked***) can have can suffer lameness and permanent damage of ligaments. So the bulls with such deformities should be avoided from selection for breeding.

5.2.2 Physical examination of External genitalia

Breeding soundness examination of bulls has to be carried out to detect the bulls with obvious potential fertility problems. The examination includes detection of defects in external genitalia; penis and scrotum, if any, by an experienced, trained person, usually a veterinarian.

Penis

The penis should be examined during electro-ejaculation or natural mating, in an erected, extended state. Potential problems of the penis may include hair rings, which restrict circulation, a persistent frenulum or adhesion, lacerations, growths, scar tissue, deviations, or a urethral fistula.

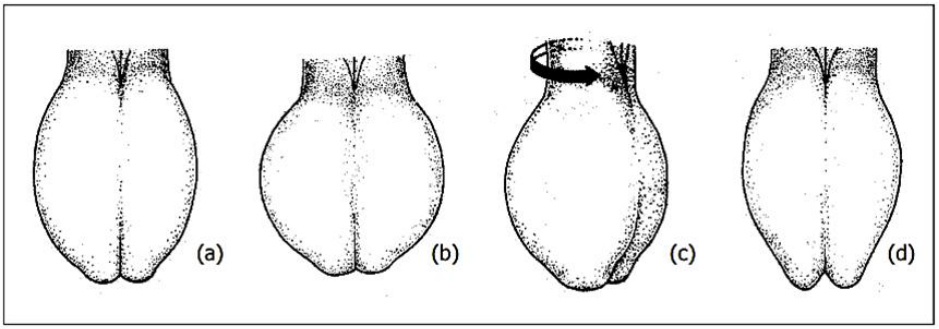


Scrotum and testes

The scrotum and testes should be palpated. The scrotum should be pendulous but well supported. The testes should be firm and uniform in size and shape. Before handling the scrotum and testicles a visual appraisal of the scrotal shape should be carried out. In a cold environment this may be difficult as the muscle of the scrotal wall and the cremaster muscles will pull the testicles closer to the body wall. The three common descriptors for scrotal shape are:

- *Normal scrotum*

A pendulous scrotum with a well defined neck is ideal for thermoregulation of testicles, and suitable for selection.



Scrotal conformation: (a) normal (elongated), (b) normal (round), (c) rotated, and (d) Y-balls/cleavage.

- *Straight (slab) sided scrotum*

Straight/slab sided scrotums usually have excessive fat in neck of scrotum, which impair thermoregulation and decreases sperm quality. Such bulls should be avoided from selection.

- *Wedge-shaped scrotum*

This is associated with smaller testicles held close to body wall and produce sperm of decreased quality due to poor thermoregulation and hypoplasia of testicles. Hence, selection of such bulls should be avoided.

5.2.3 Examination of Scrotum and Contents

The scrotal skin should be smooth and elastic and the testicles should move freely within it. Each testicle should be palpated in turn and any abnormalities noted. Abnormalities in testicular tone that are significant (ie. due to degeneration) will normally be confirmed when semen is examined. Testicles should be of even size and shape.

- *Measurement of Scrotal Circumference (SC)*

Scrotal circumference is a critical component of BSE as the SC measurement is highly correlated to paired testes weight, daily sperm production and semen quality. The desired SC for young bulls for breeding is between 31– 34 cm (table 2). Bulls with below target SC as yearlings will still have small testicles by 2 year old so culling decisions can be made when measuring SC in young bulls.

Table 2: Recommended Scrotal Circumference by Age for a breeding bull (Raza et al. (2013)

Age	SC
12 to ≤ 15 months	30 cm
15 to ≤ 18 months	31 cm
18 to ≤ 21 months	32 cm
21 to ≤ 24 months	33 cm
24 months	>34cm

5.2.4 Semen evaluation

Semen consists of the spermatozoa and a liquid composed largely of the secretions of the accessory glands. The volume of semen and the number of sperm ejaculated by different bulls varies considerably. Once sexual maturity is reached in farm animals, sperm production is continuous throughout the reproductive life. During periods of sexual rest old sperm cells in the epididymis die, degenerate and are absorbed. For this reason, the first sample collected after a long period of sexual inactivity may appear to have a high percentage of dead and abnormal sperm. Therefore, semen evaluation of a bull should not be made on one collection alone.

The primary objective of semen evaluation is to detect males that have semen deficiencies such as no sperm, a very low number of sperm cells, poor motility, large number of abnormal sperm and a large percentage of dead sperm amid the presence of large amounts of pus. For details on semen evaluation, [Refer to ***Standard Operating Procedures for Bovine Frozen Semen Production, NDRDC, Publication 1: 2018].*** Males producing such semen will usually be sterile or of low fertility.

5.2.5 Disease screening

The bulls tentatively selected for breeding purpose or semen production should be subjected to thorough disease (infectious and contagious) screening with the help of National Centre for Animal Health, Serbithang. The diseases mandatory for screening are;

- Brucellosis,
- Campylobacteriosis
- Leptospirosis
- Listeriosis
- Tuberculosis,
- Trichomoniasis
- Infectious Bovine Rhinotracheitis (IBR)

The bulls should be free from all above diseases, and should be screened on half-yearly basis to ascertain disease free condition. Any bull detected positive for the disease should be culled.

5.3 First breeding of Heifers

Due attention must be given to body weight gained rather than age while breeding the heifers for first time. The heifers bred before attaining the desired weight may lead to complications such as dystocia (difficulty in calving) followed by retention of placenta (RoP) and decreased fertility in subsequent insemination. If heifers are bred before attaining the desired weight it will affect optimal growth including nourishment of growing fetus inside and will results in lesser milk production in lifetime. The desired body weight for breeding of heifers breedwise is indicated in table 3.

Table 3: Desired body weight and age of heifers at the time 1st service

Cattle breeds in Bhutan	Avg. adult body weight	Desired body weight (70% of adult body weight)	Age to attain expected avg. body weight
Jersey cross	300 – 350 kgs	210 – 245 kgs	15 – 18 months
Jersey pure	350 – 400 kgs	245 – 280 kgs	
BS cross	400 – 450 kgs	280 – 315 kgs	24 – 27 months
BS Pure	450 – 500 kgs	315 – 350 kgs	
HF Cross	500 – 550 kgs	350 – 385 kgs	30 – 36 months
Thrabam	250 – 300 kgs	175 – 210 kgs	

5.4 Breeding of Cows after calving

The well managed cows, having undergone normal calving, are capable of exhibiting heat signs as early as 18 days after calving but they should not be inseminated/ bred. For optimum fertility or conception rate in cows, they should not be bred before 60 days after parturition. However, the cows that do not exhibit heat signs even after 90 days of calving should be checked for reproductive disorders and treatment advocated seeking the help of experienced veterinarians. Healthy cows that are managed well and undergone normal calving will have faster involution of uterus and may be inseminated even after 50 days of calving with proper involution check.

5.4.1 Proper Heat Detection and Insemination for higher Conception rate

For the success of AI, it is critical to observe animals at least three times a day for signs of behavioral heat, especially in early morning during quite and calm hours. The animal(s) in heat will be awake and on feet ahead of other animals. Standing heat is the best time for AI during which the animal will stand and allow other animals to mount her. In general, AI is done following AM – PM rule. The recommended AI timing is 12-16 hrs from 1st onset of heat or 8-12 hrs from 1st observed heat. Therefore, AI technicians must follow the AI timing for higher conception rates in compliance to the AI procedure. [Refer to ***Standard Operating Procedure for Bovine AI in Bhutan, NDRDC, Publication 12: 2019***]**.** In cows, fertility decreases in subsequent lactations. For profitability from dairy farming, the recommended AI index is max. 2. However, it may range between 1.5– 2.5 AI per conception in well managed farm to averagely managed farm.

5.4.2 Calving to calving interval

For profitability from a dairy farm, the calving to calving interval must not exceed 15 months. The optimum inter-calving period is 13 months. In order to achieve this inter-calving period, utmost care should be provided to animals during pregnancy, parturition and up to 3 months after calving. Cow should not loose BCS more than 0.5 point from the time of calving until next 2 months or optimum time for breeding. Therefore, proper feeding of cows has to be ensured.

5.4.3 Uterine Involution check and Pregnancy Diagnosis

In an organized dairy farm, cow must be checked for its uterine involution after 21 days of calving to ascertain whether the involution is taking place normally. In case the involution is not normal then the causes should be ascertained and treatment advocated and should be reexamined by experts in next 21 days (42 days after calving).

All inseminated animals do not become pregnant and at the same time, some animals after insemination (natural or artificial) do not exhibit heat signs either. Therefore, the animals once inseminated must be subjected to pregnancy diagnosis (PD) to ascertain the pregnancy.

The methods of doing PD are by way of;

- ***Per-rectal examination:*** It is least expensive and that can be undertaken within 2 – 3 months of insemination. However, it requires expertise for diagnosis of early pregnancy.
- ***Ultra-sound:*** Pregnancy can be diagnosed within 35 – 40 days, but the method is expensive and requires expertise.
- ***Analysis of pregnancy associated glycol-protein***: Pregnancy can be diagnosed from 28 days, but the method is expensive.

5.5 Management of Reproductive disorders

Some animals under low plane of nutrition are very likely to develop reproductive disorders such as persistent Corpus Luteum (CL) and Cysts on ovary/ovaries referred to as "Cystic ovary", which is indicated by animal behaviours such as irregular heat, intense/ abnormal heat or no expression of heat signs at all (if closely observed for long duration atleast 2 heat cycles). The type of disorders should be diagnosed and treated timely seeking intervention of veterinarian.

5.5.1 Persistent CL

It is the condition when the CL developed on ovary does not get regressed after 21 days of heat cycle. The CL continue to persist and blocks the development of ovarian follicles. Such animals do not come in heat at all. The animals with such disorder should be rectified through proper diagnosis and treatment to bring the animal back to production.

5.5.2 Cystic ovary

When dominant follicle on ovary does not rupture and continue to grow, it becomes cystic. Ovarian Cysts on ovary can be of two types; Luteal cyst or Follicular cyst. **Luteal cyst** is developed as a result of thickening of wall of cysts that release progesterone continuously and animals with such disorder do not come to heat. When the animals do not come to heat at intended time, such animals should be subjected to gynecological examination for timely diagnosis and treatment. For Follicular cyst refer to section under "*Repeat Breeding*".

5.6 Management of Unproductive female cattle

The cows that do not conceive after 6 months of calving, and heifers do not exhibit heat signs at intended age of first calving after attaining desired body weight for breeding are regarded as "**unproductive animals"**. Hence, this category of animals should be investigated by experienced veterinarian to identify the disorders if any and advocate corrective measures. In case, the disorders cannot be corrected they may have to be culled, otherwise their feeding and rearing would add on to cost of management.
The animals that fall under the unproductive category are related to overall poor management.

5.6.1 Repeat breeding

It is the condition when the animal fails to conceive on insemination and repeatedly comes to heat for more than 3 times at regular interval. The animal exhibits irregular heat and nymphomaniac (excessive sexual desire) condition and sometimes terminates with development of male character. It is caused by formation of "**Follicular cyst"** on ovary. The repeat breeding animals with such disorders must be corrected timely employing exogenous hormones.

5.6.2 Anestrous/ Post parturient anestrous

The heifers not exhibiting any heat signs even after attaining breedable weight and age are considered to be in anestrous condition. The condition is precipitated by management of animals under low plane of nutrition. During such condition, there will have no signs of development of follicles on ovaries upon palpation.
Similarly, cows that are undernourished during pregnancy as well as after calving and exacerbated with loss of body condition of more than 1 from calving to next two months of calving will result in post parturient anestrous. Such animals should be subjected to improved nutrition and management, and sometimes follicles development may be triggered employing exogenous hormone depending on health status of the animals.

6. GENERAL MANAGEMENT PRACTICES

6.1 Management of unwanted bulls

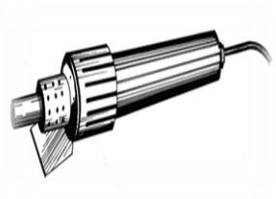
Any uncertified/unwanted bull(s) in the area/ community must be castrated and reared for any other intended purposes or disposed off so as to avoid indiscriminate breeding and chance of transmission of diseases in other cattle in the herd or community. For castration of such bulls, seek intervention from animal health service providers.

6.2 Dehorning/Disbudding of Calves

The practice of removing horns in cattle is undertaken to improve animal welfare in the longer term and for operators' safety during handling. There is an increased risk of injury, hide damage and bruising among horned cattle compared to polled cattle, particularly during handling and transport.

6.2.1 Hot Iron Dehorning

Hot iron dehorners are available in versions heated by a furnace or fire, 12-volt battery, 120-volt electricity, power packs. The head of the iron is a hollow circle and it fits over the horn bud. Proper application of the hot iron will destroy the horn-producing skin at the base of the horn. This technique works well for calves up to 6 weeks old.



Technique/ steps for hot iron dehorning

- Administer sedation, analgesia and local anaesthetic.
- Preheat the dehorning iron to a red colour. Both electric and gas irons work best when they are "red" hot.
- Wear gloves to protect your hands.
- Hold the calf's ear out of the way to keep it from being burned.
- Place the tip of the burner over the horn and apply slight pressure. When the burning hair begins to smoke, slowly rotate the dehorner by twisting your wrist.
- Continue the application of heat for 10-15 seconds. Do not leave the dehorner in place for much longer, especially in young calves. Heat can be transferred through the thin bones of the skull and damage the calf's brain.
- Dehorning is complete when there is a copper-colored ring all the way around the base of the horn.
- The horn bud or button will slough off in 4 to 6 weeks.

6.2.2 Chemical Dehorning

This is caustic soda (Sodium hydroxide) which destroys the horn bud cells. Prevent the growth of horns when properly applied to the horn buds of new-born (upto three weeks of age) calves. The chemicals are available as sticks or pastes.

Technique/ steps for chemical dehorning

1. Administer sedation, analgesia and local anesthetic.
2. Expose the horn bud by pushing the hair back
3. Apply the caustic to the horn button. Use a wooden applicator. Apply a thin layer.
4. Re-position the hair over the paste and horn bud
5. Protect the calf and the cow from accidental caustic burns with a patch of duct tape over each horn bud. The duct tape usually falls off in a few days.

7. FEEDING AND NUTRITION

7.1 Nutrient requirement of Dairy cattle

Proper feeding of farm animals is essential for best fertility and optimum production. In general, the daily diet of an animal should comprise of 70% roughage and 30% concentrate. However, it should be based on status of the animals. The roughage requirement has to be ideally fulfilled through feeding of green fodder or silage (50%) and dry fodder (20%). The requirement of these roughage and concentrate should be worked out in Dry Matter (DM) form. The daily requirement of feed and fodder for different category of animals based on its live body weight and productivity is calculated and presented in table 4.

Table 4: Daily feed requirement of cattle based on body weight and milk production level

Body weight (kg)	Milk prodn. (l/day)	**Roughage (70%)**				**Concentrated mixture (30%)**				**Total DM Requirement per day (Maintenance + Production)**
		Green fodder + silage (50%)		Dry fodder (20%) Hay/paddy straw						
		Green fodder (kg/day)	DM Qnty. (kg/day)	Qnty. (kg/day)	DM Qnty. (kg/day)	Concentrate mixture (kg/day) for Maintenance	Concentrate mixture (kg/day) for Production	Concentrate mixture (kg/day) for Maintenance +Production	DM Concentrate mixture (kg/day)	
300 - 350	< 5	26	5.2	1.7	1.4	1	0	1	0.9	**7.5**
	05-Aug	22	4.4	2.18	1.7	1	1	2	1.8	**7.9**
350 - 400	08-Nov	22	4.4	2.18	1.7	2	2	4	3.6	**9.7**
	Nov-14	25	5	2.5	2	3	3	6	5.4	**12.4**
400 - 450	14 - 17	25	5	2.5	2	3	4	7	6.3	**13.3**
	17 - 20	28	5.6	2.81	2.2	4	5	9	8.1	**16**
450 - 550	20 - 23	31	6.3	3.12	2.5	4	6	10	9	**17.7**
	>23	35	7	3.4	2.7	4	6	10	9	**18.7**

Note: 1 adult head load of green grass = 25 – 30 kgs

In a dairy farm, based on the number of animal heads, fodder requirement should be estimated and pasture established accordingly [Refer to ***Text book of Agriculture for Food Security: Class XI, Chapter 6]***.

Nutrients requirement for different stages of growth and development are;

- ***Maintenance***

A cow requires nutrients to remain alive and keep her body moving without losing weight.

- ***Growth***

Apart from maintaining the body, young growing animals like heifer require additional nutrients in order to develop and grow normally.

- ***Reproduction***

A pregnant cow requires additional nutrients to support the development of the calf growing inside her.

- ***Milk production***

A lactating cow requires more nutrients in order to produce more milk. More the milk is produced more the nutrients she will need. Therefore, for every 3 litres of milk produced, 1 kg extra concentrate should be fed [Refer to ***Text Book of Animal Nutrition and Feeding Practices, SK Ranjan]***.

The core nutrients required in the diet of dairy cattle are Total Digestible Nutrient (TDN), Digestible Crude Protein (DCP), Calcium (Ca) and Phosphorus (P). The requirements of these nutrients for different categories of animals are governed by sex and stage of growth and production. The minimum nutrient requirement specifications for different categories of dairy cattle in Bhutan are provided in the table 5 [Also Refer to ***Bhutan Standards for Animal feed, Feed mills and Raw materials, BTS 47, 2018]***.

Table 5: Nutrient Requirement for Dairy cattle

Nutrients	**< 8 lt**	**8-13 lt**	**13-18 lt**	**>18 lt**	**Dry preg.**	**Heifer bulls**	**Calf**
TDN (%)	63	67	71	75	60	60	80
DCP (%)	13	14	15	16	11	12	16
Ca (%)	0.43	0.48	0.54	0.60	0.37	0.40	0.60
P (%)	0.31	0.34	0.38	0.40	0.26	0.26	0.43

7.1.1 Feeding of Pregnant animals

Special attention should be provided particularly to pregnant animals (above six months) in terms of feeding and nutrition. The ration should contain all the nutrients in adequate quantity so that the animal at the time of calving is healthy with body condition score of minimum 3 (Scale of 1 – 5). Daily 0.5 to 1kg extra concentrate mixture, depending on the condition of the animals, should be given from sixth months of pregnancy to meet the requirement of the developing fetus; building up the reserves for ensuring good lactation and growth.

It is also usual to start with 1.5 kg of concentrate/day from two months before calving and increase it to 4 to 5 kg two to three days before calving (steaming). This steaming up increases daily milk yield, lengthens the lactation period and also increase butter fat percentage.

7.1.2 Feeding of Lactating cows

The lactating cows should be provided extra production ration on top of the maintenance ration based on its production level (Tables 3 & 4). Lactating cow producing upto 5 liters of milk can be maintained by providing good quality fodder. Any additional milk production above 5 liters per day will require an additional 1kg concentrate for every three liters of milk produced by cow.

7.1.3 Feeding of Dry cows

Mostly feeding of roughage based ration is preferable for dry cows.

Dry matter requirement is about 2.5% for every 100 kg of its body weight (BW) and reduce it to 1.6% of BWduring last 3 weeks of dry period. Dry matter intake should be reduced to 30% prior to calving. Forage intake should be at least 10% of its body weight.

Total Mixed Ration

Total Mixed Ration (TMR) is a combination of balance feed composed of grains, green and dry forages, concentrate feeds, vitamins and minerals. Forages should be chopped properly (2 – 2.5 cm length) before all ingredients are mixed together as required to fulfill nutrient requirement for the dairy cattle.

TMR is a balanced and right combination of ration which contains energy, proteins, vitamins and minerals that the

dairy cattle needs. This is an effective, efficient and profitable way to feed the cattle for body maintenance, development and growth of young stock and pregnant cows. Formulated TMR ensures right proportion of feed ingredients for feeding to dairy cows to increase milk production, reproduction efficiency, reduces feed costs and improves health conditions. However, TMR feeding has other advantages as well as disadvantages.

Advantages

- TMR facilitates better intake of low quality and unpalatable forages because of added flavor
- TMR reduces selective intake and minimize the feed & fodder wastage during feeding
- Feeding perfect combination of TMR will lower the risk of acidosis

Disadvantages

- TMR preparation requires chaff cutter machine to chop desirable length size (2- 2.5 cm), weighing balance to weigh the ingredients as required ratio.
- TMR preparation requires raw materials like forages, concentrates, mineral and molasses, etc at a time.
- TMR formulation is tedious as it has to be changed according to availability of seasonal feed and fodder ingredients/types.

TMR formulation

Available raw materials (ingredients) for TMR formulation are green grass, paddy straw, maize grain, commercial concentrates, rice bran, mustard cake (to be purchased; salt, molasses, vitamins and minerals).

For ready reference, TMR formulation for dairy cow weighing 400 kg LBW whose DM requirement is 10 kgs is presented in table 6.

Table 6: Demonstration of TMR formulation

Forage type	Quantity	Dry Matter
Green grass (Temperate + subtropical improved grass, local grass and fodder)	20 kg	5 kg
Dry grass (hay + paddy straw)	3 kg	2.55 kg
Concentrate (Commercial feeds = Rice bran+ Mustard cake)	3 kg	2.7 kg
1 kg molasses, 0.25 kg mineral mixture and 0.03 kg salt.	1.28 kg	
Total	**27.28 kg**	**10.25 kg**

Note: additional concentrate to be fed based on milk production for optimal milk production

7.2 Forage Conservation

There is scarcity of green forage during winter whereas there is abundant forage in summer. Therefore, it is necessary to conserve forage either in the form of hay (dry grass) or silage (preserved grass in anaerobic condition) for feeding during the lean season/ scarcity period.

7.2.1 Hay making

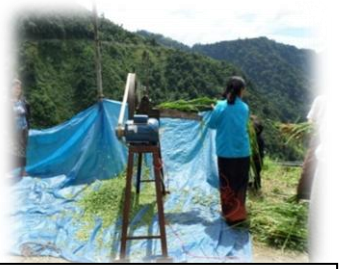
Hay is a green grass turned into dry grass by drying when there is sufficient fodder grown during the ***season***. It consists of cutting the green biomass of the fodder plot, spreading, turning, gathering each day till it is dried. Hay is usually made from autumn saved pasture usually during October and November. For making good quality hay, grass or grass legume mixture should be cut before flowering stage.

7.2.2 Silage making

Silage is fermented, high-moisture stored fodder which can be fed to ruminants (cud-chewing animals such as cattle and goat). It is fermented and stored in a process called *ensiling* or *silaging*, and is usually made from grass, fodder maize, sorghum or other cereals, using the entire green plant. Silage can be made any time when there is surplus pasture. Silage making using plastic bag is the easiest and is illustrated below.

Bringing fodder to central location

Chaff cutter placed at central location for cutting grasses into pieces



Gathering of chopped

Pressing chopped grass in a plastic bag

Removing air using vacuum

Packing and sealing of plastic

Carrying ensiled plastic bag

Storing silage

Water requirement

Water constitutes about 70% of the body weight and almost 87% of milk. A lack of water will cause more loss than deficiency of any other nutrients. A loss of 7 to 10% of water will result in death of an animal.

Dairy cows under average feeding conditions require 27 to 28 liters of clean water per day for maintenance which should be made accessible at all times.

Water intake depends on:

- Body size and breed of animal,
- Stage of lactation and milk production
- Type of feed and forage consumed (Dry matter intake)
- Temperature and relative humidity of the environment

- Quality and availability of the water
- Amount of moisture content in the feed and forage
- Dry matter intake per day in kg x 6 litre (L) water +1L of water for every 0.5 L of milk production daily

8. CLEAN MILK PRODUCTION

What is Clean Milk?

"Clean Milk' is generally defined as "milk drawn from the udder of healthy animals, which is collected in clean dry milking pails and free from extraneous matters like dust, dirt, flies, hay, manure etc. Clean milk has a normal composition, possesses a natural milk flavor with low bacterial count and is safe for human consumption".

The focus of clean milk production are to produce clean milk free from dirt, secure milk of low bacterial count, keep milk free of disease organism, prevent bad odour, prevent spread of milk borne diseases, increase the shelf life/ keeping quality of milk and produce good quality dairy products.

The basic conditions for clean milk production are:

- The animals should be regularly checked for mastitis (infectious disease resulting in inflammation (swelling) of udder and teats
- Discard foremilk to remove dirt and contamination
- Before milking udder should be wiped and dried
- Hairs around the udder and flanks should be clipped if required
- Milking utensils should be cleaned, sanitized and dried before use
- Practice of clean milking habits such as dry milking, cleaning of hands before milking is essential.

Sources of contamination

Milk is an ideal medium for bacterial growth such as spoilage and pathogenic bacteria and when contaminated lead to much faster spoilage of milk. It is therefore essential to ensure clean handling of milk to prevent rapid bacterial growth and milk spoilage.

Contamination can occur from various sources:

- ***Udder infection*** of cows such as mastitis will raise the bacterial count of milk to more than 50,000cfu per ml of milk. Contaminated milk such as this will be unfit for human consumption and if mixed with milk from other healthy cows it will also be contaminated thereby causing the whole lot to be declared unfit for human consumption.
- ***Dirty udders and teats*** contaminate milk due to the presence of bacteria on them. Even though the udder and teats may appear clean, bacteria will always be present and are not visible due to their microscopic nature. It is therefore very important to wash and dry the udders and teats of all cows prior to milking. You can also reduce the risk of udder and teat contamination by providing good cow housing and grazing management.
- ***Dirty hands and udder cloths*** are a source of contamination. The udder cloths used must be clean and one cloth should be used only for one cow. Individual milking the cow must be

clean and if possible should have a clean set of clothes used only during milking. They should wash their hands using soap and have short fingernails as long fingernails may hurt the cow.

- ***Dirty milking equipments*** are a source of contamination and should be kept very clean. All equipments used during the milking process such as the buckets, udder cloths, filters etc should be washed using detergents in hot water, rinsed and sterilized.

Milking Environment

The milking environment should be:

- Clean and free from dirt and odor
- Cleaning and sweeping of all areas must be finished before you begin milking
- Well ventilated with proper drainage
- Good Lighting
- Free from cow dung and urine

Animal Health

Animal should be

- Healthy and disease free
- Vaccinated as per vaccination schedule and if the animal is suspected to be sick, refer to your nearest animal health worker.
- If the animal is treated with antibiotics, milk from this animal shouldn't be consumed till the recommended withdrawal period is over

Milking Personnel

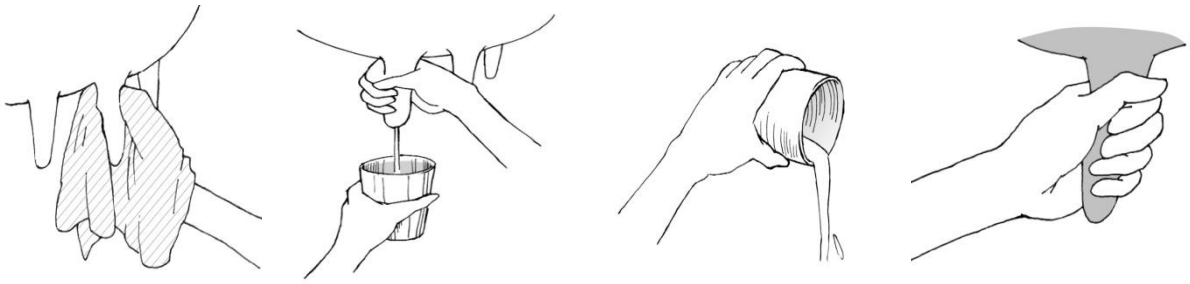
The milker should

- Be free from contagious diseases
- Have good personal hygiene
- Wear clean clothes.
- Wash hands before milking
- Not have long finger nails
- Not smoke or cough and sneeze during milking
- If the milk handler is suffering from communicable disease, the person shouldn't milk the animal as the disease can get transferred to the milk.

Milking Procedure

- Brushing away dirt and loose hair from the sides and back legs of the cow.
- Do not wet wash your cows' body as this could increase the risk of contamination

- Wet wash only the teats and lower udder of the cow and wipe dry
- Massage the back, front part of the udder and the teats to help in the let down of milk
- Start Milking soon after the above-mentioned steps
- Milk first milk from all four teats into a cup and check for any abnormalities such as lumps or odd colour. If the milk looks abnormal your cow could have mastitis and should be treated as soon as possible. Such milk is unfit for consumption
- Close the canal between the teats and udder using two fingers and squeeze the milk out by closing the rest of the fingers firmly around the teat. Strip milking should be avoided as this could harm the insides of the teats that are easily infected and lead to mastitis
- Continue milking until the udder is completely empty
- Never dip your fingers in the milk, water or spit to moisten them as this can contaminate the milk
- Filter the milk using a clean straining cloth and if it contains dirt, investigate the origin of the contaminant and keep it out of the milk in the future.
- Store milk in a bucket with a lid, protected from sunlight and deliver to the collection centre as soon as possible
- Handle the milk carefully as rough handling can cause rancid tastes
- Isolate sick animals and milk them last (Their milk should not be mixed with good milk). Seek advice from animal health worker.
- Follow proper milking techniques to avoid damage to teat. Dip teats in teat disinfectant to avoid infection of teats. Avoid feeding cows during milking



Milking Utensils

Types: Use seamless utensils preferably aluminum or stainless steel. The utensils and equipments should not have any joints or open seam and should be free from dents, rust etc.

Cleaning of utensils

- Rinse excess milk with cold and clean water.
- Scrub with a brush using hot water mixed with a detergent e.g. soap or detergent.
- Rinse again with plenty of clean water.
- Finally sterilize using very hot water.
- Dry in clean tidy place, preferably in sunlight upside down during the day to facilitate drainage of wash water.

Storage of utensils

Utensils should be stored at night in a safe and clean place, which is well ventilated.

Milk Handling and Storage

Filtering

Use a white filter cloth and filter immediately after milking. Wash and dry the filter cloth after use.

Storage and Transport

Milk should be stored in clean containers with a lid and kept in a cool and shady place. Milk should be delivered to the collection point/ market as soon as possible.

9. COMMON DISEASES, PREVENTION AND CONTROL

9.1 Characteristics of healthy and sick animal

9.1.1 Signs of healthy animal

- Alert appearance
- Smooth/ polished coat
- Wet muzzle
- Erect ears
- Eats well
- Flocks together

9.1.2 Signs of sick animal

- Dull looks - drooping head and ears
- Eye and nasal discharge
- Rough hair coat
- Dry muzzle
- Eats reluctantly - observe during feeding time
- Reluctance to get up when approached
- Lagging behind the rest of the herd, and
- Loose manure with large feed particles, mucus, or blood can indicate illness or injury

9.2 Common Infectious diseases

9.2.1 Foot and Mouth diseases (FMD)

FMD is severe, highly communicable viral disease of cattle, pigs, sheep, goats and deer.

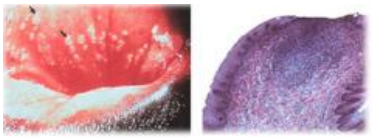
- It is characterized by;
  - blister-like lesions on tongue, nose, lips, teats, between the toes and in the mouth
  - blisters that burst and cause a flow of sticky and foamy salivation
  - high fever, stop eating, give less milk and become lame.


- Prevention: Vaccination
- Control: Quarantining of infected animal

9.2.2 Infectious Bovine Rhinotracheitis (IBR)

IBR is acute, contagious virus disease of cattle, commonly called IBR or **Red nose.**

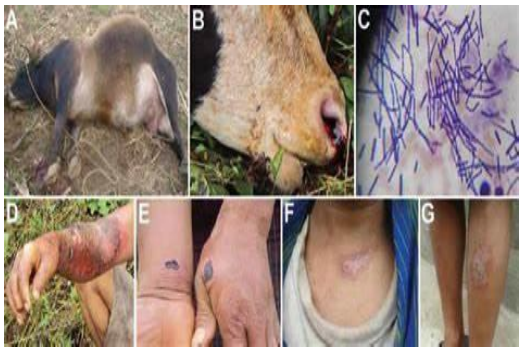
- In males: inflammation of prepuce and penis and causes balanoposthitis
- In females; inflammation vulva and vagina and causes abortion.
- Abortion occurs about 20 to 45 days after infection.
- Prevention: Vaccinate or revaccinate 30 to 60 days before breeding.


Small mucosal pustules lead to erosions overlying the submucosal lymphoid follicles

9.2.3 Anthrax

Anthrax is highly infectious and fatal disease of mammals and humans.

- The predominant signs in cattle are normal appearance to excitement, depression, fever, weakness, difficulty in breathing, uncoordinated movements, convulsions and death in few hours.
- Bloody discharges from the natural body openings after death
- This is a zoonotic disease transmissible to human beings and vice versa.



- Prevention: Vaccination in endemic areas
- Carcass should not be opened or consumed and should be buried deep in the ground

9.2.4 Black Quarter (BQ)

BQ is highly fatal disease of young cattle: 6 months and 2 years.

- The first sign observed are lameness, appetite loss, high fever, rapid breathing, and depression
- Characteristic swellings develop in the hip, shoulder, chest, back and neck with crepitating sound on push on pressure
- First- swelling is small, hot and painful.
- As the disease progresses, the swelling enlarges and becomes spongy and gaseous.
- Animal usually dies in 12 to 48 hours.
- Prevention: Vaccination of young lots before 2 years of age

9.2.5 Hemorrhagic Septecemia (HS)

HS is highly fatal hemorrhagic disease of Cattle and Buffalo.

- Initial signs;
  - dullness, lethargy, high fever, recumbency, hyper-salivation.
- Clinical signs are;
  - pharyngeal edema (spreads to the cervical and brisket regions)
  - respiratory distress
- Death usually within 6 hours of the onset of clinical signs
- Prevention: Vaccination

Severe throat and brisket oedema

9.2.6 Brucellosis

Brucellosis in cattle is also known as **"Contagious abortion"** and in human as **"Undulant fever"**

- Brucellosis in cattle:
  - abortion or premature calving between 5^{th} to 8^{th} month of pregnancy
  - suffer from RoP, and sometimes become sterile
  - spread from vaginal discharge of an infected cow or from an aborted fetus
- Infected Breeding bulls transmit the disease to cows at the time of service
- Milk produced from Brucella infected cow creates a public health hazard
- This is a zoonotic disease transmissible to human beings and vice versa

9.2.7 Leptospirosis

Multiple abortions in the breeding herd is often the first sign of the disease

- The clinical signs in adult cattle are
  - yellow mucous membranes,
  - bloody urine are seen occasionally.
  - milk of lactating cows become thick, yellow and blood-tinged.
  - abortion occurs mostly in the 7th month of gestation.
- Prevention: Vaccinate if available
- This is a zoonotic disease transmissible to human beings and vice versa

9.2.8 Listeriosis

The disease is common in Cattle, Sheep, Goats and can occur in pigs, dogs, cats, some wild animals and humans.

- Infected animals are restless, have high fever, show loss of appetite and nervous system disorders
- Infected cattle exhibits symptoms of walking in circles, uncoordinated movements, leaning against objects, and progressive paralysis.
- Death occurs within 2 - 3 days after the onset of symptoms
- Most animals recover if treated with a broad spectrum antibiotic started early
- Prevention: Grave - Vaccines not available

9.2.9 Vibriosis (Campylobacter fetus)

Vibriosis in cattle is an infectious bacterial disease of genital tract (venereal disease) spread by infected bulls

- It causes varying degrees of vaginal inflammation, uterine infection, infertility and occasional abortions in 5 to 6 months of gestation period
- Infected cow exhibits irregular estrus, repeat breeding and RoP are common.
- Vibriosis is somewhat self-limiting as most of the cattle recover within a year.
- Prevention: Vaccination if available
- Control: The use of AI is valuable in limiting the spread of the disease

9.2.10 Trichomoniasis

Trichomoniasis is a venereal disease of cattle caused by *Trichomonas fetus*, a small motile protozoan found only in the reproductive tract of bull and cow.

- It causes infertility and occasional abortions in cows and heifers.
- Repeat breeding or infertility of individual cows can last up to five months and eventually cows begin to cycle again and can carry fetus to term.
- Bulls are the main carriers of Trichomoniasis and, once infected, remain infected for life but show no signs of disease.
- Prevention: No vaccines are available, but using AI and virgin bulls aid in control.

9.2.11 Calf Scours

Calf scours is a symptom of a disease; can be viruses (*BVD, Rotavirus, Coronavirus*), bacteria (*E. coli, Salmonella)* or protozoa (*coccidiosis, cryptosporidium*).

- Severe diarrheas- can be white, yellow, grey or blood-stained, and is often foul-smelling leads to dehydration and death
- Treatment for scours should be directed toward correcting the dehydration, acidosis and electrolyte loss as well as Antibiotic treatment in grave cases
- Prevention: Feed calf with adequate quantity of colostrum in the first few hours after birth.

9.2.12 Cocciodiosis

Coccidiosis occurs more frequently in calves from 1 - 6 months of age, but others from 1 – 2 years are also affected.

- Young calves are usually infected when they are placed in pastures or lots contaminated by older cattle or other infected calves
- Typical signs are; diarrhea, rough coat, loss of appetite and weight, and general emaciation
- Death may occur during the acute period, or later from secondary complications, such as pneumonia

9.2.13 Mastitis

Mastitis is disease condition indicated by inflammation of the udder and teat**.** It is caused by bacteria and fungi. It causes greatest economic loss to the dairy farmers. About 95% of the mastitis cases are subclinical and will flare only when the animal is in stress so it is important to test the milk routinely.

Inadequate animal hygiene and housing conditions are the primary causes of mastitis. Nutritional deficiencies of selenium and vitamin E in feed may also cause mastitis.

Signs of Mastitis

- Mild signs include flakes or clots in the milk and may have slight swelling of infected quarter.
- Severe signs include secretion of abnormal milk: hot, swollen quarter or udder; cow may have a fever, loss of appetite, dehydration and death may occur.
- It is important for the farmer to know that the mastitis can permanently damage the quarters so should immediately seek the help of animal health service provider.

Prevention of mastitis

The goal of every mastitis control program is to prevent bacteria from entering a normal and healthy mammary gland. This means that each step involved in proper milking procedures must occur at each milking every day for each cow in the herd. This can be achieved through several ways.

- *Hygienic Milking* (Refer to Chapter 8: Clean Milk Production)

Bacteria are transmitted from infected to uninfected udder through hands of the milker. Thus the milkers' hands should be washed thoroughly with soaps before milking and clinically infected cows should be milked last. Teats should be cleaned and dried before milking

- *Dipping the teats*

Teat dipping reduces the rate of new infection substantially in a suitabledisinfectant

- *Dry cow therapy*

Effective use of infused antibiotic into each quarter can reduce considerablythe occurrence of mastitis in dry cows. This treatment is also very effective in clearing chronic and subclinical mastitis that are difficult to treat during lactation

9.3 Common Metabolic diseases

The common metabolic diseases are milk fever, acidosis and bloat that occurs as a result of management problems. [Refer *to* ***"Farmers' Training Mannual, RLDC, Kanglung, 2016"***].

9.3.1 Milk fever

It generally affects the old and high producing cattle. It is caused by imbalance of calcium and phosphorous in body. In the beginning of lactation, high yielding cows experience a sudden deficit of calcium as a result of lost through milk. "Milk Fever" usually develops within 48 to 72 hours after calving, and if calcium is not replenished the animal will suffer it. Death canoccur if cow is not treated promptly.

Clinical signs

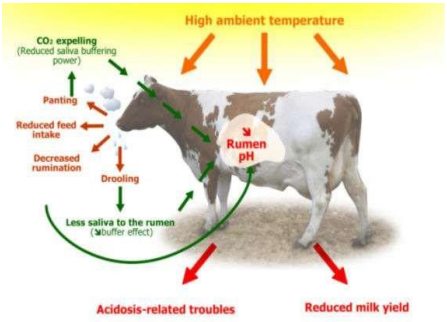
- At first, cow experiences muscle tremors, lack of appetite, and unsteadiness
- Eventually, cow is unable to rise, body temperature falls, and constipationoccurs
- Cows go down to a sitting position often with a kink in her neck

9.3.2 Acidosis

Syndrome related to a fermentative disorder and is related to feeding management, where the ration has high levels of digestible carbohydrates and low fiber content. Acidosis commonly occurs when switching from a high fiber diet to high concentrate diet that is rich in fermentable carbohydrates (starches and sugars).

Causes of Acidosis

- Diets very high in readily fermentable carbohydrates and low in roughage.
- Very fast switch from high forage to high concentrate.
- Feeding of large amount of grains or food waste.



Clinical Signs

- Diarrhea (accumulation of acid causes an influx of water from the tissues into the gut resulting in diarrhea).
- The feces are foamy with gas bubbles.
- There is an appearance of mucin/fibrin casts in feces.

For treatment the farmer should seek the help of the animal health service provider.

9.3.3 Bloat or Tymphany

It is characterized by abnormal accumulation of gas in the rumen. When bloat occurs, gases cannot escape and they continue to build up causing severe distention of the abdomen, thereby leading to compression of diaphragm squeezing lung and heart, and eventually death**.**

Causes of bloat

Grazing in young, lush legume pastures (clover)

Signs of Bloat

- Animal stops grazing and is reluctant to walk
- Left side of abdomen is distended
- Animal strains to urinate and defecate
- Rapid breathing — mouth may be open with tongue protruding
- Staggering gait

Prevention

- Feed hay/paddy straw or dry grasses before letting animals to pasture
- Legumes should be introduced into the diet gradually over several days (not at once in large quantity)
- Initially, cows should only be allowed access to the pasture for short periods (one hour or so) and monitored closely during grazing and immediately after removal
- Puncture the rumen (on the left side of the animal) with trocar and canula at the farm level as an emergency
- Drench mustard oil (200 – 250ml/animal) immediately upon observing bloat case

9.4 Disease Prevention and Control measures in Dairy farms

9.4.1 Prevention measures

- Vaccinate animals against major diseases (Table 6)
- Keep accurate and timely records of your vaccination, deworming and treatment
- Provide cattle with good nutrition and clean water
- Provide cattle with good housing

Table 6: ***Vaccination schedule for cattle***

Vaccines produced in Bhutan					
Name and type	***Dosage & route***	***Primary vaccination***	***Booster***	***Re-vaccination***	***Remarks***
Anthrax spore vaccine (live)	1ml, S/C	3-4 months of age	Not required	Annually in March/ April	Vaccination is not required in a particular area if there has not been outbreak for three years after the last outbreak.
Black Quarter vaccine (killed)	5ml, S/C	3-4 months of age	Not required	Annually in March/ April	Vaccinate animals up to 3 years of age. In endemic areas, healthy adults may be vaccinated
Hemorrhagic Septicemia alum precipitated vaccine (killed)	4ml, S/C	3-4 months of age	6 months	Every 6 months in April/ May & Aug/ Sept	Vaccination is to be done prior to onset of monsoon season and migration
Imported Vaccine					
Raksha Ovac Foot and Mouth Disease vaccine (FMD)	Cattle, buffalo, yaks & calves. 2ml, deep I/M	4 months of age	9 months after primary vaccination	Annual	6 monthly revaccination is recommended in the high risk zones in the southern Dzongkhags
Raksha HS+BQ combined vaccine	Cattle, buffalo & calves. 3ml, S/C (mid-neck region)	6 months of age	Not required	Annual	Revaccination is recommended in case of adverse climatic conditions like unseasonal rains, cyclones etc.
Raksharab rabies vaccine	Cattle & all other species 1ml, S/C or I/M	At 3 months of age and above		Annual	In case primary vaccination is given below 3 months, a booster dose should be given at the age of 3rd month.

Source: www.moaf.gov.bt/rnrfarmersdairy

9.4.2 Control measures

- Purchase new cattle or calves from reputable auction houses or local farms
- Purchase only healthy-looking animals, and ask for a health history, such as a vaccination or deworming history, if available
- Transport livestock the shortest distance possible, avoid transportation stress [Refer to **Bhutan Standard, Standard for Transport of Animals, BTS 32: 2017**]
- Isolate newcomers to the herd for two weeks and screen for diseases
- Isolate any sick animals for treatment and to prevent illnesses from spreading

Worm Infestation and Control

Worms are internal parasites found in the digestive system of the animal. Worms cause several types of damage to the host:

- They suck the blood of animals and this may lead to death from anemia (shortage of blood in the body)
- They consume nutrients causing deficiencies and leading to poor health, growth and production. This is the major negative effect of worms on farm animals
- Some worms may block the intestines and small passages in the body interfering with movement of food and flow of digestive enzymes.
- Irritation to cells of the gut may cause diarrhea and loss of body fluids leading to dehydration, abdominal pain (colic) and loss of appetite.

Signs of worm infestation

- Loss of appetite, poor body condition, weight loss, appears anemic with rough, dry coat and decreased milk production
- In some cases, adult worms or tapeworm segments may be seen in the faeces
- Diarrhea (may be bloody) and death may occur

For treatment the farmer should seek the help of animal health service provider

Control

Animals should be screened for worm infestation every three months by sending fecal sample to nearest veterinary hospitals/ laboratories. Deworming of animals should be carried out according to the recommendation of animal health service providers.

10. HOUSING OF DAIRY CATTLE

10.1 Dairy housing requirements

- There should be proper drainage system to maintain hygiene at the farm.
- Sheds of the animals should be airy with protection of the animals from extreme temperatures and strong winds.
- The space required per animal is about 70 sq.feet for smaller breed like Jersey and about 84 Sq. feet for bigger breeds like Holstein Friesian.
- It requires integration of housing with feeding, watering, cleaning and restraining including milking and manure removal systems.
- For head to head arrangement, the floor dimensions required as in the figure below:

For details on dairy farm establishment, refer to "**Bhutan Standard, Guidelines for Construction and Operation of Designated Farm (BTS 31:2017)**".

The principal functions of housing for a livestock are:

- For sustaining good health and comfortable environment to the animals
- Desirable working conditions for the labours or supervisory staffs.

Ventilation

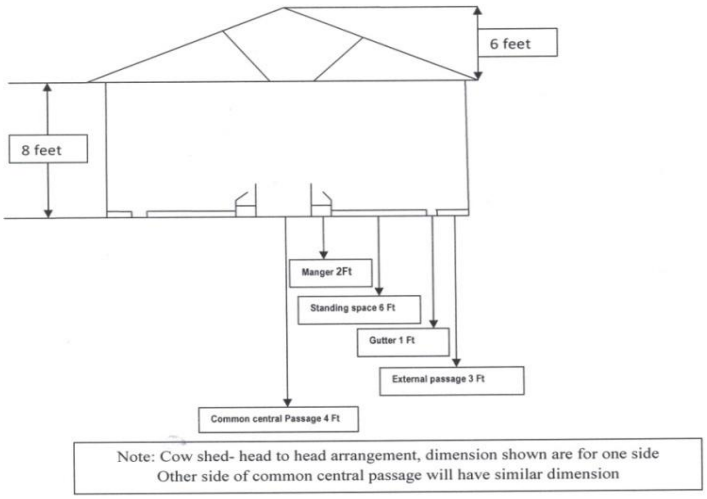
- Plenty of fresh air is necessary for maintaining the health of the animals.
- In hot regions since the houses are open type ventilation is not a problem but in the colder regions where the shed are enclosed type, proper ventilations should be ensured.

Lighting

- Housing should be located and designed to take full advantage of natural light. Construction of the shed with the long axis in the north- south direction ensures getting maximum sunlight
- Roof lighting is the most efficient form of getting natural light and is done by evenly spacing a transparent roof in the shed
- Better lighting can be also achieved through white washing all the upper parts of thewalls and ceilings

Advantages of natural lighting (sunlight) are:

- Sunlight is a source of vitamin D
- Has germicidal effect and improves hygiene



Note: Cow shed- head to head arrangement, dimension shown are for one side
Other side of common central passage will have similar dimension

Dimension for 10 cows unit shed

Total length of shed for 10 cows = 10 animals X 5 feet (distance between animal to animal) =50 feet
Total width of shed = 28 feet (Standing space 6'+ Manger (feeder) 2'+Gutter 1'+ External passage 3'=12 feet (ONE SIDE) X 2 SIDES (HEAD TO HEAD) = 24 feet (two sides) + 4 feet Common Central Passage= 28 feet

Area required for shed construction = 28'X50'=1400 sq feet/435.6 sq feet=3.21 decimal
(1 Decimal= 435.6 Sq. feet)

Site selection while establishing a dairy farm

- The site should provide good drainage, plenty of fresh air and sunshine.
- It should have protection from strong winds.
- Avoid water-logging, marshy and heavy rainfall areas.
- Water should be available in cheap and plenty.

- Should be on dry and raised ground
- It should not be located in the town or densely populated areas.
- Site must not be too distant from the market and road connectivity;
- It should not be too close to the residence

Plan and layout

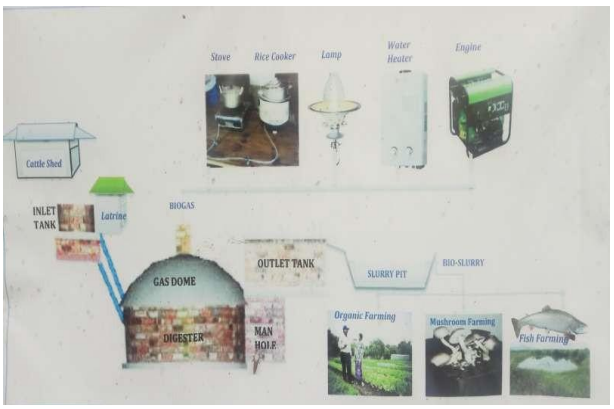
- Proper layout and plan can make housing comfortable to animals and management easier. It can also reduce labour and time of operation
- The plan and layout should depend on number of animals to be housed, facilities to be provided for feeding, collection and disposal of manual, cleaning and washing
- Store houses, hay stacks, silo pits and manure pits should be located conveniently so that transportation of materials are minimized
- For a commercial dairy farm, depending upon the climatic zones and the number of cows, the shed should be planned as single row or double row
- In hot humid regions it is advantagous to have single row housing, if the number of animals are animals are not too large
- If the number of the animals is large the double housing with the cows facing outside (tail to tail arrangement) is recommended

10.2 Manure management

Dung, urine and bedding materials are the main waste of dairy farm. It must be properly disposed in the collection pit which is connected to the irrigation channel or can be directly used to the agriculture fields.A biogas plant construction near the dairy shed will be appropriate for the utilization of dung and other farm waste.

Biogas has picked up its pace in the recent years in most part of the rural parts of the Bhutan. It is one of the efficient uses of farm waste which is sustainable and eco-friendly. The benefits of biogas amongst others produce clean energy for heating and cooking.

It will also help reduce human and animal diseases by improving sanitary conditions, reduce green house gas emissions through improved manure management systems, reduce indoor air pollution, and reduce the workload in collecting firewood and organic fertilizer to increase agriculture yield.



11. FARM INFORMATION RECORDING

Identification and Registration of animals and farms

For the purpose of traceability the animals (cattle, yak, buffalo) in the country (farm born/ imported) are required to be identified using plastic ear tag (laser printed/ hand written) following the National Cattle Information System (NCIS). The farm born animals should be ear tagged and registered within two months of calving and imported animals are tagged and registered when they are at quarantine station. The identification number is allocated to individual animal once for lifetime to avoid duplication. Along with the identification, individual animal is issued with individual bovine register for recording of information pertaining to the particular animal. If animal is sold out, the individual register of the animal should be given to new owner along with the animal.

The tag displays 10 digit numbers representing Dzongkhag by the first two digits, Geog by the next two digits and other six digits represent the serial no of the animal and accommodate 999,999 animals in a geog.

Similarly, to trace the owner of the animals individual farmer is allocated with herd/ farm holding number following the same coding pattern to accommodate 9,999 farmers in a geog. Along with the farm/ herd registration, the farmer is issued with herd register to record information of all animals in the herd.

Record keeping

Record keeping is a necessary element of good dairy management. The dairy farms operated in commercial mode should therefore ensure that all farm activities are recorded efficiently (Annexure 1).

The purpose of dairy farm recording;

- Provide the basis for tracking & evaluating performance
- Serve as the basis for sound management decisions making at different level and aspects of the farm
- Helps in overall better supervision and management of herd
- Helps in determining the income and expenditure (economics) of dairy farm
- Helps in estimating the cost of milk production
- Helps to compare the herd performances in different years
- Helps to identify problems/gaps and setting future goals/directions for the farm
- Inform farmers about strengths and weaknesses in their farm operation

Farm record analysis

The objective of "Farm Record Analysis" is to enable the farmer to identify weaknesses and strength in the technical and financial performance of his/ her farm as a decision support system.

12. FARM BIO-SECURITY

Biosecurity refers to management practices that reduce the chances of infectious diseases being carried onto the farm by animals, people and vehicles. Biosecurity measures also reduces the spread of infectious disease in farms. The following are basic and yet important measures that each dairy farm should maintain.

- Farm area and pasture land should be fenced to avoid mixing of farm animals with other stray animals
- Construct foot dip and fill with disinfectant solution at appropriate entry points to the farm and farm premises
- Minimize entry of visitors and vehicles and maintain record of entry and exit into the farm premises if at all
- Clear signs restricting access to un-authorized entry should be placed in visible areas
- Water is an important source of contamination and it should be checked both at source and at farm premises. There should be adequate and clean water supply in the farm premises.
- Record animal health activities and treatments to maintain effective herd health strategies
- Seek early advice from a animal health service provider in relation to any unusual sickness or death of farm animals
- Isolate and treat sick animals in the event of a disease outbreak

- Carryout the regular screening of worm infestation in animals for deworming purpose as per laboratory findings and recommendation
- Carry out timely vaccination of animals to prevent disease outbreak in the farm
- Dead carcasses to be disposed off in biological pit
- Adopt proper manure management practices
- Feed should be stored in clean place and feed store should be rodent proof and have ventilation system to avoid moldy feed

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ANNEXES

Annexure 1: Record keeping in dairy farms

In a commercial dairy farm, two types of records are necessary and should be maintained.

- Technical Records
- Financial Records

A: Technical Records

The technical records basically consists of the performance of cattle (production such as growth, milk production, reproduction, mortality and diseases)

Growth Record of calves

Maintaining the growth record (periodical body weight) is essential in the herd so that correction could be made for poor performers. It is also essential for practical rationing of the individual on the basis of which daily allowance of nutrients and dry matter could be made. Growth records could be maintained in the following formats.

Pre-weaning growth record sheet

S.N.	ID No	DoB	Birth Type	Sex	Pre weaning body weight				
					Birth	1 month	2 month	3 month	4 month

Pre-weaning daily growth rate (g/day)

Post weaning growth record sheet

S.N.	ID No	DoB	Sex	Post weaning body weight				
				6 month	9 month	12 month	15 month	18 month

Post weaning daily growth rate (g/day)

Nowadays, use of computer has become essential for maintaining and analyzing of records for selecting the animals in the herd.

Production Records

Different records need to be maintained according to the nature of production systems. In the dairy farming, milk production record need to be maintained.

Milk production record sheet

Cow ID No	Date of Calving	Daily Milk Yield	Lactation Yield	Lactation Length	Remarks

Reproduction Records

Pedigree records are essential for planned breeding. Reproduction records of individuals should be maintained in order to judge the performance of herd for taking necessary corrective measures if required on time.

Pedigree record sheet

ID Number:	Date of Birth:	Birth Type:
Sire No:	Dam No:	Sire's Sire No:
Sire's Dam No:	Dam's Sire No:	Dam's Dam No:

Mating and calving Record sheet

Dam ID	Date of mating	Sire ID	Date of Calving	Sex	Calf ID

In addition, the following reproductive parameters should be analyzed for understanding overall herd efficiency:

- Total number of breedable cows/heifers in a herd
- Total number of cows/heifers mated
- Total number of calves born
- Total number of calves weaned
- Pre weaning mortality percent

These records will help to identify overall farm efficiency. Besides these, individuals mating records, such as date of mating, sire used, date of calving, types of birth, mothering ability and so on should be recorded to identify individuals performing well or poor in the herd, which could be utilized for further breeding or culling of individuals to improve the herd efficiency.

Treatment Records

Treatment records of herd could be maintained as per the following format.

Date	ID No	Symptoms	Treatment	Response	Remarks

B: Financial Records

Financial records of all recurrent cost incurred; interest in fixed and running capitals; depreciations of sheds and equipments should be maintained in commercial dairy farming. The major recurrent cost items are feed cost, labor cost and treatment cost.

Feed cost record sheet

Month/ weekly or daily	Production cost of green forage	Amount of concentrate consumed	Concentrate feed cost	Remarks

Labor cost record sheet

Month/Week/or Daily	No of Labor	Rate	Total Amount	Remarks

Treatment expenditure record sheet

Period	No of animals	Medicine/vaccines	Cost	Remarks

The remuneration of Veterinarian/ AI technicians should also be included

Miscellaneous expenditure

The unforeseen expenditure could be included under this heading

Sale and income Records

Total income from the sale of dairy products/live animals/manure is maintained. Then based on these records, statement of profit or loss is prepared.

- Sale of culled cattle
- Sale of breeding bulls not required in the farm
- Sale of cows/heifers not required in the farm
- Sale of milk and milk products
- Sale of manure
- Sale of other items