MAHATMA PHULE KRUSHI VIDYAPEETH, RAHURI

AHDS-111
(Livestock Production & Management)

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Course :	AHDS 111		Credit:	2(1+1)	Semester-I
Course title:	Livestock Production & Management				

Syllabus

Theory

Importance of livestock in the national economy. Livestock development programmes of Govt. of India. Terminology used in livestock management. Important exotic and Indian breeds of cattle and buffalo. Male and female reproductive system of cattle. Measures and factors affecting fertility in livestock, Reproductive behaviour – oestrus and parturition. Mammary gland and milk secretion. Feeding and management of calves, heifers, dry, pregnant, milch animals and breeding bull. Disease – causes, symptoms, preventive and control measures. Feeding and production records. Organic production- definition, importance, principles, standards, certifications, SWOT analysis. Concept of A 1 and A 2 milk. Effect of climate change on livestock production. Integrated livestock farming. Cost of milk production, economical unit of cattle and buffalo.

Practical

External body parts of cattle and buffalo. Routine management practices followed on livestock farm. Methods of handling and restraining of animal. Methods of identification marks and dehorning of animal. Recording of pulse rate, respiration rate and body temperature of animal. Preparation of feeding schedule and feeding different categories of cattle and buffalo. Estimation of age and body weight of animal. Clean and hygienic milk productionand milking methods. Judging of animal for dairy and draft purpose. Study of computerized database on dairy farm. Vaccination and control of ecto and endo parasites in cattle and buffalo. Study of various dairy structures. Collection of semen and artificial insemination in farm animal. Pregnancy diagnosis in farm animal. Utilization of dairy farm wastes i. e. dung, urine, etc.Preparation of viable bank proposal for cattle and buffalo.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Importance of Livestock in the national economy and different livestock development programme	10
2	Livestock census and trends of livestock production	5
3	Terminology used in livestock management	5
4 & 5	Important Indian and exotic breeds of cattle and buffalo	7
6	Principles of maximization of livestock production	6
7	Feeding and management of calf, heifer and milking animal	5
8	Feeding and management of dry, pregnant, draft animals and breeding bull	10

Lecture	Topic	Weightage (%)
9	Diseases and it's preventive, curative measures in cattle and buffalo	6
10	Bovine male and female reproductive system	7
11	Fertility, sterility and reproductive behaviour viz. oestrus and parturition	7
12	Mammary gland and milk secretion	7
13	Organic livestock production- definition, importance, principles, standards, certifications, SWOT analysis, A 1 and A 2 milk	8
14	Effect of climate change on livestock production	5
15	Integrated livestock farming	7
16	Cost of milk production, economical unit of cattle and buffalo	5
	Total	**100**

b) Practical

Experiment	Topic
1	External body parts of cattle and buffalo
2	Routine management practices followed on livestock farm
3	Methods of handling and restraining of animal
4	Methods of identification marks and dehorning of animal
5	Recording of pulse rate, respiration rate and body temperature of animal
6	Preparation of feeding schedule and feeding different categories of cattle and buffalo
7	Estimation of age and body weight of animal
8	Clean and hygienic milk production and milking methods
9	Judging of animal for dairy and draft purpose
10	Study of computerized database on dairy farm
11	Vaccination and control of ecto and endo parasites in cattle and buffalo
12	Study of various dairy structures
13	Collection of semen and artificial insemination and pregnancy diagnosis in farm animal
14	Utilization of dairy farm wastes i. e. dung, urine, etc.
15	Preparation of viable bank proposal for cattle and buffalo
16	Visit to dairy farms

Suggested Readings

1) Livestock and paultry Production – Harban Singh and Moore, E. N. (1968)
2) Goat, Sheep and Pig Production and Management – Jagdish Prasad, (1996), Kalyani Publishers 1/1, Rajinder Nagar, Ludhiana
3) Text Book of Animal Husbandry – G. C. Banergee (1999), 9th ed Oxford and IBH Publishers, New Delhi.
4) Dairy Bovine Production – Thomas, C. K. and Sastri, N. S. R., Kalyani Publishers,1/1, Rajinder Nagar, Ludhiana.
5) Text-Book of Buffalo Production – Ranjhan, S. K. and Pathak, N. N. (1979) Vikas, Publishing House Pvt. Ltd. 576, Masjid Road, Jangpura, New Delhi.

IMPORTANCE OF LIVESTOCK IN THE NATIONAL ECONOMY

Livestock plays an important role in Indian economy. About 20.5 million people depend upon livestock for their livelihood. Livestock contributed 16% to the income of small farm households as against an average of 14% for all rural households. Livestock provides livelihood to two-third of rural community. It also provides employment to about 8.8 % of the population in India. India has vast livestock resources. Livestock sector contributes 4.11% GDP and 25.6% of total Agriculture GDP.

Contribution of livestock to people:

The livestock provides food and non-food items to the people.

1. Food: The livestock provides food items such as Milk, Meat and Eggs for human consumption. India is number one milk producer in the world. It is producing about 156 million tons of milk in a year (2015-16).

2. Fibre and skins: The livestock also contributes to the production of wool, hair, hides, and pelts. Leather is the most important product which has a very high export potential. India is producing about 47.9 million Kg of wool per annum.

3. Draft: Bullocks are the back bone of Indian agriculture. Despite lot of advancements in the use of mechanical power in Indian agricultural operations, the Indian farmer especially in rural areas still depend upon bullocks for various agricultural operations. The bullocks are saving a lot on fuel which is a necessary input for using mechanical power like tractors, combine harvesters etc. Pack animals like camels, horses, donkeys, ponies, mules etc. are being extensively used to transport goods in different parts of the country in addition to bullocks.

4. Dung and other animal waste materials: Dung and other animal wastes serve as very good farm yard manure and the value of it is worth several crores of rupees. In addition it is also used as fuel (bio gas, dung cakes), and for construction as poor man's cement (dung).

5. Storage: Livestock are considered as "moving banks" because of their potentiality to dispose off during emergencies. They serve as capital and in cases of landless agricultural labourers many time it is the only capital resource they possess. Livestock serve as an asset and in case of emergencies they serve as guarantee for availing loans from the local sources such as money lenders in the villages.

6. Weed control: Livestock are also used as Biological control of brush, plants and weeds.

7. Cultural: Livestock offer security to the owners and also add to their self-esteem especially when they are owning prized animals such as pedigreed bulls, dogs and high yielding cows/ buffaloes etc.

8. Sports / recreation: People also use the animals like cocks, rams, bulls etc. for competition and sports. Despite ban on these animal competitions the cock fights, ram fights and bull fights (jalli kattu) are quite common during festive seasons.

9. Companion animals: Dogs are known for their faithfulness and are being used as companions since time immemorial. When the nuclear families are increasing in number and the old parents are forced to lead solitary life the dogs, cats are providing the needed company to the latter thus making them lead a comfortable life.

Role of livestock in farmers' economy

The livestock plays an important role in the economy of farmers. The farmers in India maintain mixed farming system i.e. a combination of crop and livestock where the output of one enterprise becomes the input of another enterprise thereby realize the resource efficiency. The livestock serve the farmers in different ways.

1. Income: Livestock is a source of subsidiary income for many families in India especially the resource poor who maintain few heads of animals. Cows and buffaloes if in milk will provide regular income to the livestock farmers through sale of milk. Animals like sheep and goat serve as sources of income during emergencies to meet exigencies like marriages, treatment of sick persons, children education, repair of houses etc. The animals also serve as moving banks and assets which provide economic security to the owners.

2. Employment: A large number of people in India being less literate and unskilled depend upon agriculture for their livelihoods. But agriculture being seasonal in nature could provide employment for a maximum of 180 days in a year. The land less and less land people depend upon livestock for utilizing their labour during lean agricultural season.

3. Food: The livestock products such as milk, meat and eggs are an important source of animal protein to the members of the livestock owners.

4. Social security: The animals offer social security to the owners in terms of their status in the society. The families especially the landless which own animals are better placed than those who do not. Gifting of animals during marriages is a very common phenomenon in different parts of the country. Rearing of animals is a part of the Indian culture. Animals are used for various socio religious functions. Cows for house warming ceremonies; rams, bucks and chicken for sacrifice during festive seasons; Bulls and Cows are worshipped during various religious functions. Many owners develop attachment to their animals.

5. Draft: The bullocks are the back bone of Indian agriculture. The farmers especially the marginal and small depend upon bullocks for ploughing, carting and transport of both inputs and outputs.

6. Dung: In rural areas dung is used for several purposes which include fuel (dung cakes), fertilizer (farm yard manure) and plastering material (poor man's cement).

Livestock population (Livestock census-2012)

Total livestock population is 512.05 million numbers in 2012 and has decreased by about 3.33% over the previous census.

Sr. No.	Species	Number (in millions)	Ranking in the world population
1.	Cattle	190.9	Second
2.	Buffaloes	108.7	First
	Total (including Mithun & Yak)	300	First
3.	Sheep	65.0	Third
4.	Goats	135.2	Second
5.	Pigs	10.3	-
6.	Others	1.7	-
	Total livestock	512.3	-
7.	Total poultry	729.2	Seventh

Source: *Annual Report 2014-15, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Govt. of India.*

DIFFERENT LIVESTOCK DEPLOYMENT PROGRAMME

Government of India is making efforts for strengthening infrastructure for production of quality milk, procurement, processing and marketing of milk and milk products through following Dairy Development Schemes:

1. National Programme for Dairy Development (NPDD)
2. National Dairy Plan (Phase-I)
3. Dairy Entrepreneurship Development Scheme (DEDS)
4. Support to Dairy Cooperatives
5. Dairy Processing and Infrastructure Development Fund (DIDF)
6. Dairy Entrepreneurship Development Scheme
7. Intensive Dairy Development Programme
8. Fodder and Feed Development Scheme
9. Poultry Venture Capital Fund
10. Establishment and Modernization of Rural Slaughter Houses
11. Salvaging and Rearing of Male Buffalo Calves
12. Utilization of Fallen Animals
13. Integrated Development of Small Ruminants (Sheep, Goat) and Rabbits
14. Conservation of Threatened Breeds of Small Ruminants, Pack-Animals
15. Livestock Insurance Scheme

TERMINOLOGY USED IN LIVESTOCK MANAGEMENT

Species: A group of individuals which have certain common characteristics that distinguish them from other group of individuals with in species the individuals are fertile when in different species they are not.	**Breed:** A group of animals related by decent & which are similar in most of the characters like general appearance, size, colors, horns it is called breed.
Type: It is a commonly accepted standard that combines those characteristics essential in adopting an animal for a particular purpose e.g. milk, meat wool or work.	**Gestation period:** The period from the date of service (actual conception) to the date of parturition is termed as parturition period or pregnancy period.
Sire: The male parent of the calf.	**Dam:** Female parent of the calf.
Calf: Young one of cattle or buffalo below the age of six months is called calf.	**Heifer:** The younger female of cattle above age of six months to first calving.
Cow: The adult female of cattle from the date of first calving is called cow.	**Bull:** It is unsaturated of, cattle used for breeding or covering the cows.
Bullock: It is the castrated male of cattle used for work.	**Gestation:** It is the condition of female when developing foetus in present in the uterus.
Conception: The successful union of male and female gametes & implantation of zygote is known as conception.	**Service:** The process in which mature male covers the female i.e. in heat with the object to deposit spermatozoa in the female genital tract is called service.
Parturition: The act of giving birth to young one is called parturition.	**Lactation period:** The period after parturition in which the animal produces milk.
Dry period: The period after lactation in which the animal does not produce milk.	**Calving interval:** The period between two successive calving is calving interval.
Average: It is the sum of production divided by No. of animals.	**Environment:** The sum of all external influences to which an individual is exposed.
Herd Average: It is average daily milk yield of milling animal in a herd. $H.A. = \frac{\text{Total milk yield of a day}}{\text{No. of milking animals}}$	**Wet average:** It is the average daily milk yield of a cow is lactation. $W.A = \frac{\text{Total milk yield. of a lactation (kg or Lt).}}{\text{Lactation period (days)}}$
Genotype: The complete genetic makeup of an individual- or its combination of genes it possesses which influences its characters.	**Phenotype:** The external appearance or some other overall or measurable characteristics of an individual or it is the actual expression of the character as determined by his genes & the environment in which he has lived.
Half sib: Half-brothers or half-sisters.	**Full sib:** Full brothers or full sister.
Heridity: The occurrence of genetic factors derived from each of its parent in an individual.	**Heritability:** The percentage of variation in individual characteristics between related individuals which is due to true genetic difference.

Repeatability: It is the expression of the same trait at different times in the life of the same individual or the tendency of an individual to repeat its performance e.g. dairy cow in successive lactation.	**Allel:** One or two or more alternative foms of a gene. Alleles are those genes which may appear at same locus in homologus chromosomes.
Gene: It is the unit of inheritance, which is transmitted in gametes or reproductive cells. It is the physical basis of heredity.	**Dominance:** A gene is said to be dominant when its characteristic effect is expressed in the heterozygote as well as homozygote, i.e. Aa x AA.
Recessive: Genes which have no observable effect unless present in both members of a chromosome pair.	**Epistasis:** Interaction of two or more pairs of a gene that are not allele to produce a phenotype that they do not produce when they occur separately.
Lethal: (Deadly) A gene or genes that cause death of an individual which are possessed by them during pregnancy or at the time of birth.	**Prepotency:** The ability of certain individuals to stamp or impress their characters upon their offspring or prepotency is the ability to transmit characteristics to offspring to a marked degree.
Fertility: Ability of an animal to produce large number of living young.	**Sterility:** Inability to produce any offspring.
Fecundity: It is the potential capacity of the female to produce functional ova regards of what happens to them after they are produced.	**Cryptorchids:** The failure of testes to descend fully into the scrotum. If one testis is in scrotal position the male is usually fertile but if both are retained in the abdominal cavity sterility usually reported.
Free martin: A sterile heifer born twin with the male.	**Buller:** Cow always in estrus condition.
Teaser: A vasectomized (castrated) bull used to detect the heat or estrus of female (cow).	**Herd:** It is a group of cattle or buffalo.
Flock: It is the group of sheep, goat or poultry birds.	**Steer:** The male cattle that is castrated when he is still a calf or before the development of sexual maturity is called steer.
Veal: The meat of calf below the age of 3 months.	**Beef:** The meat of- cattle past calf stage.
Pork: The meat of swine.	**Mutton:** The meat of sheep & goat.
Chevon: The meat of goat.	**Wedder:** A castrated sheep is called wedder.
Prolificacy: Ability to produce large number of offsprings. The animal is said to be prolific.	**Inheritance:** Transmission of genetic factors from parent to offspring's.
Puberty: It is the period when reproductive tract & secondary sex organs/characteristics start to acquire their mature form.	**Variation:** The degree to which individuals differ with respect to the extent of development of expression of characteristics.
Germplasm: The material on the basis of heredity taken collectively. The sum of gene constitution of an individual.	**Foetus:** A term for developing young one during last quarter of pregnancy.

BREEDS OF CATTLE AND BUFFALO

Indigenous Cattle Breeds

1. Gir:

- Origin: Gir forest of Gujarat state.
- Colour is white with dark red or chocolate brown patches over the body.
- Body Medium sized.
- Head is moderately long, and massive and the forehead bulging.
- Face is narrow and clean.
- Muzzle is square and black.
- Eyes are placed higher up in line with root of ears.
- Ears are large and pendulous.
- Horns are black, medium sized, shapely round
- Hump is medium sized
- Tail is long touching the ground.
- Udder is of medium size.

- Avg. LMY: 2000 Kg
- LP: 310 days
- AFC: 1500 days

2. Red Sindhi:

- **Origin-** Pakistani state of Sind
- **Colour** normally a deep, rich red color but this can vary from a yellowish brown to dark brown.
- Males are darker than females and when mature may be almost black on the extremities, such as the head, feet and tail.
- **Body** medium sized, compact
- Docile in nature
- **Horns** emerging laterally
- **Hump** heavy
- **Udder** capacious & become pendulous in heavy milkers
- Accept adoption to humid climatic condition too.

- AFC: 1400 days
- LMY: 1800 Kg
- LP: 300 Kg

3. Sahiwal:

- **Origin:** Montgomery ‘district in Pakistan, but animals of this breed are found in Punjab and Haryana.
- **Body:** Medium sized, symmetrical
- **Fore head** broad
- **Horns** thick short
- **Skin** fine loose hence called **Lola**
- **Chest** is broad and deep
- **Tails** is long with a black switch
- **Udder** large, broad, fine skin with prominent veins.
- **Teats** are good, uniform in size square placed.
- **Milk veins** are large and prominent.

- **AFC:** 1200 days
- **LMY:** 2200 Kg
- **LP:** 320 days

4. Hallikar

- Originated from the former princely state of Vijayanagarm, presently part of Karnataka.
- The colour is grey or dark grey.
- Compact, muscular and medium size animal with prominent forehead, long horns and strong legs.
- The breed is best known for its draught capacity and especially for its trotting ability.

5. Amritmahal

- Originated in Hassan, Chikmagalur and Chitradurga district of Karnataka.
- Amiritmahals are grey cattle but their shade varies from almost white to near black.
- The muzzle, feat and tail are usually black.
- Horns are long and end in sharp black points

6. Khillar

- **Origin:** Aundh and Jat taluka of Sangli district., Also in Solapur and Satara districts, found in satpura ranges of khandesh i.e Jalgaon and Dhule district.
- **Body:** Compact, Cylindrical in appearance
- **Head:** Long;
- **Forehead** is long and narrow with gradual convex bulge backward toward the horns. A distinct groove in the center of the fore head.
- **Horn:** Are long, curve goes backwards and turn upward.
- **Eyes:** Bright, alert
- **Ears:** Small, pointed and always held.
- **Colour:** White or gray.
- Bullocks are fast, powerful draft animals and hence highly valued

Av. LMY: 300 to 400 kg.
Cows are poor milkers.
AFC: 51 months
CI: 16 months,

5. Tharparkar

- Originated in Tharparkar district (Pakistan) of undivided India and also found in Rajasthan.
- Otherwise known as White Sindhi, Gray Sindhi and Thari.
- They are medium sized, compact and have lyre-shaped horn.
- Body colour is white or light grey.
- The bullocks are quite suitable for ploughing and casting and the cows yield 1800 to 2600 kgs of milk per lactation.

6. Hariana

- It was originated from Rohtak, Hisar, Jind and Gurgaon districts of Haryana and also popular in Punjab, UP and parts of MP.
- Horns are small.
- The bullocks are powerful work animals.
- Hariana cows are fair milkers yielding 600 to 800 kg of milk per lactation.

7. Kankrej

- It is otherwise called as Wadad or Waged, Wadhiar.
- Originated from Southeast Rann of Kutch of Gujarat and adjoining Rajasthan (Barmer and Jodhpur district).
- The horns are lyre-shaped.
- Colour of the animal varies from silver-grey to iron-grey or steel black.
- The gait of Kankrej is peculiar called as 1 ¼ paces (sawai chal).
- Kankrej is valued for fast, powerful, draught cattle.
- The cows are good milkers, yielding about 1400 kgs per lactation.

8. Ongole

- Home tract is Ongole taluk in Guntur district of Andhra Pradesh.
- Large muscular breed with a well developed hump.
- Suitable for heavy draught work.
- White or light grey in colour.
- Average milk yield is 1000 kgs per lactation.

9.*Krishna Valley*

- Originated from black cotton soil of the water shed of the river Krishna in Karnataka and also found in border districts of Maharastra.
- Animals are large, having a massive frame with deep, loosely built short body.
- Tail almost reaches the ground.
- Generally grey white in colour with a darker shade on fore quarters and hind quarters in male. Adults females are more whitish in appearance.
- The bullocks are powerful animals useful for slow ploughing, and valued for their good working qualities.

- Average milk yield is about 900 kgs per lactation.

10. Deoni

- Home of this breed is Marathwada now in MH state.
- Developed from Gir of Gujrat & local cattle of Deoni tract.
- Colour of the animal is white and black patches or red and white patches.
- Forehead is less prominent.
- Ears are long and pendulous.
- Head is medium sized, prominent forehead, the horns curving outwards and backwards.
- Bullocks are large sized and good for heavy work.
- Body Wt. Male: 600kg, Female: 450 Kg

- **AFC**: 1300 days
- **LMY**: 900 Kg
- **LP**: 300 days
- **ICP**: 447 days

Exotic cattle breeds

1. Jersey

- Origin: Denmark to Australia, from Canada to South America and from South Africa to Japan.

Body Characteristics:

- Adaptable to a wide range of climatic and geographical conditions
- Excellent grazers and perform well in
- intensive grazing programs.
- More tolerant of heat than the larger
- breeds
- The color in Jerseys may vary from a very light gray or mouse color to a very dark fawn or a shade that
- is almost black.
- Both the bulls and females are commonly darker about the hips and about the head and shoulders than on the body.

Production Parameters:

- Average body weight 400 kg.
- Average milk production is 6000 kg.
- Age at first calving ranges from 23-24 months.

2. *Holstein Friesian*

- Originates from Holland.

Most widely distributed breed of dairy cattle in temperate zone as well as in tropical countries.

Physical Characteristics:

- Holsteins cattle are ruggedly built
- Posses large udders.
- It has color patterns of black and
- White or red and white.
- The normal productive life of a Holstein is six years.

- **Production Parameters:**
- Average milk production is 7500 9000 kg with 3.5 % fat
- A mature Holstein cow weighs about 550 kg.
- Age at first calving is 25-27 months

3. *Brown Swiss*

- Origin: Switzerland originated on the east and north of Alps. But now, they are seen in most parts of the world.

Physical Characteristics:

- Colour varies from a light fawn to almost black.
- Muzzle and a stripe along the backbone are light in colour.
- Nose, switch and horn tips are black.
- Animals are fairly large in size and have extremely strong constitution and hardiness.
- The breed is triple purpose animal in the homeland i.e. milk, meat and draught.
- Breed is quiet, docile and easily manageable.
- Adult males weigh about 700 to 800 kg and adult females about 500 to 600 kg.

Production Parameters:

- On an average a Brown Swiss cow produces 5,250 kg of milk which contains 4.2 % fat.
- Females calve for the first time between 28 to 30 months per lactation
- Calving interval of 13 to 14 months.

4. *Ayrshire*

- This breeds takes its name from the country of Ayr and South west Scotland. Where it was developed.

Physical Characteristics:

- The animals are cherry red to brown in colour and are of medium size. Ayrshire is considered by many as the most beautiful dairy breed.
- This is a relatively nervous breed and is known for its hardiness and good grazing ability.
- The animals are strong and robust.
- The udder is strongly and evenly balanced and well shaped.
- These are very active animals but hard to manage.
- The breed was also known as Dunlop cattle or Cunningham cattle

Production Parameters:

- Average milk production of this breed cows is 4,840 kg per lactation.
- Milk contains about 4.0 % fat.
- First calving at 20-30 months age.

BUFFALO BREEDS

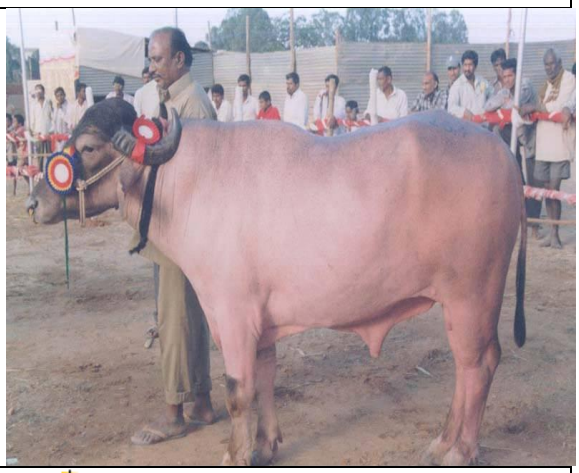
1. *Murrah*

- Most important breed of buffaloes whose home is Rohtak, Hisar and Sind of Haryana, Nabha and Patiala districts of Punjab and southern parts of Delhi state.
- Colour is usually jet black with white markings on tail and face and extremities sometimes found.
- Tightly curved horn is an important character of this breed.
- Most efficient milk and butter fat producers in India.
- Butter fat content is 7.83%.

- LMY - 1500 - 2500 kg.
- AFC - 45-50 months
- ICP - 450-500 days.

2. *Surti*

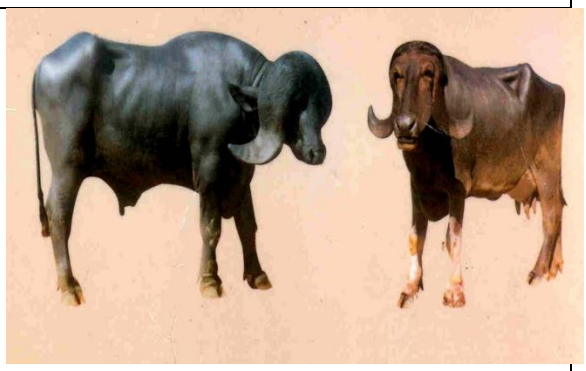
- Origin Kaira and Baroda districts of Gujarat state
- Colour is usually black; animals of gray and copper
- Body is well shaped and medium sized; the barrel is wedge shaped
- Famous for early maturity and efficiency of milk production. The bullocks are good for light work
- Head is long and eyes prominent.
- Horns are sickle shaped, moderately long and flat
- The peculiarity of this breed is very high fat percentage in milk (8-12per cent).



- AFC: 1692 days
- LMY: 1285 Kg
- LP: 344 days

3. *Jaffrabadi*

- Breeding tract of this breed is Gir forests, Kutch and Jamnagar districts of Gujarat.
- This is the heaviest Indian breed of buffalo.
- Horns are heavy, inclined to droop at each side of the neck and then turning up at point (drooping horns).
- Udder is well developed with funnel shaped teats.
- Average milk yield is 1000 to 1200 kgs per lactation.
- Bullocks are heavy and used for ploughing and carting.



- AFC: 1361 days
- LMY: 2239 Kg
- LP: 305 days

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4. Bhadawari

- Home tract of this breed is Agra and Etawah district of Uttar Pradesh and Gwalior district of Madhya Pradesh.
- Medium sized buffalo.
- The body is usually light or copper coloured is a peculiarity of this breed. Eye lids are generally copper or light brown colour.
- Two white lines ‘Chevron’ are present at the lower side of the neck similar to that of Surti buffaloes.
- The bullocks are good draught animal with high heat tolerance.
- This breed is an efficient converter of coarse feed into butterfat and is known for its high butter fat content.

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- LMY : 800 to 1000 kg
- Fat content (10-13 %)
- Average milk yield is 800 to 1000 kgs per lactation.

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5. Nili Ravi

- Originated around the river Ravi.
- This breed is found in Sutlej valley in Ferozpur district of Punjab and in the Sahiwal (Pakistan) of undivided India.
- The peculiarity of the breed is the wall eyes.
- Head is small, elongated, bulging at top and depressed between eyes.
- Horns are very small and tightly coiled.
- Bullocks are good for heavy trotting work.
- The milk yield is 1500-1850 kgs per lactation.

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- AFC : 1359 days
- LMY : 1850 Kg
- LP : 294 days

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6. Mehsana

- Mehsana is a dairy breed of buffalo found in Mehsana, Sabarkanda and Banaskanta districts in Gujarat and adjoining Maharashtra state.
- The breed is evolved out of crossbreeding between the Surti and the Murrah.
- Body is longer than Murrah but limbs are lighter.
- Horns are less curved than in Murrah and are irregular.
- Bullocks are good for heavy work.
- The milk yield is 1200-1500 kgs per lactation.

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- AFC: 1265 days
- LMY: 1988 Kg
- LP : 316 days

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7. Nagpuri

- This breed is also called as Elitchpuri or Barari.
- Breeding tract of this breed is Nagpur, Akola and Amrawati districts of Maharashtra.
- These are black coloured animal with white patches on face, legs and tail. The horns are long, flat and curved, bending backward on each side of the back. (Swaord shaped horns).
- The bullocks can be used for heavy work.

- Milk yield ranges from 700 to 1200 kgs per lactation.

8. Pandharapuri

- Origin Solapur, Kolhapur, Satara & Sangali Distrct of south east MH state.
- Colour varies from light to deep black
- Body medium sized
- Avg. milkers
- Sturdy animal
- Animals are docile in temperament
- Horns are very long, curved backward, upward and usually twisted outwards.
- Udders of lactating buffalo - medium sized, compact and somewhat hidden between hind quarters.
- Tail is long and just reaching below hock.
- Switch of the tail is usually white while hooves are black in colour.

- LMY: 1500 Kg
- Fat : 7 to 8 %

FEEDING AND MANAGEMENT

A. Care and management of calf

The future of any dairy farm depends on how the calves are raised. If calves are not fed and managed properly, it will not attain the large size necessary for maximum production. It is said that, "good animals are raised, not purchased". Good feeding and management for the calves should be given, so that they develop well and will become useful replacement stock. Underfed animals will give weak and small calves.

Early Management

- Immediately after birth remove any mucous or phlegm from those nose and mouth.
- Normally the cow licks the calf immediately after the birth. This helps to dry off the calf and helps in stimulating breathing and circulation.
- When the cow does not lick or in cold climate, rub and dry the calf with a dry cloth or gunny bag for stimulating breeding and ciruculation.
- Provide artificial respiration by compression and relaxing the chest with hands
- The naval should be tied about 2-5 cms away from the body and make a cut 1cm below the ligature and apply tincture Iodine or boric acid or any antiseptics.
- Remove the wet bedding from the pen and keep the stall very clean and dry in condition.
- The birth weight of the calf should be recorded.
- Wash the cow's udder and teats preferably with chlorine solution and dry. Allow the calf to suckle the first milk of the mother cow i.e. Colostrum.
- The calf will be standing and attempts to nurse within one hour. Otherwise suitable assistance should be given to the weak calves.
- Feeding of Calves : Feed colostrum i.e. the first milk of the cow for the first 3 days. The colostrum is thick and viscous.
- It contains higher proportions of Vitamin A and proteins.
- The proteins are immune globulin which gives protection against many diseases.
- Colostrum contains antitrypsin which avoids digestion of immunoglobulins in the stomach and is absorbed as it is.
- Feed milk twice a day and for weak calves feed thrice a day.
- The limit of liquid milk feeding is 10 % of it's body weight with a maximum of 5-6 liters per day and continue liquid milk feeding for 6-8 weeks. Over feeding causes 'Calf Scours'.
- The milk replacers can be given to replace whole milk.
- Give calf starter after one month of age.
- Provide good quality green fodder and hay from 4th month afterward.
- Feeding of antibiotics to calves (as per the advise of the veterinarian) improves appetite, increases growth rate and prevent calf scours. E.g. Aureomycin, Terramycin etc.

Other management practices

- Identify the calf by tattooing in the ear at birth, and branding after one year.
- Dehorn the calf within 7-10 days after birth with red hot Iron or caustic potash stick or electrical method.(as per the advice of the veterinarian)
- Deworm the calf regularly to remove worms using deworming drugs. Deworm at 30 days interval. (as per the advice of the veterinarian)
- House the calves in individual calf pens for 3 months afterwards in groups.
- After six months male and female calves should be housed separately.
- Weigh the calves at weekly interval up to 6 months and at monthly interval afterward to know the growth rate.
- Mortality in calves is more in first month due to pneumonia.
- Extra teats beyond 4 should be removed at 1-2 months of age (as per the advise of the veterinarian).
- Pruning 8-9 weeks of age, males should be castrated.
- Keep the body clean and dry to avoid fungal infection.
- Mineral-blocks should be provided, so that the calves lick and no chance for mineral deficiency.
- Wean the calf from the mother and feed through pail feeding system.

2. Feeding and management of Heifers

- Better Care and Management of heifer will give high quality replacement stock to the dairy farm.
- Feed the heifer sufficiently to produce normal growth. During the early stage relatively more protein than energy is needed.
- Most heifers grow well if excellent hay is given as much they can eat. The amount of growth depends upon the quality of forage fed.
- The heifers should be provided with a dry shelter free from drafts. A loose housing system with a shelter open to one side is sufficient.
- The size rather than the age of a dairy heifer at breeding time is important. Breeding under sized animals is never profitable.
- Though the heifer that is bred to calve at an older age yields higher milk yield in the first lactation, the total milk produced by such a cow will be less when compared to the heifers that freshens at an early age. Usually the heifer is bred to freshen at 24-30 months of age.
- Place the heifer in a separate shed about 6-8 weeks before calving time.
- Feed 2 - 3 kgs of concentrate daily and adequate forage also.
- Before calving let the heifer becomes accustomed to handling and to the procedures used in the milking herd.
- Maintenance of health among heifers is very important for proper growth.

- The health among the heifers is maintained by hygienic housing, water, balanced feeding and taking necessary preventive steps against common diseases.
- Periodically the heifers in the herd should be checked for their proper growth and other progress.
- Animals lagging behind below the required standards should be removed from the herd.

3. Care and management of milking animals

- To get high milk during any lactation, the milch animal should be properly fed and necessary care and management practices should be followed.
- Provide green succulent forage together with leguminous hay or straw to the extent of animal can consume, so that all its maintenance requirements are met through forage feeding.
- Extra concentrate at the rate of 1 kg for every 2 to 2.5 liters of milk should be provided. Salt and mineral supplements should be given to maintain the lactation.
- Never frighten or excite the animals. Always treat them gently and with kindness.
- With proper feeding and care, a cow will come to heat within 16 days of calving. Do not with hold insemination unnecessarily after the signs of heat are noticed in a cow.
- The shorter the interval between calvings, the more efficient the animal is as a milk producer.
- By maintaining proper records of breeding and calving of the animals will ensure a study flow of milk throughout the year.
- Individual attention to feed each animal according to its production is a must. For this purpose maintain individual production records.
- Keep up regularity of feeding. Concentrate mix is fed before or during milking, when as roughage after milking.
- Water should be provided to drink at will or at frequent intervals. It is more beneficial, if the animal is maintained on paddy straw as sole roughage.
- Regularity in milking is essential.
- Rapid, continuous, dry hand milking should be practiced without undue jerking of teats. Milking should be done with whole hand, but not with thumb and index finger.
- Cows should be trained to let down milk without calf suckling. This will held to wean the calves early.
- Loose housing with shelter during hot part of the day should be provided. The animals will get maximum exercise in loose housing system.
- Grooming of the cows and washing of the buffaloes before milking help in clean milk production.
- Daily brushing will remove loose hair and dirt from the coat. Grooming will also keep the animal hide pliable.
- Wallowing of buffaloes or water spraying on their bodies will keep the buffaloes comfortable especially in summer.

- Common ailments should be properly detected and treated.
- Common vices should be properly detected and care should be taken. Eg. Kicking, licking, suckling etc.
- Provide at least 60 - 90 days dry period between calvings. If the dry period is not sufficient, the milk yielding of subsequent lactation will be reduced.
- Vaccinate the cows- against important diseases and also guard against insects and pests.
- Every animal should be numbered and particulars pertaining to milk, fat percentage, feed taken, breeding, drying and calving dates should be recorded.
- Check for mastitis regularly.

4. Care and management of Dry Cows

The dry cows are those milking of which is stopped about 2 to 2.5 months before next calving. It is nothing but the caring of the cows again in the advance pregnancy state. It is generally considered that a cow should remain dry for a period of 2 to 3 months before calving, for following reasons

1. To give rest to the organs of milk secretion.
2. To permit the nutrients in the feed to be used in developing the foetus instead of producing milk.
3. To enable the cow to replenish in her body the stores of minerals which have become depleted through milk production.
4. To permit her to build up a reserve of body flesh before calving.

It has been found that cows not given a dry period will give less milk in the following lactation.

Methods of drying of cows

1. **Incomplete milking:** Milking of the cows is not done completely for first few days after the drying off period has begun. After the production decreases to a few liters daily milking is stopped.
2. **Intermittent milking:** The cow which is to be dried off will be milked once a day for a while, then once in every next day and finally milking will be stopped altogether.
3. **Complete cessation:** By this method, the udder fills until pressure increases enough to stop secretion of milk inside the udder. After the cessation of secretion, the milk is gradually reabsorbed from the gland until it becomes completely dry.

Thin cows should have longer dry periods than medium weight cow. Dry period for a average cow should be 60 to 80 days. Shorter dry period should be for low producers.

The dry cows should be housed in a separate compartment, where there is feeding and watering of the animal is cared. Pregnant cows should be isolated from the completely dry and open cows.

Green fodder, dry fodder and concentrates should be fed to cows as per their requirements. Mineral mixture should be added in the concentrate mixture to be fed to the cows in required

amount. Fresh and clean water should be supplied. Detection of animals against contagious diseases should be done. Deworming and dusting should be done at regular interval.

5. Care and management of pregnant animals

- The good care and management practices given to pregnant animal will give good calf and also high milk yield during the successive lactation.
- Extra concentrate mix of 1.25 to 1.75 kgs should be provided for pregnant animal and also feed good quality of leguminous fodder.
- The animal should not be not - lean - not fat in condition.
- Provide clean drinking water and protection from thermal stress.
- Do not allow them to mix with other animals that have aborted or that are suffering from or carriers of diseases like brucellosis.
- Allow moderate exercise, which helps in calving normally.
- Do not allow them to fight with other animals and take care that they are not chased by dogs and other animals.
- Avoid slippery flooring conditions, which causes the animal to fall which will leads to fractures, dislocation etc.
- If accurate breeding records are available, calculate the expected date of calving. Separate it one or 2 weeks before and shifted to individual parturition pens.
- These pens are thoroughly cleaned and fresh bedding may be provided.
- Feed one kg extra concentrates during last 8 weeks of gestation.
- Feed laxative about 3 - 5 days before and after calving (Wheat bran 3 kgs + 0.5 gms of Groundnut cake + 100 gms of mineral mixture of salt).
- Symptoms of delivery may be observed i.e. swelling of external genitalia, swelling of udder, usually majority of animals will deliver without any help.
- If there is any difficulty, provide veterinary help.
- After parturition external genitalia, flank should be cleaned with proper care.
- Placenta will normally leave the cow within 2 - 4 hours after calving. If not, takes the help of a veterinarian.
- Take care of the animal before calving from milk fever. Give calcium supplement.
- Sometimes the udder will be swollen just before calving, such cases remove the milk partially.
- Provide always free access to drinking water.

6. Care and Management of Breeding Bulls

The care and proper management of breeding bull is important for success of breeding programme.

1. **Selection:** The breeding bulls should be selected from good pedigree.

2. **Feeding:**

- The properly balanced ration should be given which contains adequate energy, protein, minerals & vitamins.
- Feed to male calf after discontinuation of milk, it should be provided with good quality, legume hay and 2 to 2.5 kg of concentrate having 12-15% DCP.
- Feeding to mature bull: Should be fed adequately to keep it on good flesh but not over fat, sufficient amount of green feed, 1 kg of good quality hay (DM) and 1.5 kg of concentrates per 100 kg of body weight per day will keep in good breeding condition.
- The breeding calf if provided with good feeding practices it will develop in a vigorous nature mature bull & reach sexual maturity of young age.

3. **Housing:**
    - The bull should be housed in a separate bull pen measuring 15' X 10' dimension.
    - The stall should open into strongly fenced paddock into which the bull has free access & movement.
    - The pen should have stanchion to which the bull can be tied during cleaning time.
    - The feeding & watering arrangement should be made in the pen and paddock.
4. **Exercise:**
    - It is needed to keep normal appetite, retain breeding power and good health.
    - Males which received plenty of exercise produce larger ejaculation containing more sperms of higher activity.
5. **Training:** Bull should be trained to be lead with bull staff at an early age population is a pressure on limited sources, so timely culling of the unwanted animals is desired.

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DISEASES OF CATTLE AND BUFFALO

Introduction:

- Cattle diseases cost millions of rupees losses every year. In addition to death, they cause loss of production and frequently a loss of body condition.
- Unhealthy animals require more food and take longer time for growth than healthy ones. Generally, animals are born free of diseases or parasites.
- Keeping animals healthy by confining purchases to healthy herds, by proper quarantine at the time of bringing in new animals, by employing sound principles of sanitation, management and feeding and by judicious use of appropriate and dependable vaccines are the practical and economical ways to avoid losses from the disease.
- By proper management and feeding, the dairy farmer can, to a great extent, prevent disease out-breaks.

- Good housing assists in maintaining the health of the herd, whereas judicious feeding not only builds up body resistance to disease but also helps in speedy recovery in case there is a disease attack.

✓ Health denotes physical, physiological and mental wellbeing of an individual.
✓ Disease means any deviation from normal state of health.

Classification of Diseases:

A. According to mode of origin

1. **Hereditary diseases:** are transmitted from parents to the offspring.
2. **Congenital diseases:** are acquired during intra-uterine life.
3. **Acquired diseases:** are acquired after birth.

B. According to specific causes:

a) Specific diseases: are produced by a specific pathogen or factor. They are subdivided into

i) Infectious diseases: are caused by pathogenic organisms

Viral diseases: Rinderpest (RP), Foot & Mouth disease (HMD)
Bacterial diseases: Black quarter (BQ), Haemorrhagie septicemia (HS)
Protozoan diseases: Surra, Thieleriosis.

ii) Non-infectious diseases: are caused by physical or chemical or Poisonous agents, nutritional deficiency or disturbed metabolism.

e.g. 1. Deficiency diseases - Rickets.
2. Metabolic diseases - Milk fever
3. Poisoning - Pesticide poisoning

b) Non-specific disease: those diseases whose causes are indefinite or multiple e.g. Pneumonia

C. According to mode of spread:

1. **Contagious disease:** sprout by means of direct or indirect contact, e.g. FMD; HS All infections discuses may or may not be contagious but all contagious dieses are injections.
2. **Non-contagious diseases:** do not spread by means of direct or indirect contact. E.g. Rickets.

D According to clinical signs:

1. **Preacute disease** is characterized by very short course (few hours to 48 hours) and very server symptoms e.g. Anthrax,
2. **Acute disease** is characterized by a sudden onset, short course (3-14 days) and severe symptoms e.g. FMD, RP.
3. **Subacutc disease:** whose course is 1-4 weeks and severity is less than acute one. E.g. Sub acute mastitis

4. **Chronic disease:** whose course is more than 4 weeks and signs are not severe in character e.g. Tuberculosis

E. According lo intensity and spread of diseases:

1. **Sporadic disease:** affects one or f-o animals and shows little or no tendency to spread within the herd e.g. Johne's disease.
2. **Enzootic/Endemic disease:** means are outbreak of disease among animals in a definite area or particular district. E.g. Anthrax, H.S.
3. **Epizootic/Epidemic disease:** which assets a large population of animals in large area at the same time and spread with rapidity e.g. FMP, RP.
4. **Panzootic /Pandemic disease:** is a widespread epidemic disease usual of world wide distribution e.g. Influenza
5. **Zoonotic disease:** a disease which can be transmitted from animal to man and vice versa e.g. Anthrax, Brucellosis.

GENERAL MEASURES FOR PREVENTION OF CONTAGIOUS DISEASES

1. Identification and isolation of infected animals.
2. Treatment of affected animals.
3. Slaughter of animals suffering from incurable diseases.
4. Disposal of dead animals either by burning or deep burial.
5. Destroy contaminated fodder by burring.
6. Proper disposal of contaminated water.
7. Regular cleaning and disinfection of cattle shed and its premises.
8. Don't allow grazing in affected area.
9. Restrict the movement of animals from affected to clean area.
10. Don't allow animals to drink water from ponds, revers etc. during outbreak of disease.
11. Close animal markets, cattle shows etc. during outbreak of disease.
12. Regular spraying of insecticide to control external parasites.
13. Regular deworming to control internal parasites\
14. Avoid stress associated with long distance transportation, inclement weather and under nutrition.
15. Provide adequate ventilation and sufficient space.

Normal clinical values in animals:

Species	Temperature F	Pulse rate / Minute	Respiration rate / Minute
Cattle & Buffalo	101.6	42-60	16-24
Sheep & Goat	102.6	70-80	18-30
Poultry	107.0	130-160	15-30

Important Diseases

HAEMORRHAGIC SEPTICAEMIA:
Etiology: *Pasteurella multocida*
Transmission: contaminated feed, water and inhalation.
Symptoms:
- High fever.
- loss of appetite.
- Dullness and depression.
- Rapid pulse and heart rate.
- Profuse nosal discharge.
- Difficult respiration.
- Swelling of throat region.
- Death within 10-72 hrs.

Control Measures:
- Isolate and treatments to affected animals.
- Burning of dead animals.
- Disposal of contaminated feed, water.
- Alum ppt. H.S.vaccine @ 5ml s/c every year before mansoon.

BLACK QUARTER:
Etiology: *Clostridium Chauvoei.*
Transmission: Contaminated feed and contamination of wound.
Symptoms:
- Fever (106-108oF)
- Loss of appetite.
- Dullness and depression.
- Rapid pulse and heart rate.
- Difficult breathing.
- Lameness in affected legs.
- Death within 12-48 hrs.

Control Measures:
- Isolation of infected and incontact animals.
- Disposal of carcass.
- Don't allow grazing in affected area.
- Alum ppt. B.Q..vaccine @ 5ml s/c every year before rainy season.

ANTHRAX:
Etiology: *Bacillus anthracis.*
Transmission:
- Contaminated feed and fodder.
- Inhalation and biting flies.

Symptoms:
- Sudden rise in body temp.(104-108oF)
- Loss of appetite.
- Dullness and depression.
- Increase respiration and heart rate.
- Bloat or tympany.
- Bleeding from natural openings like anus, nostrils, vulva etc.
- Sudden death in peracute cases.

Control Measures:
- Identification and isolation of infected animals.
- Deep burial of dead animals.
    - Destroy contaminated fodder by burning.
    - Disinfection of cattle shed.
    - Anthrax Spore Vaccine @ 1ml s/c every year before onset of mansoon.

BRUCELLOSIS:
Etiology: *Brucella abortus.*
Transmission:
- Ingestion of feed & water contaminated with discharges of aborted fetuses.
- Inhalation.
- Vagina during coitus.

Symptoms:
- Abortion mainly during advanced or late pregnancy.
- Retention of placenta.
- Infertility.
- Weak calves are born.

Control Measures:
- Test entire herd for brucellosis atleast once a year.
- Slaughter infected animals.
- Adopt AI practice as far as possible.
- Newly purchased animals should be tested for brucellosis twice at an interval of 30 days before introduction in a herd.
- Calves (6-8 months age) vaccinated by Brucella Cotton-19 strain vaccine @ 5ml s/c.

FOOT AND MOUTH DISEASE:

Etiology: *Picorna virus.*

Other 7 strains of virus- O, A, C, Asia-1, SAT-1, SAT-2, SAT-3.

Transmission:

- Ingestion of contaminated feed and water.
- Air borne infection also occur.

Symptoms:

- Fever (104-106oC) for 24-48 hrs.
- Loss of appetite.
- Drop in milk yield.
- Blisters/vesicals and ulcers on tongue, dental pad and oral mucosa.
- Lameness.

Control Measures:

- Mouth wash with 1%KMnO4 or sodium bicarbonate solution.
- Foot wash with 2% copper sulphate or 2% sodium carbonate solution.
- Apply boroglycerine on mouthlesion.
- Raksha FMD vaccine @ 3ml s/c or FMD vaccine (BAIF) @ 10ml s/c every six months i.e. September and March.

RINDERPEST:

Etiology: Paramyxovirus

Transmission:

- Spreads through inhalation.
- Also spreads through Ingestion of contaminated feed and water.

Symptoms:

- Fever usually persist for 3 days.
- Loss of appetite.
- Drop in milk yield.
- Necrotic ulcers or erosions on oral mucous membrane.
- Shooting diarrhea.
- Dehydration.

Control Measures:

- Identification and isolation of sick animals.
- Restriction of animal movements.
- Disposal of dead animals.
- Disinfection of contaminated shed and premises.
- Tissue culture Rinderpest Vaccine (TCRPV) @ 1ml s/c every alternate year.

MASTITIS :

Etiology:

i) Bacteria: Streptococci, Staphylococci, E. colli etc.
ii) Viral: Cow pox, FMD
iii) Fungus: Aspergillus, Candida
iv) Injury to teat and udder.
v) Incomplete milking
vi) Unhygienic condition etc.

Transmission:

- Spreads through infected water, contaminated bedding, milkers hands etc.

Symptoms:

Fever, Loss of appetite, Udder swollen, hot and painful, Milk may be yellowish/ brownish, Milk contains flakes/ clots and Udder becomes hard due to fibrosis.

Control Measures:

- Isolation and treatment of infected animals.
- Regular testing of cow teat for mastitis.
- Proper disposal of mastitis milk.
- Use full hand milking method.
- Healthy non infected cow milk first.

MILK FEVER

Occurrence

- Mostly occurs in high yielding dairy cattle just after calving.
- Low serum calcium during 3rd to 10th day after calving in cattle & 6th week to peak lactation in buffalo.

Prevention

- Provide good sanitation in byre, regular exercise.
- Feed 6 to 8 kg good quality of dry fodder.
- Avoid high calcium diet during dry period.
- Avoid high phosphorus & low calcium ration in advance gestation.
- Supplement sodium sulphate, ammonium chloride 25 to 30 g daily & Vit. D 20 million I.U. for 5 days before calving in conc. mixture.

Treatment

- Provide high calcium diet (1 % on DM basis)
- Provide 60 g magnesium oxide daily.
- Provide 100 g calcium gel drench daily for 3 days.

Vaccination schedule

Disease	Age	Interval	Month
FMD	3rd month	Every six month	Jan-Feb, June-July
BG	6th Month	Every year	Aug-Sep
HS	6th Month	Every Year	Sep-Oct
Anthrax	6th Month	Every Year (Affected area only)	April - May
Brucellosis	4-8th month of Heifer	--	Mar - April

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BOVINE MALE NAD FEMALE REPRODUCTIVE SYSTEM

What is reproduction?

Reproduction is an orderly systematic process in which each of the parents makes very definite contribution through union of their germ cells by mating.

Reproductive system: A group of organs which functions together for multiplication of the species is known as reproductive system.

Reproductive system of male

The reproductive system of male can be divided into 3 parts
A) Primary sex organs : Testicals
B) Secondary sex organs : Epididymis, vas deferens and penis
C) Accessory sex glands : Seminal vesicles, prostate and Bulbo-urethral glands.

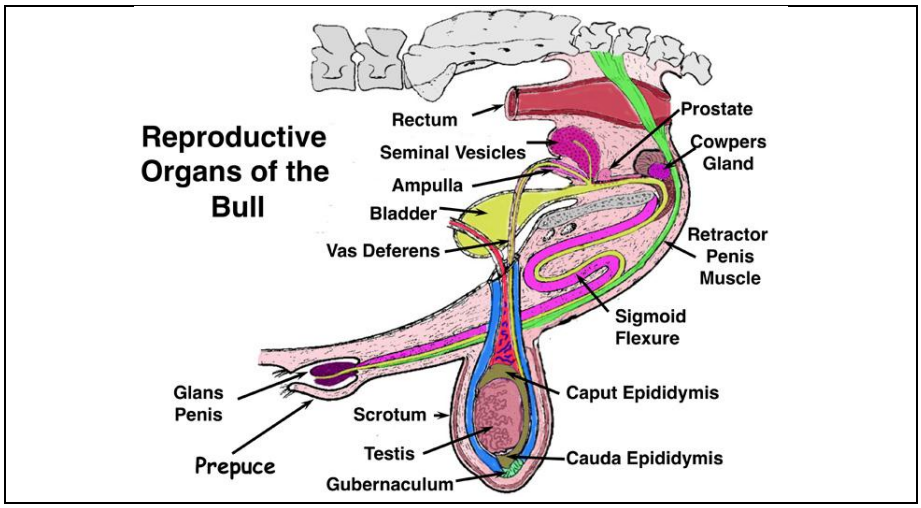
The various organs which function together in male reproductive system are viz.

Testes

- Suspended in scrotum by spermatic cord.
- Two in number.
- Length 12-16cm, diameter 6-8 cm
- Avg. wt. 300-500gms.

Function:

- Produce sperms i.e. male gametes
- Produce male sex hormone i.e. androgen
- Produce testicular fluid for transport of immature sperms in epididymis



Scrotum

- It is a cutaneous pouch in which testicals are located.
- Scrotal skin is thin, pliable and relatively hairless.
- It is 20-25cm long.

Function:

- It holds the testes external to the body.
- It regulates the temperature of testes.

Epididymis

- Coiled tube originating at the dorsal part of the testes.
- Length 30-35 meters.
- Consists of head *(caput), body (corpus)* and tail *(cauda*)

Function:

- Transport of soermatozoa.
- Maturation of sperms.
- Tail (cauda) serves as store house of sperms.

Vas deferens

- These are two slender tubes.
- They are extended from tail of epididymis upto urethra.

Function:

- Transport of sperms from epididymis to urthera.

Urethra

- Extends from the neck of the bladder to tip of the glans penis.
- Three distinct parts- a) Pelvic part b) Bulb of urethra c)Penile part

Function:

- It is common passage for urine and semen.

Penis

- Cylindrical shape.
- Size 3 feet long, 1 inch in diameter in adult bull.
- Consists of 3 parts of body- root, body and glans.

Function:

- Organ of copulation in male.

ACCESSARY SEX GLANDS

I) Seminal vesicales:

- Two tabulated elongated glands situated in pelvic cavity.
- Each glands is 10-12cm long, 3-4cm wide and 2-3cm thick.
- They secrete seminal fluid.

***II)* Prostate glands:**

- It is unpaired glands situated at the junction between neck of bladder and beginning of urethra.
- Length is about 2cm, thickness is 1cm.
- Its secretion is high in proteins, enzymes and minerals

***III)* Bulbo-urethral glands or cowper's glands:**

- These are two, small, round and compact glands.
- These are situated above the urethra near ischial arch.

Reproductive system of cow

Reproductive organ can be divided in three parts as-

- Primary sex organ: Ovaries
- Reproductive tract: Fallopian tube, uterus, cervix and vagina
- External genitalia: Vestibule, clitories and vulval lips.

The various organs involved in female reproductive system are:

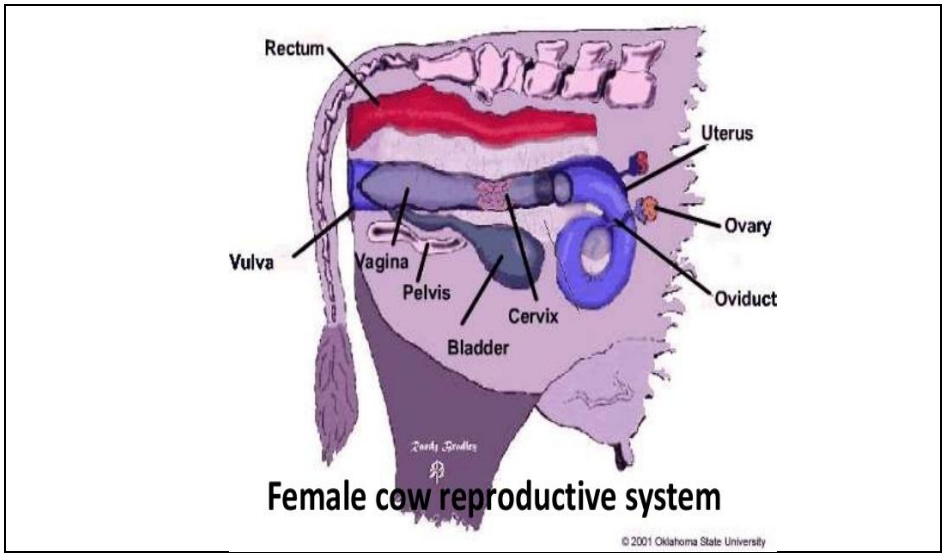
1. Ovaries

- Situated in pelvic cavity.
- Two in number.
- Oval in shape.

- Length 1-3cm, 1cm thickness.
- Weigh about 7-15gms.
- Right ovary is slightly larger than left.

Function:

- Formation of eggs or ova.
- Secretion of female sex hormone.
- Estrogen: responsible for development of secondary sexual chracters and sexual behaviour in females.
- Progesterone: is essential for maintenance of preganancy.



2. Fallopian tubes

- Also called as oviducts or uterine tubes.
- Slender, zigzag like tubes.
- Two in number.
- Extends from ovaries to uterus.
- Length 20-25cm, 2mm width.
- Fallopian tube is divided into- i) Infundibulim: funnel shape like structure located at the ovarian end. ii)Ampulla: middle part of fallopian tube. iii) Isthmus: consyricted portion of fallopian tube which lies to uterus.

Function:

- Infundibulum collects ovum or eggs released by ovaries.
- Fertilization of ova is takes place in ampulla
- Transport of sperms to the site of fertilization.
- Transport zygote to the uterus.

3. Uterus

- Hollow, elongated, musculo membraneous 'Y' shaped sac.

- Consists of short body and two horns.
- Located in pelvic cavity in non pregnant animal.

Function:

- Transport of sperms towards the fallopian tube.
- Implantation of zygote.
- Maintenance of pregnancy.
- Regulates estrus cycle by secreting prostaglandins.

4. Cervix

- Thick wall fibrous structure.
- It lies between the uterus and vagina.
- Length 10cm, 3cm width.
- Cervical canal is tightly closed during pregnancy and anoestrus, however relax during oestrus and parturition.

Function:

- Storage and transport of sperms during oestrus.
- Secretion of mucus during oestrus stage.
- Acts as barrier against type of infection.

5. Vagina

- Highly elastic musculo-membraneuos tube.
- Situated on floor of pelvic cavity above the urinary bladder and below rectum.
- Long 20-25cm and 10-15cm wide.

Function:

- It is organ of copulation in females.
- It acts as birth canal.

6. Clitoris

- It is regarded as sensory organ homologous to glans penis.

7. Vulva

- It is external opening of the uro-genital tract.
- It lies just below the anus.
- It has two lateral vulval lips, which are large, soft, thick and normally wrinkled.

INFERTILITY AND STERILITY

- Infertility: means a temporary inability of the animal to reproduce.
- Fertility: means permanent inability of the animal to reproduce.

Anatomical causes

- Blockage of fallopian tube.
- Defects in cervix and uterus.
- Abnormalities in sperms and ovum underdevelopment of testicles or ovaries.
- Scrotal hernia.

Genetic causes:

- Cryptorchidism.
- Absence of ovaries or testis.
- Freemartin.

Physiological or Hormonal causes:

- Deficiency of progesterone- silient heat, irregular oestrus cycles, abortion.
- Deficiency of testosterone- lack of libido or sex vigour in male.
- Deficiency of gonadotropic hormone- delayed sexual maturity

Nutritional causes

- Non availability of greens and concentrates.
- Deficiency of energy and fats in diet.
- Deficiency of minerals and vitamins.
- Excees feeding leading to fattiness.

Managemental causes

- Failure to detect heat in proper time.
- Improper time of insemination.
- Improper storage of semen.
- Improper technique of insemination.
- Stress of underfeeding, illness etc.

Breeding season

Female's shows signs of heat in the certain period of the year are called as breeding season. Seasonality of breeding is observed mainly in sheep and goat and not in cattle.

Sexual cycle or oestrus cycle or Breeding cycle

Female reproductive system has a well-marked functional rhythm called oestrus cycle. The interval between two oestrus cycle is called as heat cycle recurrence period. Oestrus cycle has four different phases.

a. Proestrus: This marks the animals in heat. During this phase the grafian follicle within the ovary is growing by increased secretion of follicular fluid. Then it enlarge and bulge out of the ovarian wall like pimples known Grafian follicles. In addition to developing ovum, graafian follicle produces the female hormone estrogen and brings cow in heat.

b. Oestrus: This is period of desire. Mucus discharged from cervix is increased. Graafian follicle is ruptured and ovum is liberated. At the site of rupture a set of new cells proliferate to form the corpus luteum, meaning yellow body. Corpus luteum produces the hormone progesterone which is essential to continue pregnancy, if fertilization takes place, prevents maturation of further graafian follicles.

c. Metestrus: This is period when organ return to normal condition.

d. Anestrus: Metestrus is followed by anestrus which is long period of rest, shown by monoestrus animas e.g. dogs and fox. The polyestrus animals e.g. cow, buffalo, sheep and goat will come in heat after heat cycle recurrence period. If animal is bred and fertilization takes place estrus is followed by gestation period.

e. Diestrus: This is rest period of generative organs in between metestrus and proestrus.

Gestation period:

It is the period from date of conception to the date of parturition. It is also called as pregnancy period. The oestrus cycle is interrupted by gestation or pregnancy.

Age at puberty:

It is the age of the animal at which female comes in oestrus and male produces sperms and shows desire for copulation.

Reproductive periods of Animals

Name of species	**Age at puberty**	**Period of heat cycle recurrence(days)**	**Gestation period (days)**
Cow	2 to 2.5 years	21	282
Buffalo	2.5 to 3 years	21	310
Sheep	6 to 12 months	18	150
Goat	6 to 10 months	21	150
Pig	6 months	21	120
Horse	2 years	21	336
Ass	2 years	23	365
Dog	9 to 12 months	Monoestrus	62

PARTURATION:

It is the act of giving birth to fully developed and visible young one.

Signs of approaching parturition:

- Reduced appetite and irregular rumination.
- Sluggish movements.
- Loose, soft and swollen vulva.
- Enlargement of udder.
- Rapid pulse and respiratory rate.
- Decrease body temperature.

Causes of initiation of parturition

- *Increase in the irritability of the uterus.*
- *Degenerative changes in placenta.*
- *Decreased blood supply to placenta.*
- *Released of oxytocin at the time of parturition.*

Stages of parturition

I) First stage:

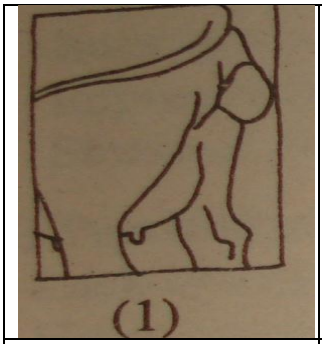
- It is called as stage of dilation of cervix.
- It lasts for 2 to 6 hours in cow.
- Characterized by restlessness, mild labour pain, rapid pulse.
- Labour pain occur at 15min. interval and lasts for ½ hour.
- Finally the tie bag rupture and allanotic fluid flows from the vulva.

II) Second stage

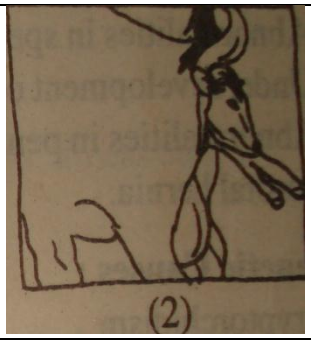
- It is also called as stage of expulsion of foetus.
- It lasts for ½ to 1 hour.
- Characterised by recumbancy, appearance and ruputure of amnion.
- Clear, sticky. Amniotic fluid discharge

II) Third stage & IV) Fourth Stage

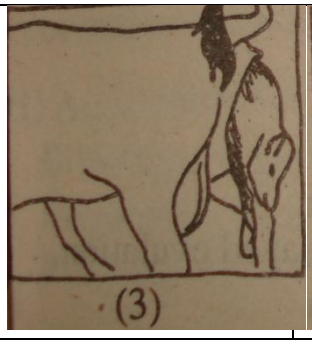
- It is also called as stage of expulsion of placenta.
- Period between the birth of calf and expulsion of placenta.
- It lasts for ½ to 8 hours in cow.
- Characterized by separation of placenta from cotyledon due to reduction in size of uterus and diminished bloody supply.

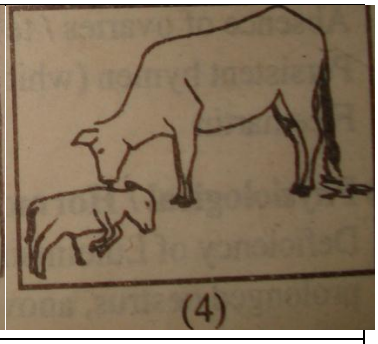


First stage



Second stage





Third stage & IV) Fourth Stage

MAMMARY GLAND AND MILK SECRETION

Structure of udder:

- The udder is located outside the body wall and it attached to it by means of its skin and connective tissue supports.
- The secretary portion of the udder consists of countless alveoli or chambers lined with individual cells.
- Each of these alveoli is drained by a small duct which leads to larger ducts.
- Clusters of alveoli resembling a bunch of grapes are drained by ducts of increasing size until some 10 to 20 ducts conduct milk into the gland cistern.
- The gland cisterns continue into the teat sinus or cistern. At i he tip of (he teal there is a sphincter tightly closing the outlet of the teal sinus.
- Each alveolus is-supplied blood through tiny capillaries which lie outside the secretary cells.
- Small muscle fibers also surround each alveolus and are important in the removal of milk from the gland.
- The individual secretary cell is the primary factor in milk production. It extracts all of the components of milk from (he blood stream and either arranges them into new compounds or passes them through directly into the alveolus.
- Internal structure of udder:
    1. Supporting structure: Median suspensory ligament, Two lateral suspensory ligament, skin.
    2. Mammary ducts system and milk secretory unit : Structures of Alveoli, lobules, lobe, intralobular ducts and function of sphincter, streak canal

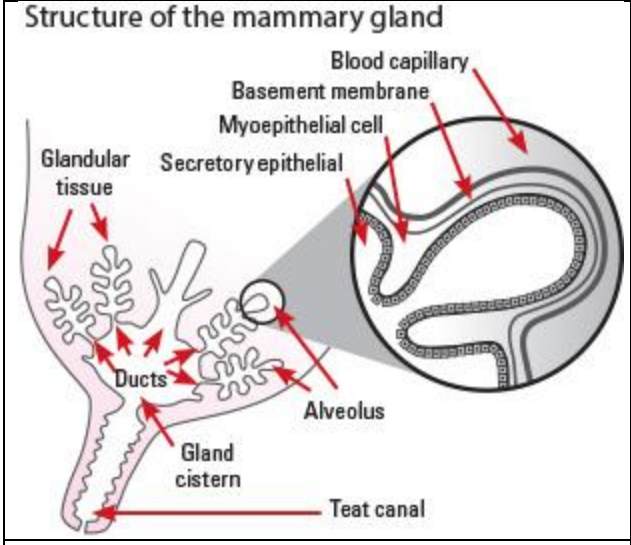


Fig. 1 Structure of mammary gland

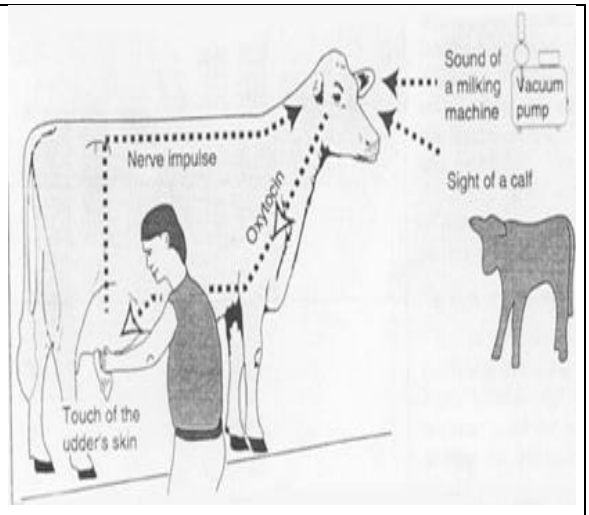


Fig. 2 Milk Leldown mechanism

The milk Leldown mechanism:

- When milk secretion has continued for a considerable time after milking, the alveoli, ducts and gland and teat cisterns are filled with milk.
- Milk in the cisterns and larger ducts can be removed readily.
- Milk in the smaller duels and alveoli does not flow out easily. However, the cow and other mammals have developed a mechanism for releasing milk from the mammary gland.
- Stimulation of the central nervous system by something associated with the milking process is necessary to initiate the read ion.
- Stimulation of nerve endings in the teats that are sensitive to touch, pressure, or warmth is the usual mechanism. The suckling action of the calf is ideal for this. However, massaging the udder or washing with warm water is also equally effective.
- Stimulation is carried by the nerves to the brain which is connected. With the pituitary gland located its base.
- Mechanisms are activated in the pituitary gland which causes the liberation of a hormone oxytocin from its posterior lobe.
- Oxytocin is carried by the blood stream lo the udder where it acts on the small muscle rolls surrounding the alveoli, causing them to contract.
- The pressure thus created forces the milk out of the alveoli and smaller ducts as fast .is it can be removed from the teat.
- The letting down process can be stimulated within half to one minute's time.
- The effective time of the hormone is limited and milking should be completed within seven minutes if all the milk is to be obtained.

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ORGANIC LIVESTOCK PRODUCTION

Define: Organic livestock production is a means rearing of livestock without use synthetic inputs in their nutrition, disease control and treatment, breeding and housing.

Importance

Livestock play an even more critical role on organic farms than they do on conventional farms. Livestock on an organic farm play a key role in:

- **Nutrient cycling** - a process in which nutrients are returned to the soil through manure and compost. Amending soils with animal manures can increase microbial biomass, enzymatic activity and alter the structure of the microbial community
- Incorporation of feed crops, such as alfalfa or grasses into crop rotations helps to **build soil organic matter**
- Increasing cropping options, **adding diversity** to the agro-ecosystem

- **Weed control** - feed crops can be used to suppress and control weeds and animals can be used to graze out weeds on crops or pastures
- **Preparing the ground for cropping**. Livestock such as pigs can 'plough' rough or new land before planting vegetables or grains, reducing tillage and weed control costs
- **Interrupting insect and disease cycles** by taking land out of cropping
- **Adding value** to grass-lands and promoting the use of green manures
- **Reducing the financial risks** of farming by converting lower quality grain crops and screenings into profit and spreading income more evenly over the year.

Principal of Organic Livestock Production

- Organic livestock farming is a land based activity. In order to avoid environmental pollution, particularly natural sources such as the soil and water, organic production of livestock must in principle provide for a close relationship between such production and the land.
- Livestock must have access to free range exercise area and / or grazing apart from specified exemptions.
- Biological diversity should be encouraged and preference should be given to breeds adaptable to local conditions. Genetically modified organisms and products derived are not compatible with organic production.
- Organic livestock should be fed on organically produced grass, fodder and other feed stuffs, apart from some specifications (for ruminants 10% of DM of specified components may come from conventional origin).
- Animal health management should be mainly based on prevention (appropriate breeds, a balanced high-quality diet and a favorable environment in terms of stocking density and husbandry practices). The preventive use of chemically synthesized medication (allopathic medicines) is not permitted, but sick and injured animals must be treated immediately as well being of the animal is more important (although this may affect their status with regards to organic certification).
- Housing should satisfy the needs of the animals concerned. Adequate ventilation, light, space and comfort should be provided to permit ample freedom of movement to develop the animal's natural social behavior.

Certification

Organic certification requires complete segregation from conventionally manage farms to upload integrity of organic production.

1.Living condition

- Require taking into account the physiological & behavioral welfare of livestock
- Cattle are allowed free movement as well as exposure to fresh air & natural day light
- They also have regular access to fresh water & high quality of feedstuff

2.Feed

- Diet should be balanced & high quality nutrients
- 100 % feedstuff from organic source

3.Livestock sources

- Cattle for beef production must be born & raised in an organic production unit

4.Health

- Vaccination therapeutic use of veterinary drugs is restricted
- Vaccination is permitted where the targeted diseases are communicable to livestock

5.Breeding

- Breeds are selected for their suitability to the environment
- AI & ET not permitted

6.Organic labeling

- It must meet all national standards

Standards

- Animals must be kept in healthy, low stress environments. Producers must use preventative health care practices and may only use approved treatments.
- Providing feed sufficient to meet the needs of the animals, including vitamins, minerals, protein etc.
- Establishing appropriate housing, pasture, and sanitation to reduce diseases and parasites.
- Providing animals with the opportunity for exercise, freedom of movement, and reduction of stress.
- Uses of hormones for the promotion of growth of livestock, Tail docking is not allowed.
- Use Oxytocin is a hormone that is allowed with restrictions. It is prohibited for routine or long-term use. It may only be used when necessary in post-parturition therapies.
- Use of parasiticides (de-wormers) is allowed only in health care emergencies and in the case of acute and dangerously high levels of infestation.
- Synthetic parasiticides (Ivermectin, Moxidectin & Fenbendazole) may not be used on animals intended to be sold as organic meat.
- If a producer uses allowed parasiticides, they must do the following: Record the event in their health records including withholding time, if applicable.
- Segregate the animal to prevent contamination of organic products.
- If applicable document sale to non-organic meat market.

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SWOT ANALYSIS OF INDIAN DAIRY INDUSTRY

General:

- Rural Based activity.
- Involve small households, rearing one or two cows/buffaloes.
- Income-generating activity.
- Source of mass employment in rural areas.

Strengths:

- Dairy farming helps directly in increasing crop production by making available draught power, manure and cash income on day- today basis.
- Provide employment to rural population mainly women
- Regular income to the farmer.
- Crop residues and by-products fed to the cattle form the basis of "grain-saving" dairying, appropriate to the mixed farming system.
- Buffalo is India's milking machine, accounting for more than half of the country's milk production.
- Whitening property of buffalo milk make it more suitable for manufacture of some dairy products and its acceptance as fluid milk is high.
- Cooperative dairying has increased milk production. • Additional income improves the quality of life in rural areas.

Weakness:

- • Feed availability to cattle throughout the year is not adequate.
- • Artificial insemination service for breeding better cattle has limited coverage
- • Animal health care activities are not adequate.
- • Limited marketing support handicaps rural milk producers seriously.
- • Dairy producers in remote areas are neglected.
- • Limited investment or delay in the availability of funds in setting up or expansion of milk procurement. • Poor infrastructure in many areas for transporting rurally-produced milk to major processing centers.
- • Farmers access to training in modern cattle management is limited.

Opportunities:

- • Cost of milk production in India is low. -more opportunities for export of quality milk products at competitive price in international market.
- • Scope exists for higher milk yield through -better use of crop residues and other feeds - upgrading cattle. -improving availability of animal health care facilities
- • Better returns because of increased awareness in consumers about Quality.

Threats:

- • Competency between organized and un-organized sectors resulting in unhealthy business practices / lowering values (quality/service/ethics).
- • Inadequate Regulatory staff to monitor quality of imported / indigenous products.
- • Possibility of importing, substandard or low-priced milk products that can destabilize dairy sector because of corrupt regulatory staff.
- • Natural calamities like floods, drought, diseases that can affect feed to cattle/cattle population.
- • Seasonal fluctuations in milk production

Conclusion: SWOT analysis, indicate if the strengths and opportunities are understood the weaknesses and threats can be managed to make Dairy Farm Sector into a profit oriented business.

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CONCEPT OF A1 AND A2 MILK

INTRODUCTION

Milk is the complete food for the infant. It contains the essential micro-nutrients needed for growth and development of human health as well as for the neonate animal. In USA, Australia, New Zealand and other developed countries, people use to consume milk according to their needs and use milk like A2 milk, since A2 milk is harmless whereas A1 milk is harmful for health. So, our future breeding policies for dairy animals should be done in a systematic manner, keeping an eye on producing clean and healthy milk which is none other than A2 Milk.

What actually is A1 and A2 milk?

- Milk contains about 85% water, remaining 15% is the milk sugar lactose, protein, fat and minerals. Beta-casein is about 30% of the total protein content in milk.
- A2 milk is the milk that contains only the A2 type of beta-casein protein whereas A1 milk contains only A1 beta casein or A1A2 type variant.
- A1 protein variant is commonly found in milk from crossbred and European breeds of cattle.
- A2 milk is found basically in indigenous cows and buffaloes of India (Asia as a whole).
- A2 milk is branded by the A2 Milk Company like A2 Corporation and sold mostly in Australia, New Zealand, United Kingdom and other developed countries.

History of A1 and A2 Milk

- A2 beta-casein is the beta-casein from cows that have been produced since before they were first domesticated over 10,000 years ago. It has no known negative effects on human health.

- In the past few thousand years, a natural mutation occurred which has resulted in a proportion of cows of European breeds producing a casein variant called A1 beta-casein. Slowly, these protein variant became dominant in milk which producing A1 milk.
- The gene encoding beta-casein was changed such that the 67th amino acid in the 209 amino proteins was switched from proline to histidine. This new kind of beta-casein that was created is known as A1 beta-casein which is found in the milk of many crossbred cows such as Holstein, jersey and Friesian.

Basic genetics of A1 and A2 milk

- The A1/A2 status of a cow is determined by a pair of genes on the sixth chromosome.
- There are two major alleles of the gene i.e A1 and A2 beta- casein alleles.
- A cow carries two copies of the beta-casein gene; she can carry either of A2A2 (homozygous), A1A2 (heterozygous) or A1A1 (homozygous) alleles.
- A1A2 cow will produce A1 and A2 beta-casein in equal amounts.
- A2A2 cow will only produce A2 beta-casein.
- A1A1 cow will only produce A1 beta-casein.
- Northern European breeds of cows such as the Friesian and Holstein carry the A1 and A2 allele at about equal levels.
- Southern European breeds and the Jersey carry the A1 allele at about 35% and 2/3 of A2.
- If a cow is A2A2 then she is guaranteed to pass on the A2 allele to her progeny.
- A1 cow is guaranteed to pass on the A1 allele. For an A1A2 cow there is a 50% chance of passing on either of the allele.

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EFFECTS OF CLIMATE CHANGE ON LIVESTOCK PRODUCTION

General

- Climate change is a long-term shift in the statistics of the weather such as temperature, radiation, wind and rainfall characteristics of a particular region.
- Climate change has profound effect on livestock.
- The anticipated rise in temperature due to climate change is likely to aggravate the heat stress in livestock, adversely affecting their productive and reproductive performance.

Definition

Climate change, defined as the long-term imbalance of customary weather conditions such as temperature, radiation, wind and rainfall characteristics of a particular region.

Contribution of Livestock to Climate Change

- The animal production system, which is vulnerable to climate change, is itself a large contributor to global warming through emission of methane and nitrous oxide.
- There are two sources of GHG emissions from livestock:

A) From the digestive process: Methane is produced in herbivores as a by-product of enteric fermentation a digestive process by which carbohydrates is broken down by micro-organisms into simple molecules for absorption into the blood stream.

B) From animal wastes: Animal wastes contain organic compounds such as carbohydrates and proteins. During the decomposition of livestock wastes under moist, oxygen free (anaerobic) environments, the anaerobic bacteria transform the carbon to methane. Animal wastes also contain nitrogen in the form of various complex compounds. The microbial processes of nitrification and de-nitrification forms nitrous oxide, which is emitted to the atmosphere.

The performance (e.g., growth, milk and wool production, reproduction), health and wellbeing of the livestock are strongly affected by climate both, directly and indirectly.

A) Direct Effects

Climate Change Effects on Feed Intake

- Increased atmospheric temperatures will reduce the rate of animal feed intake and result in poor growth performance.
- Animals in a highly productive state, such as high-producing dairy cows, have feed intakes and metabolic rates that may be two to four times higher than at maintenance.
- Heat stress in such high producing lactating dairy cows results in dramatic reductions in roughage intake and rumination.
- The reduction in appetite under heat stress is a result of elevated body temperature and may be related to gut fill.
- Decreased roughage intake contributes to decreased VFA production and may lead to alterations in the ratio of acetate and propionate.

Climate Change Effects on Livestock Milk Production

- Climatic factors or seasonal changes greatly influence the behavior of animals due to neuroendocrine response to climatic elements, consequently affecting production and health of animals.
- High production animals are subjected to greater influence by climatic factors, particularly those rose under tropical conditions, due to high air temperatures and relative humidity.
- Climatic factors such as air temperature, solar radiation, relative humidity, air flow and their inter- actions, often limit animal performance.
- Quantifying direct environmental effects on milk production is difficult as milk production is also strongly affected by other factors such as nutritional management, that may or may not be directly linked to environmental factors.

Climate Change Effects on Livestock Reproduction

- Reproductive functions of livestock are vulnerable to climate changes and both female and males are affected adversely. Heat stress also negatively affects reproductive function.
- The number of changes in reproductive performance due to further global warming will include:

✓ Decreased duration and intensity of the estrus period.
✓ Decreased conception (fertility) rate.

- ✓ Decreased size and development of ovarian follicles.
- ✓ Decreased fetal growth and calf weight at calving.
- ✓ Increased risk of early embryonic losses.
- ✓ Increased number of artificial insemination per conception.
- ✓ Increased incidence of silent heat in buffaloes.

Climate Change Effects on Disease Occurrence in Livestock

- The impacts of changes in ecosystems on infectious diseases depend on the ecosystems affected, the type of land-use change, disease specific transmission dynamics, and the susceptibility of the populations at risk – the changes wrought by climate change on infectious disease burdens may be extremely complex.
- Climate change will affect not only those diseases that have a high sensitivity to ecological change, but there are also significant health risks associated with flooding.

B) Indirect Effects

Besides the direct effects of climate change on animal and animal production, there are profound indirect effects as well, which include climatic influences on quantity and quality of feed and fodder resources such as pastures, forages, grain and crop by-residues, and the severity and distribution of livestock diseases and parasites.

Climate Change Effects on Feed Resources

- Climate change can be expected to have several impacts on feed crops and grazing systems, including the following:
- Changes in herbage growth brought about by changes in atmospheric CO2 concentrations and temperature;
- Changes in the composition of pastures, such as changes in the ratio of grasses to legumes;
- Changes in herbage quality, with changing concentrations of water-soluble carbohydrates and nitrogen at given dry matter (DM) yields;
- Greater incidences of drought, which may offset any DM yield increases;
- Greater intensity of rainfall, which may increase nitrogen leaching in certain systems.

Management Strategies to Counteract Climate Change

Grazing Management

- Balancing and adapting grazing pressure on land and can provide increase grassland productivity.
- By restoring degraded grassland, these measures can also enhance soil health and water retention. is Reduced the grazing pressure by simply lowering animal numbers, then total output per hectare may be lower except where baseline stocking rates are excessively high.
- Rotational grazing to adjust the frequency and timing of grazing and better match grazing needs and pasture resource availability is one of the main strategies for increasing the efficiency of grazing management.

Pasture Management & Nutrition

- Pasture management measures, additional to grazing management, include the sowing of improved varieties of pasture, typically the replacement of native grasses with higher yielding and more digestible forages, including perennial fodders, pastures and legumes.
- The intensification of pasture production though fertilization, cutting regime and irrigation practices may also enhance productivity, soil C, pasture quality and animal performance.
- Grass quality can also be improved by chemical and/or mechanical treatments and ensiling.
- Supplemental feeding can be an important adaptation strategy.

Animal Breeding

- Animal breeding to select more productive animals is a further strategy to enhance productivity and thereby lower CH4 emission intensities.
- In general, cross breeding strategies that make use of locally adapted breeds, which are not only tolerant to heat and poor nutrition, but also to parasites and diseases which may become more common with climate change.

Agro-forestry Practices

- Agro-forestry is an integrated approach to the production of trees and of non-tree crops or animals on the same piece of land.
- Shade trees have impacts on reducing heat stress on animals and contribute to improve productivity, improved forage value and productivity and body condition of animals, reduced overgrazing.

Improved Waste Management

- Most methane emissions from manure derive from swine, beef cattle feedlots, and dairies, where production is concentrated on large operations, and manure is stored under anaerobic conditions. Methane mitigation options involve the capture of methane by covered manure storage facilities (biogas collectors).
- Captured methane can be flared or used to provide a source of energy for electric generators, heating, or lighting (which can offset CO2 emissions from fossil fuels).
- Manure application practices are also available to reduce N2O emissions.
- Improved livestock diets as well as feed additives can substantially reduce CH4 emissions from enteric fermentation.

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INTEGRATED LIVESTOCK FARMING

Introduction

- Livestock based integrated farming system provides an opportunity of increasing economic yield per unit area per unit time to small and marginal farmers.
- In this system, waste materials are effectively recycled by linking appropriate components. Thus, minimize the environment pollution.
- Recycling of product, byproducts and waste material in integrated farming system are the factors responsible for the sustainability of farming system.
- Due to integration of different livestock components with crops, production of eggs, meat and milk provide nutritional security and income generation round the year to the farmers.
- Combining crop with livestock enterprises would increase the labour requirement significantly and helps in reducing the problems of under employment to a great extent.
- IFS provide enough scope to engage family labour round the year.
- The nutritional security, natural resource management and environment protection are the major concern for sustainable agriculture.
- Integration of livestock is the way forward to promote proper utilization of available resources and environment protection for economic growth.
- Integrated farming system diversifies farm production, increase the income, improve nutritional security and promote nutrient recycling.

Integrated farming (also known as mixed farming) is a farming system with simultaneous activities involving crop and animal. The main purpose of integrated farming is so that the farming components support one another; hence, reducing external inputs.

Benefits or Advantages of Integrated Farming System

1) Productivity: IFS provides an opportunity to increase economic yield per unit area per unit time by virtue of intensification of crop and allied enterprises.

2) Profitability: Use waste material of one component at the least cost. Thus reduction of cost of production and form the linkage of utilization of waste material, elimination of middleman interference in most input used. Working out net profit B/ C ratio is increased.

3) Potentiality or Sustainability: Organic supplementation through effective utilization of byproducts of linked component is done thus providing an opportunity to sustain the potentiality of production base for much longer periods.

4) Balanced Food: We link components of varied nature enabling to produce different sources of nutrition.

5) Environmental Safety: In IFFS waste materials are effectively recycled by linking appropriate components, thus minimize environment pollution.

6) Recycling: Effective recycling of waste material in IFFS.

7) Income Rounds the year: Due to interaction of enterprises with crops, eggs, milk, mushroom, honey, cocoons silkworm. Provides flow of money to the farmer round the year.

8) Adoption of New Technology: Resources farmer (big farmer) fully utilize technology. IFS farmers, linkage of dairy / mushroom / sericulture / vegetable. Money flow round the year gives an inducement to the small/ original farmers to go for the adoption technologies.

9) Saving Energy: To identify an alternative source to reduce our dependence on fossil energy source within short time. Effective recycling technique the organic wastes available in the system can be utilized to generate biogas. Energy crisis can be postponed to the later period.

10) Meeting Fodder crisis: Every piece of land area is effectively utilized. Plantation of perennial legume fodder trees on field borders and also fixing the atmospheric nitrogen. These practices will greatly relieve the problem of non – availability of quality fodder to the animal component linked.

11) Solving Fuel and Timber Crisis: Linking agro- forestry appropriately the production level of fuel and industrial wood can be enhanced without determining effect on crop. This will also greatly reduce deforestation, preserving our natural ecosystem.

12) Employment Generation: Combing crop with livestock enterprises would increase the labour requirement significantly and would help in reducing the problems of under employment to a great extent IFS provide enough scope to employ family labour round the year.

13) Agro – industries: When one of produce linked in IFS are increased to commercial level there is surplus value adoption leading to development of allied agro – industries.

14) Increasing Input Efficiency: IFS provide good scope to use inputs in different component greater efficiency and benefit cost ratio.

Livestock based farming systems

1. **Livestock + Crop based farming system:**
   - Livestock + crop farming system is a predominant farming system revalent in most of the parts of India.
   - Integrating crops with livestock on the same farms helps smallholder farmers to diversify the sources of income and employment generation.
   - Crop and livestock complement one another through mutual benefit. In livestock + crop system, the animal component is often raised on agricultural waste products while the animal is used to cultivate the land and provide manure to be used as fertilizer and fuel.
   - The animals play important role in enriching the soil gradually and increasing soil organic matter to support the crop.
   - The draft power of animals is used for farm operations, while crop residues provide fodder for livestock and grain provides supplementary feed for productive animals.

- Animals also provide manure and other types of animal waste.
- Cow dung helps in the overall sustainability of the farming system.
- Dung contains macro and micro nutrients required for improving the soil fertility and crop growth. Cow dung is used for the production of biogas. Biogas is a source of renewable, alternative and sustainable energy.
- The cost of weed control is reduced where the livestock graze under plantations.

2. Livestock + Crop + Fish based farming system:

- Livestock+Crop+Fish farming systems can be followed by integrating fish with Livestock +Crop farming system, raise the fish without any additional feed, rearing fish in the fish pond with the help of available dung from livestock.
- Integrated Livestock + Crop + fish farming can be carried out for increasing returns from a limited land area and reducing risk by diversifying crops.
- There should be ample supply of fresh and clean water available throughout the year to maintain water level for fish management purposes.
- The nutrients content in cow dung will help in growth of phytoplankton and zooplankton in fish pond.
- The by-products of livestock can be used for aquaculture.
- Direct application of wastes of livestock is common practice. The by-products of livestock are manure, urine and spilled feed.
- The adult cattle produce about 4,000-5,000 kg Livestock based integrated farming systems for livelihood improvement of small and marginal farmers dung, 3,500-4,000 liter urine annually.
- For a pond size of 1 ha of 5-6 adult cattle can provide adequate manure. In addition to 9,000 kg of milk, about 3,000-4,000 kg fish/ha/year can be produced in this system.
- This system will save labor for lifting the cow dung. The requirement of green and dry fodder for an adult cattle is 9- 10 and 2-2.2 ton respectively and will be met from crop component. The manure will be used for improving the fertility of soil.

3. Poultry + Fish based farming system:

- Poultry+ fish farming system can be integrated to reduce the cost of fertilizers and feeds in fish farming.
- Poultry can be reared near or over the fish pond and the poultry excreta will directly drop into fish pond and get recycled.
- In this system poultry is reared under deep litter system. Poultry droppings in the form of litter contains: 3% nitrogen, 2% phosphate and 2% potash.
- Poultry droppings acts as a good source of fertilizer which helps in producing fish feed i.e. phytoplankton and zooplankton in fish pond.
- The integrated poultry-fish farming provided additional income of Rs. 4000-5000 per annum and generated 45-50 man days of employment.

- The fish-poultry farming system could generate maximum profit of Rs. 33664.06 per 0.025 ha yr-1 with B: C ratio of 1.09.
- Fish+Poultry integration produced 4500 to 5000 kg fish, 70,000 eggs and 1000 kg (live weight) of chicken meat from 1.0 ha fish pond annually without any supplementary feed.

4. Livestock +Crop+ Backyard poultry

- Backyard poultry plays a significant role in rural people's life for generating income and nutritional security of the family.
- Integration of livestock+ crop farming with backyard poultry farming will improve the nutritional security as well as increase the income of farmers. Backyard livestock comprising of sheep, goats, pigs and poultry provide emergency sources of income for family.
- Bird scavenges on the undigested grains in dung as well as the threshing wastes in the fields. Backyard poultry also predates the insect and pests which are responsible for incidence of diseases in the crops.
- Separate inputs are not required for additional feeding of the birds. Eggs and chicken are good source of protein available to the farm family as well as provide income on regular basis.
- Backyard poultry as a subsidiary occupation substituted farm income as a secondary income source.
- Majority of the women (51%) earned 6- 10 % of maximum household income from backyard poultry, with high income (11-20%) from 28 % of women and only 7 women members have earned 21-30 % income from poultry.

5. Small ruminant + Crop+ Horticulture based farming system:

- Small ruminants play a vital role in the economy of small, marginal and landless farmers in the country. Integration of these enterprises can increase the total productivity; maintain ecological balance and economic sustainability.
- Small ruminants based integrated farming system will also provide income to the farmers, helps in improving the soil fertility, weeds will be utilized as fodder by goat and incidences of diseases in crop will be minimized.
- Small ruminants can directly graze fodder tree/shrubs. Thus, this system will save labors.
- The grazing periods for small ruminants in this system is of 1-2 weeks, followed by recuperation periods for 3-6 weeks.
- Under arid condition the recuperation period may need to be longer.
- Horticulture plantation will be place for movement of small ruminants under this system and boundary plantation will provide fodder to the small ruminants during lean period.

- Horticulture trees will provide high quality leaf fodder for small ruminants and fruits for income generation.

6. Small ruminant + Silvi pastoral based farming system:

- In this system improved pasture species or mixture of grasses are grown along with perennial trees on same piece of land.
- It involves grazing of animals and looping of tree leaves as fodder for animals. This system solves the problem of green fodder and reduces the cost of concentrated feed to animals during lean period.
- Fodder trees such as Leucaena latisiliqua, Bauhinia variegata, Albizzia labbek, Albizzia amara, Moringa olerifera, Sesbania sesban, S. grandiflora, Hardwickia binata are used in different regions of the country for silvi pastoral systems.
- The animals were able to gain body weight continuously on both the pasture without any supplementation of concentrate feed.
- Due to grazing of animals the fertility builds up with dung and urine adds valuable nutrients to the soil.
- The movements of animals during grazing the leaves and shrubs are disturbed that harbor insect and pest; because of this the incidence of diseases will be low.
- Trees provide timber and fodder for animals during lean period.

Livestock based integrated farming system provides an opportunity of increasing economic yield per unit area per unit time in small and marginal farmers. In this system waste materials are effectively recycled by linking appropriate components. Thus minimize the environment pollution. Recycling of product, byproducts and waste material in integrated farming system are the factors responsible for the sustainability of farming system. Due to integration of different livestock components with crops, production of eggs, meat and milk provide nutritional security and income generation round the year to the farmers. Combining crop with livestock enterprises would increase the labour requirement significantly and helps in reducing the problems of under employment to a great extent. The nutritional security, natural resource management and Livestock based integrated farming systems for livelihood improvement of small and marginal environment protections are the major concern for sustainable agriculture. Integration of livestock is the way forward to promote proper utilization of available resources and environment protection for economic growth.