CHAPTER 1

DOMESTICATION AND UTILITY OF FARM ANIMALS AND THEIR ROLE IN INDIAN ECONOMY

Origin of Livestock:

Livestock are domesticated animals raised in an agricultural setting to produce commodities such as food, fiber and labour. Livestock are generally raised for profit.

Animal Husbandry is a component of modern agriculture. It can be defined as an art and science of keeping or raising the domesticated animals most profitably or economically. It also includes handling and marketing of livestock and livestock products. It is said to be an art because skill is required in sound application of basic principles of animal sciences, viz, breeding, feeding, housing, management and health care of animals in a perfectly suitable manner to a particular situation.

Mammals: Cattle, buffalo, sheep, goat, pig, horse and camels.

Avian : Poultry

Mammals are the animals in which the females possess paired mammary glands which secret milk for nourishment of their young ones. Mammals are viviparous as they give birth to fully developed young ones whereas, Aves are the birds, which posses paired wings for flying and are oviparous i.e. egg laying. Mammals and birds have originated from reptiles by evolution. Evolution is defined as a gradual process of development of modern species of plants and animals from their earlier primitive forms by:

(i) Hereditary transmission of slight variation in successive generation (from generation to generation).

(ii) Mutation

(iii) Natural selection

All types of mammals and birds have originated/evolved from reptiles by evolution. Evolution took place 7 crores years ago. Hoofed animals (ungulates) were evolved before 4.5 to 5 crores years. Mammals and Avian class animals are better suited to terrestrial life than any of other class of vertebrates.

Domestication of Livestock:

Domestication: Making the animals to adopt their life in intimate contact with human beings and that too for their benefit. The benefits men derive from animals include food, fertilizer, fuel, cultivation, transport, protection, sports and games etc.

Advantages of Domestication:

(i) Nomadic life: Prior to domestication of animals, man was living nomadic life. Domestication of animal helped man to live settled life. It leads to the establishment of small villages which later on developed into towns and cities.

(ii) Land management: The grazing of livestock is sometimes used as a way to control weeds and undergrowth. For example, in areas prone to wild fires, goats and sheep are set to graze on dry scrub which removes combustible material and reduces the risk of fires.

(iii) Animal proteins and dairy products: It helped in easy and assured supply of animal proteins. Animals convert grasses and fodders into milk and meat. Mammalian livestock can also be used as a source of milk, which can in turn easily be processed into other dairy products, such as yoghurt, cheese, butter, ice cream, kefir, and kumis.

(iv) Woolen clothes: In cold countries people started domestication of sheep and started preparing clothes from wool. Livestock produce a range of fiber/textiles. For example, sheep and goats produce wool and mohair; cows, deer, and sheep skins can be made into leather and bones, hooves and horns of livestock can be used.

(v) Transport: Domestication of horses and camels helped in speedy movement of men.

(vi) Motive Power: Animals like bullock, horses and camels became the source of motive power to perform various agricultural operations like transport, cultivation, irrigation etc.

(vii) Mastery over environment: Domestication also helped man in getting mastery over environment and utilize the available resources.

(viii) Fertilizer: Manure can be spread on fields to increase crop yields. This is an important reason why historically, plant and animal domestication have been intimately linked. Manure is also used to make plaster for walls and floors and can be used as a fuel for fires. The blood and bone of animals are also used as fertilizer.

India's Mega Diversity of Livestock:

Several species of domesticated animals have originated here. The genetic diversity within these species is astounding. Some examples are:

Cattle	26 breeds
Goats	22 breeds
Sheep	40 breeds
Poultry	18 breeds
Buffalo	8 breeds

The Beginning of Animal Husbandry:

Animal-rearing has its origins in the transition of cultures to settled farming communities rather than hunter-gatherer lifestyles. Animals are 'domesticated' when their breeding and living conditions are controlled by humans. Over time, the collective behaviour, life cycle, and physiology of livestock have changed radically. Man in Old Stone Age (10000-8000 B.C.) made no attempt to domesticate animals but used to eat those animals that he was lucky to hunt. In the New Stone Age (8000-6000 B.C.) man changed from hunter to husbandry man of animals by domestication. Domestication came after food cultivation.

Domestication of Animals:

Species	When (Years from present time)	Where	Why (Reason for domestication)
Dog	8500-9000	East Asia	Pet, Companion
Goat	8500-9000	Southwest Asia	Food, Milk, Clothing
Pig	8000-9000	Eastern Anatolia	Food & Sports
Sheep	6000-7000	Southwest Asia	Food, Milk, Clothing
Cattle	6000-6500	Southwest Asia, India, North Africa	Religious reasons
Chickens	5000-5500	India, Sumatra	Cockfight Shows, religion
Horse	4000-5000	Eurasian Steppes Mountain	Transportation

General Utility of Livestock and Poultry:

1. Cattle: For milk, meat (beef/veal) and motive/draft power for agriculture.
2. Buffaloes: For milk, meat (beef/veal) and motive/draft power for agriculture in humid high rainfall areas.
3. Sheep: For wool, meat (mutton), skin and hide, manure/night folding.
4. Goat: For milk, meat (chevon), hair, skin and hide and manure.
5. Rabbit: For wool/fur, meat, lab animal and recreation.
6. Pigs: For meat (pork) and bristles.
7. Poultry: For eggs, meat (broiler), lab animal and for recreational purpose.
8. Horse/Donkey/Mule: For riding, transport of goods/men, sports/racing and novelty.
9. Camel: As motive power for transport of men/goods in arid zones, water lifting, crushing oilseeds, sugarcane etc. Popularly called "Ship of desert".
10. Yak: For milk, meat and as source of motive power for transport of goods/men in hilly tracts and cold countries.

Present Status and Scope of Animal Husbandry in India:

India is an agricultural country. Animals are kept under mixed farming system. Animal products are widely used in human diet, so development of animal husbandry is recognized very well. A.H. is also recognized for animal power for farming and adoption of better land use pattern. Animals utilize agricultural byproducts and agro-industry byproducts

and convert them into valuable products. A.H. also provides employment to rural people. Large scale animal industry (dairy, leather, meat and animal feed industry) also provide employment to people. The country has total land area of 328.8 million hectares, of which 143 million hectares is under cultivation and of this approximately 60 million hectares (gross) is irrigated. Less than 5% of the irrigated area is under fodder crops.

In spite of largest livestock wealth as number, species, breeds in India, the level of production of livestock products (milk, meat, wool, eggs) is most unsatisfactory. This may be due to the poor feed resources availability, tropical diseases, as well as poor attention being paid to organize breeding. The livestock provide protective food in the form of meat, milk, eggs etc. They provide motive power to farmers and rural poor's. They also provide valuable by products in the form of skins, fibers, organic manures and other usable items (Feather, bone, horns, hairs etc). Their contribution to rural employment is relatively large being 29%. The majority (62%) of small and marginal farmers and landless labourers have livestock specially cattle and buffaloes. Dairy development programmes taken up under the operation flood benefited to these classes very much. A.H. thus offers a vast scope for application of science and technology to the problems of food, hunger and rural employment.

Animal Husbandry is a supplementary occupation to agriculture in our country. It is a part of life in rural people. It provides cash insurance in case of crop failure to the farmers. A.H. provides better support in poverty elimination. Co-operative dairy activity provides strong way of progress to rural economy. Overall 27.28% income to farmers generated from dairy business. Our country stood first in milk production since 1998 in the world.

Our country has 16% cattle, 17% goat, 4% sheep and 57% buffaloes of the world. We produce 7.11% milk of cattle. 61.95% milk of buffaloes, 21.52% milk of goat of the world. Dairy development rate was 4.5% in last two decade as against 2.2% in agriculture. Most of the nomadic tribes and people living on edges of villages depend on sheep and goat rearing.

Role of Animal Husbandry in National Economy:

- India is an agricultural country with agriculture based economy.
- Cattle and buffaloes are the backbones of Indian agriculture/dairying industry.
- It is densely populated and has limited land resources. More than 50% of the population depends directly or indirectly on agriculture for their livelihood.
- Nearly 4% of the national GDP and 25% of the agricultural GDP is derived from animal husbandry.
- Livestock, especially dairy cattle and buffaloes are useful to Indian economy in the following ways:
    1. Provide protective food in the form of milk and meat.
    2. Provide motive power for agriculture.
    3. Provide supplementary income to the farmers.
    4. Provide valuable organic manure and fuel.
    5. Utilize unproductive land.
    6. Provide miscellaneous products-raw materials.

Animal Husbandry and Dairying play an important role in development of India's economy. Animal Husbandry, Dairying and Fisheries sectors play an important role in the national economy and in the socio-economic development of the country. These sectors also play a significant role in supplementing family incomes and generating gainful employment in the rural sector, particularly, among the landless laborers, small and marginal farmers and women, besides providing cheap nutritional food to millions of people. Livestock are the best insurance against the vagaries of nature like drought, famine and other natural calamities. Highlighting the importance of the livestock sector in the Indian economy, the Annual Report as per Central Statistical Organization (CSO) states that the value of output from livestock sector at current prices was about Rs. 4,59,051 crore during 2011-12 which is about 25.6% of the value of output from the agriculture and allied sector.

The present contribution of livestock to the national economy is estimated to be Rs.18000 crores, mainly from milk and milk products (70 per cent); meat and meat products (11.5 per cent); poultry (8.8 per cent) and dung for fuel (7.8 per cent). In addition, the value of other animal products as eggs, wool, leather goods etc, makes the total of Rs.18000 crores. Apart from above items, the value of draught power from 88 million bullocks including 8 million buffalo bullocks indispensable to agricultural operations is of the order of Rs. 5000 crores. In 2008-09, this sector contributed 108.5 million tonnes of milk, 55.6 billion eggs, 42.7 million kg wool and 3.8 million tones of meat. Several measures have been initiated by the government to increase the productivity of milch animals, which has resulted in increasing the milk production significantly from the level of 102.6 million tonnes at the end of the tenth plan (2006-07) to 127.9 million tonnes at the end of the eleventh plan (2011-12). Poultry development in the country has shown steady progress over the years. Egg production was around 66.45 billion in 2011-12. The poultry meat production is estimated to be about 2.47 million tonnes.

According to 2019 census, the livestock population is estimated at 535 million comprised of 192.5 million cattles, 109.9 million buffaloes, 74.26 million sheep, 148.9 million goats and 9.06 million pigs and poultry birds 851 million.

India is

- World’s highest livestock owner at about 535.78 million
- First in the total buffalo population in the world - 109.85 million buffaloes
- Second in the population of goats - 148.88 million goats
- Second largest poultry market in the world
- Second largest producer of fish and also 2nd largest aquaculture nation in the world
- Third in the population of sheep (74.26 millions)
- Fifth in the population of ducks and chicken (851.81 million)
- Tenth in camel population in the world - 2.5 lakhs

Cattle and Buffaloes:

India has 14 per cent of the world's cattle and 57 percent of the world's buffalo population. India continues to be the largest producer of milk in the world and India produced 13.1 per cent of the total milk produced in the world. Hence, India has attained the first rank in milk production in the world. At present the first five countries in the world producing maximum milk are India, USA, Russia, Germany and France. At the beginning, production of milk was only 17 million tonnes (MT) in 1950-51 in India. Now it is increased to 108.5 million tonnes in 2008-09. World milk production is estimated at 693 million tonnes during 2007-08 and Indian milk production stands at 104.8 million tonnes. Several measures have been initiated by the government to increase the productivity of milch animals, which has resulted in increasing the milk production significantly from the level of 102.6 million tonnes at the end of the tenth plan (2006-07) to 127.9 million tonnes at the end of the eleventh plan (2011-12). India, the largest producer of milk in the world, is set to produce over 187.7 million tones milk during 2018-19. The per capita availability of milk in India is 394 grams per day (2020). Per capita milk availability is highest in Punjab (1181g) while in Gujarat it is (626g). The average milk production of a milking cow is only 173 kg and that of buffalo is about 500 kg milk per lactation in India which is far below than world average.

Some of the key outcomes of the 20th Livestock Census (2019)

- The total Livestock population is **535.78** million in the country showing an increase of 4.6% over Livestock Census2012
- Total **Bovine** population (Cattle, Buffalo, Mithun and Yak) is **302.79** Million in 2019 which shows an increase of 1.0% over the previous census.
- The total number of cattle in the country is **192.49** million in 2019 showing an increase of 0.8 % over previous Census.
- The Female Cattle (Cows population) is 145.12 million, increased by 18.0% over the previous census (2012).
- The Exotic/Crossbred and Indigenous/Non-descript Cattle population in the country is 50.42 million and 142.11 million respectively.
- The Indigenous/Non-descript female cattle population has increased by 10% in 2019 as compared to previous census.
- The population of the total Exotic/Crossbred Cattle has increased by **26.9 %** in 2019 as compared to previous census.
- There is a **decline of 6 % in the total Indigenous** (both descript and non-descript) Cattle population over the previous census. However, the pace of decline of Indigenous Cattle population during 2012-2019 is much lesser as compared to 2007-12 which was about 9%.
- The total buffalo in the country is **109.85** Million showing an increase of about 1.0% over previous Census.

- The total milch animals (in-milk and dry) in cows and buffaloes are 125.34 Million, an increase of 6.0 % over the previous census.
- The total sheep in the country is **74.26** Million in 2019, increased by 14.1% over previous Census.
- The Goat population in the country in 2019 is **148.88** Million showing an increase of 10.1% over the previous census.
- The total Pigs in the country are **9.06** Million in the current Census, declined by 12.03% over the previous Census.
- The total Yak in the country is **Fifty Eight Thousand** in 2019, **decreased by 24.67%** over previous Census.
- The total Horses and Ponies in the country are **3.4 Lakhs** in 2019, decreased by 45.6% over previous Census.
- The total Camel population in the country is **2.5** Lakhs in 2019, decreased by **37.1%** over previous Census.
- The total Poultry in the country is **851.81 Million in 2019, increased by 16.8%** over previous Census.
- The total Backyard Poultry in the country is 317.07 Million in 2019, increased by 45.8% over previous Census.
- The total Commercial Poultry in the country is 534.74 Million in 2019, increased by 4.5% over previous Census.

CHAPTER 2

REPRODUCTION IN FARM ANIMALS

Efficient reproduction (i.e. regular calving at 12-14 months interval) is a key for profitable dairy farming. The knowledge regarding anatomy and physiology of reproduction is very essential to maximize fertility and minimize reproductive disorders.

Male Reproductive System

The male reproductive system has been shown in figure below. The primary organs of reproduction in male are two testes, which are located outside the body in a sac like structure called scrotum. Scrotum maintains the temperature of testes about 4-5^{0}C below body temperature. The cooler temperature is required for the normal spermatogenesis (process of formation of sperms in testes). The temperature is maintained by contraction and relaxation of muscles of scrotal wall. During cold atmosphere testes are retracted towards body whereas in warm weather they are relaxed.

The male reproductive tract consists of two parts –

1. Testicles (primary sex organ) including

- Seminiferous Tubules made of Leydig Cells and Sertoli Cells

2. Secondary sex organs, including…

- Epididymis
- Vas Deferens
- Urethra and Penis
- Seminal Vesicle
- Prostate Gland and
- Cowper's Gland

Testes:

Two in numbers suspended vertically within sac known as scrotum, ovoid in shape. Length is 10 - 16 cm and 8 cm width. Each testes composed of several crypts enclosed in serous layer called tunica vaginalis. Each crypt has several numbers of seminiferous tubules. The wall of seminiferous tubules consists of basement membrane & multilayered sperm producing epithelium having two types of cells i.e.

(i) Germ cells -Spermatozoa produced here.

(ii) Sertoli Cells - Sperms get matured. The space between seminiferous tubules occupied by interstitial cells (Leydig's cells) produces male hormone.

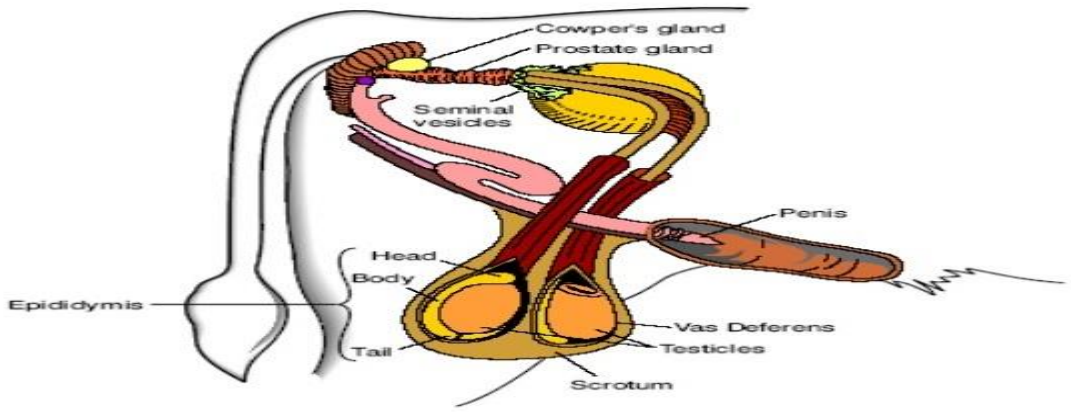


Figure – Reproductive tract of bull

Epididymis:

Is considered in three parts i.e.

(i) Caput (head),

(ii) Corpus (body),

(iii) Cauda (tail).

It arises from efferent ducts testes. Throughout of its length epididymal tube is lined with secretary cells. Spermatozoa produced in testis accumulate and mature during their journey through epididymis which is 30-35 meters in bull.

Transport:

Sperms transported from rete testes to efferent duct by the fluid pressure of testis and by active beating of cilia. It lakes 7-9 days for any sperm to travel from germinal epithelium to caudal epithelium.

Concentration:

Dilute sperm concentration originated in testes- water absorbed into epithelial cell of epididymis mainly in caput & highly concentrated sperm left in cauda (tail).

Maturation:

In the course of migration of sperm cells get matured as; it result of secretion from epididymal cells.

Storage:

Cauda (tail) is store depot for sperms where they remain viable up to 60 days.

Vas deferens:

It is slender tube with thick cord like wall originating from tail of epididymis ending into urethra. It is paired and is with spermatic arteries, veins, nerves. It passes through the inguinal ring and pelvic cavity. It is abundantly supplied with nerves & by voluntary contractions of musculature/it is involved in ejaculation.

Urethra:

It is common passage way for product of testes, accessory glands and for excretion of urine. It extends through penis to the glands penis.

Penis:

It is male organ of copulation arid composed of erectile tissue attached and held by sigmoid flexure. It has function of ejaculation and excretion of urine.

Seminal Vesicles:

Two in number located on either side of ampulla which secrete a fluid high in sugars (fructose) to nourish the spermatozoa – feels like a bag of grapes (palpation). The secretion contains mainly fructose and citric acid contributes to seminal plasma which is rich in carbohydrates, salt of citric acid, proteins, amino acids, enzymes, vitamins. This fluid also dilutes sperm at ejaculation and serves to activate motility – the bulk of fluid production occurs here. Secretes prostaglandins, causing uterine contractions.

Prostate Glands:

Consist two joined parts. It is surrounded by urethral muscles. Secretion is high in mineral content.

Cowper's gland:

Are paired, round - compact of walnut size, located above urethra. Secretion is viscid & mucus like.

Female Reproductive System

It consists of organs, namely

1. Ovaries : Reproductive glands
2. Fallopian Tubes: Coveys ova from ovary to uterus.
3. Uterus: In which fertilized ovum develops.
4. Vagina: Dilatable passage from uterus to Vulva.
5. Vulva : Terminal segment of system

Ovaries:

Two in number laying in the abdominal cavity sizes are 0.5 to 1.5 Inch diameter and 0.5 to 1.5 inch width & thickness. Dual purpose - production of eggs or ova and production of female hormone i.e. estrogen.

Oviduct (Fallopian Tube):

Are slender, zigzag lubes attached to ligament 20-25 cm in length, close to ovaries in such a way that eggs / ova released by ovary area cached through funnel shape wide end called as "Infundibulum". The epithelial lining of oviduct is ciliated of which ciliary motion helps to conduct ova from ovaries to uterus. The fertilization occurs in the ampullary region.

Uterus:

It consists of short medium body, pair of spirally twisted internally cavity connecting two horns known as body of uterus. The uterus has three layers i.e. outer servosa, middle muscular and inner is mucosa. In non-pregnancy period uterus lies in the pelvic cavity which descends into abdomen during pregnancy. Fertilized ovum/embryo develops into uterus until the time of birth. It nourishes the developing foetus through cotyledons of inner layer.

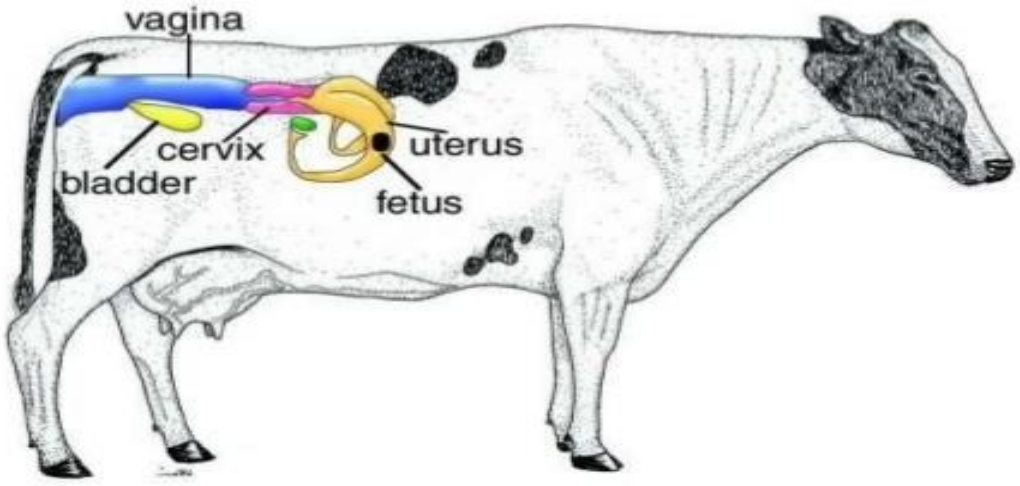


Figure – Reproductive system of cow

Cervix:

It is thick walled portion which lies between uterus and vagina having muscle layers forming longitudinal folds forming spiral passage way through it. It is 4 inch long and 1 inch or more thick. It is tightly closed during pregnancy and anoestrus period and reopens during estrus and parturition.

Vagina:

It is between cervix to vulva in cow. It is 8-10 inch long highly elastic organ. Responsible for secretion of mucus, serves as birth canal dung parturition & admits male organ during copulation.

Vulva:

It is external vertical opening of genital tract just below anus. Diameter is larger than that of vagina. Vulva walls supplied with glands which are active during excitement.

Oestrus Cycle

Definition:

1. The interval from the first signs of sexual receptivity at Oestrus (heat) to the next estrus is called estrus cycle.
2. The chain of physiological events that begins at one Oestrus period and ends at next is called as Oestrus cycle.

The cycle is of 20 + 2 days in cows for normal female in quite regular cycles. This cycle may be studied in four distinct phases as designated by Marshall i.e. Proestrum, Estrum, Metestrum and Diestrum.

Proestrum: (Pre-estrus)

This phase is indication of animal coming in heat. The ovary is surrounded by follicular fluid containing high level of estradiol. The Graffian follicle within ovary grows. The increased level of estradiol is absorbed into blood making effect to oviduct causing growth of cells lining the tube & increasing in the number of cilia which are shortly helpful to transport ova to uterus. Also, epithelial wall of vagina increases in thickness to accommodate smooth coitus this period is of S hrs to 2 days.

Estrum: (Estrus)

This is period of sexual desire. The Graffian follicles are mature or ripe in this stage. This phase period comes to close by rupture of follicle of ovulation i.e. release of Ovum. This period lasts for 12-24 hours in cow while 1-2 days in ewe. The symptoms exhibited during this period by cow are it bellows frequently, mounts other animals, excited, licking to other animals and stands to be ridden by other animals. This period is called period of standing heat. The proper period to breed is 8 to IS hrs, for getting high fertility rate.

Metestrum: (Met-estrus)

Period during which reproductive organs return to normal condition. The phase is of 1-5 days in which the cavity of the Graffian follicle from which ovum had been expelled becomes reorganized and forms new structure known as corpus luteum (C.L.) which secretes progesterone hormone having following functions:

1. Prevents maturation of further Graffian follicles which prevent occurrence of further estrus period for a time.
2. It is essential for implementation of fertilized eggs.
3. It initiates the development of mammary gland.

Diestrum: (Di-estrus)

This is the longest phase of cycle. The corpus luteum is fully grown, making its effect on uterine wall to accommodate the embryo. The muscles of uterus develop. The uterine milk is produced to nourish embryo. If pregnancy succeeds, this stage is prolonged throughout gestation remaining C.L. intact for the period. In absence of fertilized eggs, the C.L. undergoes retrogressive changes the cell becomes vacuolated in the lipid droplets. Since the C.L. got reabsorbed, the level of progesterone is .declined and the level of estradiol increases, bring the animal in heat and the cycle is repeated in case of failure of fertilization.

Pregnancy

The period from the date of conception to the day of parturition is called "gestation period" and the condition of the female of carrying the foetus during this period is called "Pregnancy".

OR

"The period of pregnancy is the duration of time which elapses between conception and parturition".

Importance of Pregnancy Diagnosis:

Whether animal is pregnant or not is directly related to economy of dairy management Pseudo-pregnancy may lead to loss of valuable time period in the life of animal. Pregnant animals need to change their feeding schedule as well as the management from early stage. An early detection of pregnancy becomes an indispensable job for herd owner.

Methods of Pregnancy Diagnosis:

1. Signs of Pregnancy - exhibited and and detected externally.
2. Symptoms of Pregnancy - per rectum / vaginal examination.
3. Laboratory Tests - Presence of certain hormones tested in laboratory.

Signs of Pregnancy:

1. Cessation of Oestrus cycle.
2. Sluggish temperament
3. Tendency to fatten.
4. Gradual drop in milk yield.
5. Gradual increase in weight
6. Increase in size of udder.
7. Waxy - appearance of teats in last month of pregnancy

CHAPTER 3

HOUSING PRINCIPLES, SPACE REQUIREMENTS FOR DIFFERENT SPECIES OF LIVESTOCK (RUMINANTS)

HOUSING FOR DAIRY CATTLE

An efficient management of cattle will be incomplete without a well planned and adequate housing of cattle. Improper planning in the arrangement of animal housing may result in additional labour charges and that curtail the profit of the owner. During erection of a house for dairy cattle, care should be taken to provide comfortable accommodation for individual cattle.

Livestock is provided housing for following purposes/objectives:

Objectives

1. To protect the animals from extreme/harsh climatic conditions.
2. To protect them from the predators.
3. To increase the efficiency in the herd management in terms of feeding, cleaning, watering, health control, handling etc.
4. To increase the efficiency of labour utilization in carrying out the farm work.

Location of Dairy Farm Buildings:

The points which should be considered before the erection of dairy buildings are as follows.

1. Topography and Drainage

A dairy building should be at a higher elevation than the surrounding ground to offer a good slope for rainfall and drainage for the wastes of the dairy to avoid stagnation within. A levelled area requires less site preparation and thus lesser cost of building. Low lands and depressions and proximity to places of bad odour should be avoided.

2. Soil Type

Fertile soil should be spared for cultivation. Foundation soils as far as possible should not be too dehydrated or desiccated. Such a soil is susceptible to considerable swelling during rainy season and exhibit numerous cracks and fissures.

3. Exposure to the Sun and Protection from Wind

A dairy building should be located to a maximum exposure to the sun in the north and minimum exposure to the sun in the south and protection from prevailing strong wind currents whether hot or cold. Buildings should be placed so that direct sunlight can reach the platforms, gutters and mangers in the cattle shed. As far as possible, the long axis of the dairy barns should be set in the north-south direction to have the maximum benefit of the sun.

4. Accessibility

Easy accessibility to the buildings is always desirable. Situation of a cattle shed by the side of the main road preferably at a distance of about 100 meters should be aimed at.

5. Durability and Attractiveness

It is always attractive when the buildings open up to a scenic view and add to the grandeur of the scenery. Along with this, durability of the structure is obviously an important criterion in building a dairy.

6. Water Supply

Abundant supply of fresh, clean and soft water should .be available at a cheap rate.

7. Surroundings

Areas infested with wild animals and dacoits should be avoided. Narrow gates, high manger curbs, loose hinges, protruding nails, smooth finished floor in the areas where the cows move and other such hazards should be eliminated.

8. Labour

Honest, economic and regular supply of labour is available.

9. Marketing

Dairy buildings should only be in those areas from where the owner can sell his products profitably and regularly. He should be in a position to satisfy the needs of the farm within no time and at reasonable price.

10. Electricity

Electricity is the most important sanitary method of lighting a dairy. Since a modem dairy always handles electric equipments which are also economical, it is desirable to have an adequate supply of electricity.

11. Facilities, Labour and Food

Cattle yards should be so constructed and situated in relation to feed storages, hay stacks, silo and manure pits as to effect the most efficient utilization of labour. Sufficient space per cow and well arranged feeding mangers and resting are contribute not only to greater milk yield of cows and make the work of the operator easier also minimizes feed expenses. The relative position of the feed stores should be quite adjacent to the cattle barn.

Noteworthy features of feed stores are given:

- Feed storages should be located at hand near the center of the cow barn.
- Milk-house should be located almost at the center of the barn.
- Centre cross-alley should be well designed with reference to feed storage, the stall area and the milk house.

DAIRY CATTLE HOUSING:

Loose Housing System:-Loose housing may be defined as a system where animals are kept loose except milking and at the time of treatment. The animals are provided with a shed for feeding, watering and shelter during extreme climate. This system is more economical. The system consists of various units for successfully layout as follows: The entire shed is surrounded by boundary wall of 5 feet height. On one side of house, there is provision of feeding area under covered shed having 2-2 ½ feet of feeding space per cow. A common water tank is providing on one side of house. Concentrates are fed at the time of milking in hopper bins, where cow stands in stanchion in milking area. The paved area is a place of house where she gets fresh air and sunshine (100-150 square feet/cow). A box stall or calving box of 10'x10' or 12'x18' should b provided for calving and sick animals (1 per 15 animals). A calf pen of 10'x10' will be sufficient for 4 calves.

There should be a provision of weight bridge, plateform balance for weighing animals and bull pen 12'x18' for housing and feeding a bull. There should be a manure pit located away from barn. In nut shell, the loose house should have facility for feeding, watering, milking, rest, calving box, calf pen and sick animal box.

Advantage of Loose Housing:

- It is economical as the cost of construction is significantly lower than conventional type.
- Animals get enough exercise and feel more comfort.
- Facilitates easy detection of animals in heat.
- Possibility to make further expansion without much change.

Disadvantage of Loose Housing:

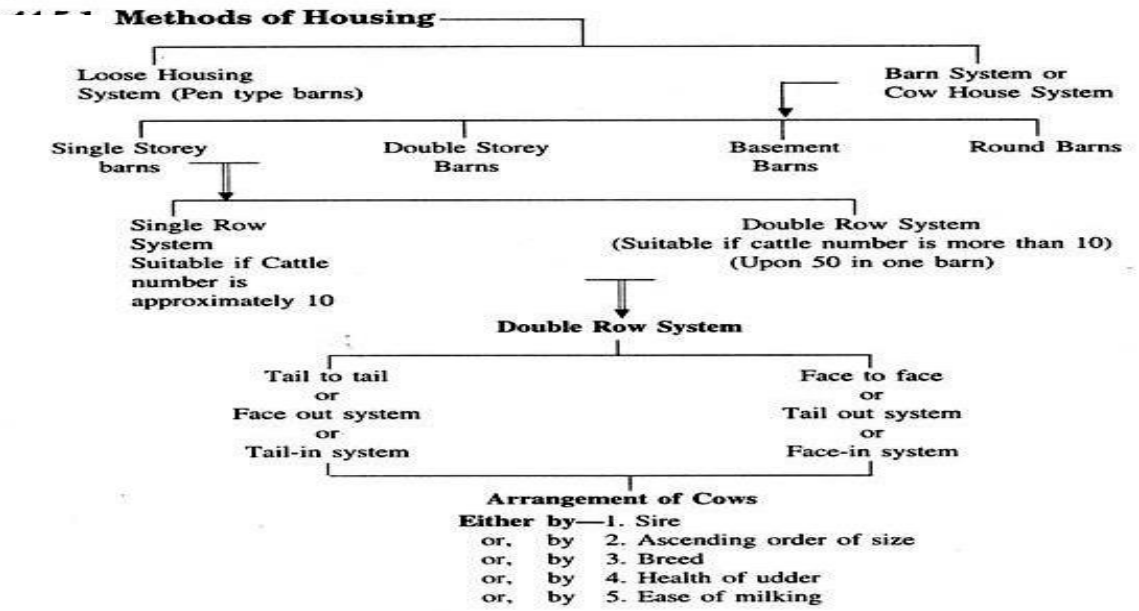
- More space (10-20% extra) is required than conventional type of housing.
- Individual feeding attention is not possible.
- Herd cannot be displayed easily.
- The animal in heat is disturbed by fellow animals.

(Cattle Shed)

Conventional Housing System: - They are standards stalls with facilities for feeding, watering and housing of individual animals. The conventional dairy barns are comparatively costly but animals are more protected from adverse climatic conditions. In this system, cow sheds can be arranged in a 'single row' (if cattle number is more than 10 or up to 50). In double row system, the cows can either be faced in (face to face system) or faced out (tail to tail system). The system consists of various units for successfully layout for proper housing of different classes of dairy cattle and buffaloes on the farm.

Cow Sheds:

Cow sheds can be arranged in a single row if the numbers of cows are small. Say less than 10 or in a double row if the herd is a large one. Ordinarily, not more than 80 to 100 cows should be placed in one building. In double row housing, the stable should be so arranged that the cows face out (tail to tail system) or face in (head to head system) as preferred.



Advantages of Tail to Tail System:

Under the average conditions, 125 to 150 man hours of labour are required per cow per year. Study of time: Time motion studies in dairies showed that 40% of the expended time is spent in front of the cow, and 25% in other parts of the barn and the milk house, and 60% of the time is spent behind the cows. Time spent at the back of the cows is 4 times more than the time spent in front of them.

- In cleaning and milking the cows, the wide middle alley is of great advantage.

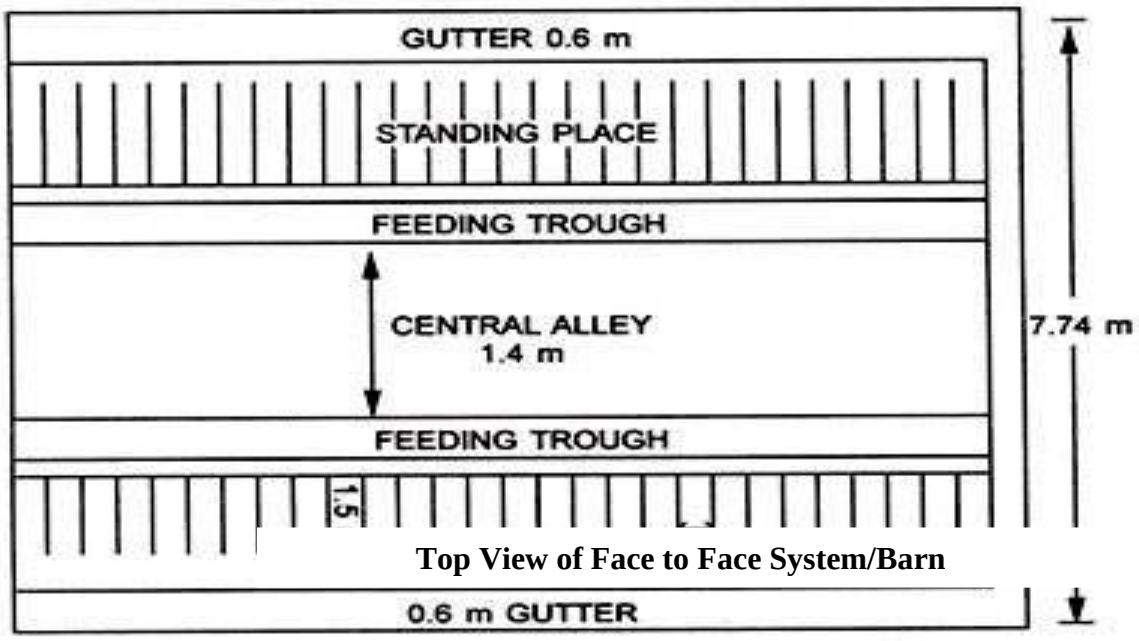
Tail to Tail System

- Lesser danger of spread of diseases from
- animal to animal.
- Cows can always get more fresh air from outside.
- The head gowala can inspect a greater number of milkmen while milking. This is possible because milkmen will be milking on both sides of the gowala.
- Any sort of minor disease or any change in the hind quarters of the animals can be detected quickly and even automatically.

Advantages of Face to Face System:

- Cows make a better showing for visitors when heads are together.
- The cows feel easier to get into their stalls.
- Sun rays shine in the gutter where they are needed most.
- Feeding of cows is easier; both rows can be fed without back tracking.
- It is better for narrow barns.

Face to Face System



Top View of Face to Face System/Barn

Fig. 44.8. Top View of Head to Head Barn.

Floor:

The inside floor of the barn should be of some impervious material which can be easily kept clean and dry and is not slippery. Paving with bricks can also serve ones purpose. Grooved cement concrete floor is still better. The surface of the cow shed should be laid with a gradient of 1" to 14" from manger to excreta channel. An overall floor space of 65 to 70 sq.ft. per adult cow should be satisfactory.

Walls:

The inside of the walls should have a smooth hard finish of cement, which will not allow any lodgement of dust and moisture. Comers should be round. For plains, dwarf walls about 4 to 5 feet in height and roofs supported by masonry work or iron pillars will be best or more suitable. The open space in between supporting pillars will serve for light and air circulation.

Roof:

Roof of the barn may be of asbestos sheet or tiles. Corrugated iron sheets have the disadvantage of making extreme fluctuations in the inside temperature of the barn in different seasons. However, iron sheets with aluminium painted tops to reflect sunrays and bottoms provided with wooden insulated ceilings can also achieve the objective. A height of 8 feet at the sides and 15 feet at the ridge will be sufficient to give the necessary air space to the cows. An adult cow requires at least about 800 cubic feet of air space under tropical conditions. To make ventilation more effective continuous ridge ventilation is considered most desirable.

Manger:

Cement concrete continuous manger with removable partitions is the best from the point of view of durability and cleanliness. A height of 1'-4" for a high front manger and 6" to 9" for a low front manger is considered sufficient. Low front mangers are more comfortable for cattle but high front mangers prevent feed wastage. The height at the back of the manger should be kept at 2'-6" to 3". An overall width of 2' to 2 1/2' is sufficient for a good manger.

Alleys:

The central walk should have a width of 5'-6' exclusive of gutters when cows face out, and 4'-5' when they face in. The feed alley, in case of a face out system should be 4' wide, and the central walk should show a slope of 1" from the center towards the two gutters running parallel to each other, thus forming a crown at the center.

Manure Gutter:

The manure gutter should be wide enough to hold all dung without getting blocked, and be easy to clean. Suitable dimensions are 2" width with a cross-fall of 1" away from standing. The gutter should have a gradient of 1" for every 10' length. This will permit a free flow of liquid excreta.

Doors:

The doors of a single range cow shed should be 5 feet wide with a height of 7 feet and for double row shed the width should not be less than 8 to 9 feet. All doors of the barn should lie flat against the external wall when fully open.

Calving Boxes:

Allowing cows to calve in the milking cow shed is highly undesirable and objectionable. It leads to insanitary in milk production and spread of disease like contagious abortion in the herd. Special accommodation in the form of loose-boxes enclosed from all sides with a door should be furnished to all parturient cows. It should have an area of about 100 to 150 sq.ft. with ample soft bedding, it should be provided with sufficient ventilation through windows and ridge vent.

Isolation Boxes:

Animals suffering from infectious disease must be segregated soon from the rest of the herd. Loose boxes of about 150 sq.ft. are very suitable for this purpose. They should be situated at some distance from the other barns. Every isolation box should be self contained and should have separate connection to the drainage disposal system.

Sheds for Young Stocks:

Calves should never be accommodated with adults in the cow shed. The calf house must have provision for daylight ventilation and proper drainage. Damp and ill-drained floors cause respiratory trouble in calves to which they are susceptible. As far as possible the shed for the young calves should be quite close to the cow shed. Each calf shed should have an open paddock or exercise yard. An area of 100 square feet per head for a stock of 10 calves and an increase of 50 square feet for every additional calf will make a good paddock. It is useful to classify the calves below one year into three age groups, viz., calves below the age of 3 months, 3-6 months old calves and those over 6 months for a better allocation of the resting area. An overall covered space of:

1. 20-25 square feet per calf below the age of 3 months,
2. 25 -30 square feet per calf from the age of 3-6 months,
3. 30-40 square feet per calf from the age of 6-12 months and over, and
4. 40-45 square feet for every calf above one year, should be made available for the sheltering. A suitable interior lay-out of a calf shed will be to arrange the standing space along each side of a 4 feet wide central passage having a shallow gutter along its length on both sides. Provision of water troughs inside each calf shed and exercise yard should never be neglected.

Bull or Bullock Shed:

Safety and ease in handling a comfortable shed protection from weather and a provision for exercise are the key points while planning accommodation for bulls or bullocks. A bull should never be kept in confinement particularly on hard floors. Such a confinement without adequate exercise leads to overgrowth of the hoofs creating difficulty in mounting and loss in the breeding power of the bull. A loose box with rough cement concrete floor about 15' by 10' in dimensions having an adequate arrangement of light and ventilation and an entrance 4' in width and 7' in height will make a comfortable housing for a bull. The shed should have a manger and a water trough.

If possible, the arrangement should be such that water and feed can be served without actually entering the bull house. The bull should have a free access to an exercise yard provided with a strong fence or a boundary wall of about 2' in height, i.e., too high for the bull to jump over.

From the bull yard, the bull should be able to view the other animals of the herd so that it does not feel isolated. The exercise yard should also communicate with a service crate via a swing gate which saves the use of an attendant to bring the bull to the service crate.

Floor Space Requirement for Cattle and Buffalo:

Type of animals	**Floor space required (sq. met/animal)**		**Max. no. of animal/pen**	**Height of shed (cm)**
	Covered area	**Open paddock**		
Bulls	12.0	120.0	1	175 in medium and heavy rainfall area and 220 in semi arid and arid areas
Cows	3.5	7.0	50	
Buffaloes	4.0	8.0	50	
Down calvers	12.0	12.0	1	
Young calves	1.0	2.0	30	
Older calves	2.0	4.0	30	

HOUSING FOR SHEEP AND GOAT

Normally, sheep and goat do not require elaborate housing facilities but minimum provision will definitely increase productivity by protecting the animals against bad weather conditions. Shed should be provided with gunny bags or thatching material and bamboos. The roof of shed should be made up of asbestos sheet and supported by angle iron.

Generally, loose housing is practiced which is having following sheds:

- General flock shed
- Shed for rams/bucks
- Lambing/kidding shed
- Lamb shed/kid shed
- Sick animal shed

HOUSING FOR SHEEP:

The sheep should be protected from adverse climatic conditions particularly during winter and rainy weather. The sheep barn should be located on dry, well drained site with yard space and paved area adjacent to it. A floor space of 12 square feet/ewe is sufficient in barn having the facility for feeding and watering. The feeding pasture should be fenced to protect the sheep from dogs and predators. Feed racks may be placed in zigzag fashion along the fence. The hay racks 16’ long and 2 ½’ to 3’ height with and 8” opening at about 1’ from the bottom are sufficient for a flock of 40 ewes. The grains are fed from separate trough which may be of 10”x12”x4” in size and may be kept at about 8-10” from the ground. A watering trough of similar size may also be constructed.

For lambs, a 12’ long water tank equipped with float valve may be constructed. Dipping vat made up of cement concrete with a size of 16’ x 4’ x 10’-12’ inside width at bottom and 20-24’ inside width at top is sufficient. The top of vat should be 8-12’ above the ground level. The inclined ladder and a ramp for exit of sheep should be 6’-7’ long for a 3’ deep vat. At the exit end, a drain plateform is built.

Shearing room should be made for shearing the sheep which should be well lighted and ventilated. On either side of shearing room, there should be 2 simple fenced lofts for collection of sheep before and after shearing with a passage of 1.5’ width leading to shearing room should also be there. There should be provision for sheds for breeding rams and lambs and an isolation box for sick animal. A lambing pen for pregnant ewe should be provided for safe lambing pen for pregnant ewe should be provided for safe lambing. Other accessory units like store for wool, feed and fodder, farm equipments, clinic, etc. should also be provided.

Sheep house should have the following sheds and facilities:

1	Sheep barn/general flock shed	6	Stores	11	Grain trough
2	Ram shed	7	Shearing room	12	Watering tank
3	Lambing shed	8	Feed racks	13	Dipping vat
4	Lamb shed	9	Loft/yard		
5	Isolation box	10	Grazing pasture area		

HOUSING FOR GOAT:

Goat housing is somewhat similar to sheep housing. In close housing pen an area of 1.80 square meter par animal with feeding and watering through is sufficient. In open house an area of 4.5 square meter/goat is sufficient. The milch goat shed may be partitioned with brick wall, stone slab or iron tubing install for each done for individual milking and feeding. The kidding pen should be of 6’x5.5’ dimensions enclosed with a fence of 4’-4.5’ height. Large flocks of goats are usually kept in groups except adult male, pregnant doe, and heavy milkers which are housed individually or in small groups. Kids may be housed in a loose box or in a large wooden box. Sufficient hay racks and watering through should be provided in every shed.

Sheds and facilities under conventional housing:

1	Doe shed	4	Kid shed	7	Milk storage room
2	Buck shed	5	Weaned sheep	8	Stores
3	Kidding shed	6	Milking shed	9	Isolation box

Floor space, feeding and watering space for sheep and goat:

Sr. No.	Types of animal	Floor space per animal (m^2)	Feeding space per animal (cm)	Watering space per animal (cm)
1.	Kid/lamb	½-1	30	3
2.	Adult female	1-1½	40	4
3.	Pregnant and lactating animals	2	50	5
4.	Adult ram	2	50	5

Feeding/watering space requirements (cm) for different categories of livestock:

Type of animal	Space per animal	Total manger length in a pen / 100 animal	Length of water trough in a pen/100 animal	Manger/water trough (cm)		
				Width	Depth	Height of inner wall
Adult cattle and buffalo	60-75	6000-7500	600-750	60	40	50
Calves	40-50	4000-5000	400-500	40	15	20
Adult sheep and goat	40-50	4000-5000	400-500	50	30	35
Lambs and kids	30-35	3000-3500	300-350	50	20	25

CHAPTER 4

MANAGEMENT OF CALVES, GROWING HEIFERS, DRY AND PREGNANT ANIMALS AND MILCH ANIMALS

(A) Importance of Calf Raising (as replacement stock)

In dairy herd, adult cows or buffaloes produce milk. Milk is the main source of income to the dairyman. Every year some of these cows or buffaloes are to be sold/culled because of the following causes/reasons.

a) Old age/senility,

b) Not breeding properly –repeat breeding,

c) Loss of teat/s & udder- mastitis,

d) Low production –uneconomic

e) Vices – self suckling, suckling others, bossism

f) Chronic contagious diseases – TB, JD, Brucellosis etc.

The proportion of such animals may be 20 to 30 per cent of the total cows. As these uneconomic animals are removed from the herd, equal number of new animals should be added every year to maintain the herd strength and the milk production. This new addition (or herd replacement) can be done by two ways.

(i) By purchasing cows or buffaloes and

(ii) By raising the farm-bred heifers.

Replacing the uneconomic cows through purchases has following disadvantages.

a) Only unwanted animals are sold. So in most cases we purchase animals having low production or some defects/vices.

b) Diseases are introduced in the herd along with purchased animals.

c) Consistent increase in level of production of the herd, every year or every generation, cannot be done.

In view of the above disadvantages, raising heifers on the farm is advisable.

(B) Systems of Calf Raising: Calves can be raised by two methods. They are;

(i) Natural methods, and

(ii) Artificial method or weaning.

In natural method the calf is allowed to suckle the dam at the time of milking, morning and evening. In ‘weaning’ or ‘artificial’ method the calf is not allowed to take milk directly from the teats of the dam, but it is fed known quantity of whole milk or other substitute by the man in bowl/pail.

The advantages of weaning are as follows:

a) In natural method the calf suckles large quantity of milk; say 25-30% of the milk received in the pail. This comes to 450-500 liters per lactation. In weaning method the quantity of whole milk feeding can be very much reduced. So the calf can be raised more economically.

b) We can know the real milk producing ability of cows.

c) In case of death of the calf, the milk yield of the dam is not lost. If dam dies, calf can survive on milk of other cows.

d) Male calves and defective female calves can be sold at early age.

e) The cows become regular breeder. They come in heat earlier and conceive earlier than the cows, suckling their calves.

The only disadvantage of weaning method is that if proper care is not taken and proper sanitation is not observed, there is higher rate of mortality (death rate) among calves due to pneumonia, enteritis, calf scour, septicemia etc.

(C) Care of the Calf right at Birth:

Care of the calf starts well before it is born. The dam should be housed in a clean well-bedded calving pen. As soon as the cow shows **signs of labour pain**, one man should constantly and quietly watch her. Uneasiness, kicking the floor, frequent getting up and sitting down, lying down and straining, are the signs of initiation of parturition. Within two to three hours after starting of labour pain, usually, the water bag appears at the vulva. This ruptures and the hooves of the two fore legs appear. At each contraction/ straining by the cow the feet of the calf are pushed out gradually. The head is presented- pressed on the knees, as the feet are out. This is the normal presentation. If the calf is not in this position at the time of birth, it leads to **"Dystokia"-** difficult birth. When there is dystokia, expert help should be called immediately. If the position is normal, the calf may be pulled out, gently, when the cow is straining. The cow generally does not need assistance for birth of the calf, if the presentation is normal.

As soon as the calf is out, we should see that the respiration is started. Clean the mouth and the nostrils off the obstruction if any. If the respiration is not established a light jolt may be given to the calf.

(D) Care of the Calf after the Birth:

a) **Natural system**: The newly born calf, if it is to be raised by natural method, should be placed before the dam. The cow will immediately begin to lick and dry the calf. This will stimulate respiration, improve the circulation and dry the calf. A vigorous calf will attempt to get up in about 15 minutes. When the calf is dried and can stand on its legs, it may be weighed. It may be noted that male calves are slightly heavier than the female calves. The naval chord may be cut to about 3 to 6 cm size by sterilized scissors and disinfected with 30% solution of tincture of iodine or with solution of savlon.

b) **Weaning system**: The calf to be raised by weaning should be removed to the next room, soon after it is born. It should be cleaned dry with a clean soft towel or cloth. The drying should be done quickly to prevent the calf from chilling especially in winter. After drying the calf, it may be weighed and the naval chord cut and disinfected as stated above.

Soon after this, ear marking with tattooing fork or ear tagging should be done for definite identification of the calf. Earlier application of identification marks is very important for calves to be raised in groups by weaning.

Feeding Colostrums:

The first milk that a cow gives after dropping a calf is known as colostrum. It is thick, sticky and yellow in colour. The colostrum from the dam is to be fed to the calves to be reared by natural as well as weaning method for first 3-4 days.

The importance (advantages) of colostrum feeding is as follows.

a. Colostrum contains 3 to 5 times more protein than normal milk. It is also richer in minerals (copper, iron, magnesium, manganese), carotene, vitamin A and other vitamins of B complex group, than normal milk. These nutrients are very essential for a good start of the growth of the calf.

b. The laxative property of colostrum helps to clean away the **"muconium" -** a solid metabolic waste product collected in the intestines of the young one. This is sticky, foul smelling and black in colour – first faeces passed out by calf.

c. The globulin fraction of the protein of colostrum carries antibodies. They enable the calf to protect itself from many infections.

The colostrum from the mother should be fed to the calf preferably within 30 minutes and not later than 90 minutes of birth. This is because with passage of time the permeability of intestinal wall to globulin (antibodies) decreases. If the colostrum from the mother is not available, that from any other cow may be fed. If no colostrum is available, the calf may be given the normal milk supplemented with 20 ml of cod liver oil, 60 ml of castor oil and one egg yolk.

Teaching the Calf to Nurse/Suckle:

- **Natural method**:

By instinct the calf looks for the food at and above the level of its head, and tries to suck anything it goes into touch with. Under natural conditions most of the calves will find out the teats, within ½ to 1 hour after their birth, and begin to nurse themselves. However, there may be calves, which need assistance in suckling for a period from one to several days. The calves have difficulty in nursing because of tight, turgid, thick teats full of milk, so they should be allowed to suckle after some milk is drawn from the udder.

- **Weaning method**:

In case of weaning system it is very necessary to teach the calf to drink milk. The calf has the instinct to look for food at and above the level of its head. This comes in the way of making the calf to understand that the food comes from below that level. Again, the calf knows "suckling" instinctively, but not "drinking". Therefore, the fingers should first be dipped into colostrum and be given to the calf for suckling from above. As the calf sucks, the fingers should be inverted and lowered down and dipped into the vessel containing colostrum. The mouth of the calf will follow the fingers to the surface of the colostrum. As its mouth comes in contact with the surface of the colostrum it will be induced to drink. By repeating the above action the calf should be taught to drink milk. This operation requires a great deal of patience. For

convenience, the calf may be taken to one corner of the pen and the milk pan should be kept at suitable height near the mouth of calf. Milk feeding pails with nipples attached are also available. The vessel and hand of operator should be thoroughly washed and disinfected prior to milk feeding, otherwise the calf may get infection leading to scour.

Feeding the Calves:

(a) Natural Method:

In this method, the calf is kept with the dam day and night for first 3-4 days. Then it is transferred to the calf pen. The calves in the same pen should be of about the same age. The calf should be taken for suckling twice to the dam. Ordinarily the calf should be allowed to suckle 1 kg of milk per 10 kg of its body (i.e. 10% of its body weight) per day for first 6 to 8 weeks of age. This may then be gradually decreased. The calf should be given a handful of concentrate mixture, moistened with milk after 1 week of age. This may gradually be increased to 0.5 kg daily. Similarly the calf should be given excellent quality roughage – preferably green - after it is about 2 weeks old. As the calf learns to eat the fodder, the quantity may be increased and fed *ad-libitum*.

(b) Weaning Method:

Under weaning system, the calf may be reared by feeding.

1. Skim milk or butter milk or whey (Milk replacer/substitute).
2. Calf starter (Conc. mixture containing 22-24% CP & one animal origin ingredient)
3. Milk replacer and calf starter combined.

Feeding schedule for method-1 (milk replacer) is given in Table below

Age of calf	Rate of feeding per day (kg)			
	Whole milk	Skin milk	Grain	Hay
1 to 3 days	colostrum	-	-	-
4 to 14 days	3 to 5	-	-	-
2 to 3 weeks	5 to 6	½ to 5	-	-
3 to 4 weeks	-	5	100g	-
4 to 5 weeks	-	5½	200g	Ad libitum
5 to 6 weeks	-	6	300g	“
6 to 8 weeks	-	6	400g	“
8 to 12 weeks	-	6	1 kg	“
12 to 16 weeks	-	5	1½ kg	“
16 to 24 weeks	-	-	1½ kg	“

It is thus estimated that the following ***amount of feeds*** will be required for raising the calf ***up to six months of age*** by this method.

Whole milk: 45 to 75 liters. Grain: 175 kg

Skim milk: 500 to 700 liters. Hay: 300 kg

When skim milk, butter milk or whey are not available for feeding, method 2 or 3 may be employed.

Precautions in Feeding Weaned Calves:

1. Care should be taken in maintaining sanitation and disinfection of milk feeding vessels, calf pen etc. The mouth of calf is cleaned after milk feeding & common salt be applied.
2. The temperature of milk or milk substitute should be nearer to the body temperature.
3. Routine timing of feeding should be followed.
4. The calves are kept tied individually at and after milk feeding to avoid suckling body parts of each other.

The calves should be taught to eat feed as early as possible. This will hasten rumen development, so that they can digest and eat more of their natural, economical feeds, viz. roughages and concentrates. Little milk may be sprinkled on concentrates initially when these are offered first time at the age of 1 to 2 weeks. The calves like clean, green and leafy legume or mixed fodders. The calves should have access to clean, fresh drinking water at all times.

Housing:

1. The calves should be kept in dry, clean and well-ventilated pens.
2. They may be provided clean bedding in winters.
3. They are kept individually until one month of age.
4. Then they are housed in groups according to age.
5. After 3 month of age, male & female calves are kept separately in similar age group.
6. The calf pen should have attached open yard for sufficient exercise.

Dehorning /Disbudding:

Advantages: Dehorned animals are safe to handle and require lesser floor and feeding space. There is no danger of horn cancer or injury afterwards.

Methods and age: The dehorning is done by physical method using electric dehorner / hot iron rod or by chemical method using KOH /$AgNO_3$ crystals at **10 – 14 days of age.**

Deworming:

The calves, especially buffalo calves, are prone to numerous roundworm infestations. So **regular deworming** of calves is important to maintain their normal growth rate. They are drenched with various **broad spectrum anthelmentics** periodically, such as Piperazine adipate, Heltac, Mebendazole, Parbendazole, Vermax etc. **Coccodiostats** like DOT, Sulpha drugs and Amprosol are also given to control coccidiosis.

Vaccination:

Calves are vaccinated for foot and mouth disease at 2 month of age and again booster dose is given at 6 months of age.

Growth pattern (Test of efficient calf management)

1. At birth weight of Kankrej, Jersey X Kankrej crossbred, Holstein Friesian X Kankrej crossbred and Mehsani buffaloes are 21–22 kg, 22-24 kg, 25-26 kg and 24-26 kg, respectively.
2. Indigenous, crossbred and buffalo calves should grow at the rate of 300, 450 and 400 gm daily.
3. Calf mortality should be within 10 %. Buffalo calves have little higher mortality rate (<15%) than this.

MANAGEMENT OF DAIRY HEIFERS

(A) Management of Growing Heifers:

From the management point of view, growing female bovines after the milk feeding or suckling stage (4 months of age) till first calving are called heifers. These are actively growing, yet unproductive animals. Therefore, there is a general tendency to neglect these animals. They should be managed as cheaply as possible, at the same time taking care that they grow at the normal rate and start breeding at an early age.

(a) Early Post-Weaning Period:

For the period of about 4 to 6 months after milk feedings or suckling stage (i.e. from 4 to 8-10 months of age) the dairy heifers should be fed 1-2 kg concentrates of good quality. The mixture, if possible, may contain some protein from animal origin. Concentrates mixture should contain nearly 14- 16% protein, if legume roughage is fed, and if not, the protein percent in the ration should be about 16-18%. Mineral mixture and common salt each should be fed daily @ 20 to 25 g to each heifer. Since the rumen is not fully functional in the early post-weaning period, good quality roughage should be fed to dairy heifers. Mixed (legume /non-legume) succulent roughage is very good. If all roughage is only non-leguminous it is necessary to feed about 25 g of steam-sterilized bone meal or any other calcium supplement to the heifers daily.

(b) Late Post-Weaning Period:

By about 4-6 months after weaning, i.e. after 8-10 months of age, heifers adjust themselves to high roughage-low concentrates ration. The rumen is also fully developed and functional by this age. In view of this, the heifers may not be fed concentrates mixture if good quality leguminous or mixed roughage is available for feeding. If the roughage is all cereals and is not of good quality, it is necessary to feed concentrates @ 1 to 2 kg. Mineral mixture and common salt each be fed @ 25 to 35 g daily.

Measures to Economize Feeding of Dairy Heifers:

One can economize ration for growing heifers by feeding

1. Some unconventional concentrates: Babul pods, cassia torra, mango seed kernel etc.

2. Urea treated poor quality roughage: Urea @ 4% breaks lingo-cellulose complex.

3. Molumin (urea + molasses + mineral) blocks.

The growing heifers are more comfortable under ***loose housing*** system. Buffalo heifers eat more and grow at faster rate when ***water is sprinkled/splashed*** on their body or are allowed to wallow in pond during noon hours in summer. This also helps in reducing the problem of anoestrus, silent estrus etc (summer sterility) by improving signs of estrus manifestation. They should be ***protected from external and internal parasites*** for efficient growth. They are ***vaccinated*** for HS, BQ, RP and FMD every year.

(B) Management of Breedable Heifers (Reproduction management):

The heifers should be fed, cared and managed in such a way that they attain optimum body size at their breeding age. For onset of puberty, body growth and development are more important than the age. They should not suffer in growth. Otherwise, (1) there will be delay in age at first calving and (2) loss in life time milk production. Optimum age and body weight at puberty, first breeding/maturity and calving for heifers are given below. There are species and breed differences in these characters.

Reproductive trait	Exotic	Crossbred	Zebu	Buffalo
1. Age at first heat/puberty (month)	8-9	12-15	20-24	18-24
2. Age at first breeding/maturity(mths)	13-15	15-20	24-30	20-27
3. Weight at first breeding (kg)	240-260	240-260	260	230-240
4. Age at first calving (months	24-28	28-30	36-40	36-40
5. Weight at first calving (kg)	340-360	300-320	300-320	340-380

Pubertal/Mature heifers should be **checked for heat at least two times daily**, i.e. morning and evening, so that animals in heat are not missed. If the herd size is large, a **teaser** (vasectomised bull) **is used for heat detection**. **Anoestrous heifers** of breedable age and having proper growth should be routinely **examined every month** and necessary action be taken.

The heifer should be got **bred depending on her breed/genetic group and the breeding policy** to be followed. In case of crossbred heifers the breed and exotic inheritance of the sire to be used should be decided well in advance to carry on breeding according to a planned program. It is desirable to maintain the exotic inheritance between 50 and 62.5% for better heat & disease tolerance. Breeding heifers to bulls, known to produce small calves, helps reducing trauma/dystocia at calving and subsequent reproductive problems. Purebred exotic heifers and indigenous heifers of dairy breeds should preferably be bred with progeny tested

pure breed sires, and not for crossbreeding. ***Pregnancy diagnosis*** of the heifers should be a routine on the farm.

Those heifers which are pregnant should be well looked after and cared for and be ***fed slightly liberally***. They may be ***accustomed to getting tied and be groomed***.

(C) Management of Advanced Pregnant Heifers:

Gestation period:

Average **gestation period** of indigenous **cows** is about ***280 to 285 days*** and that of **buffaloes** ***310 days***. Average gestation period of exotic dairy cattle is about 283 days. But this varies with breed from 278 to 288 days. Ordinarily, heifers have 1 to 2 days shorter gestation period as compared to that of the cows. Similarly on average male calves are carried 1 to 3 days longer than the female calves.

Management:

Up to about 7 ½ months of pregnancy, no much extra feeding or care is necessary to be given to the heifers. They are housed, fed and managed along with other heifers. Then on completion of about 7 to 7 ½ months, the heifers should be transferred to the milking herd. They should be housed and fed along with milch cows. They should be brought to milking byre/parlour, tied and fed concentrates along with milking cows. While feeding concentrates they should be groomed. Their hind legs be tied, and udder and teats be manipulated as if milking is done.

Feeding:

Advance pregnant heifers are growing animals. Not only is this, in their body the foetus also actively growing. Hence they need especially extra energy, proteins and minerals in their ration. Such heifers should be fed daily, about 1½ to 2 kg of concentrate mixture in addition to their usual ration fed till now. In the concentrates mixture, they should be fed 25 to 30 g of mineral mixture or steam sterilized bone meal.

Housing:

About a fortnight before the expected date of calving, the advance pregnant animals should be housed in maternity pen/calving box at night time. The pen should thoroughly be cleaned and disinfected and sufficiently bedded before the animals are housed in them. With approaching parturition, they may be housed in the pen all day and night, and should be looked for calving, every 2 to3 hours during the day and night. They should be given laxative ration.

(D) Care of Pregnant Heifers at Calving:

When the animal is observed to kick the floor, it is to be presumed that the labour pain has already started and that parturition is expected within 2-4 hours. Arrangement should be made to observe silently the progress of the process of parturition and readily assist the cow in the process in case of need/dystocia. During this process of watching, we should ascertain whether the calf is in normal position or not. If the presentation is normal, generally no assistance is necessary. Yet, we may pull the calf out gently after the head and legs up to knees are out. In case of abnormal presentation **(Dystocia- difficult birth)** expert aid should be called for to assist the birth.

CARE & MANAGEMENT OF FRESHLY CALVED ANIMALS

The cow should be fed palatable feeds (***calving mixture***) like wheat bran 1 kg mixed with high energy feeds like Jaggery 500 gm, Common oil 200 gm, cooked Bajra/Jowar 1 kg plus Suva, Ashalio, Methi each 100 gm, after the birth of the calf. It is customary to feed to parturient animals the calving mixture after cooking for a period of 10 to 15 days after calving.

This will provide to the cow readily available energy. It is also believed to induce the milk flow and to aid cleansing the reproductive tract. It is not necessary to feed special calving mixture, if the heifers were fed well during gestation.

After feeding calving mixture/concentrates, the cow should be given lukewarm drinking water. This may be warmed up if it is very cool. Good quality dry roughage should then given to the animal. The animal then be allowed to take rest and watched silently for passing out of the placenta or fetal membranes. The placenta is expelled out normally within 6 to 8 hrs of calving. It weighs between 2.5 to 3.0 kg. If placenta is not expelled out, there will be decomposition in uterus and may impair general health and subsequent reproduction of the cow. If the placenta does not get expelled within 24 hrs, arrangement should be made to remove the same manually. The placenta, on expulsion, should be immediately removed away from the animal and be buried. As the animal have a very strong urge of eating these membranes and hence constant attendance is necessary to prevent the animal from eating the same and dispose it away. It is believed; if the animals eat these membranes their milk production is decreased and may develop troubles in digestion.

After the expelling of the fetal membranes the hind region of the cow should be washed with warm water and dried with cloth. The soiled and wet bedding then be removed and replaced by fresh dry bedding material. Freshly calved cow should be milked as early as possible to remove colostrum. The colostrum is to be fed to the calf. For first few days, the cow may not be milked completely to avoid problem of milk fever.

Freshly calved cow may be housed in the maternity pen for about 4 days. She should be fed good quality roughage ad-libitum and calving mixture or concentrates mixture. The quantity of concentrates mixture fed should be gradually increased and in the calving mixture normal concentrates should be mixed in increasing proportion and finally cow to be taken to only the normal milch ration.

For a period of about 10-15 days after calving, the cow should be protected from stormy cold winds, rain or direct sun as the case may be. The cow also needs protection from dogs, foxes, wolves, crows etc., during and just after calving.

CARE AND MANAGEMENT OF MILKING ANIMALS

Milking animals are the earning members of the dairy herd. These animals produce milk, sale of which forms more than 80-85% of the income from the dairy farm. Any lapse in the management of these animals is immediately reflected in lowered milk production and hence the reduced income. That is why it is necessary to look after the milking animals very carefully. Different body systems of the milking animals have to work very hard for producing high quantity of milk. As a result of this, the milking animals are under a sort of stress. Hence, even the slightest deviation from the normal routine makes them upset resulting into low milk production.

The salient 10 features of the management of the milking animals are as follows:

(1) Regularity of routine operations:

Dairy animals are the creatures of habits. Repeating any action at appointed time in a given sequence forms habit. Performing various daily operations in a sequential manner at a particular time on a farm makes a routine. Hence, on a dairy farm any convenient sequence of daily operations should be followed at conveniently fixed timings. However, having fixed the routine according to our convenience, it should not be lightly changed; but be followed regularly. Milking animals get very nervous to any change in the routine and react very badly by producing less milk.

(2) Gentle and kind handling and behaviour:

Animals of all the categories of the herd should be treated with kindness. This is more so with the milking animals. Ill-treating the animals, shouting very loudly, beating etc., should be avoided with milking animals, as they are readily frightened and become nervous. This leads to reduction in feed intake and milk yield. Milking animals should be called with gentle voice and affection, and should be patted and groomed gently.

(3) Feeding:

(a) Concentrates:

From a very long-standing experience of keeping and feeding very large number of animals, dairymen have evolved certain guidelines for feeding concentrates to animals. They are known as **thumb rules**. In this method concentrates is fed for maintenance and for milk production.

(i) **Maintenance Allowance**:

Ordinarily, mixed roughage of good quality fed to the milking animals, supply fully their nutrients requirement for maintenance. In other words it is not necessary to feed any concentrates to the milking animals for supplying nutrients for maintenance, if the roughage is mixed and is of good quality. But if the milking animals are getting all cereal roughage, i.e. not mixed, it is necessary to feed concentrates to them. This may be fed @1-2 kg daily/head according to the roughage quality and condition of the animals.

(ii) **Milk Production Allowance**:

The concentrates for milk production are to be fed in addition to what is fed for maintenance. The amount of concentrates to be fed for milk production depends principally on the **fat content of milk**, i.e. whether the animal is cow or buffalo, and to some extent on **type of roughage fed**.

With good quality mixed roughage feeding and if the fat content of milk is not exceeding 5.0 %, i.e. for cow, the concentrates may be fed at the rate of 33% of milk production. If roughage is all cereals and/or its quality is not good, the concentrates may be fed @ 40 % of milk production. If the fat content of milk is 6.5 - 7.0 % or more, i.e. in case of buffaloes, with good quality mixed roughage, the concentrates may be fed @ 40% of milk production. With all cereal roughage or medium to poor quality roughage, the rate of concentrates feeding should be 45 - 50% of milk production.

(A) Production allowance for Fat % in milk	Concentrate to be fed (as % of milk production), if fed	
	Good quality mix roughage	All cereal roughage
(i) 4-5 % fat (cow)	33 % of milk	40 % of milk
(ii) 6-7 % fat (buffalo)	40 % of milk	45-50 % of milk
(B) Maintenance allowance	nil	1-2 kg

(b) Feeding Minerals:

Ordinarily, except for the calcium, phosphorus, sodium and chloride all the other minerals required by the milking animals are present in conventional feeds to meet with their normal requirements. Hence they need not be supplemented. But there may be certain areas where soil is deficient in one or more of the micro-minerals. In that case, the forages grown on such soils are also deficient. Under normal conditions milking animals should be fed about 30 g of common salt daily. This may be fed mixed with concentrates or in form of bricks or blocks of salt as licks, or loose in saltboxes, or loose in mangers. If the animals do not get about 50 % of roughage as legumes, they should be fed daily about 25 to 30 g of calcium supplement or steam sterilized bone meal. It is advisable to feed minerals supplement to the high yielding animals even if they are fed mixed roughage.

(4) Milking:

After parturition, the dairy animals are milked. The milk produced for first 3 to 5 days may not be taken for sale or use as fluid milk as it is 'colostrum'. It is very high in protein and coagulates on heating.

After parturition, the dairy or weekly milk yield of the animal increase very rapidly up to 5 to 9 weeks and reaches the maximum level. This highest level reached, is called the **peak yield**. In Kankrej animals, this peak is reached in the sixth week after calving. The peak production then declines at the rate of 1.7 to 2.0 per cent per week. **Persistency** of high milk production is important for getting higher lactation yield.

The **lactation milk yield** of the dairy animals is lowest in the first lactation. It then **increases up to 3rd to 4th lactation**; after which it gradually decreases showing the effect of advancing age.

The dairy animals are mostly milked two times daily. It is well known that **milk secretion is a continuous process** and also that the **rate of milk secretion is inversely proportional to the intra-mammary pressure,** hence cow should be milked at regular interval of 12 hrs. In view of these facts, soon after milking, secretion rate is at its maximum and soon before milking secretion is at its lowest. Therefore if animals are milked three times instead of twice there will be an increase in production of milk by about 15 to 20%. The animals yielding 10 liters or more milk daily can be milked three times. Very high yielding animals may be milked even four times daily.

Measures/Tips for Clean Milk Production:

It is desirable to milk the animals in a clean milking byre. Milking should be done in clean sterilized utensils by healthy milkers, dressed in clean cloths. Udders and teats of these animals should be washed with warm potassium permanganate solution and dried with a clean piece of cloth. Strip cups should be routinely used to detect mastitis in early stage.

Precautions at milking time:

After the letdown of milk by action of hormone oxytocin released, the milking operation should be swift, yet comfortable to the cows. At the time of milking the surrounding should be clean, quiet and peaceful. Barking of dogs, shouting, beating the animals, presence of peculiarly dressed strangers, visitors in large number should be avoided, since these results in release of fright hormone adrenalin and withholding of milk/ reduction in milk production.

(5) Breeding:

After parturition, animals may come in heat within about a month's time. However, it takes about **2 months for complete uterine involution**. Hence animals coming in heat within two months of parturition may not be bred.

Exotic cows have a calving interval of about 13 to 14 months; crossbred cows about 14 to 16 months, indigenous cows about 17 to 19 months and buffaloes about 16 to 20 months. The calving interval longer than 15 months leads to uneconomic production. Hence the milking animals should be successfully bred between 3 to 5 months after calving. All the relevant measures of heat detection, pregnancy diagnosis etc., as described under 'to maintain the reproductive efficiency' under the managerial function on a dairy farm, should be taken for maintaining optimum calving interval.

(6) Housing: (objectives of providing house)

Milking animals should be housed in such a way that-

(i) They are protected from extremes of climatic elements, wild life and ecto-parasites.

(ii) They are comfortable under sufficient ventilation and sanitation.

(iii) There is convenience in feeding and management of the cows.

(7) Drying:

It is necessary that dairy animals have adequately long (60 days) dry period. Because during this period (i) the nutrients reserve that is lost during lactation is replenished in the body, (ii) the mammary system makes good wear and tear of different tissues and gets ready for the next lactation and (iii) the nutrients are diverted to the actively growing foetus. Dry period of about 60 days in believed to be adequate for exotic/crossbred animals. With high yielding indigenous animals the period of about 100 days is considered adequate. The dry advance pregnant animals should be given extra allowance of nutrients called "***steaming up***" to meet the above needs of the body.

Methods of Drying:

The animals which have had a lactation period of about 10 months and which carry the foetus of 6 to 7 months may be dried. The animals to be dried should not be allowed to come in contact with their calves. Their concentrate feeding is discontinued. They should not be fed any

succulent roughage. Even dry fodder fed should be of poor quality and that to only 50-60% of normal quantity. Water intake should also be reduced. These steps help in reducing the milk secretion materially and hence drying the animal quickly. The animals can be dried by any one of the following three ways/methods.

(i) Partial milking method:

In this method of drying, all the milk the cow gives is not removed, but some amount is allowed to remain in the udder. Thus, the intra-mammary pressure in the udder is not completely relieved. This results in reduced secretion of milk day by day, since milk secretion is inversely proportional to i/ma pressure. When the milk yield is considerably reduced, milking first on alternative days, then once in three days etc, dries the animals.

(ii) Intermittent milking method:

In this method animals are milked once daily, then once in 2 days, once in 3 days etc., thus gradually extending the period between milking and then stopping the milking.

(iii) Abrupt stoppage of milking:

This is the most effective method of drying. Animals yielding even up to10 litres of milk can be dried by this method without any trouble. As the milking is not done the intra-mammary pressure is built up in the udder, hence milk secretion comes to stand still. As the formation of fresh milk is stopped the milk already filled in the udder gets re-absorbed into the blood streams and the cow gets dried up.

(8) Providing water:

Milking animals perform very hard work in secretion of milk. In addition, they lose quite a lot of water from the body in form of milk. As a result of these, they need more water than that needed by animals of any other category of the dairy herd.

The amount of water required by the milking animals is governed by the following factors, viz. (i) Ambient temperature/season (ii) Moisture content of the feeds, (iii) Milk yield (iv) Temperature of water and (v) The degree of cleanliness of the water.

Milking animals, in addition to 30-35 litres of water for maintenance, need 2 to 3 litres of water for every one litre of milk production (total 55-60 lit). In summer, the water requirement of milking animals increases by 100% over that in winter. In addition to drinking water needs, about 40 to 70 litres of water per cow daily is also required for cleaning and washing of animal/shed etc.

Milking animals should have free access to clean drinking water, all the time. If this is not possible, they should be given water at least four times daily. In regions, where winters are very chilly the drinking water for milking may be slightly warmed up. Providing water to the milking animals through automatic drinking bowls is the most satisfactory way.

(9) Health Care Measures:

Sanitation, isolation of sick animals and timely treatment are important. Regular CMT testing for mastitis helps control of disease. All the animals of the dairy farm, viz, calves, heifers, cows, breeding bulls, bullocks etc should be kept free from infectious/ contagious diseases. Therefore, as routine the herd should be got regularly tested annually once for

Tuberculosis, John's disease & Brucellosis, and reactors/doubtful animals be removed/slaughtered.

Timely vaccination for prevention of disease like Foot and Mouth disease, Rinderpest, Hemorrhagic Septicemia, Black Quarter etc., should invariably be done. Regularly, as a routine for control of endo-parasites, deworming of the dairy herd should be done at least once before the onset of monsoon and once after the monsoon is over. This must scrupulously be observed in case of crossbred and exotic animals as they are very badly affected by worm infestation. The whole dairy herd should also be protected from ecto-parasites like the ticks, mites, lice, grubs etc by periodical dipping.

A health calendar should be prepared, indicating the approximate dates and months of the year and the prophylactic measures to be taken against diseases, worms, ecto-parasites etc., and this should be rigidly followed.

(10) Daily Routine Inspection:

It is very necessary that daily some responsible person should observe each milking animal individually very closely. At the time of the observation the following points/ objectives be kept in mind and be noted, viz. (i) general health and condition of the animal, whether there is loss in condition or improvement, (2) whether the animal is cycling, is in heat, or has passed the heat or has been bred and is pregnant etc., (3) whether there are ecto-parasites like ticks on the body, especially underneath the root of the tail etc., (4) whether there is any injury to the teat or udder, (5) the level of current milk production of the animal, whether increasing or decreasing etc. The actions necessary to be taken as a result of the inspection should be decided and promptly executed. The additional advantage of this routine inspection is that the responsible man will know all the milking animals individually. The animals also feel familiar with the person and do not get frightened or nervous when he moves in the herd or approaches very closely to any of them.

CARE OF THE DRY COWS

In an efficiently managed dairy herd the dry cows are always pregnant, carrying the foetus at least of five months or more, (mainly because of proper calving hygiene, timely post-partum breeding, and sound care & management throughout lactation). As the foetii are growing actively in the wombs of advanced pregnant animals, they require liberal supply of energy, protein and minerals in their ration (steaming up). They have also to replenish the reserve storage of nutrients already depleted during the lactation period through milk secretion, and to have improved yield in ensuing lactation.

Therefore, after about 7 1/2 months of pregnancy, the dry cow should be fed 1.5 to 2.0 kg of concentrate as pregnancy allowance, over and above the maintenance need. If leguminous roughage is lacking, daily about 25 to 35 gm of steam-sterilized bone meal or any other suitable mineral supplement be fed. The other management of the dry pregnant cows should be similar to that described for advance pregnant heifers.

CHAPTER 5

SHEEP PRODUCTION MANAGEMENT

Text books:

1. Farm animal management by N.S.R. Sastry and C.K.Thomas
2. Text book of Animal husbandry by G.C. Banerji
3. ICAR. 2002. Handbook of Animal Husbandry 3rd Ed. ICAR.

Sheep production is one of the oldest and most important agricultural enterprises. Usefulness of sheep is known by their early domestication (6 to 8 thousands years ago). Sheep with its multifaceted utility (for wool, meat, skins. manure and to some extent for milk) plays an important role in national and especially in arid and semiarid areas (with marginal and sub-marginal lands) unsuitable for agricultural production. Sheep is perhaps the most appropriate livestock species for utilizing the sparse vegetation. Sheep can survive on poor and low-set vegetation because of their existence to their ability to survive prolonged periods of drought and semi-starvation and to travel long distance for obtaining sufficient forage and water to subsist. They are less prone to hazards of tropical heat and are more resistant to parasitism and other sheep diseases. Sheep in tropics are non-seasonal breeders; whereas other sheep are seasonal breeders.

Sheep provide two sources of revenue annually. The first and the most important are the market lambs. The percentage of lambs raised is an important factor in determining profit. Under average conditions a lamb may be marketed at 9 months after birth. The second source of income is the fleece (Wool).

Sheep have a permanent place in any sound system of agricultural production. They are the most adaptable feed consumers on the farm. They stand first as weed consumers and destroyers. The ability of sheep to maintain the fertility of the soil and to restore productivity; is the cause for their common name **golden-hoofed animals.**

Place of Sheep in Animal Kingdom:

Class : Mammalia

1) Hairy coat
2) Mammary glands
3) Full developed foetus-birth
4) Warm blooded

Sub class :Eutherid- Placenta

Order :Ungulata- Hoofed

Sub order :Artiodactyla-Even toed

Family :Ovidae –Two claws

Species :Ovis aries – Domesticated sheep

Regionalization of Sheep:

On the basis of geophysiographic and climatic conditions and the type of sheep, the country can be divided four regions.

Sr. no.	Region	Comprising of states/part	Important/Principal breeds	Contribution of India
1	Northern temperate-Himalayan region	Jammu and Kashmir, Himachal Pradesh and hilly districts of U.P.	Gurez, Bhakarwal (imp wool producing breed of India), Rampur Bhushair (outstanding breed of this region) Karnah, Gaddi.	Sheep population : 7.6% Wool production : 6.0%
2	North Western Region	Rajasthan, Punjab, Haryana, Gujarat, MP, and Western U.P.	Bikaneri (Chokla, Magra and Nali), Lohi, (Jaiselmeri, Malpura, Sonadi), Marwari, Patanwadi etc.	Sheep Population : 32.4% **Wool production. :64%**
		The wool from this region is considered **suitable for carpet manufacture** and is exported in large quantities. Joria Region : Arid region of Kutchh, Saurashtra, North-Gujarat and Rajasthan,		
3	Penninsula region	Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu	Deccani/Bellary (Wooly type breed), Nellore, Mandya (Mutton type), Nilgiri, Coimbatore etc., Either Coarse, Hairy and Colored fleece or no wool.	**Sheep population : 52%** Wool production = 28 % of IndiaWool production : : 28%
4	Southern Region	Bihar, West Bengal, Orissa and Assam.	**Mostly for Meat.** Mostly Non-descript breeds. Two well known breeds-Shahbadi and Chhottanagapuri in Bihar.	Sheep population : 8% Wool production : 2 %

In foreign countries there is a considerable demand of the white carpet wool produced in the north-western India for clipped in India is exported annually. Sheep meat is an important nutritious item in the diet of non-vegetarian section of people. In India, special class of people rear sheep. They move with their flock from place to place according to the changes in the seasons and availability of grazing. Shepherds have adjusted the sheep rearing practices to routine agricultural operation and practices prevalent in different tracts. When lands are sown with food crops in the rainy season, the shepherds move to the hills, avoiding damage to the

crops and also providing dry, healthy autumn when the kharif crops are harvested, the sheep return to the plains and get their quota of straws and grass, helping the farmers to fertilize the land when they fold the flock of 50 to 60 sheep as the minimum economic unit. Small flock of 20 to 30 ewes is found as side occupation to farming. Very large flocks of 500 to 1000 sheep are also found in west arid areas.

Advantages of sheep Production:

1. Sheep utilize the more arid type of waste land and pastures.
2. They can utilize and destroy weeds.
3. As compared to cattle, they are more efficient in conversion of feed to products viz., Meat, Milk and Wool.
4. They give income three times in year viz., once from sale of lams and two times from sale of wool. There may also be daily small income from milk.
5. In comparison to cattle the return on investment on sheep starts earlier e.g., lambs may be marketed 8 to 9 months after ewes are bred.
6. Sheep manure is twice as rich in potassium and phosphorus compared to that from bovines.

Plant nutrients in one tone of different manures:

	N (lbs.)	**P_2O_5 (lbs.)**	**K_2O (lbs.)**
Cow	11.4	3.1	9.9
Sheep	15.8	6.7	18.0
Horse	13.2	5.1	12.1

7. Wool clip is easy to store and transport therefore marketing of wool is relatively easy.
8. Labor and housing requirement minimum.

Factor unfavorable for sheep production:

1. Price of wool varies too much from place to place, lot to lot and grade to grade. It is also influenced by political situations.
2. In India demand of lambs for meat is limited.
3. Sheep are attacked by predatory animals including dogs.
4. Sheep are less resistant to diseases and parasites. A number of external and internal parasite infestations occur in sheep.
5. Keeping sheep is not an attractive profession.
6. Wool has to complete with synthetic fibers.

Because of the above facts, the sheep rearing industry is developed only in certain regions and countries of the world. New Zealand has the maximum development the mutton type sheep. Whereas, Australia has the largest sheep population in the world, mainly fine wool sheep. Wool

producing and exporting countries are mostly in the southern hemisphere viz., Australia, New Zealand, South Africa, Argentina etc. Wool consuming countries are situated in the northern hemisphere are USA, England, France, Germany and Belgium etc.

Systems of sheep production:

In USA, Australia, New Zealand etc. sheep are maintained mainly by any one or combination of more than one of the three systems.

a) Ranching system **b)** Semi-ranching system and **c)** Stall feeding system

Sheep raising system in India:

In India there is no any definite system of sheep rising. The shepherds have made their own adjustment to suit the agro-climatic conditions prevailing in different regions and tracts.

Hilly areas:-

When lands are sown with food crops in rainy season, the shepherds move to the hilly areas having low rainfall to avid damage to food crops and protect the animals from parasitic infestation. They return to the foot of the hills as the winter sets on favoring food grazing in harvested field and protecting animals from cold.

Plains:-

The migration of sheep flocks (is similar to that of hilly areas). Instead of going on hills in rainy season, (they move) to the arid regions/desert. Sheep require dry climate and this is the way to provide it. Shepherds move to heavy rainfall areas after monsoon and fold their animals in fields from which kharif crop are harvested.

Classes of sheep:-

The most common classification of sheep is based upon the type of wool they produce.

1. Fine wool type :

This type of sheep produces a fine, wavy wool. Fibers and the fleece are dense and contain a large amount of grease. They produce more wool of good quality. Fiber diameter of wool is less than 22 microns. The breeds of this type are primarily developed for their wool production. They possess a strong banding instinct and the ability to graze on poor quality range. E.g., Merino, Rambouillet.

2. Medium wool type :

The medium wool breeds have wool fibers with medium fitness (22 to 33 microns) and are primarily developed for mutton production. They are low-set, blocky and compact in type. They are best in mutton conformation. They do well on semi-range or farm condition e.g., Dorset, Suffolk, Southdown, Cheviot, Hampshire, etc.

3. Long wool type :

They have wool fibers of 15 to 30 cm. long, but coarser in quality. They are large in size compared to the other classes of sheep. Now they are not so popular because of their poor quality carcasses with extra muscular layer of fat. However, they are extensively and successfully used in crossbreeding for market lamb production and evolving new dual purpose breed of sheep. e.g., Lincoln, Leicester, Cotswold, Romney marsh.

4. Crossbred wool type :

They produce wool similar to medium wool in quality. These breeds have been produced by crossbreeding between fine wool and long wool breeds of sheep. The crossbred sheep have also retained banding instinct but lost some fitness of wool. The crossbred breed are often classified as medium wool rather than placed in a separate class e.g., Corriedale, Pollworth, Panama Columbia, Hissardale, Avikalin, Bharat Merino etc.

5. Carpet wool type :

These breed of sheep produce coarser, wiry and tough fleece. Most of the sheep of north western Indian origin produce wool suitable for carpet manufacturing. Carpet wool is produced in Argentina, Pakistan, India, New Zealand, Syria and Iraq. The fiber diameter of this type of wool is more than 33 microns. e.g., Bikaneri, Patanwadi, Marwari, Scottish black face etc.

6. Fur type sheep :

These types of sheep (Karakul) are kept for producing lambs. The lambs are sacrificed for producing pelts. **'Pelts' are sheep skins with fur but little or no wool.** Pelts are of 3 main classes. There are several grades of pelts within each class, depending upon color, quality and general appearance.

The 3 classes of pelts are as follows:-

Broad tail pelt	**Persian lamb pelt**	**Karakul pelt**
It is **most valuable** pelt, produced from stillborn or premature lambs or lambs killed after birth. The reflection of light gives it watery appearance.	It is produced by killing the lambs when they are 3 to 10 days old, after hair has formed a tight, lustrous curl.	It is the **least valuable** pelt with opened curls and taken from the lambs when are two weeks or more of age.

EXOTIC BREEDS OF SHEEPS:

MERINO

It is the most popular fine wool breed of sheep in the world, originated in Spain. They are distributed all over the world. In different countries the Merino strains have been developed by selection viz., Russian Merino, Australian Merino, French Merino (known as Rambouillet), American Merino etc. The wool produced by merino is very fine without hairy fibers. More than 40% of the wool produced in the world comes from merino and their derivatives. They nave been proved to be an extremely adaptable sheep under the rough range conditions. They are active and good grazers and thrive well on scant pastures.

Characteristics: Merino is white with skin folds around neck. They are wool type sheep with angular form. Rams are horned but ewes are hornless or polled. The face and head are covered with wool. Sometimes wool blindness is observed. Sheep with open face are desired. They are having weak back, short and drooping rump, long straight legs and narrow chest. Depth of the body is not adequate i.e., they are having poor mutton conformation.

Prolificacy in the breeds is only fair i.e. about 110 %. (100 ewes will produce 110 lambs in a lambing season). Rams weigh 64 to 80 kg. Ewes weigh 40 to 57 kg. Annual greasy fleece yield is about 5 to 9 kg. Quality of wool is about 64's – 80's.

RAMBOULLET

Merinos from Spain were imported (in 1786-1801) to France and kept at Rambouillet farm (near Paris), hence the named Rambouillet. They were pure breed on the farm and selected for large size, better mutton conformation and acceptable fleeces. They do not thrive well on very severe range condition i.e., they are less hardy than Merinos.

Characteristics: Rambouillet sheep produce a fair market lamb and produce an excellent fine wool fleece. The rams may have horns or be polled, but the ewes are polled. They are large sized animals with straight top and deep body. The average weight of mature ram is around 110 to 125 kg and that of mature ewe is 70 kg. They are uniform in depth and width. They have thick quarter. Fleece is dense. They produce 9 to 10 kg of fine quality wool in a year with 64's to 70's. Prolificacy of this breed is 125 %. Rambouillet sheep are best adapted to ranches with less severe condition and used for producing crossbred lambs using any medium wool- mutton type ram. Rambouillet ewes are good feeders and produce top quality fat lambs. Recently polled strain of Rambouillet is becoming more popular. Hornless animals are free from fear of injuries and trouble of flies.

SOUTHDOWN

They are originated in south down hills of South-eastern England. Southdown is the ideal and model mutton breed. It has the best mutton type/carcass conformation. Southdown sheep are characterized by short legs, wide chests, straight tops, deep twists and bulging rear quarters (LOW-SET appearance). Face color ranges between dark gray and light brown. Similar color is observed on legs.

Characteristics: Southdown is smaller breed of sheep. Rams usually weigh 90 kg, and ewes weight 60-62 kg. Rams are more 'prepotent' than those of any other breed. (Prepotency means the ability of the ram to produce his own characters in the progeny). It is fairly prolific breed, producing 135 to 140 lambs in a year per 100 ewes. This breed is not so hardy and can thrive well on semi ranching system. The animals are attractive and stylish.

They produce medium wool having 56's to 58's. Annual greasy fleece weight is 3 to 4 kg/sheep. Staple length is below 5 cm.

DORSET:

Dorset or Dorsethorn is the native of Dorset County in Southern England. **Dorset is famous for early lamb production**.

Characteristics: It is a medium sized sheep with medium low-set body. Average weight of the mature ram and ewe is the 110 kg and 85 kg respectively. Dorset ewes have good mutton conformation. Both males and females have of corkscrew triangular horn which curve backward and around in a close spiral. Naturally polled animals are preferred. Dorset is open faced. The face is covered with short, white hair and is principal covering below the knees and hocks. Dorset is lighter shearing breed producing annually about 3.5 to 4 kg., fleece of 54's to 58's.

The staple length is about 7 to 8 cms. The fleece has low shrinkage. Dorset is highly prolific having lambing % of 150. Triplets are more common. Ewes are excellent milk

producers. The rams when crossed with any ewe producing good quantity of milk, produce fast growing lambs which make very desirable milk lamb at an early age.

SUFFOLK

Suffolk is native of South-eastern England. It has originated from the crossing of improved Southdown rams and the indigenous/local Norfolk Sheep.

Characteristics: Suffolk is an attractive and useful breed of sheep. They have black head, ears and legs. They have open face having black hairs on face, black hairs are also found below the knees and hocks. Both sexes are polled. Suffolk is medium low-set. Adult rams weight about 125-136 kg and adult ewes around 80-80 kg. The wooling along the underline is sparce. This gives the animals a shallow appearance. They are very alert and thrifty animals. Annually greasy fleece yield is 3 kg with low grease content. The fleece grades 50's to 58's.

Suffolk is having a relatively small head and fine bones. Because of this Suffolk can be used successfully in crossbreeding. Suffolk ewes are one of the most prolific-lambing % is 150. Ewes are good milker and good mother. Lambs are fast growing and good feeders.

LEICESTER

Leicester is a longwool breed, originated in Leicester county in central England. Robert Backwell improved it in the form and quality. There are two distinct types of Leicester's in England viz., England Leicester and Border Leicester.

Characteristics**:** It is smaller in size as compared to other long wool breed. Adult rams weigh 114 kg and adult ewes 82 kg. The fleece of the Leicester grades excellent for coarse wool and is carried in fine spiral locks. The wool is long measuring from 15 to 25 cm. Annual fleece yield is 4 kg with 40's to 48's. Leicester sheep are fair in prolificacy (110-120 lambing %.) They mature slowly and produce poor quality carcasses with thick layer of extra muscular fat. The animals are valued for crossbreeding and evolving new breeds.

LINCOLN

Lincoln breed of sheep is native to Lincoln County in eastern England. The large size and hardiness of the Lincoln together with its heavy fleece of lustrous wool has made it the most widely distributed breed in the world, excepting only the Merino.

Characteristics: **It is the largest sized sheep in the world**. Adult rams weight 148 kg and adult ewes 98 kg. Lincoln is rather rectangular in form, is deep bodied and show great width. Fleece of Lincoln is carried in heavy, twisted, spiral locks. Wool is very long 25 to 37 cm. It is of coarser quality with 36's to 40's. Annual wool production is 10 kg/sheep.

Lincoln carcasses are heavy and long. They have thicker external layer of fat. Hence Lincoln is not preferred for lamb production. The carcasses also have coarser grains of mutton. The Lincoln breed has been extensively used in crossbreeding. It has played important role in evolving new crossbreeds.

Crossbred evolved	Males of Breed	Used to breed	Females of Breed
Corriedale	Lincoln Rams	X	Merino Ewes
Columbia	Lincoln Rams	X	Rambouillet Ewes
Panama	Rambouillet Rams	X	Lincoln Ewes

CORRIEDALE

It is originated in New Zealand (in latter part of 18th century) by crossbreeding with large framed Merino ewes with good Lincoln rams. Careful selection of crossbred ewe and ram lambs for further mating accompanied by close culling, this Corriedale sheep was developed. Later on some Leicester rams had also played some role in establishment of this breed.

Corriedale sheep were exported to Australia, U.S.A., South Africa, Canada and many other countries. India has imported Corriedale sheep from Australia and Started a Breeding Farm near Hissar.

Characteristics: Corriedale is a hardy, dual purpose breed of sheep. It is a good producer of both, wool and mutton. Mature rams weigh 90 to 125 kg and ewes 60 to 90 kg. They have open faces. Both rams and ewes are polled. Corriedale are relatively early maturing and have good mutton conformation but usually have little longer legs than desired for mutton breed. They are well adapted to range condition. Corriedale rams are remarkably prepotent in cross breeding.

Corriedale wool is of medium fineness, with about 50's to 58's. Corriedale sheep produce on average 5 kg wool in a year per head. Wool of Corriedale has low shrinkage and good fiber length.

KARAKUL

Karakul breed of sheep is famous throughout the world for pelt production. It is native of Bokhara in Central Asia, but large number of Karakul sheep are found in U.S.S.R. India has imported some animals in from U.S.S.R. for crossbreeding with native sheep and increasing pelt production. They are kept near Bikaner in Rajasthan.

Characteristics: They are hardly animals. Medium in size, the weight of mature rams is 90 kg and that of ewe is 65 kg. The rams are generally horned and the ewes polled. Karakul sheep have long and narrow faces with Roman nose. Ears are long and drooping. The color of the face and legs is black or brown. They have broad, fat tails. Fat tail serves a useful purpose in the desert country as a nutrient reserve. The Karakul sheep have poor mutton conformation. They produce a light weight fleece of low grade annual wool yield is 23 kg. Wool quality is coarser carpet quality. Te outer coat is usually grey, brown or black and the under coat is much shorter and dark brown or black.

The karakul lambs are having fur bearing skin pelt. Lambs are killed immediately after birth of after some days for collection of pelts. The quality of fur on pelt varies depending on the time interval of slaughter. Major types of Karakul pelt are Broad tail, Persian lamb and Karakul.

INDIAN BREEDS OF SHEEP

I) Temperate Himalayan Region :

GUREZ

Gurez is an important wool (long stapled and lustrous predominantly white and less hairy) producing breed in India. Gurez is bred in Gurez Tahsil situated in the high elevated zone of Kashmir state. In summer small sprouts of grasses come up, which provide grazing to the sheep. In cooler months, when snow-fall begins, they come to valleys. Animal are stall fed in winter with stored hay, barley straw or maize straw.

Characteristics: Gurez is the largest sheep found in Jammu and Kashmir region. They are two strains of Gurez sheep. One which is the major strain is polled and the other is horned. They have short but broad tail. Ears are short. Fleece of Gurez is without any defective fibers –kempy fibre. Average greasy fleece yield is 1350 to 1800 grams per year. Quality of wool is 40's wool with 26 % shrinkage i.e., more grease content. Fiber length is about 15 cm. shearing is done twice or thrice in a year. Gurez sheep are active. Twins are common. Ewes produce good amount of milk.

BHAKARWAL

Bhakarwal is the name of the nomadic community which raises this breed in Jammu-Kashmir. They carry their sheep on Pirpanjal mountain ranges in summer. They keep their animals on nutritious grasses and shrubs. In winter they migrate towards southern parts of Jammu and Kashmir which is warmer. Bhakarwal sheep are hardy can thrive without any shelter.

Characteristics: Though the size of the animals is large, they are good climbers. Average weight of mature sheep is 38 kg. Rams are generally horned and ewes polled. Some times Bhakarwal sheep have heavy and thick tail. They have long, broad and pendulous ears. Bhakarwal sheep have white or coloured fleece. Shearing is done thrice in year. Average 1380 to 1800 gms. Wool quality is coarser (40's) with 15 cm fibre length. Wool is suitable for rough blankets and carpet production.

GADDI

Gaddi is an impotent breed of Kister and Bhadarwan Tahsil in Jammu. They are also reared in the Kulu and Kangra valleys of Himachal Pradesh. Gaddi sheep are continuously migrating from place to place. In summer, they are grazed on mountains and in winter they are brought to the valleys.

Characteristics: Gaddi sheep are medium sized and sturdy climbers. Head of the animals is of brown color. The rams are horned and the ewes hornless. The average body weight is 32 kg. Fleece of the Gaddi sheep is of white color and the quality is fine. Average wool in a year is 900 to 1350 Gms. Shearing is done twice or thrice in a year.

RAMPUR-BHUSHIAR

This is an outstanding breed of Himalayan region. The home tract of this breed is Mahasu and Kinnaur districts of Himachal Pradesh. These sheep have brown coloured fleece and a soft undercoat. Annual fleece yield is 1.36 to 1.81 kg. Wool is suitable for tweeds. Rampur-Bhushiar breed has prominent horn curling backward and downwards. They are grazed in Tibet border in summer and brought to low valley of Jammu and Sutlej in winter.

(II) Dry western region:

LOHI

This breed originally belongs to Lyallpur Montgomery districts of West Pakistan. These sheep are also reared in Punjab. The breed has 3 verities/strains viz., Jaisalmeri, Malpuri and Sonadi reared in Rajasthan.

Characteristics: Lohi breed has long ears, brown head and thick- short tail. They have large head, free from wool and Roman nose. They yield coarse, long stapled wool. Average wool yield is 1350 gms/Ewe/year and 2250 gms/Ram/year. Fibre length as about 7 to 10 cm. They have large compact body. The average weight is 70 kg. Quality of mutton is good. They produce good amount of milk. Twins are common in this breed. Lohi is thus highly sited to mixed farming.

BIKANERI

This is an outstanding breed of Rajasthan producing carpet type wool. Bikaneri sheep is of Bikaner district. It is reared in Punjab and Haryana state in pure or non-descript form. In their native home they are reared by true ranching system. They are hardy. They can tide ranching system in the period of Bikaner or Famine. There are three district strains of Bikaneri breed viz., Chokla, Magra and Nali. Chokla produces superior carpet wool.

Characteristics: They are of medium size. Rams weigh 45 kg whereas adult ewes weigh 36 kg. Ears are short and curled like tube-Tubular ears. Face is clean with "Roman nose". Face is white, black or brown, may extend up to neck. Both sexes are polled. They produce long stapled carpet type wool. Fibre length is about 8 to 12 cms. Quality is about 28's to 32's. Average wool yield per year is 1200 gms in ewes and 3100 gms in rams. Lambing % is 75 to 90. They are not good meat animals.

MARWARI

This breed is found in Jodhpur and Jaipur divisions of Rajasthan. Selected flocks are raised in Pali and Barmer districts. They are also found extensively in north Gujarat and Saurashtra.

Characteristics: Marwari is medium sized breed. Rams have 35 to 45 kg and ewe's 28 to 35 kg body weight. Marwari sheep have black head, straight nose and tubular ears. Some sheep have long pendulous ears. They have long black/white legs. They have long tail. Marwari produces white but coarser wool having the diameter of bout 36 microns. Average wool yield per animal is 1 to 1.5 kg/year. Medulation % in wool is 62.3. Staple length is 6 cms. Shrinkage in grease wool is about 18 %. Density is 714 fibres/sq.cm. Prolificacy is about 70 to 80 %.

PATANWADI

This breed is native of Patan in north Gujarat. This breed is also known as 'Gujarat' or 'Desni'. It is found in Mehsana, Banaskantha, Kutchh, Surendranagar, Rajkot and Jamnagar districts of Gujarat. Migratory flocks of Patanwadi are also found in Rajasthan, Madhya Pradesh and Maharashtra states. Bharwad, Rabari etc. community generally rear animals.

Characteristics: Patanwadi is medium sized animal (Adult ewes, 28 to 32 kg; rams 35 to 45 kg). Weight of lamb at birth is about 2.5 to 3.5 kg. Head and legs of Patanwadi sheep are of brown or tan color. They have 'Roman nose'. Both sexes are polled. Ears are medium size, pendulous and curled inward. Some times a tuff of hair is found on ears. Generally wattles are present.

Ewes have large udders. Tail is short. Prolificacy is about 70 to 80 %. Average wool production in a year is 1 to 1.5 kg. They produce softer and finer fleece than Marwaris. Mean fiber diameter is about 30 microns. Staple length is about 5.5 cms. Medulation of fibres is about 33.3%. Density of fleece per sq. cm. is about 637 fibres. Shrinkage is about 13%. Wool of Patanwadi is suitable for manufacturing carpets and blankets.

(III) Southern Region:

DECCANI

This breed is found in South -eastern part of Maharashtra and Andhra Pradesh. Deccani breed is an admixture of wooly type of North Western region and the hairy type of Andhra Pradesh and TamilNadu states. They are small and hardy and well adapted to poor pastoral conditions. It possesses colored or white fleece. The fleece is of low grade and is a mixture of hair and wool fibres. It is used for manufacturing of rough blankets and carpets. The average annual fleece weight is 350 to 400 gm. Body conformation of sheep is not good for mutton also. But they are kept chiefly for mutton. Animals are of small size, adult ewes weight 20 to 25 kg and rams weight 30 to 36 kg. Rams are horned or hornless. Ewes are polled.

NELLORE

It is found in Nellore district of Andhra Pradesh, hence the name "Nellore". Nellore is a hairy breed of sheep and is noted for producing good mutton. Nellore is considered to be the tallest breed of sheep in India. The rams are horned and the ewes are polled. Tail is very short with a hairy whorl at the end. Adult rams weight 41 kg and ewes weight 37 kg. Colour of the fleece is white or white with black or tan patches. Wattles are present.

MANDYA

Mandya is also a hairy breed of sheep of Peninsular India. Mandya is an important breed producing mutton in Karnataka state. It is a medium sized animal with average body weight 30 kg. It has a compact body and faster growth rate.

BANDUR

This breed of sheep derives its name from the village Bandur in Mandya district, Karnataka. **Bandur is an outstanding mutton breed**. It is a heavy animal with low-set body. It is an attractive breed. The mature rams weigh 50 to 60 kg and ewes 35 to 45 kg. There has been increasing demand for Bandur sheep from other states for improvement of local breeds. Bandur has good dressing % (40 to 58%). Quality of mutton is also good. Mutton is tender, juicy with nice flavor and fine grains.

FEEDING AND MANAGEMENT:

Breeding flock is the flock of sheep which are taking active part in reproduction. Breeding ewes and rams are used for further procreation.

100 Ewes and 3 Rams (103 breeding flock): Reproduce → 85 lambs are produced

Ewe lams (50%): 42 to 43

Ram lambs (50%): 42 to 43

Ewes Lambs: They are grown on their mother's milk up to weaning and then on grasses and grains up to maturity. After attaining the age of maturity they take part in breeding.

Rams lambs: Some of the ram lambs are selected at the age of weaning for breeding purpose i.e. they become breeding/stud rams. Majority of the lambs are castrated and grown up to certain age after which they are fattened and sold for slaughter.

Old ewes and rams are culled out. Most of the ewe lambs come in breeding stock when mature and replace unproductive or low productive, old ewes. Thus strength of breeding flock is maintained.

Shepherds get income from sale of: (1) wool (2) ram lambs and (3) cull ewes.

Rams produce more wool than the ewes but the quality of wool from rams is inferior (coarse). This is due to effect of sex.

Sheep come in heat in particular seasons only. This is called the breeding season. The season when they lamb is the lambing season. Summer is a bad season so far as lambing is concerned. This is because due to higher environmental temperature and scanty grazing many lambs die.

If a healthy productive flock of sheep is to be maintained the shepherds must give special attention to the feeding and management practices. Generally, Indian sheep live on grazing wild grasses, herd's and farm waste products. Sheep relish young green grasses. The young tender grass has more of proteins and is more digestible than old rank pasture. Ordinarily the sheep **require 3 to 4 kg of dry matter per 100 kg of their body weight**. Sheep requires more amount of salt and minerals in their ration other farm animals.

Flushing: About two weeks before the actual onset of breeding season ewes are kept on higher plane of nutrition. This practice is known as flushing.

- Flushing the ewe will start the heat periods earlier, which is an advantage when early lambs are desired.
- It has also the effect of bringing all of the ewes into heat at nearly the same time, which will be helpful in breeding them.
- As ewes gain body weight, their reproductive organs begins functioning normally. Ova produced in this condition will be more in number and more fertile leading to higher conception rate and twin lambs.
- As a result Ewes lambs are more in uniformity resulting in easy management of ewes and new-born lambs at and after lambing.

Twins are an advantage when is sufficient fodder and grains for feeding.

Flushing can be done by keeping the ewes on lush, green pasture. If good pasture is not available, extra grains should be given @ about 125 to 150 gm daily.

If there are any over-fat ewes, they should be thinned down so that they may be placed on a flushing ration prior to flushing. For this purpose they can be placed on a sparse pasture and/or given plenty of exercise. Over-fat ewes do not breed.

FEEDING EWES DURING GESTATION:

Gestation period of ewes averages 147 days (142 to 152 days). It can be divided into two parts for feeding the ewes judiciously. During the first ten weeks of the pregnancy period the foetus grows slowly hence, the demand of nutrients for nourishment of unborn offspring is not so great. But the growth of the foetus is very rapid the later half of gestation and therefore the requirements of nutrients is more in the later part of gestation.

Low grade roughage can be fed to the ewes in their early period of gestation or they can be kept on ordinary pasture. Supplementary feeding to pregnant ewes can be done either by green roughage, silage or hay. If this is not possible, additional concentrates can be fed at the rate of 110 gms/d/head.

Another/Later half (from11thweek) period of gestation is known as advance pregnancy. Proper /better **Feeding during advance pregnancy period is very important as it -**

1) Results in heavy lambs at birth.
2) Reduces lamb losses at birth.
3) Decreases the number of week or crippled lambs
4) Increases the growth rate of lambs after birth.
5) Decreases the danger of ewes disowning their lambs as a result of their weakness.
6) Prolongs the productive lifetime of ewes.

A combination of hay and pasture may successfully be used during the gestation period. During the last half of the gestation, the best forage available should be fed. Unless the roughages are entirely legume hay, an additional amount of protein supplement should be added. **Beginning with the 16th week, the grain ration should be increased to about 225 gm.**

Natural feed will provide sufficient minerals to the ewes, except for salt. But it is good plan to furnish a mineral mixture free choice and salt should be available.

FEEDING OF LACTATING EWES:-

Feeding of nourishing ewes require ration. Milk production is very heavy/stressful exercise and the lambs make their most economical gains while nourishing the ewes. Therefore, ewes should be fed liberally during this period. Depending upon the quality of pasture, supplementation is done with good quality hay, silage or grains. If necessary, concentrates should be provided at the rate of **225 to 400 gm/day/ewe**. Common salt should invariably be given.

FEEDING OF BREEDING RAMS:

Breeding rams should be fed judiciously. If rams are over fat, they should be thinned down by gradual reduction in feed and plenty of exercise. An over fat ram is sexually inactive. If the rams are normal in condition, they should be kept on higher plane of nutrition before a fortnight of commencement of breeding season. During breeding season, ram may be provided good grazing along with ewes or separately. Extra concentrate ration at the rate of 200 to 450 gm per head may be given.

Grain ration for breeding ram: Crushed gram/guar-2 parts + Wheat bran-1 part (Salt-1 %).

Grazing of Sheep: About 85 % of sheep feed comes from grazing or roughages. Sheep get tired, if kept on one pasture continuously. Grazing of sheep on the place leads to monotony and result in incomplete feeding. So sheep should be grazed on different pasture from time to time. Sheep relish short, tender grasses which are actively growing and which have higher protein content. Sheep must not be taken to low lying area and stagnant water pools because such areas may cause infestation of internal parasites. Sheep do not like moisture. Morning dew on grasses is not good for sheep. In monsoon, sheep should be taken up to places of low rainfall or higher altitude. After monsoon, sheep can be brought to the plain or valleys in winter. Animals should be grazed on light soils in the morning and can be taken to heavy soils in the afternoon. In summer season, sheep may be grazed on field from where winter crops are harvested. Generally summer is very hard for sheep. Pods of acacia tree can be fed to sheep as apart of concentrates. Grazing lands in India are not protected against over grazing and are not improved by scientific ways. They are very poor in condition and require special attention if they are to be improved.

Breeding of the Sheep flock:

Heat period: The period of estrus i.e., duration of the sexual heat period in sheep ranges from 1 to 3 days. The average for our sheep is 21 to 30 hours. Generally ewes are bred near the end of the heat period. The estrous occurs every 17 to 19 days during the seasons of breeding.

Gestation: The gestation period varies from 142 to 152 days, with an average of 147 days.

Mating season or Breeding season:

In India, there are three main breeding season-

1. The most important season of mating is autumn (June, July ad August), as about 60 to 80 % ewes

come in heat during this season.

2. In summer season (March and April month) about 5 to 20 % ewes come in heat.

3. The third and the least important season of breeding is the winter season (October to December) in

which very few ewes come in heat.

In the **Western region the ewes are mostly bred in autumn season**. The lambs from this mating are born during the period of early spring (November to January). The rams are allowed to run with ewe flock only for 40 to 50 days during the breeding season. This results in uniform lambing. Because of uniformity in lambing proper care, protection and feeding required during this critical period of life can be provided easily. Labourers and other expenditure to be incurred for this purpose are restricted only to a short and limited period of about 40-50 days.

Systems of Mating :-

i) **Flock mating: -** In ranching system one ram is provided for 40 to 50 ewes and rams move together in the flock in breeding season. The rams may be 'breast painted' or may be fitted with 'marking harness for recording the service details.

ii) Pen mating: The ewes in heat are detected in the morning and evening. Heat detection may be done with the help of the vasectomized rams (teasers) or the rams with aprons. The ewes found to be in heat are bred either naturally or artificially. If ewes are bred naturally, one ram will be required for 50 to 60 ewes under this system of mating. The ewe in heat and the ram are penned separately for the natural mating.

Age of breeding and average productive life:-

A normal ram is in full vigor for breeding during his age of 2.5 to 5 years. A ram should be started for breeding from about 18 months of age. The recommended age to breed the ewe lambs (hoggets) is about two years. Generally ewe hoggests are bred in next breeding season after completion of 18 months of age. The productive life of ewes will vary considerably depending upon breed, environment and managemental practices. Under average range conditions, ewes may be expected to produce about five crops of lambs. After about 7 years of age they lose vigour and productivity. Unproductive or low productive, old animals are culled from the flock as it not economical to keep them.

Preparation of ewe and ram for breeding:-

Tagging: - Tagging means cutting the wool from around the dock, vulva and inner portion of thighs (Breech region). Ewes are tagged prior to breeding and lambing. It is carried out

(1) To prevent blowfly strike in breech region

(2) To facilitate mating

(3) For general cleanliness at lambing

In Australia this practice is known as crutching.

Eyeing or Wigging: - In some breeds of sheep, wool grows aground the eyes. Sharp thorny grasses,

seeds and other material gets accumulated in this wool. This results in wool blindness. So the wool should be clipped from around the eyes. This process is known as "Wigging" or "Eyeing".

Ringing: - Shearing of ram prior to breeding season will make him more active. But if this is not practiced, ram should at least be clipped from neck and from belly in the region of penis. This process is known as "ringing". It will help in preventing the chances of infection at the time of mating and facilitates easy contact with ewes while mating.

Care of feet: -Trimming of hooves is not necessary when sheep are raised under range conditions. These sheep have to walk sufficiently for a distance to keep their hooves smooth and clean by wearing, but when sheep are either stall fed or do not have sufficient exercise, the wearing of feet does not take place sufficiently. Due to this, the hooves over grow and facilitate accumulation of dung and dusty soil. Sometimes decaying of hoof takes place. A ram will have difficulty in mating if he has over-grown hooves. For the reason mentioned above, trimming of

hooves prior to breeding season is necessary. It can be done with the help of knife or pruning shears.

Marking of ram:- When we are not using a teaser for detection of heat and rams are directly used for mating, it is advisable to mark ram. Marking of a ram will be helpful in recording of breeding date, for knowing the sexual activity of ram and for knowing which ewes are bred. Breast marking of a ram is done with different oil color which may be changed after 17 to 18 days. Special marking harnesses are also available, which can be fitted to the rams in breeding seasons. Breast paint will be stamped on the rump of the mated ewe. It is useful to identify the ewes bred.

Housing of sheep:-

Sheep do not require elaborated type of housing. Only a very simple cheap shelter to protect the sheep from rains, snowfall and extremes of weather is all that is required. A sheep requires 1.7 sq. meter of floor space under a shed. Advance pregnant ewes, ewes at the time of lambing and young stock need the special care. A shed should have coral to have sufficient space for the sheep to move around. The area may be protected from predators by means of rabbit proof fencing. Area should be selected where good natural drainage is possible. An area with shade of trees should be preferred.

GENERATION AND MORPHOLOGY OF WOOL FIBRES

A common belief that – whatever grows on the body of sheep is wool is not true. In addition to wool, some other fibres also grow on the body of sheep viz., Hairy fibres, Kempy fibres etc. in different proportion according to the breed of sheep.

Wool is the natural protective covering of sheep. It contains two types of cells.

(1) Epidermis or Cuticle and (2) Cortex

Epidermis or Cuticle:-

It is a surface layer of the wool fibre. It is made up of flat, irregular horny cell or scales. These scales overlap one on top of the other, much like the scales of a fish, with the free upper end projecting outwards and upwards the tip of the fibre. This gives wool fibre surface a serrated appearance. The fine wool has many more serrations per centimeter than coarse wool. The serrations impart spinning and felting qualities/property to the wool.

Cortex:-

The cortical cell of crimped wool fibres has a bilateral structure which is made up of two distinct regions. The cells of these regions are called the ortho cells and the para cells. The manners in which these two kinds of cells are distributed, determined the degree and character of the crimp of the fibre. The crimp in wool is important for softness of the fibre and fabrics. It is also somewhat helpful in spin ability of the wool.

Some fleece fibres and all the hair fibres in general contain a third main component known as the medulla. The medulla consists of a group air filled cells. Although, medulla is usually absent in fine wool, when it is present it forms the innermost layer. The cells are of various shapes, often polygonal like a honey comb. They may either occur through the length of the fibre or be restricted to certain area. Medullated fibres are generally coarse, uneven in diameter and rough. Some proportions of medullated fibres are desirable in carpet wool.

Chemical composition of Wool:-

Chemically, wool is chiefly **keratin,** which is also the primary consistent of hair, nails, hooves, horns and feather. Keratin is a protein made up of nitrogen and sulphur compound and amino acids.

Impurities of Wool:

Fleece naturally contains a greasy substance. In a broad sense, **grease** refers to all the impurities found in the wool, including the yolk (wool fat), suint and soluble foreign matter but not vegetable matter. Over and above these the fleece contains some acquired impurities like the vegetable matter and dust. Vegetable matters entangle in the wool during grazing or some times during the process of shearing and storage. Generally vegetable matter includes burrs (grass seeds), pieces of chaffed fodder etc. constituent the. Sometimes wool gets impure during marking when paint brands are used. For this reason the paints used in marking of sheep should be such that it can be removed during scouring process.

Fine wool contains higher amount of grease than the coarse wool. The fine raw wool or fine greasy wool will shrink more as compared the raw coarse wool. Clean wool yield of a sheep is the true indication of its wool production capacity.

Defective fibres of fleece:-

Although wool is the principal covering of the sheep certain defective fibres are occasionally found. Most common defective fibres are hairy fibres, kemp or kempy fibres and Hetero type fibres. All of these are medullated fibres having certain special features.

Defective fibres will not behave in similar manner as true wool. Fibres in the manufacturing processes will not readily take the dye. Their presence in the fleece can be controlled or reduced by careful breeding.

Factors affecting quality of wool:-

Some genetic and nongenetic factors affect the quality of wool. Certain important factors are dealt below:

(1) Breed: Breed of animals affect so many qualities of wool viz., staple length, grease content, softness, density, fibre diameter etc. Merino produces finer, shorter staple wool as compared to Lincoln breed. Wool from Merino contains higher amount of grease and is having more and uniform crimp as compared to the coarse wool.

(2) Nutrition: Level of nutrition affects the quality of wool. Whenever poor quality feed is given to the sheep, it causes weak points. This **wool having such weaker points is referred to as tender wool.** The tender wool breaks easily.

(3) Sickness: Sickness of the sheep may also cause weaker points in wool.

(4) Sex of the animal: Wool shorn from a ram is coarser as compared to the wool shorn from a ewe. Wool of a ram has more grease and is difficult to scour out.

(5) Soil: The type of soil on which sheep are run gives the wool certain color, for example, the wools from the black soil have quite a different color from those grown on red soil.

(6) Region of sheep body: The quality of wool varies from region to region of body. The wool of breech region is coarser than that of the shoulder region. Medullated fibres are more in numbers in the breech, the belly and the head regions.

(7) Shearing Practices: When wool is shorn by a skilled operator using a machine shearing, the staple length of the wool will be uniform.

(8) Season of shearing: It also affects the color of wool, the staple length and the fineness of wool.

Mohair: Mohair is very similar to wool in chemical composition. **It is hairy fibres grown on body of Angora goat.** It is a beautiful, smooth and very lustrous fibre, but it is somewhat coarser and lacks the felting properties of wool.

Mohair has uniform diameter. Pronounced crimp and lower grease content is valued the most. Mohair is very useful in the manufacturing of the goods where strength and durability are desired. It is used in manufacturing of blankets, pilofabrics, nets, shoe-laces, hats, decorative trimmings, switches, curtains etc. Mohair caches dye readily. USA, Turkey and South Africa are the three leading mohair producing countries in the world.

Pashmina: It is a hairy undercoat obtained from the **Kashmiri (Pashmina) goat** found in higher attitudes of Himachal Pradesh. Outer covering is used for making blankets, numdas, bags etc. Pashmina is used for making the famous ring-shawls of Kashmir.

WOOL GRADING OR WOOL CLASSING:-

It is grouping of fleece into various classes according to length, fineness, condition and color. Graded wool can be placed on the market in reasonably even lines. This will help the broker or merchant to judge its utility efficiency and the shepherd gets the highest possible price of his wool.

Wool grown by the different breeds of sheep varies in many characteristics viz., length, condition and fineness. Variation in these characteristics also occurs within the same breed and even on the body of the same sheep. The manufacturing value of wool varies accordingly to length and quality of wool. In the process of wool grading, each clip is divided into a number of different classes of wool called lines. The number of lines into which clips is divided depends on the size of the flock. Min. number of lines is four. Whereas in a large flock up to twenty lines of wool may be made. Grading of wool is done on the wool table just after shearing the sheep and before rolling and packing. Wool grading is usually carried out by professional wool classers. Wool-grading can be done by an experienced shepherd.

Grading of wool is **done with the help of sight, touch and good judgment by wool classer.**

Grading of wool in foreign countries: Two systems

1. Numerical count system (**Bradford system**) under which the wool is graded according to spinning count into different lines e.g. coarse wool with 44's to 48' s or very coarse wool with 40' s to less than 40's.

2. The System of wool grading is American **Blood system.** This system is popular in the USA. When Merino sheep were introduced, they were crossed with native, coarse wool producing sheep. The wool from this first cross sheep was coarser than that from Merino and was known

as half blood. Wool of decreasing degree of fineness were designated as 3/8 blood. ¼ blood, common etc. The latter is the coarsest lines. Now a days this system is not commonly used.

Comparison of two systems of wool grading:

Type of wool	Old Blood system	Numerical count system	Diameter (microns)
Fine	Fine	80's and 80's 70's to 64's	17.7 to 19.14 19.15 to 22.04
Medium	½ Blood 3/8 Blood ¼ Blood	60's to 62's 56's to 58's 50's to 54's	22.05 to 24.94 24.95 to 27.84 27.85 to 30.99
Coarse	Low quarter Braid	44;s to 48's 48's a and less	31.00 to 36.19 36.20 and above

Wool grading in India:

Grading of wool is new for India. Grading of wool is done only in limited areas and accepted by very few flock owners. Wool grading is done by state government department in Rajasthan. In Gujarat grading of wool is started on small scale in major wool producing districts. Wool is graded on the basis of fibre fineness (diameter), burr (grass seeds) content and color of wool. Sometimes clean wool yield is also one of the criteria.

Grading of Indian wool is not done extensively because of the facts that **1.** Wool produced in India is only coarse wool type (carpet wool) and **2**. Wool produced by an average shepherd is very less in quantity. So it is very difficult to make several lines but shepherds can however form co-operatives and can get their wool graded and thus can market their wool more efficiently.

Skirting and Rolling of fleece:

Skirting: It is removal of any inferior wool (of the fleece shorn from a sheep), done on the wool table, usually along with process of wool grading. The inferior wool is usually found around the edges of the fleece. Along with inferior wool, some urine and dung stained wool is also removed. Wool higher burr content is with kept separate. Over-skirting should be avoided. After skirting and grading wool is rolled and tied.

Rolling of a fleece is done in such a manner that the most attractive wool (shoulder wool) will remain on the other side of the bundle.

Carbonizing: It is the process of giving chemical treatment to wool to remove vegetable matter like burrs entangled with wool fibre. It involves treatment of wool with dilute acids. Carbonizing converts vegetable matter into hydrocellulose which may be bitten out afterwards.

Sorting: Graded lines are still not uniform enough for a certain specific manufacturing use. Wool is subdivided in various groups according to spinning quality. Sorting is done in the spinning mill or the warehouse prior to processing.

Scouring: Removal of high content of dust and sand from wool after passing through duster. Unfortunately, these impurities are embedded with grease and can be not removed without removing wool grease.

Scouring is carried out by passing the wool though a succession of long tanks containing suitable detergents in lukewarm water. This gently agitated to loosen the dirt. Finally wool is washed with plain water and squeezed between the rollers and dried by spreading on the open floor.

Feed lot: After weaning lambs are kept on high plane of nutrition for fattening. This is known as "feed lot" or its management.

Prime lambs: Superior and early maturing lambs meant for export are called prime lambs.

Canary Coloration: It is due to the reaction of sweat with wool fiber because of humidity in September as there is no evaporation of moisture from the body. Wool shorn in autumn will have more canary coloration.

Spinning count ('s): No. of hanks, each of 560 yards, that can be spun from 1 lb. of wool.

Gujarat Sheep and Wool Development Corporation: Fixes the wool price based on quality of wool and market demand.

Sheep Breeding Farms: Morvi and Patan.

CHAPTER 6

GOAT PRODUCTION MANAGEMENT

Text books:

4. Livestock Production Management by N.S.R. Sastry and C.K.Thomas, 2005
5. Text book of Animal husbandry by G.C. Banerjee ,2008
6. ICAR, 2011. Handbook of Animal Husbandry 3rd Ed. ICAR.
7. Devendra C & Mecleroy GB. Goat and Sheep Production in Tropics. Longman.

The goat is known to its friends as the '**Poor man's cow'** and regarded as **'Gold'** as can be encased at any time. The title is appropriate and well deserved. But the domesticated goat is quite characteristically different from cow.

The goat was the first animal to be domesticated by man (8000 B.C.). Goat provides milk, meat, hair, skin, manure and also used for sacrificial purposes. It is a popular, hardly, prolific animal serving the needs of man.

Place of Goat in Animal Kingdom:

Class	: Mammalia
	5) Hairy coat
	6) Mammary glands
	7) Full developed foetus-birth
	8) Warm blooded
Sub class	: Eutheria- Placenta
Order	: Ungulata- Hoofed
Sub order	: Artiodactyla-Even toed : Two claws/digits
Family	: Antilocapridae
Species	: Capra hircus – domestic sheep

The goat is closely related to the sheep. The wild ancestors of domesticated goat are- **1.** Capra aegagrus of Persia and Asia minor **2.** Capra falconeri of Himalayas and **3.** Capra Persia of Mediterranean. The modern goat's tolerance of heat and cold and drought is because of this ancestry.

Moreover the goat has certain advantages over cow and sheep. The goat can survive and produce ½ litre milk where cow would starve to death in a few weeks. Goats can meet their nutrients requirement as they can consume dry matter upto 6 % of their body weight. Goats can face severe heat and cold better than sheep but they are at disadvantage in a damp cold climate.

The goat is browsing animal which eats variety of plants and fodder. As such, goat rearing is cheap and is major occupation of landless laborers in India. In India majority of the goats are used for meat. Goat meat is in no way inferior to mutton but can not be compared with prime beef or lamb. In India the goat meat is preferred as cow is sacred and the bullocks are required for agricultural work.

The skin of goat makes leather of high quality. The hair of long haired goat is used for weaving cloth. The mohair and pashmina of Angora goat and Kashmir goat have their own value.

The goat production in rural area plays an important role in meeting the animal protein of rural population as cow and buffalo milk is being sold to dairies by villages.

Goat population

The goat is distributed throughout the world in the temperate, sub tropical and tropical zones. About 80 % of the goats of the world are found in tropical region. In Asia the highest populations are found in India (125.5 million., 15.32 % of World's population as per FAO,2007), Pakistan and Iran. The goat population of India is increased at the rate of about one million per year in spite of lack of developmental programme for this species. The obvious reasons for increase in goat population are :

1. High rate of reproduction.

   A) It breeds at least thrice in two years. B) Twins and triplets are common.

2. Relative greater resistance to disease.
3. Marketing facilities.

The goat population is more than sheep in high rainfall areas than in the drier areas. There are about 5 to 8 times more goats than sheep in North Eastern States. In Kerla , there are about 140 goats to one sheep. The goats in India, 1/5 (20%) are dairy goats and rest (80%) are meat type goats.

Advantage of goat keeping:-

The goat keeping has following advantages:

1) **Financial investment is small:**

   The money required to purchase a doe is relatively small. A good doe is **expected to milk for six to ten years.** At the end of this, she may be sold for full salvage value.

2) **The building and equipment needs are less:**

   The goat is small animal and can be housed in an inexpensive house, hut or verandah. In our country, the goat requires shelter from rain and hot sun. A wooden box or an old bucket can be used as manager.

3) **Returns start earlier**:

   A doeling can be **bred at the age of 12 months**, i.e., when it weighs 30-35 kg in general breeds or 60% of adult body weight. The income from **milk starts at about 16 to 18 months**.

4) **Goat are prolific**:

Exotic goats are fairly prolific. Twins are common. **On an average, an exotic doe produces 1.6 to 2.0 kids.** The **tropical goats like those of India produce triplets and quadruplets**. The sexes are equally distributed.

5) **Goats require less feed**:

A doe will consume about one-fifth as much feed as a cow. In case of buffalo it may be one-sixth to one –eight.

Goat milk composition:-

Fat	Protein	Sugar	SNF	Ash	Fat globules are small in sized, used for preparing soft cheese (can not used for butter making).
4.9%	4.33%	5.8%	9.3%	0.89%	

- As compared to the milk of other animals, **goat's milk approaches nearest to human milk in fat and protein.** The **fat globules of goat's milk are small** and it **makes soft curd** which is easily digested. The milk is recommended for infants. It is also advocated especially to T.B. patients. It is rich in iron, so it helps in the formation of RBCs.

6) **Goats helps in solving unemployment:**

The village woman and children can easily manage goats which are docile by nature. So the family members who are not employed can earn by goat keeping.

7) **Goats provide stable income**.

Goat provides a daily stable income which is useful for the family.

8) **Goat manure increases crops**.

Goat manure maintains and builds-up soil fertility. Goat manure is turned back to soil as it is never used for fuel.

9) **No prejudices against slaughter**.

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

10) Advantages of integration of goat production with cropping system.

A) Controls the growth of waste herbage or weeds roots can be maintained on those. No special land required for browsing. B) It improves the soil fertility.

Disadvantage of goat production:

1) **Goats destroy plant life**.

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

2) **Palatability of goat's milk**.

Goat's milk may have peculiar flavour – **'goaty odour** 'which is not liked by people. The buck is responsible for this odour. This is avoided by- 1. Keeping buck for away from milking barn and 2. Maintaining hygienic conditions during milking. 3. Removal of the milk to a cool room immediately after milking.

3) **Labour requirement is more.**

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

4) **Milk customers are temporary**.

The consumer of goat milk may purchase it for short time. The demand may be temporary. Goat's milk is mostly consumed on medical advice and consumers may not purchase as soon as he recovers. The goat milk producer has to search customers every now and then.

DAIRY GOAT INDUSTRY

In India, the goats are in the **hands of landless labourers**. Most of the goats (**80%) are for meat purpose**. But some of them are good milk yielders. Moreover the **demand for milk in India is far greater than the supply**.

Even when the situations are good, the dairy goat production has not taken the shape of industry. This is so in advanced courtiers like U.K., Switzerland, Norway etc.

Commercial goat farming must come up on two points:

1. Peculiar good quality of goat's milk.
2. Goat's feeding habits and digestive capacity

The demand for goat milk will increase when people start consuming in large quantities. This **requires publicity.**

The goats' milk **can be sold as cows' or buffalos' milk by mixing**. The **detection of the same is difficult b**ut cream output will be less.

With the current trend of prices of milk, in future it may be expected that dairy goat production will develop into industry.

<u>Factors in dairy goat production:</u>

In any business, the profit is the main motto. The profit is calculated by substracting total expenditure from total income or gross return. Thus,

Profit = Gross return-Total expenditure.

The important components of gross return in goat production are;

1. Milk and 2. Meat

Components of expenditure in goat production are:

1. Feed cost
2. Labour cost
3. Depreciation on capital i.e. House, Equipment and Animals.
4. Interest on capital investment.
5. Miscellaneous cost on breeding, veterinary aid etc.

Generally, expenditure remains more or less same for same number of goats producing more milk or less milk. So to have more profit the milk production of goats must be on high level.

Important factors in governing profit in dairy goat production:

1. Select the breeding flock carefully. Higher the milk production per goat, higher the profit.
2. Prolificacy of does should be more for culling of animals with low production. Sound breeding programme should be followed.
3. Cost of housing and equipments should be as low as possible. They should be designed to save labour and time.
4. Feed the animals with balanced ration. The feed should be as cheap as possible.

   If the feed lacks in any one or more nutrients, there will be loss in production. The feeds of dairy goat comprises of (1) fodder and the (2) concentrates. If good quality fodder like legume grass or hay is used, animals require less concentrates. This results in minimizing cost of feeding.
5. Keeping of records for milk production, prolificacy, growth etc. Will help in proper evaluation of animals. Records are very important for selection of animals.
6. A health programme should be prepared and adhered to, as sick and weak animals will not be productive.
7. A uniform, attractive and high quality product should be marketed.
8. Goats like to live in natural condition. Hence provide fresh and clean water. They should be allowed to move freely in the yard.

CLASSIFICATION OF BREEDS OF GOATS:

A) Zonal Distribution of Indian Goats:

There is distinct zonal distribution of goats for meat or milk or both or Pashmina. Though majority of goats in India are milked for domestic use and male kids and surplus animals are sold for slaughter, specific areas in the country can be identified where emphasis is more on meat or both or fibre only.

These zones are:

1. **Himalayan region :**

   Small pocket of Kashmiri ('Pashmina') goats in Ladakh and Himachal Pradesh covering five contagious valleys viz. Zanskar ,Rupshu Changthang ,Lahul, and Spiti. These valleys are dry. The Pashmina goat is designated by different names viz. Chamba, Gaddi, and Kashmiri. These goats are mainly for fibre.

2. **North western zone:**

   This zone comprises Haryana Punjab, Rajashthan ,Western U.P. parts of M.P. and extends into Gujarat .The goats breeds of this are known for milk production. These are Jamnapari, Beetal, Barbari, Zakhrana, Sirohi, Surati ,Marwari, Mehsani Sindhi etc. this group **comprises 80% of** total goat population .

3. **Dry southern zone:**

   Meat and milk purpose goats. The entire southern region is having dual purpose goats. But more emphasis is on meat. There are no distinct breeds in this region. In Kerala the Malbari breed is specific which produces relatively more milk.

4. **North Eastern region :**

   This region comprises of Bihar, Orissa, Bengal, Assam, Meghalaya, Tripura, Nagaland, Sikkim etc. The goat breeds of this region are **highly prolific meat breeds**. The goats are small in zone and known for twins and triplet births. They breed twice a year. The breeds are Black Bengal, Assam hill and Ganjam .

B) Classification based on utility:

Milch goats: Surti and Barbari breeds of goats are good milk producer and are known as milch goats

Meat type goats: They produce small amount of milk (less than 1 kg. in a day) .But there growth rate mature body weight, and meat conformation are better, so they are grouped under the meat type goats, e.g., Bengal goats

Dual purpose goats: They produce fair amount of milk (more than 1 kg. per day) there growth rate is also good mature body wt. of this type of goat is medium about 65 kgs. Ex. Jamnapari goats.

Fibre purpose goats: These goats produce fibre like Pashmina and mohair e.g., Kashmiri and Angora.

Indian breeds of goats :

BARBARI

Barbari is primarily dairy type goat. Its origin is native of east-Africa. In India this goat is found most commonly in U.P., Punjab and Haryana .

Breed characteristics**:** Barbari goats are small in size they have good dairy conformation the body colour of this goats is white or white with red spots. They have short legs. Mature bucks wt. about 45 kg and does wt. 36 kg.

This goat is suitable for stall-feeding so it is found in towns and village. Barbari goat can be kept as family goats. The average milk yield during the lactation is 250 - 300 kg with 5% milk fat. Barbari goat is prolific twins are common They produce more milk compare to body weight.

JAMNAPARI

Jamnapari goats are found in Etawah district and hilly areas of U.P. They are dual purpose goats.

Breed characteristics: Jamnapari goats are larger in size and are most handsome of Indian goats. They are generally white or yellowish tinge with light brown spots on the neck and face some times patches of tan or black are found on the body. They have long pendulous ear and a prominent "Roman nose" .They have long legs and hind quarter have long, thick hair. They are hardy and very active. The avg. wt. of mature buck is 60-90kg and of mature doe is 50-60kg.

They yield 300-400 kg milk in 10 months of lactation. The fat content of milk is 5.2%. They kid once in a year. Twins are common.

Jamnapari goats give good amount of milk and have meat conformation. They are well adapted to village condition and rough range. They have contributed in development of Nubian breed of goat.

BEETAL

Beetal goats are found in Punjab and Haryana.

Characteristics**:** Beetal goats resemble to Jamnapari goats but smaller in size and are not so heavy in weight. The colour of body is generally black, red-tan, brown and often heavily spotted on white. They have roman nose and long pendulous ears. They have curved, spiral horns. The bucks have beards. The bucks weight is about 52 kg to 75 kg and does wt. 40-50 kg. Age of first kidding is 20 to 22 months. Beetal goat gives kid once in a year. Twins are common. This goat produces 180 kg milk in a lactation .The fat content in the milk is about 4.5%

SURATI

Surati is a small dairy goat. It is found in Surat dist. of Gujarat state. The Surati goats are also taken to southern India. It is believe that they have some blood of Arabian goats.

Breed characteristics**:** They have angular body. They are of white colour. Ears and horns are smaller. Sometimes polled strains are also found. They have short legs. Mature buck and doe weigh 50 to 60 kg and 40 kg, respectively.

Surati is well suited to stalled fed condition and generally kept in urban area. They kid twice in a year. Twins are common. The Surati goats produce 1.2-1.5 kg of milk in day.

BLACK BENGAL

Bengal goats are found in west Bengal, Assam and in adjoining area.

Characteristics: They are smaller in size with black coloured body coat. They have good meat conformation. They have low-set body. The ears are erect. Mature buck weigh 14 to 15.3 kg and doe weight 8.4 to 13.5 kg.

They are prolific goats. They kid twice in a year and give twins or triplets every time. They produce milk sufficient for their kids. They are kept for chevon. Skin of Bengal goat is superior and is in great demand in foreign countries.

KASHMIRI

Goats of this breed are found in hilly tracts of H.P and Tibets. They do not thrive well in plains and humid areas. They can withstand very severe cold weather.

Breed characteristics: Generally, their coat colour is white or black and white. They long curved horns and long ear. Their body is covered with fine silky hairs. They have fur like under coat known as Pashmina. The Pashmina grows during winter and is shorn in the spring. This undercoat is collected by combing for 8 days. The silky hair are clipped and used for making ropes and numdas.

This goat produces very little amount of milk. It is kept for Pashmina, silky hair and meat. They are used as pack animals also.

OTHERS

There are some breeds like **Jhalawadi in Gujarat, Marwari in Rajsthan** which have importance in the region. There are originated from Jamanpari goat.

Exotic Breeds of Goats:

ALPINE

This breed was originated in the Alps Mountain of Europe (France and Switzerland). The home tract of this breed cooler and snow falls is common. But Alpine goats do well in warm climate also. This breed has been imported in our country and some flocks are kept at Ludhiana. They are kept to evolve a crossbred new breed.

Breed characteristics: Alpine goats have perky (short and erect) ears, slightly dished faced and variable colours, such as black, fawn, gray, brown, white or combinations of these colours. The beard of males is quite pronounced. Usually they are polled and have shorter hair coat. Adult bucks weigh 65 to 80 kg and the does weigh 50 to 60 kg.

Alpine goats produce 915 kg milk and 58 kg butter fat in ten months of lactation. They have 3 to 4 percent fat in milk.

NUBIAN -'Jersey' amongst the goats

They are native of Nubia in North eastern Africa. They have been developed in England –known as Anglo-Nubian. Anglo-Nubian was developed by crossing the Nubian and Jamnapari bucks on native British does.

Characteristics**:** Nubian goat is aristocratic in appearance. The colour of Nubian goat varies from white to black, red tan or combination of these colours. Nubian goat has large drooping ears and a peculiarly long shaped head with 'roman nose'. It has long legs. It is a large breed. Mature buck weights 85 kg and doe weigh 65 kg.

Nubian does have capacious, pendulous udders and larger teats. They produce 1900 kg of milk and 88 kgs of butter fat in 10 months of lactation. They are known as 'Jersey 'amongst the goats. The fat content in the milk is 4 to 5 %.

SAANEN - Queen of Goat world

Sannen, originated in Switzerland is famous for its high milk production and high persistency.

Breed characteristics: Saanen is white or light cream coloured. They may or may not have horns. The face of the Saanen may be straight or slightly dished. The ears point upward and forward. Weight of mature buck is about 90 kg and that of doe is about 65 kg.

The milk yield and butter fat production of the Saanen doe is 2200 kg and 87 kg, respectively and regarded as Queen of Goat world. Fat % in milk is about 3 to 4 %.

TOGGENBERG

It is originated in Switzerland. It is the **most prominent breed of dairy goat in U.S.A.**

Characteristics**:** The colour of the Toggenberg varies from brown to dark chocolate. There are white spots on the ears, face and legs below the hocks and knees. Mature doe weighs on an average 60 kg and mature bucks weigh on an average 80 kg.

Toggenberg does yield about 2500 to 2600 kgs of milk and 92 kgs of butter fat in ten months of lactation. The average fat content of the milk is about 3 %.

ANGORA

Angora goat is native of Turkey which is dry with extremes of temperatures. Angora goats are **extensively bred in U.S.A.** and South Africa for Mohair production.

Breed characteristics: Angora is comparatively small in size and its legs are much shorter. It is more like a sheep in appearance than a goat. Its back is straight and the body is blocky. It has long pendulous ears. Both male and female are horned. Mature buck weigh 70 kg and doe weigh 50 kg.

Angora goat is kept for their lustrous, fine and white fleece/hair covering known as 'Mohair'. It possesses high tensile & strength and spiral locks. Mohair is clipped twice in a year. Angora goat produces 2.5 kg mohair in a year.

Angora goat thrives well in a dry climate subject to extreme variations in temperature. India has also imported some Angora goats and started crossbreeding programme with native goats.

BODY CONFORMATION OF DAIRY TYPE GOAT

1) Head should be long and of moderate width.
2) Neck and shoulder – the neck should be long and slender and good depth.
3) Chest- should be moderately deep and good width giving the appearance of strength.
4) Fore-legs should be straight, strong and possesses good bone thickness/diameter/strength.
5) Foot- the animal should stand well its legs without the tendency to turn walks on heels.
6) Body- good depth is an important feature. The back should be level from the shoulder to the hips and then drop slightly at the tail region.
7) Ribs- should be well sprung to give a barrel effect. Large barrel indicates capacity to take more feed.
8) Bones should give the appearance of strength with the hocks slightly bent.

9) Udder and teats should be carried well under the body of should be large and proportional to sized of the body. It should undergo considerable shrinkage after milking. The teats should be considerably apart of moderate length and of suitable sized to be conveniently held in hand during milking.
10) Milk veins should be well developed.

BREEDING OF GOATS:

A young doeling can be bred at the age of 12 months by which time it weigh about 30-35 kg in general breeds or 60% of adult body weight . Age of breeding doeling much depends upon the body development and facilities to feed and to manage. If these facilities are favourable, the doeling may be bred at an early age.

On an average a doeling will kid for ten times in her life.

A mature buckling may be utilized for breeding at the age of 12 months. But it is full sexual vigour and considered best for breeding at the age of 2 to 3 years.

The breeding season in Goats:

The length of oestrus cycle is doe ranged from 18 to 21 days. The heat period is about 34 to 48 hours. The gestation period is 151±3 days.

The Indian goats can be bred through-out the twelve months of the year (whereas in the exotic goats the breeding season is from September to February) . It is advisable to breed Indian goats in the months of May-June, so that goat will kid during October-November. At this time plenty of green grasses are available and environment is comfortable for the young one. This is not of much importance when stall feeding is in practice.

Sign of heat:

A doe in heat shows following symptoms or signs.

1. A doe in heat becomes uneasy and shakes its tail frequently.
2. In milking doe, there will be drop in milk production.
3. A doe in heat seeks the company of the buck.
4. The vulva gets slightly swollen and little mucous may also flow from it.
5. A doe in heat may try to mount on other does or may allow other does to mount on her.
6. A doe in heat urinates frequently and bleats restlessly.
7. Teaser/vasectomized buck are the best for detection of heat in goats.

It is advised to breed the goat on second day of heat period 2-3 days. But in summer they should be bred immediately on noticing the sign of heat as heat period last for an hour or two.

Signs of pregnancy:

Pregnancy signs are many and varied. The first one is cessation of coming in heat. The goat become quieter in disposition and generally goes down in milk yield during 2 to 3 weeks. After this the milk yield declines very slowly. At 2 to 3 months of pregnancy, her figure shows her condition. As compared to other animals, pregnant goat becomes heavy and lethargic.

This may lead to difficult kidding if they are not given light exercise daily. The pregnant does should be allowed to dry up six weeks (1 ½ month) prior to kidding.

Drying up the doe:

It is necessary to dry a doe in milk either when the milk produced is little or doe is advance pregnant. Drying up of doe is advantageous as it is observed that dry period (6 weeks) is helpful in higher milk production after next freshening /parturition. Drying up may be done by-1.Abrupt stopping of milking, 2. Gradual skipping of milking for some time or 3. Incomplete milking .

Disadvantages of drying off a doe by abrupt stopping of milking-

1. In high yielder chances of mastitis will be there.
2. Lower milk production in next lactation.

Kidding:

The time of kidding or parturition can be easily calculated, if the breeding date is known. As the goat approaches in term, the kid can be felt moving inside the bulge on the right side.

The maternity/kidding box should be small and on no account goat should be tied up. Care and help is essential because of multiple births.

1. About 2 to 3 hours before actual kidding, the doe becomes fussy and bleats for help to any one passing by.
2. It will then be seen that the udder is tight, shiny and engorged with milk.
3. The goat shrinks in the belly and is rather hollow in the flank.
4. Her tail head appears to be higher than usual as the ligament on either side is relaxed.
5. She may breath rapidly or be panting.
6. She shows evident signs of pain and keeps scratching up her bedding, lying down and getting up repeatedly with anxiety.
7. There will be thick white starchy discharge resembling the white of an egg.
8. This is quickly follow by water-bag with the kid floating in it . This must not to be broken.
9. It bursts in 15 minutes and then front feet with the tip of the nose resting on them exhibit.
10. After renewed efforts, she expels the kid within a few minutes.

In multiple births, second kid may come with hind feet first so often, hence consider it almost a normal presentation.

After the kids have arrived, the goat should be given a warm cereal meal (gruel) e.g., boiled crushed bajri/wheat /barley to drink. Some goats like table spoonful of treacle in it. The kids are now ready for feeding and the goat is glad to have her udder relieved. If she can not be sucked by her kids, the newly kidded goat should be milked soon after she has kidded, but only that much milk should be taken from her, which relaxes the tension in the udder. She can be milked out fully from 3rd day.

Some tips while breeding goats:-

While breeding goats, the following tips may prove helpful.

1. Check the tattoo or tag number of the individual animal to facilitate better recording.
2. Provides best grazing facilities to the breeding stock.
3. Improve the physical condition of the flock (flushing) 4-6 weeks before tupping. It will increase chances of implantation of fertilized ova and the number of ova shed.
4. Shorten the breeding seasons before actual mating by allowing either the vasectomized buck or teaser to join the breeding flocks. Remove the hair around the vulva for easy mating. Examine the quality of semen and check the breeding.
5. Save the buck from summer sterility. Observed heat detection properly by use of a teaser buck and thus conserved the energy of fertile buck to be used for sound mating.
6. Extra growth of hooves to be trimmed.
7. Daily exercise is most essential or the breeding buck.
8. Your buck is half your flock your goats the other half. There for use a pedigreed and proven buck.
9. The buck can serve more goats if it is permitted to stay with the flock during night.
10. Increased the length of mating period. It will bring those late comers in heat who to conceive in the first phases of mating.
11. Selection of foundation stocks is very important. Cull out uneconomical.
12. If horned bucks insist on spending their energy in fighting discourage them by rubbing a little kerosene or other foul smelling agent along the nose, head and back.
13. Keep exact records of individuals for better management.

CARE AND MANAGEMENT OF ADULT GOATS

A dairy goat may be considered as ‘a miniature cow’. An adult doe should be groomed regularly. This helps in circulation of blood. At the same time external parasites, if any, can be noticed. Clipping of hairs must be carried out. This is necessary especially in those regions having long hairs.

Goats are very active animals. When they are confined lot of exercise is necessary. They should be let loose in open yards and the feeding and watering may be provided in these yards.

The feeding of adult is similar to feeding of a cow. Goat will consume 1/5 as much as feed as a cow. To get high production from a goat, it is important she be fed a good ration. An adult doe may be given 300 to 350 gm of concentrate and good fodder should be given ad. libitum. Extra concentrate should be given to milking animals depending upon milk produced.

Milking:-

It is best to milk a goat from a small stand or a bench that has a stand at one end of which the goat may be secured by a neck-strap. Goats should be milked twice a day as close at 12 hours interval. A high yielder may be milked 3 times a day at interval of 8 hours. The synthesis/secretion of milk takes place throughout day and night. The accumulation of milk in the udder slows the rate. Therefore, milking at even interval give the best results. They may milked from either side, but only one method should be adopted and use as regular routine. Best result obtained when the same person does feeding, handling and milking of the animal.

1. Before milking, the doe's udder should be either washed or wiped clean.
2. Any long hair around the udder should be clipped. The first milk drawn at each milking should be not saved as it contains dust or bacteria, accumulated in the end of the teat canal.
3. Care should be taken to milk out the udder completely. The last stripping contains more fat than they otherwise would.
4. If the teat are sore to cracks, they should be treated with little savlon and the milking should be especially gentle.
5. Record of milk yield should be kept and used to determine her selection and breeding value. Warm of milk should not be placed as refrigerator as it absorbed odour, develops off flavours with high bacterial counts.

Management of buck :

The buck must be kept away from the other stock. It should be given enough of exercise to keep in active condition. Regular grooming must be carried out. The buck usually consumes more feed than a doe. Balanced concentrate and good fodder should be provided. During breeding season, it is necessary to feed more concentrate.

CARE AND MANAGEMENTS OF KIDS

Rearing the kids:

Colostrum feeding within an hour of birth is essential for passive immune transfer , health and vogour. The kids are usually hand reared when the goat is to supply the family milk. Kids may be allowed with their dam until they are four days old than should be removed from her sight and sound. The kids must be fed the recommended amount of milk three to four times a day up to 2-3 weeks of age. The milk should be warmed 95^0 F to 100 ^{0} F. the kids take 1 ½ to 2 pints (1 pint = 473.17 ml) of milk per day@ of $1/5^{th}$ to $1/10^{th}$ of their body weight. They may be fed cow milk if goat milk is not available. Milk substitutes can be discontinued at 3 to 4 months of age. The males should be separated at this age and castrated.

Males kept for slaughter are sold at the age of 3 Months when the meat considered excellent. Kids are mainly raised for meat and not for breeding. Goat meat is dark pink and coarse. Characteristic goaty odour and may have hairs adhering to its surface.

Disbudding/Dehorning:-

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

Mature goats may be dehorned by sawing the horns close to the head with a meat saw. This should be done during cool weather and wounds should be coated with pine tar or other disinfectant repellant. The other methods are :- (1) Dehorning iron method: by hot red iron. (2) Dehorning colloidin method : dehorning outfit with colloidin. and (3) Electric dehorner.

Removal of off-flavour producing –‘ Musk glands ’:-

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

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

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

Bucks should be thoroughly trimmed otherwise they suffer from lameness/foot rot.

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

Ageing of goats:- Age of goats can be determined by the front teeth on the lower jaw. Both the kids and adults have eight teeth on the lower jaw. These are small and sharp in kids. At about one year of age the central pair drops out and is replaced two large permanent teeth, at 2 years of age, two more small teeth drops out and are replaced by two more large teeth, one on each side of the 1st pair, at three year of age there are 6 permanent teeth, and at 4 years a complete set of permanent teeth. After this the degree of wear and tear gives the rough indication of age.

FEEDS AND FEEDING OF GOATS

Goat is a ruminant, but its feeding is quite different from sheep and cows. For its size, a goat can consume substantially more than either cow or sheep, can viz, 6 to 8 % and even up to 11 % of her body weight in dry matter as compared to 2.5 to 3.0 % in case of cattle and sheep. Thus, goats can satisfy their maintenance and production requirement on good fodder and pasture. It is interesting to note that each 100 kg body weight goat require 1.5 times as much feed per day for maintenance as a 100 kg cow. For every 140 pounds (36.5 kg) of common concentrate mixture, a goat produced 2 gallon (9.1 lit.) more milk than a cow. The goat should not be fed more than 50 % of dry matter as concentrate. The remainder of the ration should be roughages supplied as hay, silage, or roots. Good quality lucerne or berseem hay is more desirable for milking animals.

A goat can utilize a large variety of feed stuffs than any other animal. Goat likes to browse tree leaves, twigs and tender branches. Most of our goats get their food through grazing and browsing. Only city goats are more or less stall-fed. For higher milk production the goats should be fed more systematically. Feeding dairy goats involves the same principles as for dairy

cows. They may be fed at more frequent interval by using hay racks to avoid wastage which is likely to occur otherwise.

A goat can consume total dry matter about 6.5 to 8 % of body weight. This requirement varies greatly from animal to animal. Well-cured lucerne, berseem or cowpea hay is the best source of nutrients for a dairy goat. Depending upon the quantity and quality of grazing and the roughage fed, an adult doe may be fed up to 300 g of concentrate for maintenance. A milking doe will require 100 g of extra concentrate mixture per 300 g of milk production. The concentrate mixture should contain about 14 % to 16 % protein.

Feeding stuffs are chiefly divided into two classes: **(I) Roughages and (II) Concentrates**

The leaves and stalks of plants rich in crude fiber form roughage while

Grains and it's by- products containing less crude fibre are concentrates.

(I) Roughages:-

The nutritive value of roughages depends on whether, they are green or dried, have been harvested before or after flowering or are grain by-products. Legumes (Lucerne/Berseem) are superior than ordinary grasses. Goats are exceptionally fond of leguminous crops. They do not like jowar, maize, silage or bhusa which are commonly fed to dairy cattle. All green feeds should be either tied in bundle or hung up before goats. It may be thrown on a high platform or in a special manger to avoid spoilage of the feed by droppings. Special care should be taken to serve it repeatedly in small quantities while feeding green legumes, as it is likely to cause tympany other digestive troubles. Regular feeding, 3 to 4 times a day in small quantities, to be consumed in half an hour is best. They should not be fed wet grass, fodder or leaves. It is better to sun-dry these and then offer as wilted green. All left over green feeds should be removed from the manger as it may become a hiding place for fungus and vermins.

(II) Concentrates feeds:-

A proper concentrate mixture essential for the milking doe is composed of mainly cereal grins including maize, oats and barley. However to supply a properly balanced ration, these cereal must be supplemented with protein (gram, tuver etc. Chuni/fotri), minerals and occasionally with vitamins. Young kids may be raised on milk of their mothers separate milk, whey or on milk replacer. A kid will start nibbling of tender grasses at the age of about two weeks. After this age quantity of milk fed may be reduced. At the same time kids may be fed grain mixture separately. Feeding the kids separately from their dams i.e. creep feeding will improve their growth rate.

SITE FOR GOAT PEN AND HOUSING:-

Housing should be planned before goats are purchased. They should have a shed or small barn that is well lighted and well ventilated. The building should be clean. Dry and free from drought. Goat's houses are designed for the primary object of feeding concentrate and green feeds.

Cheap houses with low roofs and large coral, hanging hay racks, water buckets, concentrate trays; arrangements of dips, kids boxes and raised plate-from with narrow drainage are pre-requisites for housing milking does. Individual breeding buck pen measuring 2 x 1/4 meters with open coral of 6 x 1/4 meters and draught-free small rooms to house 15-20 newly born kids are essential to raise good breeding stock.

The following points should be considered in selecting the site for constructing goat pens.

(1) Plan so as to have the advantages of exiting trees.

(2) The site should be on a high land so that the building and their approaching always remain well drained and dry, especially in rainy season.

(3) Goat pen should be away from main road but should have a convenient all weather connecting road.

(4) It should face towards the morning sun to get plenty of morning sunshine .The morning sun is usually preferred than the afternoon sun.

(5) The building should be oriented planned to keep cool in summer and yet admit sunshine and warmth in winter. Goats seek shelter from rain and cold sooner than most farm animals.

Housing (goat's pens):

A good goat house should be a compromise between that which is most comfortable and health giving to goat and that which is most convenient and economic from the view point of management.

Milks goats should not be allowed to run together in their pens for getting roughages and concentrates. They should be fed in separate stalls or in a group of 8-10 does.

A part of goat pen should be a concrete floor with a drain nearly 4" wide and 2" deep, round the outside walls. The water pails can be fastened to the wall on the opposite of the hay rack or they can be placed on the floor just inside the door. Where several goats are kept, it is recommended to use a small light iron barrow for feeding purpose. The space required per goat is (2.5' x 3') and the manger should not be less than 15" wide. There should be no dampness in the house as goats easily catch cold which may later developed into pneumonia, one of the few disease to which goats are quite susceptible.

There should be one or more kidding pens fitted with kidding boxes. Each feeding stall and kidding pen/box should be equipped with a rack for hay, a trough or pail fastened to the wall and a bucket for water.

To increase the productivity of goats following provisions are to be made.

Adult goats	12-16 sq.ft/goat	Kids , 7 days to 3 months 5-6 sq.ft/kid
Lactating and pregnant goats	20 sq.ft /goat	,, 3 to 6 months 8 sq.ft/kid ,, 6 month to 1yers 10 sq.ft/kid
Bucks	20 sq.ft /buck	

CHAPTER 7

UTILITY CLASSIFICATION OF BREEDS AND FAMILIRIZATION WITH CATTLE, BUFFALOES, SHEEP AND GOST BREEDS

UTILITY CLASSIFICATION OF BREEDS OF CATTLE:

Breeds of Cattle:

There are 43 well defined cattle breeds classified as milch, draught and dual purpose and are usually named after area, location and habitat they occupy. India possesses 7.75% of world's and 32.11% of Asian breeds of cattle.

Utility Classification of Cattle Breeds:

(A) Bos. indicus: Indian cattle, humped cattle.

Utility: Milk production, draught purpose.

1. Milch Breeds: (Dairy Breeds)

Features:

(i) The cows are high yielder produce 1500 liters or more milk per lactation.

(ii) The cows are docile and mild in temperament.

(iii) The bullocks are slow workers.

(iv) These animals are preponderous in build with pendulous dewlaps and sheath and loose skin.

Breeds: Red Sindhi, Sahiwal, Gir, Deoni and Gaolao (5 breeds).

2. Dual Purpose Breeds: Useful for both milk and draught purpose.

Features:

(i) The cows are fairly good milkers, produce 900-1400 liters milk per lactation.

(ii) Bullocks are medium fast and good for draught.

Breeds: Kankrej, Hariana, Ongole, Tharparkar, Rathi, Mewati, Nimari (7 breeds).

3. Draught Purpose Breeds: Useful for agriculture works (16 breeds)

Features:

(i) Majority of Indian breeds raised for draft purpose.

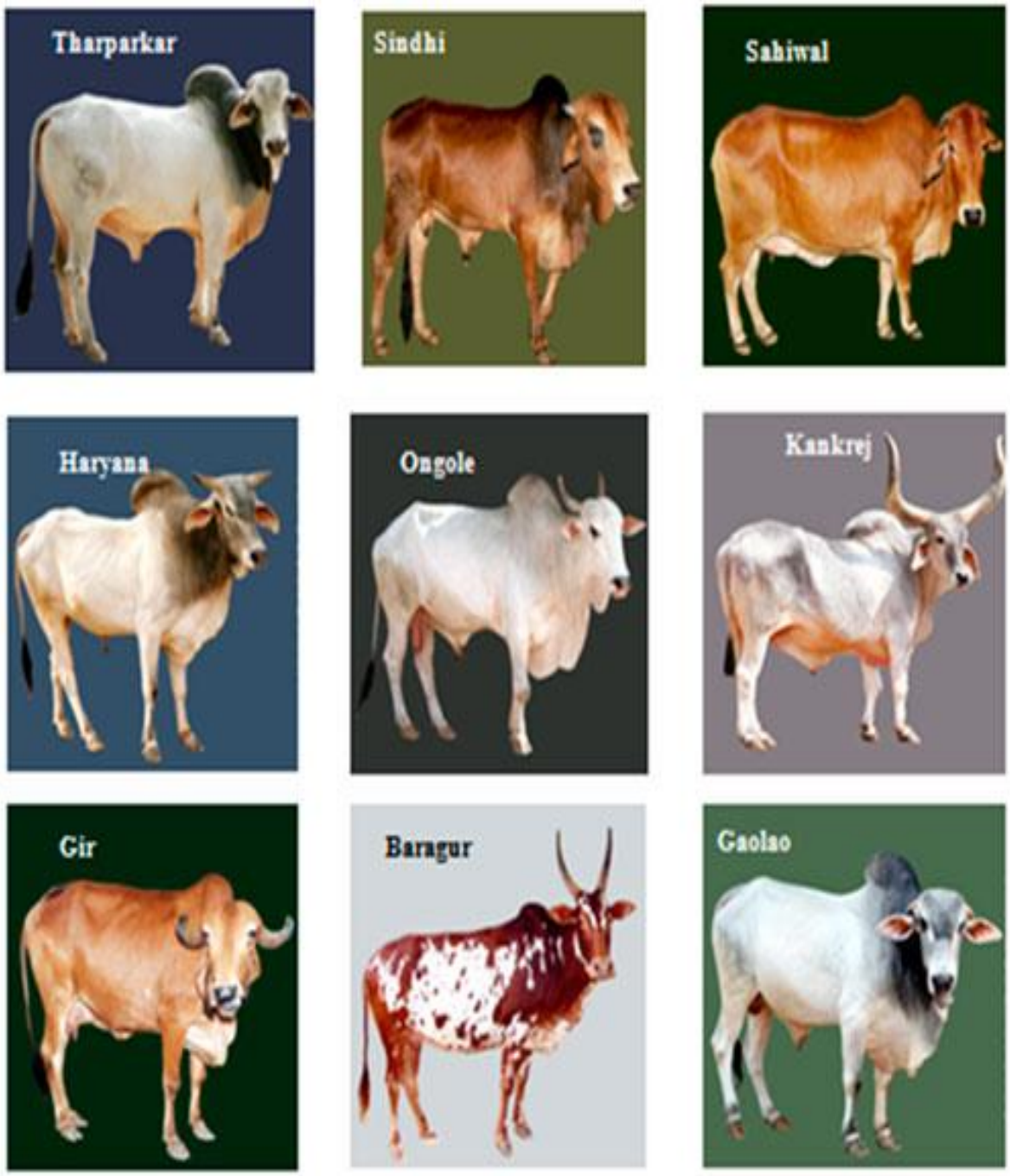
(ii) Cows are poor milk producers; produce less than 900 liters milk per lactation.

(iii) Bullocks are active, powerful and good draft animals.

Salient features are:

- Well proportionate body.
- A long barrel tight sheath and skin, fast gait and alertness

Photographs of Breeds of Cattle



(B) Bos Taurus: Humpless cattle, European cattle.

Useful for milk production as well as for beef purposes.

1. **Milch or Dairy Breeds:** For milk purpose.

Features:

(i) Cows produce more than 3000 liters milk per lactation.

(ii) Low milk fat content 3.5 to 5.0 %.

Example: Jersey, Guernsey, Holstein Friesian, Brown Swiss, Ayreshire.

2. **Dual Purpose Breeds:** Milk and beef purpose.

Features:

(i) Cows produce 2000-3000 liters milk per Lactation.

(ii) Weight gain more quickly and efficiently than milch breeds. Growth rate is faster.

(iii) Males, unwanted heifer and cows are sold as beef animals.

Example: Red Dane, Milking shorthorn.

3. **Beef Breeds:** Meat purpose.

Features:

(i) The cows are not milked.

(ii) Cows are maintained for producing young ones.

(iii) Young ones are sold for slaughter after certain age and weight.

Example: Aberdeen Angus, Hereford, Santa Gertrudis.

Identification of Various Breeds of Cattle, Buffalo, Sheep and Goat:

Breed is a group of animals of a species having similar physical and economical characters. Each ecological region has a breeds of animals adapted to the climate of that region. According to necessity and adoption, a breed of animal developed by the people in a region.

Objectives: - To be familiar with breeds.

- To know the physical characteristics of breeds.

- To know the breeds of animals of the region, state and country.

Cattle Breeds

	Milch purpose	Dual purpose	Draught purpose
North Gujarat	--	Kankrej	--
Gujarat	Gir	--	Dangi
India	Red Sindhi, Sahiwal, Deoni, Gaolao	Tharparkar, Haryana, Ongole, Rathi, Mewati, Nimari	Amritmahal, Khillari, Kangayam Nagori, Malvi, Ponwar, Siri

Buffalo Breeds

North Gujarat	Mehsana, Banni
Gujarat	Jaffarabadi, Surti
India	Murrah, Nagpuri, Bhadwari, Toda, Sambalpuri, Jerangi, Kalahandi

Indian Breeds of Cattle

Breeds/ Synonyms	Location	Physical characteristics	Economical characteristics	Professional breeders	Special remark
Kankrej Synonym: Bani, Banniai, Vaghadia, Wadhiar,Kacchi . (Dual purpose)	Kankrej taluka Banaskantha, Kutch, Ahmedabad to Deesa of Gujarat (North).	The newly born calves have rusty red colour poll, adult animals are silver-grey to iron grey or steel black. Forehead is broad with short face, black muzzle and prominent eyes. Hump and dewlap are well developed. Tail is long whip like. Udder is well developed.	Male body wt. 540-590 kg Female body wt. 410-500 kg Calf wt at birth- 22 to 24 kg Av. Milk yield 1200 to 1500 liters per lactation; Fat 4.2 to 5.0 %. Age at first calving 45 months Age for service (bull) 34 to 35 months.	Rabari, Bharwad rear these animals.	"Savai Chal" of bullock. New breeds evolved from this breed is; Indubrazyl in Brazil, Santa Gertrudis in USA. Breeding farms: At. Sardarkrushinagar, Chharodi, Thara, Bhuj, Barkol, Mandvi (Surat)
Gir Synonym: Kathiawari, Bhodali, Sorathi, Desan. (Milch breed)	In Saurashtra region-Jamnagar, Junagadh, Rajkot, Bhavnagar and Amreli districts. In western India in Rajasthan, MP and Maharashtra.	Entirely deep red colour body. Bulging forehead like a shield, eyes are big almond shaped gives sleepy appearance. Hump-Dewlap and sheath are heavy and pendulous. Tail long whip like with a black switch.	Male body wt. 500-550 kg Female body wt.340-410 kg Calf wt at birth 20 to 22 kg Av. Milk yield 1800-2600 liters per lactation. AFC 46 to 57 months; Fat 4.2% to 4.8%.	Rabari, Bharwad, Ahir, Maldharis rear these animals. Gir bulls are used for grading up of local cows.	"Banyan leaf" like ears New breeds evolved from this breed is; Indubrazyl in Brazil, Santa Gertrudis in USA. Breeding farms: At. Junagadh, Morbi, Kandivali (Bombay),

Sahiwal Synonym: Lola, Montgomery, Lambibar. (Milch breed)	Punjab province of Pakistan near the river Ravi.	Medium size animals with long body. Body coat colour is yellowish red/pale red. Skin of the animal is thin and loose. Whitish ring around the eyes. Tail is very long touching to the ground. Legs are short.	Male body wt. 425-525 kg Female body wt. 350-375 kg Lactation length: 300 days Av. Milk yield 3000-3200 liters per lactation; Milk fat % - 4.6-5.2.	"Jungalies" keep these animals.	New breed "Jamaica Hope" (USA) - Jersey x Sahiwal. "Karanswiss" (India): Brown Swiss x Sahiwal at NDRI, Karnal, Haryana. Breeding farms: NDRI, IARI & IVRI.
Tharparkar Synonym:Thari, Kutchi. (Dual purpose)	Tharparkar district of Sindh province of Pakistan, Adjoining tract of Rajasthan, Jodhpur, Jaisalmer.	Light grey colour with strip of light grey colour along the back, ear large semi-pendulous, Black rings around eyes. Mixture of different breeds like Kankrej, Sindhi, Nagori and Gir.	Male body wt. 450 to 500 kg Female body wt. 350 to 400 kg AFC: 38-42 months; Av. Milk yield 500-1200 liters per lactation. Bullocks are good draft animals.	----	New breed "Karan-Fries" (India) – Tharparkar x Holstein Friesian bulls developed at NDRI, Karnal, Haryana. Breeding farms: NDRI, Karnal LRS Patna, Bihar LRF at Chetinad, TamilNadu
Hariana (Dual purpose)	Hissar, Rohtak, Gurgaon, Karnal dist. and near Delhi.	Long and narrow face with black muzzle, body is light grey colour, short horns, forehead flat with prominent poll. Hooves are hard	Male body wt. 360-400 kg Female body wt.300-325 kg Weight at birth- 22-23 kg	----	Breeding farms: IVRI, Izatnagar, U.P. NDRI, Karnal, Haryana.

		and black in colour.	Milk yield 1100-1500 liters per lactation. Milk fat % - 4.0-4.8. Calving interval - 16-20 months. Bullocks are active, powerful and willing workers.		HAU, Hissar, Haryana. Cattle breeding farm, Mathura, U.P.
Red Sindhi Synonym: Sindhi, Malir, Red Karachi. (Milch breed)	Karachi and Hyderabad (Sindh) and Kohistan in Pakistan.	Mostly red, shades varying from dark red to light yellow, white spots on forehead and dewlap, forehead slightly bulging, horns short and stumpy, drooping hind quarter, pendulous udder.	Male body wt. 425-450 kg Female body wt. 350 kg Birth wt of calf – 19- 23 kg Milk yield 1800 kg per lactation Milk fat % - 4.6-4.9. AFC: 38-41 Months Calving interval-14-16 months.	"Maldharis" rear these animals on grazing near water pools of canals of river Indus.	Breeding farms: NDRI, Karnal, AAU, Allahabad, Govt. LRS Hosur (T.N.), Export in Ceylon, Philipines, Malaya and Iraq for pure breeding and upgrading of local cattle.
Nimar Synonym: Nimad (Draft purpose)	"Narmada valley" in Madhya Pradesh.	Mixture of Gir and Tapti. Red colour with white blotches, buldging forehead. Ear moderately long, copper coloured muzzle. Strong and hard hooves, pendulous dewlap.	Draft purpose cows, Poor in milk production. AFC: 48 to 54 months. Calving interval- 18 months.	----	----

Gaolao Synonym: Gavarani (Dual purpose)	Wardha and Chindwara in MP, Nagpur in Maharashtra.	Medium sized, narrow and long body. Colour white to grey. Forehead flat, horn short, almond shaped eye, voluminous dewlap.	Av. milk yield- 820-1200 kg per lactation. Bullock castrated at 2.5 year of age.	----	Utilized to upgrade scrubbed cattle at Balaghat (MP)
Khilar Synonym: Khillari, Thillari (Draft purpose)	Native breed of Maharashtra state. 4 types of Khilar cattle are :Alpadi southern Maharashtra, Mhaswad Sholapur and Satara, Tapti – Satpura ranges Nakali- Adjascent to Khandesh dist.	Developed from 'Hallikar' breed. Khillari means herd of cattle. Yellowish white to grayish tan body colour. Horns are long and pointed. Eyes are prominent and fiery. Yellow patches inside ears.	Well known draft breed. Cows are poor milkers. Male body wt. 500-550 kg. Female body wt. 320-360 kg. AFC: 30-36 months Male calves castrated at 5 to 5.5 yrs of age. Khillari bullocks are very good for all agricultural purposes.	----	Cattle Breeding farms: Hingoli, Parbhani. CBF Bankapur Dharwad, Karnataka. Kangayam in Karnataka State.
Deoni Synonym: Dongrapatti (Dual purpose)	Native breed of Western Andhra Pradesh. It is an admixture of Gir, Dangi and local	Resembles Gir breed but less bulging forehead. Horns have outward and backward curve. Body colour is black and white or red and white with irregular spots.	Cows are good milkers. Average milk yield: 900 kg in 300 days of lactation. Bullocks are well suited for heavy work.	----	-----

	animals.				
Rathi Synonym: Rath (Dual purpose)	Home tract of this breed is Alwar and Rajputana region of Rajasthan.	Medium sized powerful cattle, well built and deep chest, straight face, flat forehead, large and wide eyes, short and pendulous ears, short tail with black switch.	Av. male body wt. 385 kg Av. female body wt. 326 kg Cows yield about 5.5 kg milk per day. Bullocks are powerful and active suitable for field and road work.	----	----

Buffaloes: Even toed ungulates (Order: Artiodactyla).

Suborder: Ruminant, **Family:** Bovidae. It can be further grouped into three groups.

Genus Bovina (Cattle/ Bison)

Bubalina (Asian buffaloes - angular horns)

Syncercina (African buffaloes - oval shaped horns)

Asian Buffaloes *(Bubalus bubalis)* are of Swamp and Riverine type.

Riverine Buffaloes	Swamp Buffaloes
• Chromosome number 50	• Chromosome number 48
• Native Indian sub continents, Egypt and Mediterranean basin of Europe	• South East Asia and China
• Maintained chiefly for milk production. Dual purpose animals also exhibit good meat characteristics.	• Minor or no role in milk production. Used for draught power, for land preparation, threshing, water lifting, oil extraction and transportation.
• Wallows in river water and in clean running water, water tank or reservoir. Feed on pasture or cultivated fodder, example: Murrah, Mehsana, Surti, Pandharpuri and Jaffarabadi. • Generally found in India, Pakistan, Nepal, Bangladesh and Sri Lanka. • Physical characteristics: Longer body and weight more than Swamp buffaloes. Usually black sometime white makings on body.	• Permanent denizen of marshy lands, wallows in mud and feed on coarse marshy grasses. • Generally found in Malaya, Singapore, Philippines, Thailand, Indonesia and Malaysia. • Physical characteristics: Short stocky body, short face, wide muzzle and short thin legs. Dark grey in colour normally black to albinoids occasionally.

Normal Habits of Buffaloes:

- They are nocturnal in habit.
- Not only do they like to wallow at night, but if left to their own devices they will mate, suckle their calves and travel more during hours of darkness than in day light.
- More like rain or water splashing and mud plastering on body.
- Poor heat resistance/tolerance due to poor heat regulating mechanism.
- Resting habits during several hours in the middle of the day.
- Remarkable characters are their docility as they can be easily managed by even children and women.

BREEDS OF BUFFALOES

16 breeds of buffalo in India.

Indian buffaloes: (*Bubalus bubalis Linn.)*

Local name: Arna, Bhains, Geva, Erumai.

Feature:

- Semi aquatic animal.
- Abundant in humid localities.
- Large massive and clumsy creature.
- Short thick legs and conspicuous hoofs.
- Horns thick, flat, curved or straight.
- Jet black colour or light coloured brown breeds.

Photographs of Breeds of Buffaloes

Nili Ravi

Toda

Jaffarabadi

Mehsana

Murrah

Bhadawari

Sixteen indigenous (Desi/local) standard breeds of buffaloes:

MURRAH:

Home Tract: Hariana, Delhi, Uttar Pradesh, Rohtak, Karnal, Hissar, Gurgaon Districts of Haryana.

Synonyms: Delhi, Ravi, Kundhi.

Physical Characteristics:

- Tightly curled horns.
- Massive body, thin and long neck, small face.
- Male body wt: 540-590 kg, female: 450-475 kg.
- Hairless skin with glistening jet black body colour.
- White switch of the tail. Humpless.
- Wedge shaped body. Barrel is massive and well developed.
- Straight and powerful limbs with black hooves.

Economical Characteristics:

- Milk yield per lactation – 1400 to 3000 kg in 300 days.
- Milk fat: 6.8 to 7.2%
- Average lactation length: 280-340 days and av.dry period: 150-200 days.
- Average age at first calving: 45 to 58 months.
- Inter calving period is 450 to 500 days.

Breeding Farms:

- HAU Hissar, NDRI Karnal, PAU Ludhiana, IVRI Izatnagar, CBF Meerut.

NILI RAVI:

Home Tract: Main breed of buffalo in Pakistan, distributed in Gurdaspur, Amritsar, Firozpur and Muktasar district of Punjab.

Physical Characteristics:

- Broad massive hairy forehead with prominent nasal bone.
- Tightly coiled horns, Muzzle with prominent double chin.
- Well developed udder with pink markings. White markings on the forehead, face, muzzle, legs, switch and around eyes.
- The tail is long, almost touching the ground.

Economical Characteristics:

- Age at first calving: 41-53 months.
- Lactation yield: 1600 kg. Milk fat content:4 %.
- Peak daily milk yield: 9-11 kg.
- Lactation length: 285-326 days. Calving interval: 15-18 months.
- Males are used for draught purpose.

Breeding Farms:

- Military farm Firozpur (Punjab), Buffalo farm Nabha (Punjab) and Khanna (Punjab).

Endangered Breeds: Endangered status of a breed can be determined by the size of breeding stock which can be expressed by the number of breeding females, sex ratio or effective population size. The population size of cattle and buffalo breed for normal, insecure, vulnerable, endangered and critical status as suggested by Nivsarkar and Bhat (1986) for Indian condition is given below.

Category	**Cattle**	**Buffalo**
Normal	25000	30000
Insecure	15000-25000	20000-30000
Vulnerable	5000-15000	10000-20000
Endangered	2000-5000	5000-10000
Critical	<2000	<5000

- **There are 9 breeds of endangered cattle:**

  Vechur, Punganur, Siri, Ponwar, Kenkatha, Nagori, Bachaur, Mewati and Kherigarh.

- **There are 3 breeds of endangered buffaloes:**

  Toda, Bhadwari and Nili Ravi.

MEHSANA:

Home Tract: Originating from Inter breeding of Surti and Murrah. Breeding tract is Mehsana, Banaskantha and Sabarkantha district of North-Gujarat.

Physical Characteristics:

- Medium sized animals with long body and lighter limbs than Murrah.
- Adult male weigh: 525-575 kg and adult female weighs: 425-450 kg.
- The head is long and heavier, horns less curved at the end but longer.
- The colour is usually black to gray with white markings often on face, legs or tail tips.

- Face long and straight. Dewlap is almost absent.
- Eyes are prominent, black, bright and bulging.

Economical Characteristics:

- Reputed for regular breeding and high breeding efficiency. Good persistency so preferred by city milk producers.
- Milk yield 1300-1800 liters per lactation. Having shorter dry period.
- Fat % - 6.6 to 7.2, Age at first calving: 42 to 54 months. Inter calving period 450-550 days.

Breeding Farms:

Sardarkrushinagar Dantiwada Agricultural University, LRS, Sardarkrushinagar, Gujarat, CBF, Udaipur.

SURTI:

Synonyms: Desi, Nadiadi, Charotari, Gujarati.

Home Tract: Lies between Sabarmati and Mahi river. Kheda, Baroda, Bharuch, Surat district and adjoining districts of Maharashtra.

Physical Characteristics:

- Medium sized animals with wedge shaped body, straight back, black or brown in colour.
- Sickle shaped long and flat horns with long head.
- Two white chevrons one just around the jowl from ear to ear and other just one the brisket is the peculiarity of the breed.
- Ears are medium sized, squarely placed and drooping.
- Skin of udder is pinkish.

Economical Characteristics:

- 1000 to 2000 liter milk yield in 10 months lactation.
- Fat rich (8.9%) milk.
- AFC 40-50 months.
- Lactation length is 300-320 days and dry period is 150-220 days.
- Inter calving period 400-450 days. Bullocks are good for light work.

Breeding Farms:

- Livestock Research Station (LRS), GAU, Navsari, Gujarat.
- Buffalo Breeding Centre (AICRP) Dharwad, Karnataka.
- NDRI, Bangalore, Karnataka.
- Progeny Testing Centre, Central Buffalo Breeding Farm, Dharmod, Bharuch.

JAFFARABADI:

Synonyms: Kathiawari, Sorathi.

Home Tract: Around Jaffarabadi town in Gujarat state, Kutch, Junagadh, Jamnagar. Forest grazing buffaloes of Gir forest.

Physical Characteristics:

- It is the heaviest breed of buffaloes in the world.
- Adult male weigh: 600-650 kg, adult female weigh: 500-525 kg.
- Body colour is jet black with thick skin and scanty hair.
- Forehead is large and bulging like that of a baby elephant; horns are long, flat and loosely curved.
- Eye are sunken and small with sleepy appearance, neck and brisket are massive and well developed.
- Udder is well developed and pendulous with irregularly placed teats. Tail is long with white switch.

Economical Characteristics:

- Milk yield 1800-2700 liters per lactation. High fat % 9 to 10.
- Fat globules are big with high fat content; hence milk is very suitable for ghee making.
- Inter calving period 600 days. AFC 480 to 60 months.
- AFC is 48-54 months.

Breeding Farms:

- Cattle Breeding Farm, GAU, Junagadh.

BHADWARI:

Home Tract: Bhadwari estate of Agra district and adjoining areas of Gwalior and Etwah. Also found in the areas of Yamuna and Chambal rivers.

Physical Characteristics:

- Medium sized and wedge shaped body.
- Small head bulging towards horns. Legs are short and stout.
- Barrel is short and well developed.
- Coppery body colour. Eyes are prominent, active and bright.
- Udder is not so well developed.

Economical Characteristics:

- Average milk yield ranges from 2000-2100 kg per lactation (305 days).
- Milk fat may exceed 13% in some animals.

- AFC: 48-51 months, Calving interval: 15 months and dry period: 150 days.

Breeding Farms:

- CBF, Babugarh (Meerut), Agri. College Dairy Farm, Kanpur.

BANNI:

Home Tract: Banni area of Kutch district in Gujarat. They are also found in Sabarkantha, SurendraNagar and Banaskantha districts of Gujarat.

Physical Characteristics:

- Body is medium to heavy, typical double and vertical coiling horns, strong body conformation.
- Wide head and neck is without wrinkles/folds, absence of dewlap, soft, thin and black skin.
- Mostly black in colour, in some cases copper colour or black with white markings on forehead.
- Udder is well developed, cup shaped and square.

Economical Characteristics:

- Well known for high milk production, disease resistance.
- Average daily milk yield is 9-10 kg.
- Average milk fat content is 5-6%.
- AFC is 46 months.

CLASSIFICATION OF BREEDS OF SHEEP AND GOAT

Classification of Breeds of Sheep:

According to ICAR India possess 43 breeds of sheep; which is 6.41 percent of world sheep breeds. Sheep produce fleeces of different types. The fleece differs in their hair content, fiber diameter, fiber length and fineness of wool and accordingly sheep breeds are classified as:

1. Fine wool breeds. 2. Medium wool breeds.
3. Long wool breeds. 4. Crossbred type wool breeds.
5. Carpet wool breeds. 6. Fur wool breeds.

Note: Details of important breeds of sheep are given in sheep production management chapter.

1. Fine Wool Breeds:

Features:

(i) Produce only wool fibres in their fleece, hair absent.

(ii) Fibre diameter ranges from 17 to 23 µ (microns), very fine wool.

(iii) Produce poor quality lambs.

(iv) Sheep are hardy, hence suitable for ranches.

Example: Merino, Rambouillet, Pollworth.

2. Medium Wool Breeds:

Features:

(i) Fleece of these sheep does not contain hair.

(ii) Diameter of wool fibre varies from 23 to 32 µ (microns).

(iii) Produce less and lower quality wool than fine wool breeds.

(iv) Produce very good quality lambs, higher prolificacy and higher growth rate.

(v) Not suitable for ranches, do better in stall feeding.

Example: South Down, Suffolk, Hampshire.

3. Long Wool Breeds:

Features:

(i) Wool is coarse having fiber diameter more than 33 µ.

(ii) Fibre length varies from15 to 30 cm.

Example: Lincoln and Leicester.

4. Crossbred Type Wool Breeds:

Features:

(i) Developed by crossbreeding between fine wool breeds and long wool breeds.

(ii) Wool quality similar to medium wool sheep.

(iii) Better mutton conformation.

(iv) Classified as medium wool breeds.

Example: Corriedale, Panama, Columbia, Hissardale.

5. Carpet Wool Breeds:

Features:

(i) Fleece contain hair i.e. modulated fibers

(ii) Wool is coarse wiry and tough.

(iii) Wool fibre diameter is more than 33 µ.

(iv) Wool is used for carpet manufacturing.

(v) Length of wool fibre is 5 to 15 cm.

(vi) Carpet wool – India, Pakistan, Newzeland, Syria, Argentina and Iraq.

Example: Marwari, Patanwadi, Bikaneri, Chokla, Magra.

6. Fur Wool Breeds:

Features:

(i) Skin of sheep with wool known as fur.

(ii) Skin is obtained by killing of lamb called pelt.

(iii) Used for making fancy articles, fur coat, purse, ladies wear, gloves etc.

Example: Persian, Lamb pelt, Karakul, Broadtail.

Classification of Breeds of Goat:

Our traditional goat farmers have extensively practiced the art of selection and inbreeding for evolving definite breeds with specific or multiple functions. The country as a whole represents an important genetic reservoir of goat breeds for meat, milk, fibre and skin production. Some of these are well-known but more than half of the population is on non-descript type. There are about 34 breeds of goats with specific characteristics.

(A) Milch Breeds: These breeds of goats are mainly reared for milk purpose on commercial lines. E.g. Alpine, Saanen, Toggenburg and Nubian. Saanen is also known as Jersey of the goat world due to its high milk production potential.

(B) Dual Purpose Breeds: These breeds of goats are reared for milk as well as for meat purpose. They produce 100-200 liters of milk per lactation and 1-2 kids per kidding. E.g. Jamunapari, Barbari, Beetal. Whereas, triple purpose breeds i.e. for milk, meat and hair are Marwari, Mehsana, Kutchi and Zalawadi.

(C) Meat Breeds: These breeds of goats are mainly reared for meat purpose on commercial lines. E.g. Black Bengal goat breeds (known for excellent mutton and skin quality), Deccani, Malabari etc.

Utility Classification of Breeds of Swine (Pigs): Domestic pigs are farmed primarily for the consumption of their flesh, called pork. The animal's bones, hide, and bristles have been fashioned into items such as brushes. Thus **s**wine/pigs give two important marketable products viz; meat (pork) and the lard. Lard is the fat obtained from pig carcasses. It is used for cooking, making soap etc. At present swine are mainly kept for pork and there are 8 recognized breeds of pigs in India.

(A) Meat Type Breeds: Such breeds yield less than 15% lard of the carcass weight. E.g. Landrace, Duroc, Yorkshire and Tamworth (UK).

(B) Lard Type Breeds: The pigs of these breeds yield 15% or more lard of the carcass weight. E.g. Berkshire, Guinea Hog and Mulefoot.

Utility Classification of Poultry: Chickens are grown for their egg and meat. Likewise they are classified as egg-type chickens and meat-types chickens. Egg type chickens are composed of stock that has been developed for egg production and are maintained for the principal purpose of producing chicks for the ultimate production of eggs for human consumption. Breeds of meat type chickens primarily include broilers, fryers, roasters, and other meat type chickens. Here broilers and other chickens are raised for their meat. Broilers are genetically selected for fast growth and raised for meat rather than eggs.

- **Commercial Broiler Strains:**

E.g. Cobb, Hubbard, Lohman, Anak 2000, Avian -34, Starbra, Sam rat etc.

- **Commercial Layer Strains:**

E.g. BV-300, Bowans, Hyline, H & N nick, Dekalb Lohman etc.

India has made considerable progress in broiler production in the last two decades. High quality chicks, equipments, vaccines and medicines are available. With an annual output of 41.06 billion eggs and 1000 million broilers, India ranks fourth largest producer of eggs and fifth largest producer of poultry broiler in the world. The broiler production has also sky rocketed at an annual growth rate of about 15 percent at present.

Based on Utility Poultry Breeds are Classified into:

(A) Egg Purpose: Producing more than 180-200 eggs per head per year and weighing 2-3 kg. E.g. White leghorn.

(B) Dual Purpose: Producing nearly 150 eggs per head per year and weighing 3-4 kg. E.g. Rhode Island Red.

(C) Table Purpose: Producing less than 100 eggs per head per year and weighing 3.5-4.5 kg. E.g. Brahma, Cochin.

Classification of Camels: There are 9 registered breeds of camels in India. The Indian camels are divided into two types depending on the work they perform, viz;

(A) Baggage Camels: These are robustly built than riding camels. These can carry 3-4 quintals of load over a distance of 35 km in a day with an average speed of 3-4km per hour. E.g. Bikaneri camels.

(B) Riding Camels: These can cover about 50 km per day for several days at an average speed of 10 km per hour. E.g. Jaiselmeri camels can cover up to 200 km in a night without stopping for food or water.

Depending Upon the Origin/Hump, Camels can be Classified into Two Groups:

(1) Dromedary Camel (Camelus dromedarius): These are from the Middle East and North Africa. Single hump. Head and body length: 9.6-11 feet. Shoulder height: 5.8-7.5 feet. Weight: 700-1500 pounds. Their color ranges from white, brown, tan, red, black and spotted. With their longer legs they can easily out run the bactrian camel.

(2) Bactrian Camel (Camelus bactrians): These are Asian camels, which come from the deserts of China and Mongolia. They have two-humps, shorter legs, are usually a beige color with hair that ranges from short to long depending on the season. Head and body length: 10-12 feet. Shoulder height: 6-7.6 feet. Weight: 1300-2100 pounds. Height of humps: up to 9 feet.

CHAPTER 8

IMPROVEMENT OF FARM ANIMALS (RUMINANTS)

SYSTEMS OF MATING (BREEDING POLICIES)

The aim of the breeders is to evolve outstanding and improved average meritorious types of animals. Selection and systems of mating constitute the only tools available to the breeder for improvement of animals, since new genes cannot be created, though they can be linked together into more desirable groupings.

Systems of mating have been broadly ***classified as*** under:

1. Inbreeding – Breeding of the related animals.
2. Outbreeding- Breeding the unrelated animals.

Relatives means animals related up to 6 generations.

IN-BREEDING: Inbreeding can again be divided into two groups:

	(a) Close breeding	**(b) Line breeding**
e.g. mating	(i) Sire to daughter	(i) Half-brother-sister
	(ii) Son to dam	(ii) More distantly related animals
	(iii) Full brother and sister	

(a) Close breeding:

This means the mating of full sister to full brother or sire to his daughter or dam to her son. These types of mating give the greatest concentration of similar traits and can be used in the production of sires.

(b) Line breeding:

This means the mating of animals of wider degrees of relationship than those selected for close breeding. It promotes uniformity in the character, but brings in more hereditary influence than mating of animals by close breeding. Homozygosity is not reached so quickly as in close breeding. Neither desirable nor harmful characters are developed so quickly. It is a slow method for the fixation of hereditary character of outstanding bull or cow. The progeny is mentioned as being line-bred to certain ancestors.

Advantages of inbreeding:

1. It increases prepotency of a sire, because he has many homozygous genes.
2. It brings about the uniformity of required type in the animals of the herd.
3. It takes less time for reaching the desired standard of production/type in the herd.

Disadvantages of inbreeding:

1. Undesirable characters are intensified in the progeny if wrong selection is made.
2. The vigour and resistance to diseases is reduced in the progeny.
3. Progeny may have reduced growth and reproductive performance.
4. Hereditary abnormalities or lethal factors are likely to appear more in the inbred animals than in the outbreds.

Line-breeding is less severe in bringing about the advantages as well as the disadvantages than the close-breeding.

OUT-BREEDING

Out-breeding is the breeding of the unrelated animals. It includes the following types of breeding:

(a) Out-crossing

(b) ***Cross-breeding*** (i) Criss-crossing (ii) Triple crossing (iii) Back crossing

(c) Species hybridization

(d) Grading-Up

(a) Out-Crossing:

It consists of the practice of mating unrelated purebred animals within the same breed. The animals mated should not have common ancestors in either side of their pedigree up to 4-6 generations The offspring of such a mating is known as the out-cross.

Advantages:

1. This method is highly effective for characters that are largely under the control of genes with additive effects and are highly hereditary, e.g. milk production, growth rate in beef cattle etc.
2. It is an effective system for fixing genetical factors if carefully combined with selection.
3. It is the best breeding method for herd that are below average, i.e. that of a common farmer.

When ceiling is reached and no further improvement is possible it has to change over to other system of breeding for fixing them up.

(b) Cross-Breeding:

It is the mating of animals of different breeds within a species. It is generally resorted to where the crossbred progeny is directly marketed and is not needed for breeding and further multiplications. It has become quite common in pigs and in the production of hybrid chickens. With beef cattle also it is practiced to a certain extent. Cross-breeding for milk production has been tried with varying degrees of success with motive of evolving new breeds.

Advantages of Cross-breeding:

1. It is valuable as a means of introducing desirable characters (genotypes) into a breed in which they were absent formerly.
2. It serves as good purpose in evolving a new breed owing to the fact that it disturbs the balance and brings about recombination in the germplasm to cause variations.
3. It is an extremely handy tool to study the behaviour of characteristics in hereditary transmission.
4. The CB animals usually exhibit an accelerated growth and vigour of heterosis, which means the blending of desirable genes from 2 breeds in the first generation. Such animals are thriftier than either of the parents; they grow rapidly, produce more milk, wool, eggs etc., than would be expected from their pedigree.

Disadvantages:

1. The breeding merit of crossbred animals is generally reduced because of the heterozygous nature of their genetic composition, and the fact that all animals transmit only a sample half of their own genetic materials to the offspring. I.e. it has a tendency to break up (segregate) established characters and destroy combinations of characters which have long existed in the strains and which, under the system of pure breeding, have behaved in a manner like unit characters in transmission.
2. The crossbred are useless for breeding purposes because their offspring are more variable than themselves, and are of lower merit.
3. It is possible that most of breeders cannot resist the temptation to use some practically good crossbred animal for breeding purposes. Such a bull passes various assortments of genes from both the breeds to its offspring and hence is incapable of producing even a relatively uniform set of offspring.
4. Replacement cost of stock is heavy.
5. Cross-breeding requires maintenance of two or more pure breeds in order to produce the crossbreds, which undoubtedly involves a considerable investment, as rapid progress need not be expected in any line of breeding unless sufficient numbers can be kept to allow for rigid selection.

Efforts are made to evolve new dairy cattle breeds in India. (1) Karan-Swiss breed is evolved by crossing Brown Swiss (Exotic dairy breed) with Sahiwal (Indian breed) and subsequent inter-se mating of the crossbreds with rigid selection for several generations. (2) Karan-Fries breed has foundation of Holstein Friesian and Tharparkar. Both the new cattle breeds, viz. Karan-Swiss and Karan-Fries are evolved at NDRI, Karnal. They have promising performance under our climate as indicated earlier in breed description.

Similarly, Sunandini and Jersindh are new cattle breeds produced by cross-breeding in South India.

(c) Species Hybridization:

By crossing two different species sometimes we get good virile individual. The 'Mule' and 'Hinny' are good examples of commercially important species hybrids.

Jack (male ass) x Mare (female horse) = Mule.

Stallion (male horse) x Jennet (female ass) = Hinny.

European cattle and American bison when crossed produce sterile males and fertile females. By backcrossing the females to bison and cattle, attempts are being made to form a new hybrid species the '***Cattalo***'.

Heterosis or Hybrid Vigour:

Heterosis or hybrid vigour is phenomenon, in which the crosses of unrelated individuals often result in progeny with increased vigour much above their parents (i.e. superiority of first filial generation over both the parents). The progeny may be from the crossing of strains, varieties, breeds or species. The explanations for this increase vigour are that genes favourable for reproduction are usually dominant over their opposites. They also have few unfavourable recessive genes. When one breed is crossed with the other, one parent supplies a favourable dominant gene to offset the recessive one supplied by the other and vice versa.

(d) Grading-Up:

Grading-up is the practice of breeding purebred sires of a given breed to local non-descriptive females and their offspring's generation after generation.

By the successive use of a good purebred sire only a few generations are required to bring the herd to the point at which it has all the appearance, production and practical value of the pure breed. Following table will explain how the desired characters of purebred are introducing to replace undesirable non-descriptive ones.

	OFF-SPRINGS	
Generation	**Per cent replaced**	***Per cent non-descriptive left***
First	50.00	50.00
Second	75.00	25.00
Third	87.50	12.50
Fourth	93.75	6.25
Fifth	96.87	3.12
Sixth	98.44	1.56
Seventh	99.22	0.78

The grading process does not create anything new, but it may transfer the good quality of an improved breed to the local non-descript cattle. A grade is also likely to carry many undesirable recessives that would appear in future mating.

For a grading-up program, it is advisable to use a breed that thrived well under local conditions, otherwise the graded animals may not be able to adapt well to the local environment.

Grading-up is the only system of mating left for improving indigenous non-descript buffaloes.

FERTILITY AND BREEDING EFFICIENCY

The profile that is obtainable through milk, meat, eggs, wool, etc., is dependent on the reproductive efficiency of the stock. **Fertility** is the ability of an animal to produce large number of living young ones. This is a relative term, consequently 'high' and 'low' fertility are terms used to describe differences between numbers of young per litter or differences in the frequencies of pregnancies. This applies to both males and females.

Fecundity is the potential capacity of the female to produce functional ova, regardless of what happens to them after they are produced, e.g. a hen may have high fecundity but her eggs may have low fertility/hatchability. **Sterility** is inability to produce any offspring at all, while **infertility** is inability to reproduce temporarily.

Some of the ***management suggestions***, which will tend ***to improve breeding efficiency,*** are listed below:

1. Do not breed cows following parturition until uterus has involuted and entire vaginal discharge has ended and at least 60 days have elapsed.
2. Keep an accurate record of dates of parturition, heat periods, services, etc.
3. Maintain regularity of heat detection and use teasers in large herds.
4. Breed cows from mid to end of heat period, i.e. later half of oestrus.
5. Have regular pregnancy examination by a competent veterinarian.
6. Get the animals examination by a competent veterinarian failure to come into heat, irregular heat periods, repeat breeding, abortion and retained placenta, and follow his recommendation as to correction of the problem.
7. Be sure to feed well-balanced ration.
8. Use proper sanitation, care & isolation when contagious disease is found in the herd.
9. Follow annual testing of the herd for chronic diseases like TB, JD and Brucellosis, and Regular mass vaccination against common contagious diseases.

CHAPTER 9

DIGESTION IN RUMINANTS

The cow's digestive tract consists of the mouth, esophagus, a complex four-compartment stomach, small intestine and large intestine. The stomach includes the rumen or paunch, reticulum or "honeycomb," the omasum or "manyplies," and the abomasum or "true stomach."

The rumen. The rumen (on the left side of the animal) is the largest of four compartments and is divided into several sacs. It can hold 25 gallons or more of material, depending on the size of the cow. Because of its size, the rumen acts as a storage or holding vat for feed. It is also a fermentation vat. A microbial population in the rumen digests or ferments feed eaten by the animal. Conditions within the rumen favour the growth of microbes. The rumen absorbs most of the volatile fatty acids produced from fermentation of feedstuffs by rumen microbes.

The reticulum. The reticulum is a pouch-like structure in the forward area of the body cavity. The tissues are arranged in a network resembling a honeycomb. A small fold of tissue lies between the reticulum and the rumen, but the two are not actually separate compartments. Collectively they are called the rumino-reticulum.

The omasum. This globe-shaped structure contains leaves of tissue (like pages in a book). The omasum absorbs water and other substances from digestive contents.

The abomasum. This is the only compartment (also called the true stomach) with a glandular lining. Hydrochloric acid and digestive enzymes, needed for the breakdown of feeds, are secreted into the abomasum. The abomasum is comparable to the stomach of the non-ruminant.

The small intestine. The small intestine measures about 20 times the length of the animal. It is composed of three sections: the duodenum, jejunum, and ileum. The small intestine receives the secretions of the pancreas and the gallbladder, which aid digestion. Most of the digestive process is completed here, and many nutrients are absorbed through the villi (small finger-like projections) into the blood and lymphatic systems.

Cecum. The cecum is the large area located at the junction of the small and large intestine, where some previously undigested fibre may be broken down. The exact significance of the cecum has not been established.

Large intestine. This is the last segment of the tract through which undigested feedstuffs pass. Some bacterial digestion of undigested feed occurs, but absorption of water is the primary digestive activity occurring in the large intestine.

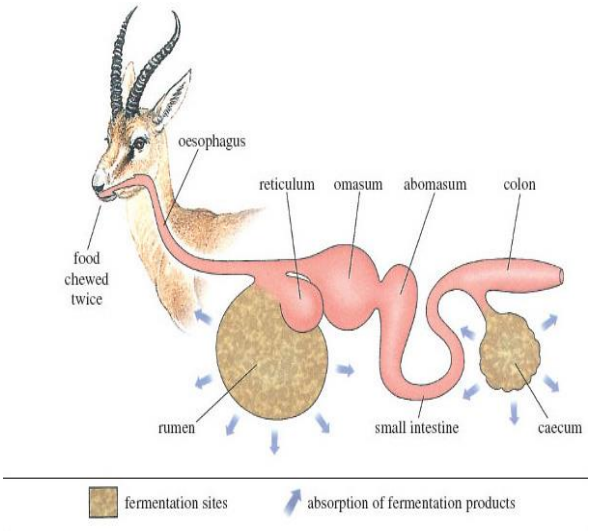
Function of the Digestive Tract

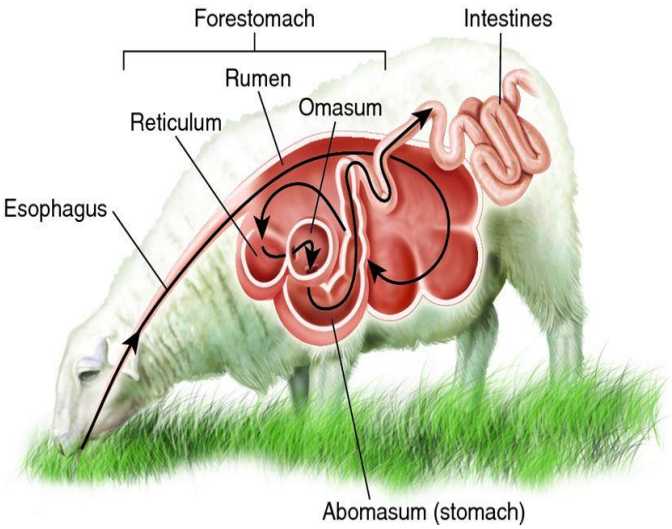
Eructation (belching). Large quantities of gas, mostly carbon dioxide and methane, are produced in the rumen. Production amounts to 25 to 50 litres per hour and must be removed; otherwise bloating occurs. Under normal conditions, distension from gas formation causes the cow to belch and eliminate the gas. **Rumination.** A cow may spend as much as 35 to 40 percent of each day ruminating (cud chewing). The actual amount of time spent ruminating varies from very little (when grain or finely ground rations are fed) to several hours (when long hay is fed). Mature cattle spend little time chewing when eating. During rest periods, feed boluses (cud) are regurgitated for rechewing to reduce particle size and for resalivation. Feed is more readily digested by rumen microbes as particle size is reduced.

Motility of the rumen and reticulum. The rumen is always contracting and moving. Healthy cows will have one to two rumen contractions per minute. The contractions mix the rumen contents, bring microbes in contact with new feedstuffs, reduce flotation of solids, and move materials out of the rumen. Lack of or a decrease in frequency of rumen movements is one way of diagnosing sick animals.

Saliva production. As much as 60 to 70 litres of saliva can be produced by salivary glands and added to the rumen each day. Saliva provides liquid for the microbial population, recirculates nitrogen and minerals, and buffers the rumen. Saliva is the major buffer for helping to maintain a rumen pH between 6.2 and 6.8 for optimum digestion of forages and feedstuffs.

Vomiting. Cattle rarely vomit. Occasionally certain feeds will induce vomiting. Some pasture plants, usually weeds, contain alkaloids that can cause this problem. Should this condition persist, a veterinarian should be consulted. *Microbial digestion of feed carbohydrate in the rumen*





Digestion of energy feeds in the rumen. Simple and complex carbohydrates (fibre) are digested by rumen microbes and converted into volatile fatty acids. The volatile fatty acids, which consist mainly of acetic, propionic, and butyric acids, are the primary energy source for ruminants. When large amounts of forage are fed, the formation of acetic acid predominates (60 to 70 percent of total) with lesser amounts of propionic (15 to 20 percent) and butyric (5 to 15 percent) acids occurring. However, when grain feeding is increased or when finely ground forages are fed, the proportion of acetic acid may decrease to 40 percent, while the amount of propionic acid may increase to 40 percent. Such a change in volatile fatty acid production generally is associated with a reduction in milk fat test. Approximately 30 to 50 percent of the cellulose and hemicellulose is digested in the rumen by the microbial population. Sixty percent or more of the starch is degraded, depending on the amount fed and how fast ingested materials move through the rumen. Most sugars are 100 percent digested within the rumen. The volatile fatty acids are absorbed from the rumen into the blood stream and transported to body tissues, including the udder, where they are used as sources of energy for maintenance, growth, reproduction, and milk production. The cow derives 50 to 70 percent of its energy from the volatile fatty acids produced in the rumen. **Protein and non-protein nitrogen utilization in the rumen.** Some of the protein consumed by the cow escapes breakdown in the rumen. Protein undergoing fermentation is converted to ammonia, organic acids, amino acids, and other products. Approximately 40 to 75 percent of the natural protein in feed is broken down. The extent of breakdown depends on many factors including solubility of the protein, resistance to breakdown, rate of feed passage through the rumen, and others. Many rumen micro-organisms require ammonia (breakdown product of protein) for growth and synthesis of microbial protein. Ammonia also may be provided from NPN sources such as urea, ammonium salts, nitrates, and other compounds. Rumen microbes convert the ammonia and organic acids into amino acids that are assembled into microbial protein. Excess ammonia is mostly absorbed from the rumen into the blood stream, but small amounts may pass into the lower digestive tract and be absorbed. Feed protein (that escapes breakdown in the rumen) and microbial protein pass to the abomasum and small intestine for digestion and absorption. **Vitamin synthesis.** The rumen micro-organisms manufacture all of the B vitamins and vitamin K. Vitamin synthesis in the rumen is sufficient for growth and maintenance. Under most conditions, cattle with functioning rumens do not require supplemental B vitamins or vitamin K in the diet. Niacin (B3) and thiamine (B1) may be needed under stress conditions. **Fat digestion.** Most of the digestion and absorption of fat occurs in the small intestine. Rumen micro-organisms change unsaturated fatty acids to saturated acids through the addition of hydrogen molecules. Thus, more saturated fat is absorbed by cows than by simple-stomach animals. Feeding large quantities of unsaturated fatty acids can be toxic to rumen bacteria, depress fibre digestion, and lower rumen pH.

Digestive System of Calf

At birth and during the first few weeks of life, the rumen, reticulum, and omasum are undeveloped. In contrast to the mature cow, in the calf, the abomasum is the largest compartment of the stomach. At this stage of life, the rumen is non-functional and some feeds digested by the adult cannot be used by the calf. During nursing or feeding from a bucket, milk bypasses the rumen via the oesophageal groove and passes directly into the abomasum. Reflex action closes the groove to form a tube-like structure which prevents milk or milk replacer from entering the rumen. When milk is consumed very rapidly, some may overflow into the rumen. Development of rumen begins at the age of 3-4 weeks and will begin functioning like the adult's when the calf is about 3 months of age.

CHAPTER 10

(A) Feeding Standards

Feeding standards are guidelines or statements of the amount of nutrients required by animals for their normal functions and productions. These requirements are given for different purposes (viz. growth, lactation, work, pregnancy etc) in table form. Feeding standards so far designed are of ***three types*** **(1) Comparative type (2) Production value type and (3) Digestible nutrient type.** Among the later (digestible nutrient types), following three feeding standards are in practice now-a-days.

(i) Morrison Feeding Standard:

Morrison observed stockmen spending large sums of money for entirely unnecessary amounts of protein supplement to their animals, thus considerably reducing their profits. He therefore, endeavoured to combine in one set of standards what seem in the judgment to be the best guide available in computation of rations for the various classes of livestock. These standards have been expressed in terms of Dry Matter (DM), Digestible Crude Proteins (DCP) and Total Digestible Nutrients (TDN). The average of Morrison standards has been accepted for Indian Livestock, which are ahead under the heading "Indian Feeding Standards".

(ii) National Research Council Standard:

A sub-committee of the committee on animal nutrition of the National Research Council (USA) recommended a nutrient allowance for dairy cattle, which was first published in 1945 with the latest revision in 1989. The requirements are quite similar to those of the Morrison standard.

The standard includes requirements of crude protein, un-degradable protein and total digestible nutrients and also includes the recommended requirements for calcium, phosphorus, carotene and Vit-D for growing animals.

(iii) Indian Feeding Standard:

For many years, we were dependent on feeding standards drawn up in foreign countries. Sen, Ray and Ranjhan (1978) gave a feeding standard based on average of recommended upper and lower limits of nutrients required for animals. They have prescribed nutrient requirement for maintenance, growth, milk production, work and pregnancy in cattle. The nutrient requirements are given in terms of DM, DCP, TDN, Ca, P, carotene etc.

Recently Indian Research Council (1985) has published a feeding standard prescribing nutrient requirement of livestock and poultry. It is based on research work carried out in India. The requirements are given for almost all species of domesticated animals and poultry.

A brief summary of Sen, Ray & Ranjhan standard is given here.

Table 1: Nutrients required for growing cattle per head per day (Growth Requirement)

Live Wt (Kg)	Daily Wt Gain (g)	DCP (Kg)	TDN (Kg)
45	300	0.15	0.8
70	500	0.22	1.3
100	500	0.28	1.9
200	500	0.40	3.0
300	450	0.47	4.0
400	450	0.48	5.0

Table 2: Nutrients required for maintenance of adult cattle per head per day

Live Wt (Kg)	DCP (Kg)	**TDN** (Kg)	ME (Mcal)	Calcium (g)	Phosphorus (g)
350	0.227	2.70	9.72	8	8
400	0.254	3.03	10.91	9	9
450	0.282	3.37	12.13	10	10
500	0.296	3.69	13.28	11	11
550	0.336	3.71	13.36	12	12
575	0.356	3.72			
600	0.376	3.73			

Table 3: Nutrients required for milk production (per kg of milk) to be added to maintenance requirement (Production Allowance)

Fat % in milk	DCP (Kg)	TDN (Kg)	Calcium (g)	Phosphorus (g)
4.0	0.045	0.316	2	1.4
5.0	0.051	0.363	2	1.4
6.0	0.057	0.411	2	1.4
8.0	0.069	0.506	2	1.4
10.0	0.081	0.602	2	1.4

Table 4: Nutrients required for working cattle per head per day

Live Wt (Kg)	Normal work		Heavy work	
	DCP (Kg)	TDN (Kg)	DCP (Kg)	TDN (Kg)
400	0.45	4.0	0.57	4.8
500	0.56	4.9	0.71	6.4
600	0.66	5.8	0.84	7.2

Pregnancy Allowance:

During pregnancy, the animal should receive an extra allowance of 0.240 kg DCP and 1.4 kg TDN over and above what one should get for maintenance and milk production, which helps in the proper development of the fetus and in replacing the body sores of the energy that may have been utilized in the earlier part of lactation.

During the first and second lactations of early maturing animals (crossbred & exotic cattle) about 20 and 10 per cent, respectively, of the maintenance requirement should be added to the requirement given in Table for their continued growth.

Table 5: DCP & TDN content (Kg/100Kg DM) of some common fodder & concentrates

Name of Fodder	**DCP (Kg)**	**TDN (Kg)**	**Name of Concentrate**	**DCP (Kg)**	**TDN (Kg)**
Green Fodders			**Grains and Seeds**		
Cereals: Jowar	2.4	56.6	Bajra	4.6	70.9
Maize	2.6	53.8	Guar	22.1	69.8
Oat	3.2	56.8	Pigeon pea	17.1	77.7
Hybrid Napier	5.8	52.5	Cotton seed	14.1	67.2
Legumes: Lucerne	19.3	69.7	***Oil seed Cakes***		
Berseem	14.2	63.9	Ground nut Cake	37.8	82.0
Cabbage	9.3	52.9	Cotton seed cake	15.6	57.07
Cauliflower	9.0	73.5	***Cereal byproducts***		
Silage: Jowar	1.5	54.7	Maize bran	7.6	88.4
Hybrid Napier	3.3	48.7	Wheat bran	9.3	70.4
Dry Fodders			Rice bran	6.0	55.0
Jowar straw	1.5	59.3	Maize Gluten	40.5	71.3
Bajri straw	0.6	51.3	***Legume Byproducts***		
Wheat straw	0.2	56.8	Guar meal	35.1	73.9
			Sal seed cake	0.1	57.9
			Amul Dana	28-30	75.0

FEEDING AND WATERING REQUIREMENT OF DAIRY CATTLE

(A) Feeding Roughage:

On an average, dairy cattle consume dry roughage at the rate of 2.5% of their body weight. If the roughage is succulent, the consumption is 2 ½ to 3 times i.e. at the rate of 6 to 7.5 percent of body weight. If the cow weighs 400 kg, she will consume about 10 kg of dry roughage. If the roughage is succulent, she will take about 25 to 30 kg. The quantity of roughage consumption by an animal will vary from 1½ to 3½ % of its body weight according to the quality of the roughages. Good quality roughage is eaten more and vice-versa.

Dairy cattle should be fed good quality roughage as far as possible. Good quality roughage is low in fibre, is more leafy, is greenish in colour and is palatable. Dairy animals should be fed at least 33% of their total roughage requirement in form of succulent roughage. It contains factors of succulence i. e. certain unidentified nutritive factors, which lead to higher milk production. Preferably the ratio of leguminous to non-leguminous roughage should be 2:3.

(B) Feeding Concentrates:

The basal feed of dairy cattle is roughage. Moreover, the roughage is cheaper as compared to concentrates. Hence as far as possible, the nutrients required by dairy cattle should be given in the form of roughage. The concentrates should be fed to supply only their remaining nutrient requirement.

The quantity of concentrates to be fed daily to dairy animals will depend upon the quality and quantity of roughage fed to them. With good quality roughage, the concentrates to be fed will be less and vice-versa. So by feeding better quality roughages, we can curtail concentrate requirement.

The compound concentrate mixtures are available from private as well as dairy co-operatives. The concentrate mixture produced by reliable firms and with the composition of our need should be used. Generally, the farmers prefer compounded concentrate mixtures produced by dairy co-operative unions in Gujarat. Because they have advantages of (1) well-formulated production under expert's supervision, (2) bulk purchase, (3) feasibility of using cheaper & unconventional feeds to economise the concentrate mixture.

(C) Feeding Minerals:

Dairy cattle need minerals like calcium, sodium, potassium and phosphorus in relatively larger amounts, and iron, copper, iodine and cobalt etc., in traces. Ordinarily, dairy cattle receive from their normal ration all the minerals required by them in sufficient quantities, except for sodium, calcium and phosphorus. But in areas where the soil on which the forage crops are grown is deficient in any one or more of the above minerals, there may be deficiency of the same in the ration of animals. This deficiency should be corrected by feeding suitable mineral supplements.

Under ordinary condition, the dairy cattle are fed common salt mixed with the concentrates. If the roughage fed is non-leguminous, they may also be fed steam sterilized bone meal or any other calcium supplement. When leguminous roughage is fed to dairy cattle, supplying additional calcium through such supplement is not necessary. Now-a-days, several

mineral mixtures are available in the market. They are mixed with concentrates. Extra mineral mixture is given to high producing cows.

(D) Providing Water:

Water constitutes over 70% of the animal body and over 85% of the milk. It is therefore not surprising that the daily consumption of water is greater than that of the any other nutrient. Lack of water will retard growth and reduce production.

Qualities of water:

- Drinking water must be free from pathogens
- Should not contain organic matter or inorganic impurities.
- Such water is safe- wholesome –for animal life.
- At the same time drinking water should be palatable to the animals, so that they will drink sufficient amount.
- The drinking water should be cooler in summer and warmer in winter.

Functions of water in animal body:

1. It is one of the constituents of the body tissues and fluids.
2. By its solvent action, it serves as a universal medium for metabolism, transport of nutrients, transport and excretion of metabolic waste from the body etc.
3. It helps in maintaining body temperature.
4. It is helpful in digestion of food, assimilation and absorption of digested nutrients.

Factors affecting water requirement/consumption:

The amount of drinking water needed will depend upon the

- Class of animal,
- The level of production,
- The water content of the feed,
- The type of ration and the
- Ambient temperature.

As a general rule, allow 5 parts of water for each part of air dry feed. Equal mount of water is also needed for washing of animals, utensils and sheds.

Under average conditions the (a) Beef cattle, Dry cows, Bullocks etc. may drink 5 to 8 litres of water/100 kg body wt. and (b) Lactating Dairy cows may drink 5 to 8 litres/100 kg body wt for maintenance plus 3 litres of water per kg of milk produced.

(E) Calculation of Feed and Water Requirement for a Dairy Herd:

From the herd register or roll call register, collect the information of different classes of animals in the herd. From this information calculate the equivalent adult units in the herd. The adult units give rough idea about feed and water requirement, wherein different classes of animals are compared with an adult cow of average body weight. Under average condition, following guideline is used for calculation of adult units.

1 Cow = 1 adult unit (AU) Indian heifers from 1 to 2 yrs of age = 1 AU

1 Bull = 1.25 AU 2 Indian heifers from 2 to 3 yrs age = 1 AU

1 Bullock = 1 AU 2 Crossbred heifers above 1 year of age = 1 AU

4 Calves = 1 AU

Now, from the total adult units calculate the feed and water required in the herd daily, monthly or yearly.

(F) Formulation / Computation of Ration:

The feeds available and production as well as physiological status of animal changes frequently. Therefore, it is necessary to compute ration for animals of different classes under different feeding conditions we have. The data comprising a feeding standard and feed composition are useful as a guideline in computation of ration.

(V) DESIRABLE CHARACTERISTICS/QUALITIES OF A RATION

1. **Liberal Feeding**: Dairy cows need all nutrients liberally incorporated in the ration for exploiting inherent capacity to the maximum. However, they should not be overfed, as it is wasteful and sometimes harmful.
2. **Individual Feeding**: To obtain max profits, cows must be fed individually according to their production and physiological status instead of group feeding, because in group feeding, weaker or sicker animals get lesser feeds as against powerful ones.
3. The ration should be **well balanced** for all nutrients required by animals. Excess of nutrients are wasteful. Any deficiency of nutrient affects health and production.
4. **Palatable Feeds:** This affects feed consumption. Evil/bad smelling, mouldy, dusty, spoiled and inferior feeds are unpalatable.
5. **Variety of feed should be included in the ration:** By combining many feeds in a ration, better and balanced mixture of proteins, vitamins and other nutrients are furnished. Moreover, variety of feeds in the ration makes it cheaper and palatable.
6. The feeds used in the ration should be **free from foreign materials** like mould, dust, nails, toxins, gravel etc. It is better to clean them if necessary.
7. The ration should be **fairly laxative and not constipating**. Otherwise it may lead to digestive trouble and depression of appetite/hunger.
8. The ration should be **fairly bulky,** so that the hunger of animal is satisfied. If ration is more bulky, animal cannot eat sufficient quantity to fulfill its nutrient requirement.

9. **Allow much of green fodders**: As they are rich in carotene, slightly laxative, more palatable and easily digestible. Feeding only green fodder may not supply sufficient dry matter for satisfying hunger.
10. **Avoid sudden changes in the diet**: These may cause digestive troubles.
11. **Maintain regularity in feeding timings**. Otherwise animals become restless and go down in production.
12. **Feed must be properly prepared/processed by chaffing, soaking, grinding, boiling, pelleting, mixing etc**. These have special advantages associated with them.

COMPUTATION OF RATION FOR LIVESTOCK

Objectives:

- To provide balanced ration to farm animals in view of production.
- Scientific approach for feeding of farm animals.
- To make economical use of available feed resources.

Principle:

Computation of ration includes translating the recommendations contained in feeding standards into actual formulation of feed mixture and feeding practices. In formulation of ration for ruminants DM, DCP, energy in terms of TDN, minerals and vitamin A is given consideration.

Formulation of Ration:

Ration may be defined as total allowance of the feed given to an animal during 24 hrs period to perform the various functions. The ration of animal may be divided for the sake of convenience into two parts, one for maintenance and other for production or reproduction whatever the case is. The word "balanced ration" means feeds or mixture of feeds which contain all essential nutrients in right quantity and in optimum proportion to meet the needs of the animal for maintenance and production.

Desirable Characteristics/Qualities of a Ration:

- Liberal Feeding: Dairy cows need all nutrients liberally incorporated in the ration for exploiting inherent capacity to the maximum. However, they should not be overfed, as it is wasteful and sometimes harmful.
- Individual Feeding: To obtain maximum profits, cows must be fed individually according to their production and physiological status instead of group feeding, because in group feeding, weaker or sicker animals get lesser feeds as against powerful ones.
- The ration should be well balanced for all nutrients required by animals. Excess of nutrients are wasteful. Any deficiency of nutrient affects health and production.
- Palatable Feeds: This affects feed consumption. Evil/bad smelling, mouldy, dusty, spoiled and inferior feeds are unpalatable.
- Variety of feed should be included in the ration: By combining many feeds in a ration, better and balanced mixture of proteins, vitamins and other nutrients are furnished. Moreover, variety of feeds in the ration makes it cheaper and palatable.
- The feeds used in the ration should be free from foreign materials like mould, dust, nails, toxins, gravel etc. It is better to clean them if necessary.

- The ration should be fairly laxative and not constipating. Otherwise it may lead to digestive trouble and depression of appetite/hunger.
- The ration should be fairly bulky, so that the hunger of animal is satisfied. If ration is more bulky, animal cannot eat sufficient quantity to fulfill its nutrient requirement.
- Allow much of green fodders: As they are rich in carotene, slightly laxative, more palatable and easily digestible. Feeding only green fodder may not supply sufficient dry matter for satisfying hunger.
- Avoid sudden changes in the diet: These may cause digestive troubles.
- Maintain regularity in feeding timings. Otherwise animals become restless and go down in production.
- Feed must be properly prepared/processed by chaffing, soaking, grinding, boiling, pelleting, mixing etc. These have special advantages associated with them.

Points to be Considered while Formulating the Ration:

a. Live weight of the animal

b. Age of the animal

c. Condition of the animal

d. Producing or non-producing

e. Production level-high or low

f. Types of the feed and fodders available

Ration for Dairy Cattle:

The computation of ration must be done in a systematic manner otherwise it will be a cumbersome exercise. The steps involved in ration formulation are:

Step-I	Determination of dry matter requirement.
Step-II	Distribution of required DM to different category of feeds.
Step-III	Determination of DCP and TDN requirement of animal for maintenance.
Step-IV	Determination of the DCP and TDN requirement for production or reproduction functions over and above the maintenance requirement.
Step-V	Sum up the maintenance requirement of nutrients with production/reproduction requirement. This will be total requirement of the nutrients for particular animal in a day for maintenance and production/reproduction.
Step-VI	Refer the chemical composition of the available feed resources to fulfill the DCP and TDN requirement as per the allocation of DM to particular feed category and at the cheapest price.
Step-VII	Calculate the nutrients supplied through roughage and concentrate according to DM allocation and also calculate the quantity of individual feedstuff on fresh and dry basis.

Step-VIII Match the supply of nutrients with their requirement for one day. It should be exactly same or somewhat higher than the requirement but, if anyone is deficit then re-adjust the level of individual feed ingredient within the category and according to deficit nutrient.

Step-IX Preparation of ration.

Note: Mineral mixture @ 2 per cent and salt @ 1 per cent of the ration should be given to the animal.

Chemical composition of feedstuffs: The quantity of individual feedstuff in the ration can not be fixed until unless you have the idea about its chemical composition. Different principles of the composition may be analyze in the laboratory or may refer from the books. The composition of some common feed ingredients in terms of DCP and TDN is given below.

DCP and TDN content of some common feedstuffs

The nutritive value of some important feeds are as follows:

FEEDS	**DM**	**DCP**	**TDN**
Wheat straw	90	0.0	42
Bajra straw	90	0.8	48
Jowar straw	90	1.0	50
Rice straw	90	0.0	35
Berseem hay	90	9.0	60
Lucerne hay	90	14.0	50
Green bajra	30	1.0	15
Green jowar	30	0.8	16
Green maize	30	1.2	17
Green berseem	20	2.8	13
Green Lucerne	20	3.0	12
Guar	90	29	71
Moth	90	8	78
Barley grain	90	19	72
Wheat bran	90	10	62
Cotton seed cake	90	17	72

Groundnut cake	90	42	72
Til oil cake	90	30	78
Linseed cake	90	28	65
Gram	90	12	75
Guar churi	90	38	74
Moth churi	90	25	75
Gram churi	90	38	72

CALCULATION OF WATER AND FEED REQUIREMENT FOR DAIRY HERD

Objectives:

- To calculate nutrient requirement of cattle and buffaloes for maintenance in terms of DCP and TDN.
- To determine the requirement of DCP and TDN for bovines to perform various productive functions like growth, milk production, field work and pregnancy.

Introduction:

The nutrient requirements viz. DM, DCP and TDN vary with body weight, intensity of production, intensity of work, average daily gain and gestation month etc. The requirement of a particular animal for performing a specific function is compile in tabular form which is known as feeding standard. Thus, the feeding standard may be defined as tabulated statement of the requirement of nutrients of animals for performing various body functions. Feeding standards broadly are divided into three categories namely comparative, digestible nutrient type and production type feeding standards. There are various agencies in the world such as NRC, ARC, CNCPS, ICAR etc. which provide the information about the nutrients requirement of animal. The Indian feeding standards prepared by ICAR is basically based on the average value of Morrison feeding standard. ICAR (1985) feeding standard describe the nutrient requirement in terms of DM, DCP, TDN, Ca and P based on recommendations of scientific panel on nutrition and physiology. This standard includes recommendation based on experimental work carried out in India over the past several years. The figures given for TDN can be converted to DE and ME by taking 4.4 Mcal DE and 3.6 Mcal ME per kg TDN, respectively. The requirements for maintenance are the same for buffaloes as that for Indian cattle.

Requirement of Nutrients for Dairy Bovine:

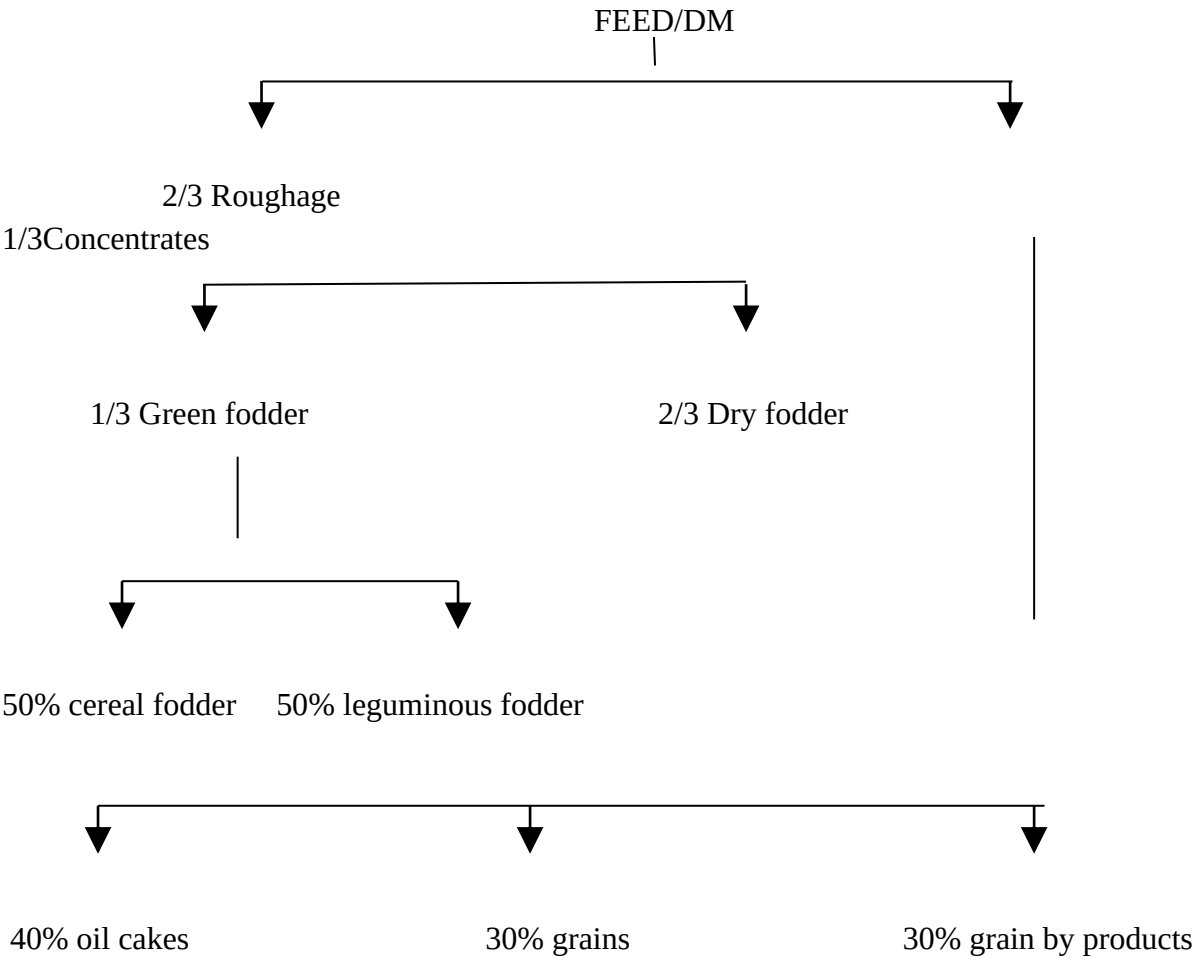
(1) DM Requirement:

DM Requirement of different animals depends on the body weight of animal and species.

For indigenous cattle: 2.0-2.5kg/100kg BW

For cross bred cattle and buffalo: 3.0 kg/100kg BW

Supply of DM by dietary feed resources



The DM supplied by the dietary feed ingredients will furnish the nutrients required by the animal for different body functions viz. for maintenance, milk production, pregnancy, field work etc. The requirement of DCP and TDN, which are the measures for expressing the protein and energy need of the animal, respectively, depend on the body weight and intensity of production.

a) Maintenance Requirement:

This is the minimum requirement of the nutrients for the animal to perform various vital functions of the life like respiration, circulation, transportation of nutrients, metabolism of nutrients and secretion of hormones etc. The maintenance requirement of particular animals depends on its body weight. The nutrients requirement in terms of DCP and TDN at different body weight has been compiled in the below given table.

Daily Maintenance Requirement for Various Nutrients:

B.W. (kg)	DCP (g)	TDN (kg)	Ca (g)	P (g)
250	168	2.02	6	6
300	197	2.36	7	7
350	227	2.70	8	8
400	254	3.03	9	9
450	282	3.37	10	10

b) Production Requirement: Production requirement varies animal to animal and species to species e.g. in cow and buffalo additional allowance of nutrients required to produce milk while in sheep it is for wool production and in goat for meat production. The production requirement in dairy animal get change with the level of production and not only with quantity of milk but the quality is also important specifically the fat per cent. The production requirement is given to the animal in addition to the maintenance requirement. Nutrients requirement in terms of DCP and TDN for producing 1 litre of milk with varying level of fat has been given below.

Nutrient Requirement for Milk Production:

Fat %	DCP (g)	TDN (g)
3.0	48	275
3.5	51	300
4.0	55	325
4.5	58	350
5.0	62	375
5.5	65	400
6.0	68	425

Growth: growth is a function of the nutrients, which require protein and energy in addition to the maintenance. The requirement of DCP and TDN depends on the daily gain in body weight. The table given below gives an idea about the nutrient requirement for growth at different body weight and different average daily gain.

Daily Nutrient Requirement in Terms of DCP and TDN for Growth:

B.W. (kg)	DCP (g)	TDN (g)
45	150	800

70	220	1300
100	260	1900
200	400	3000
300	470	4000

Work Allowance: The allowance for working bullocks depends on the intensity of work. The nutrient requirement describing the protein and energy requirement in the form of DCP and TDN is given in the table as under for normal working bullocks.

Daily Nutrient Requirement for Working Bullocks:

B.W. (kg)	**DCP (g)**	**TDN (g)**
200	240	2000
300	330	3100
400	450	4700
500	560	4900
600	660	5800

Pregnancy Allowance: In addition to the maintenance requirement, an additional allowance should be given to female animals during pregnancy especially in last three months for the development of foetus. Generally 140 g of DCP and 700 g of TDN daily is sufficient for the pregnant animal.

Breeding Bull: The nutrient requirement for nutrients again depends on the body weight of animal, which must be given in addition to the maintenance requirement.

Daily Allowance for Breeding Bull over and Above the Maintenance:

B.W. (kg)	**DCP (g)**	**TDN (kg)**
400	380	3.6
500	450	4.5
600	530	5.4

CHAPTER 11

INTRODUCTION TO COMMON FEEDS AND FODDERS, THEIR CLASSIFICATION AND UTILITY, FEED INGREDIENTS AND RATION FOR LIVESTOCK

Livestock feeds are generally classified according to the amount of a specific nutrient they furnish in the ration. They are divided into two general classes – *roughages and concentrates.* Roughages are bulky feeds containing relatively large amount of less digestible material, i.e. crude fibre more than 18 per cent and low (about 60 per cent) in T.D.N on air dry basis. Concentrates are feeds which contain relatively smaller amount (less than 18 per cent) of crude fibre and have a comparatively high digestibility and as a result higher nutritive value having more than 60 per cent T.D.N.

The number of substances used as feeding stuff to different species of livestock may exceed over 2000 items. All that is being attempted in this section is to indicate the outlines of classification of the conventional feeds into broad categories and to give typical examples of different groups under this classification.

Roughages:

Roughages are sub-divided into two major groups- succulent and dry, based upon their moisture content. Succulent feeds usually contain moisture from 60-90 per cent, whereas dry roughages contain only 10-15 per cent moisture. For the sake of convenience, succulent feeds are again classified into various types such as pasture, cultivated fodder crops, tree leaves, silage and root crops. Dry roughages have been further classified as hay and straw based on the nutritive values and methods of preparation.

Succulent Feeds:

1. Pasture: Of the succulent feeds, pasture is the most convenient and economic for maintaining larger livestock. Young rapidly growing grasses are rich in protein and highly palatable.

2. Cultivated fodder crops: In the absence of sufficient grazing ground of good quality for maintaining cattle, sheep, goat on pasture all the year round, the importance of growing fodder crops to provide feed economically for production of milk for draught animals, need no special emphasis. For the sake of convenience, these are classified into two groups- leguminous and non-leguminous. Among leguminous fodders, cowpea (*Vigna catjung),* cluster bean (*Guar – cyamopsis psoraloides)* are the most common kharif leguminous crops. They contain from 2-3 per cent D.C.P. and about 10 per cent T.D.N. on fresh basis and yield about 100 quintal of forage per acre. Berseem (*Trifolium alexandrium)* and lucerne (*Medicago sativa)* are two other commonly cultivated leguminous fodder in India. The former is an annual crop grown during the rabi season; the later is a perennial one having maximum growth in winter and spring but the growth is retarded during the monsoon season. Both these crops can yield over 300quintalas per acre in 5-6 cuttings. The disadvantage is that, both the fodders are liable to produce "bloat" if given in large quantities and thus it is advisable that they should always be given along with some dry fodder. Lucerne and berseem contain on an

average 2.5 to 3 per cent D.C.P. and 12 per cent T.D.N. on fresh basis. The phosphorus content of these two forages are poor and thus have wide calcium to phosphorus ratio. It is advisable to supplement a ration containing a large amount of leguminous fodder with a limited quantity of wheat or rice bran.

Among non-leguminous fodder jowar (*Sorghum vulgare),* maize (*Zea mays)* and sudan grass (*Sorghum sudanens)* are most common kharif fodder. Yield ranges from 100-200 quintals per acre. Most of the fodders belonging to this group (Non-legume kharif) are having 0.5 per cent D.C.P. and 11-15 per cent T.D.N. except maize, which is the nutritious of all, having 1 per cent D.C.P. and 17 per cent T.D.N. on fresh basis. An improved variety of bajra named as I.C. 2291, has been evolved by I.C.A.R., which has protein content of 2.5 per cent on fresh basis and the yield is about 65 tonnes per acre in 4 cuts. Among the rabi non-leguminous fodder crops, oat is by far excellent for milch cattle. It has 2 per cent D.C.P. and 17 per cent T.D.N. on fresh basis. Non-leguminous perennial

fodder crops consists of napier grass (*Pennisetum purpureum),* para grass (*Bracharia mutica) and guinea grass.*

All these grasses flourish vigorously during summer and rainy seasons. About 4-6 cuttings can be taken under north Indian conditions, so that an annual yield of 30-40 tonnes per acre is the yield.

Important Forage Crops:

I. Cultivated fodder - Legumes

Berseem, Lucerne, Senji, Cowpea, Guar, and Rice bean.

II. Cultivated fodder – Cereals

Oats, Sorghum, Bajara, Maize, Teosinte, Barley etc.

III. Cultivated fodder – Other than cereals and legumes

Brassica spp.

IV. Cultivated fodder – Perennial grasses

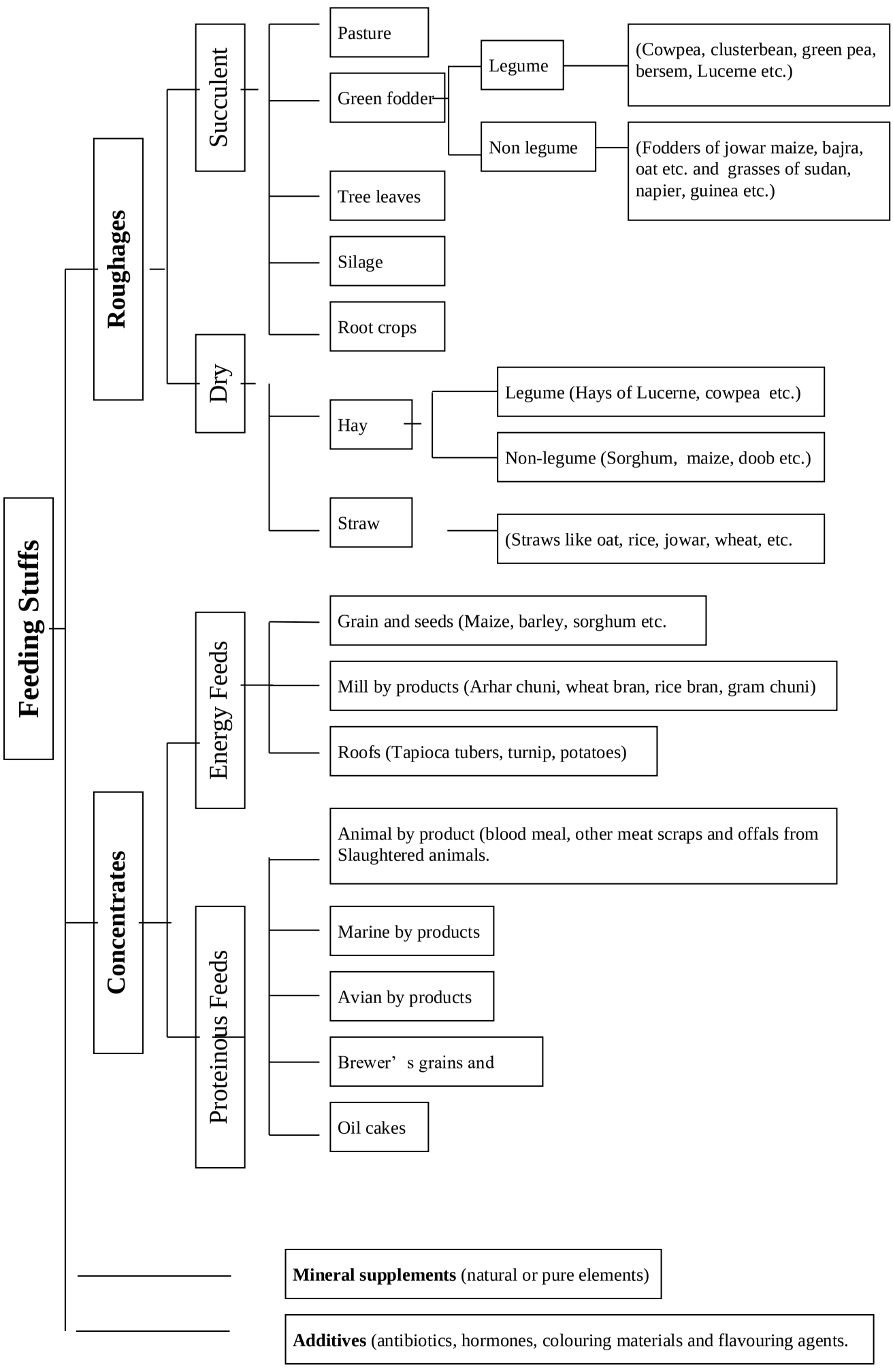
Napier, Bajara hybrid, Guinea grass.

V. Cultivated fodder – Annual grasses

Deenanath grass

VI. Perennial Range Grasses

Setaria, Anjan grass, Dhaman grass, Marval grass etc.


Feeding Stuffs
Roughages
Succulent
Pasture
Green fodder
Legume
(Cowpea, clusterbean, green pea, bersem, Lucerne etc.)
Non legume
(Fodders of jowar maize, bajra, oat etc. and grasses of sudan, napier, guinea etc.)
Tree leaves
Silage
Root crops
Dry
Hay
Legume (Hays of Lucerne, cowpea etc.)
Non-legume (Sorghum, maize, doob etc.)
Straw
(Straws like oat, rice, jowar, wheat, etc.
Concentrates
Energy Feeds
Grain and seeds (Maize, barley, sorghum etc.
Mill by products (Arhar chuni, wheat bran, rice bran, gram chuni)
Roofs (Tapioca tubers, turnip, potatoes)
Proteinous Feeds
Animal by product (blood meal, other meat scraps and offals from Slaughtered animals.
Marine by products
Avian by products
Brewer' s grains and
Oil cakes
Mineral supplements (natural or pure elements)
Additives (antibiotics, hormones, colouring materials and flavouring agents.

CHAPTER 11

PRESERVATION AND STORAGE OF FORAGES AS SILAGE AND HAY

Forages can be preserved either in the green form as Silage or in the dry form as Hay or Straw.

(A) Silage Making

Silage is the product resulting from storage and fermentation of succulent forage under anaerobic conditions in a silo.

Advantages of Silage Making

1. It furnishes high quality succulent feed for any season of the year and can be stored for number of years.
2. Nutrients are better preserved in silage than in hay, and it has high carotene content.
3. The animals eat fermented coarse stems of jowar and maize practically without waste.
4. It requires less storage space than the hay.
5. There is no hazard of fire as it contains 65% moisture.
6. Weedy crops/plants can be utilized in silage making.
7. It is slightly laxative and easy to digest by the animal.
8. Silage making is possible during monsoon, but not the hay.

Limitations of Silage Making

1. Transport of the fodder from distant places to the silo is difficult and costly especially during rainy season.
2. If not ensiled (filled and sealed) properly, wastage is high.
3. Small farmers can not afford to make silage, since silage once opened need to be utilized and silo can not be reclosed.
4. Vit-D content is less in silage than the hay.

Crops Suitable for Silage Making

All cereal crops rich in carbohydrates are suitable for silage making. Green maize has higher soluble carbohydrates and hence on anaerobic fermentation produces more organic acids (lactic and propionic acids), which preserve the silage well. This is the reason why green maize and jowar make excellent silage. The leguminous crops like green Lucerne, berseem not only have lower carbohydrates, but also have higher crude protein, which is broken down into butyric acid and ammonia, which make the silage unpalatable. If the carbohydrate content of silage material/crop is low, one may add molasses, vinegar or ground grains.

Types of Silo

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Vertical or Upright Silo **Horizontal Silo**

_____!_____ _____!_____

Pit Silo *Tower Silo* *Tower cum pit Silo* *Trench Silo* *Bunker Silo* *Trench cum Bunker Silo*

Silos, viz. tower silos and to some extent tower cum pit and trench cum bunker silos are more suitable where water table in the soil is very high.

Advantages of Vertical/Upright Silo

1. The gravitational force of the material is an advantage in self-packing of the silage.
2. The surface area exposed to air is less in such silo, and hence
3. Even with less skill, the material can be packed well in upright silo.

Because of these benefits upright/vertical silos are more popular in India.

Limitations/Disadvantages of Vertical Silo

1. It requires more labour in filling and emptying of silage material.
2. It does not facilitate mechanical filling, pressing and self-feeding.

   Hence they are getting out-dated in European countries and are replaced by horizontal type of silos as they facilitate above aspects and therefore save labour.

The wall of a silo should be air tight, without any cracks and crevices. If walls are smooth plastered, it facilitates well settling and packing of material. On an average one cubic meter space in silo can store 600 kg silage (i.e. 15-17 kg per cubic feet space). Silage is much more compact and heavier as the depth from surface increases.

Ensiling (Filling the Silo Pit) includes following steps:

1. Harvest the crop (jowar, maize) at 50% flowering /dent stage, when it contains maximum nutrients.
2. Dry/wilt the harvested crop for 1-2 hrs so that its moisture content is reduced to 70% or so. If moisture content is more, silage will be slimy / lumpy, and with lower moisture, there will be mould growth.
3. Chaff the green fodder into small pieces (1-2.5 inch) by electric chaff cutter. Set the chaff cutter in such a way that the chaffed fodder is thrown directly into the silo pit.
4. Spread the chaffed green fodder evenly into the silo and press it to the maximum extent for expulsion (removal) of air trapped in. Occasionally, trampling should also be done.

5. Do even spread of common salt @ 0.5-0.7% i.e. 10-15 kg per 2 tons of chaffed materials. Because all the fodders are deficient in sodium and chloride. Salt improves the test and acts as preservative. If the crop is poor in sugar and/or protein content like legumes and/or Napier hybrid/natural grasses, respectively one can add molasses @ 0.8% and urea @ 1 % in the silage material.
6. Fill up the silo layer by layer using chaffed fodder (1-2 feet) and silage additives (salt, molasses) in as much compact manner as possible, over a week time.
7. Cover the top of the silage material with poor quality dry roughages like wheat or paddy straw (about 1 feet layer).
8. Lastly, close the silo pit with a plastic sheet and pack it with minimum of 3 feet layer of earth/soil on the top for complete pressing of silage material.
9. Finally, seal or plaster the top of earth layer with a mixture of cow-dung and mud to create anaerobic condition in the silo. Check after 3-4 days for the presence of any cracks and if found, seal it again.
10. Maintain this air-tight condition for 2.5 to 3 months for complete fermentation of green forage into the silage.

Silage Additives

For making good quality silage, the fodder crop should contain sufficient amount of moisture and sugar. Napier hybrid, Guinea grass, Para grass, pasture grasses etc. contain less sugar and need addition of molasses @ 0.8% (8 kg/ton). Some time urea is also added @ 1% (10 kg/ton) to increase the protein content of the silage. Salt is added @ 0.5% (5 kg/ton) to increase palatability and preservability. Ground grains and grain byproducts are also added to absorb excess moisture and to increase the nutrient content of silage. Various organic acids are also used to increase the acidity, which helps in preservation of silage.

Figure – Process of silage making

How Ensiling Preserves the Green Fodder (Chemical Reaction in Silage)

When the green forage is placed in a compact mass in a silo, for some time the living plant cells continue to respire/breath rapidly using the O_2 of the air trapped within the mass and give out CO_2. Within few hours practically all O_2 disappears and CO_2 level built-ups, which prevents development of mould. Initially heat is generated. This favours the growth of desirable ***anaerobic microbes*** mainly ***Streptococcus lactis*** and ***Lactobacillus bulgaricus.*** These microbes multiply vigorously in absence of O_2 and break the sugars of green forage, and produce various organic acids, viz. Lactic acid, Acetic acid and others. When enough lactic acid is produced in the silage, pH goes down to 3.8 to 4.0. In this condition silage is preserved for a long time. There is also production of other volatile fatty acids namely formic acid and butyric acid. When there is exchange of air inside the silo, the butyric acid producing bacteria multiply and break down the protein into butyric acid and ammonia leading to spoilage of silage. The moulds and fungi also grow/multiply under such aerobic conditions.

If silage is prepared and preserved well the losses are less. Loss of nutrients due to bleaching and shattering of leaves observed in hay making are not occurring in silage. However, if silage is not prepared skillfully, the losses are greater due to total spoilage. As compared to silage, hay making requires less skill and facilities. Moreover, there is shortage of green fodder, hence Indian farmers prefer hay making rather than silage making.

Qualities of Good Silage

1. It should have yellowish green colour **(Khaki colour)**.
2. It should have fine aroma of lactic and acetic acids.
3. There should not be any mould or fungus growth.
4. It should have soft texture without coarse steams.

(B) Haylage

It is between hay and silage. It is low moisture silage. It is a product of legumes and/or grasses, which are wilted to about 50% moisture before ensiling in upright silo. The lower moisture content of haylage makes it difficult to pack sufficiently to exclude air from the mass, which results in greater spoilage.

Advantages of Haylage

1. Where the climate is not conducive/favourable (heavy continuous rain) for hay making, haylage can be prepared.
2. Animals also consume more dry matter in the form of haylage than the silage.
3. Feeding value of the forages when fed as hay or haylage is about the same, when proper procedures for both are followed.

(C) Hay Making

Forages, which are harvested before seed formation i.e. at flowering/bloom/ dent stage and dried to near 85-90% dry matter, form hay. Indian hay just like straw consists of dry grass on which seeds have been ripened and leaves usually has been shed. For hay making, forages are dried (cured) either under the sunrays or inside the barn or in the machine, i.e. Sun curing, barn curing or machine curing is used to prepare hay.

Harvesting and Field Curing of Hay

The best time for cutting the crop for hay making is when it is 1/3rd to ½ in bloom. The crop cut early is higher in protein, lower in crude fibre and contains more vitamins i.e. more nutritive. Such hay is more palatable and will shatter less. It is best to let the crop lie in the field for few hours until it is well wilted or about 1/3rd to 1/4th dried cured. It should be raked in to small loose bundles called "windrows". It is necessary to handle the hay only early in the morning to avoid loss of leaves.

Figure – Steps in hay making

Requisites/Characteristics of Good Quality Hay

1. It should be leafy. Leaves are rich in protein, vitamins and minerals.
2. Colour of hay should be green parrot like, which indicates the amount of carotene – a precursor of vitamin-A present in it..
3. It should be soft and pliable in texture.
4. It should be free from dirt, dust and fungus/mould growth.
5. It should have smell or aroma characteristic of the crop from which it is prepared.
6. It should be free from weeds and stubbles.

Losses of Nutrients in Hay Making

1. Losses of leaves by shattering. Gentle handling in early morning prevents shattering.
2. Losses of vitamins due to bleaching by sun and fermentation by bacterial action. Avoid bacterial action by complete drying/curing of material.
3. Losses of carbohydrate due to fermentation, starch is oxidized into CO_2 and water
4. Losses of soluble nutrients by leaching in heavy rain.
5. When hay is not properly dried, more heat will be produced by fermentation in staked hay and have a chance of spontaneous combustion.

Kinds of Hay

1. **Leguminous hay**: It has got more of digestible protein and other nutrients, viz. carotene, vit-D & E as it is prepared from leguminous crops like lucerne, berseem etc.
2. **Non-leguminous hay**: It contains less protein, minerals and vitamins and is less palatable as it is prepared from non-leguminous crops like jowar, grasses etc.
3. **Grain crop hay**: It is made from crops like barley, oat, harvested at dent stage.
4. **Mixed hay**: prepared from mixed legume and non-legume crops, has balanced nutrients.

Physical Forms of Hay (Treatment of Dry Roughage)

1. **Long hay**: Forages that are cut dried and then stored as such in the barn.
2. **Chopped hay**: Dry hay cut into small pieces of 2.0 - 2.5" in size and then stored.
3. **Baled hay**: Hay is tied in the form of bales of about 1m x 1m x 1m size. It requires less storage space than the chopped or long hay.
4. **Pelleting**: Grinding and pelleting of hay results in a product, which is easy to handle and store than the previous three forms. Pelleted hay is consumed in greater amount than the other forms, resulting in faster body weight gain. The processing cost is however little higher under Indian condition.
5. **Wafering or Cubs**: Hay is packed in form of 2-3" long x 1.25" wide x 1.25" high blocks/cubes. It requires less space for storage (25 lbs/cubit feet), because of small size and compactness. It also requires less labourers for transport, storage and feeding.

CHAPTER 12

INTRODUCTION OF LIVESTOCK DISEASES AND PREVENTION AND CONTROL OF IMPORTANT DISEASES OF LIVESTOCK

The herd health calendar includes schedules in the form of charts, tables, pamphlets etc of various operations like vaccination (immunization), annual/ periodical testing, de-worming and dipping or spraying etc to be performed on animals to preserve their normal health. It gives information about the content, dose, route and mode of administration of vaccines or drugs, and also the time of its application and the name of disease against which it is to be used.

Livestock Health

Herd health programme that emphasize prevention of disease, rather than treatment play a central role in any attempt to increase production efficiency. Treatment will always be important in terms of survival of the individual sick animal. However in terms of survival of the total production unit (profit verses loss) prevention is the more desirable method of disease control. 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: Transmitted from parents to the offspring.
2. Congenital diseases: Acquired during intra-uterine life.
3. Acquired diseases: Acquired after birth.

B. According to Specific Causes:

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

i) Infectious diseases: Caused by pathogenic organisms like

Viral diseases: Rinderpest (RP) and Foot & Mouth disease (FMD).

Bacterial diseases: Black quarter (BQ) and Hemorrhagic septicemia (HS) and

Protozoan diseases: Surra and Theileriosis.

ii) Non-infectious diseases: 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) <u>Non-specific disease:</u> Those diseases whose causes are indefinite or multiple e.g. Pneumonia.

C. According to mode of spread:

1. **Contagious disease:** Spread by means of direct or indirect contact, e.g. FMD and HS. All infectious diseases may or may not be contagious but all contagious diseases are infectious.
2. **Non-contagious diseases:** Do not spread by means of direct or indirect contact. E.g. Rickets.

D According to clinical signs:

1. **Per acute 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. **Sub acute 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 to intensity and spread of diseases:

1. **Sporadic disease:** Occurring occasionally, singly, or in scattered instances and shows little or no tendency to spread within the herd e.g. Johne's disease.
2. **Enzootic/Endemic disease:** Outbreak of disease among animals in a definite area or particular district. E.g. Anthrax, H.S.
3. **Epizootic/Epidemic disease:** Which affects a large population of animals in large area at the same time and spread with rapidity e.g. FMP, RP.
4. **Panzootic /Pandemic disease:** Widespread epidemic disease usually of worldwide 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 burning or deep burial.
5. Destroy contaminant fodder by burning.
6. Proper disposal of contaminated water.
7. Regular cleaning and disinfection of cattle shed and its premises.

8. Don’t allow animals to come from affected to clean area.
9. Restrict the movement of animals from affected to clean area.
10. Don’t allow animals to drink water from ponds, rivers etc. during outbreak of disease.
11. Close animal markets, cattle shows etc. during outbreak of disease.
12. Regular spraying of insecticides to control external parasites.
13. Regular de-worming 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 ^{0}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

(I) Vaccination or Immunization Schedule:

`Vaccine is a Proteinous preparation of any living attenuated or killed micro-organisms, which is used to evoke immune response of host specific to the antigen when injected, and thereby protecting animals from that disease.

However, the young animals below 2 months of age should never be - vaccinated as it would neutralize the passive antibodies/immunity received in the form of maternal or colostral immunoglobulin, and thus, would make the animal more susceptible to infection rather than creating resistance/immunity against that disease. Normally first dose of vaccine is administered to young growing animals at the age of 4-6 months, except for FMD which can be given earliest at 2 months of age.

No vaccine has so far been developed for fungal and parasitic diseases, except Theileriosis.

(II) Annual/Periodical Testing:

Farm animals are generally tested annually once (in the month of June- July) for the possibilities of certain chronic, zoonotic or contagious diseases like TB, JD & Brucellosis, and periodically (monthly/fortnightly) for detection of sub-clinical mastitis for immediate treatment/action.

1.Tuberculosis (TB) and John's Disease (JD) — Intra-dermal Tuberculin and Johnin tests are done in the skin fold of neck region by injecting 0.1 ml of antigen by a tuberculin syringe and then measuring the circumference of the bead with the help of Venire Caliper immediately and after 48-72 hr. In positive reactors, the site appears swollen, hot, painful and hard within 72 hrs. Therefore, the difference in the reading above 4 mm is considered positive and such animals are retested 3 months later and if again found positive, are culled/slaughtered.

2. Brucellosis - Milk ring test is done as a herd test on pooled milk sample of the entire herd using coloured *Brucella abortus* antigen in a test tube and if it is found positive (coloured ring formation in tube on incubation at *56°C* for 1 hr) then blood or serum of individual animal is checked by plate agglutination or tube agglutination test respectively. A serum titer above 1:40 is taken positive and such animals are culled immediately from the herd.

3. Sub-clinical mastitis: California Mastitis Test **(CMT)** is carried out periodically on milk samples of all four quarters of each lactating animal in a **strip-cup** using coloured California reagent. The change in colour and consistency of milk (greenish-sticky) indicates infection in that quarter of the udder, and intra-mammary treatment should be given soon to prevent development of clinical form of mastitis in that case, as it is economically very harmful to the farmer.

(III) Control of Internal (Endo-) Parasites (by Deworming):

As a routine, deworming is usually done twice a year i.e. before (June-July) and after (Oct-Nov) monsoon. In young growing animals, it should be done at 10 days and then at 1, 3, 6, 9 & 12 months of age and then every year before & after monsoon. Important deworming agents used are albendazole, mebendazole, perbendazole, fenbendazole, fasciolax, flukin, distodin, oxyclosanide, banminth, heltac, piperazine, vermax etc.

(IV) Control of External (Ecto-) Parasites (by Dipping or Spraying):

Dipping means immersing the animals in insecticide solution or spraying of some safe insecticides on the animal body to eradicate ecto-parasites like ticks, fleas, lice, mange, mites etc present in the skin or hair coat. For the purpose, DDT, BHC, Malathion, Butox (safe), Pestoban, Arsenic- sulphur dip, Tobacco leaves extract etc can be used. Dipping or spraying should be done at least twice at 14 days interval to kill adult as well as egg/larval stages of parasites from the body coat.

Spraying of disinfectant on udders

Dipping of cattle in insecticide solution

Vaccination Schedule for Farm Animals

Sr. No.	Vaccine/Disease	Content of vaccine	Animals to be vaccinated	Dose and route	Remarks
A. Bacterial vaccines					
1.	HS — vaccine for hemorrhagic Septicemia	Oil adjuvant, formalized or alum precipited killed *Pasteurella multocida* bacteria	Cattle/Buffalo/ Calves /Sheep/Goat	3.0ml S/C	Vaccinate 3 wks before onset of rainy season (pre-monsoon vaccination)- i.e. in the month of May or June.
2	BQ vaccine for black Quarter	Killed/activated suspension of C*lostridium chauvoei* bacteria	As above	3.0ml S/C	As above
3	Anthrax spore vaccine for anthrax	Live attenuated spores of *Bacillus anthracis* bacteria	As above	1.0ml S/C	Avoid self-inoculation - Practice only in endemic areas in June.
4	Brucella vaccine for Brucellosis	a) Live attenuated *Brucella abortus* strain-C 19 vaccine	Calves 4-8 M old only **(Calf-hood vaccine)**	1.0ml S/C	Avoid self-inoculation- Practice only in young stock, not in adults.
		b) Killed/inactivated suspension of Br. *abortus* strain *45/20*	Adult cattle and buffaloes	5.0ml S/C	Used in adults during actual outbreak of disease.
5	Enterotoxaemia	Inactivated toxin of *Clostrid. Perfringi-D*	All age groups of Sheep	3.0ml S/C	Follow Pre-monsoon vaccination i.e. in June.

6	Tetanus toxoid for tetanus	Inactivated toxin of *Clostridium tetani*	All age group, all species	0.5-5.0ml I/M	Whenever there is serious injury/ accident or operation.
B. Viral Vaccines					
1	FMD polyvalent vaccine for Foot & Mouth Disease	Killed/inactivated suspension of FMD (*Aptho)* virus serotypes O, A, C, $Asia_1$	**All cloven footed farm animals, 1st dose at 2 months**	5.0ml S/C	Vaccinate twice a year i.e. Feb-March and again Sept-Oct (half yearly)
2	R.P. vaccine for Rinderpest	Live attenuated or killed tissue culture of RP (*Myxo*) virus	Calves at 6 & 10 Months of age and then, annually	1.0ml S/C	Vaccinate once a year in epidemic areas and every 3 yrs in other zone
3	Rabisin or Raksha -rab vaccine for rabies	Inactivated suspension of Rabies (Rhabdo) virus	All pet and farm animals, 1st dose at 4-6 months of age.	1.0ml S/C	Post-bite immunization: 1 dose on day of bite in vaccinated animals, and 7 dose each of 1 ml on 0,3,7,14,30,60& 90days of bite in non-activated animals
C. Protozoan Vaccine					
	Raksha-T vaccine for Theileriosis	Killed suspension of Theileria annulata blood protozoa	Exotic and crossbred calves	1.0ml S/C	Costly vaccine, used only in susceptible young cattle

CHAPTER 13

PREPARATION OF MILK PRODUCTS

COMMON TERMS PERTAINING TO VARIOUS SPECIES OF LIVESTOCK

COMMON ANIMAL HUSBANDRY TERMS

(1)	**Humped Cattle**	**:**	Indian cattle, Brahma or indigenous cattle having hump. Spp. Indicus.
(2)	**Humpless Cattle**	**:**	European or exotic or foreign cattle having no hump. Spp. Taurus.
(3)	**Castration**	**:**	The act of rendering the gonads of an animal nonfunctional, generally it is used for males.
(4)	**Calving Interval**	**:**	Interval between two successive parturition in cows and buffaloes.
(5)	**Lactation Period**	**:**	Period during which the animal gives milk i.e. from day of calving to last day of giving milk in cattle 290-330 days (standard 305 days).
(6)	**Dry Period**	**:**	Period in which animal do not gives milk i.e. from last day of giving milk to subsequent calving.
(7)	**Service Period**	**:**	Period between calving to successful service i.e. animal became pregnant.
(8)	**Gestation Period**	**:**	Date of successive service up to parturition i.e. period during which animal remain pregnant.
(9)	**Breed**	**:**	A group of animals of a species having similar physical and economical characteristics.
(10)	**Prolificacy**	**:**	Ability to produce large number of offsprings.
(11)	**Avian**	**:**	A generic description of birds in general.
(12)	**Bovine**	**:**	A generic name of cattle.
(13)	**Broiler**	**:**	A chicken rose especially for meat purpose.
(14)	**Broody**	**:**	A hen which attempts to incubate its egg.
(15)	**Browse**	**:**	Fodder obtained from eating leaves and twigs of bushes by goat and camel.
(16)	**Carcass**	**:**	The dressed body of slaughtered animal or dead animal.
(17)	**Concentrate**	**:**	Feed stuffs low in fiber and high in digestible

nutrients.

(18)	**Crossbred**	**:**	The offspring resulting from the mating of male and female animal of different breeds.
(19)	**Cull**	**:**	To dispose of the poorer animals in a herd or flock.
(20)	**Fleece**	**:**	The total wool coat of a sheep.
(21)	**Flush**	**:**	To increase feeding level of females just prior to breeding.
(22)	**Gestation Period**	**:**	The time period between conception and parturition or is the condition of female when developing foetus is present in the uterus.
(23)	**Heat/ Estrus**	**:**	Period when female will accept service by male.
(24)	**Insemination**	**:**	To place semen in female reproduction tract.
(25)	**Litter**	**:**	A group of young ones born to one mother at one time or materials placed on floor to absorb moisture.
(26)	**Livestock**	**:**	A collective term to denote those animals kept on a farm for productive purposes.
(27)	**Natural service**	**:**	Insemination of female by the male.
(28)	**Parturition**	**:**	The general term about process of giving birth to young one.
(29)	**Purebred**	**:**	The offspring of the mating of a male and female of the same breed.
(30)	**Restrain**	**:**	To stop the movements of an animal so it can be examined or treated.
(31)	**Roughage**	**:**	Feed stuffs high in fibre and low in digestible nutrients.
(32)	**Semen**	**:**	The discharge ejaculated from the testes and accessory sex glands of the male which includes sperm and accessory fluids.
(33)	**Shear**	**:**	To remove the fleece from a sheep.
(34)	**Sire**	**:**	The male parent of the calf.
(35)	**Dam**	**:**	The female parent of the calf.
(36)	**Steaming Up**	**:**	To give extra-feed to milk producing animal 6-8

weeks prior to parturition.

(37)	**Tusk**	**:**	Elongated or enlarged permanent canine tooth, usually seen in boars.
(38)	**Domestication**	**:**	Means making the animals to adopt their life in intimate contact with men for their benefit.
(39)	**Vice**	**:**	A habit or action of animals that is harmful to itself or to others.
(40)	**Yearling**	**:**	A bovine in its second year of life which has not yet produced young one.
(41)	**Crone**	**:**	An old broken mouthed ewe, which has been retained in breeding flock, beyond the normal time, because of her excellent breeding performance.
(42)	**Gimmer**	**:**	A female sheep between first and second shearing.
(43)	**Seggy**	**:**	A ram castrated after service.
(44)	**Puberty:**	**:**	It is the period when reproductive tract and secondary sex organs/characteristics start to acquire their mature form.
(45)	**Runt**	**:**	The smallest and last born piglet in a litter.
(46)	**Brood Mare**	**:**	Mare kept for breeding purpose.
(47)	**Free Martin**	**:**	A female calf when born along with male calf usually sterile with abnormal genitalia is known as free martin.
(48)	**Hybrid Animal**	**:**	Animal born due to mating of animals of different species.
(49)	**Mule**	**:**	Animal produced by mating of male donkey (Ass) and female horse (Mare).
(50)	**Hinny**	**:**	Hybrid animal produced by mating of Jennet (She donkey) with stallion (Male horse).

COMMON TERMS USED IN LIVESTOCK PRODUCTION:

Sl. No.	Details	Cattle	Buffalo	Sheep	Goat	Pig	Horse	Rabbit	Poultry
1	Genus and Species	Bos. indicus	Bubalus. bubalis	Ovis. aries	Capra. hircus	Sus. domesticus	Equs. caballus	Oryctolagus. cunniculus	Gallus. domesticus
	Generic name	Bovine	Bovine	Ovine	Caprine	Porcine	Equine	Leporidae	Avian
2	Act of parturition	Calving	Calving	Lambing	Kidding	Farrowing	Foaling	Kindling	Hatching
3	Young one of either sex	Calf (<1yr)	Buffalo calf (<1yr)	Lamb (<6 months)	Kid (<6 months)	Piglet/Pigling (<8 wks)	Foal (<1yr)	Kit	Chick (<8 wks)
4	Female young one up to parturition	Heifer (>1yr)	Buffalo heifer (>1yr)	Ewe lamb/ Gimmer	Doeling/ Goatling (>1yr)	Gilt	Filly (>1yr)	Doeling (>2 months)	Pullet/ Grower (18-22 wks)
5	Male young one housed for future breeding	Bull calf (<1yr)	Buffalo bull/calf (<1yr)	Ram lamb/ Tup lamb	Buckling (>6 months)	Boarling	Colt	Buckling (>2 months)	Cockerel (18-22 wks)
6	Adult female parturated at least ones	Cow	Buffalo	Ewe	Doe/ Nanny	Sow	Mare	Doe	Hen (>21 wks)
7	Adult male used for breeding	Bull	Buffalo Bull	Ram/Tup	Buck	Boar	Stallion	Buck	Cock

8	Castrated male	Bullock/ Steer (>2yr)	Buffalo Bullocks (>2yr)	Wether/ Wedder	Wether/ Wedder	Stag/ Hog (>1yr)	Gelding/ Geld	Neuter	Capon
9	Meat	Beef	Cara beef	Mutton	Chevon	Pork	Cheval	Vanison	Chicken
10	Group	Herd	Herd	Flock/ Band	Flock/ Band	Herd/ Drove/Stock	Stable/ Herd/Pack	Warren/Flock/ Band	Flock

THEORY NOTE

LPM – 6.2

POULTRY PRODUCTION AND MANAGEMENT




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CONTENT

UNIT-I

ROLE OF POULTRY IN NATIONAL ECONOMY

History: Over 150 million years ago, first known bird Archaeopteryx took its birth, size of crow and certain features not possessed by present day birds. It is not known when first chicken was captured and domesticated. Archaeological surveys indicates that fowls were first domesticated in china, 1400 B.C. In India, According to Arthshashtra of Kautilya, existence of poultry farm during Mauryan Empire (300 B.C.) According to Darvin, Modern chicken (Gallus domesticus) are descendants of the wild species *Gallus gallus.* Fowls were maintained only for Cock fighting, early efforts to improve economic potential of Chicken was first made in 1873 by America. The need of more eggs and meat felt during Second World War which gave impetus for the scientific poultry industry.

CHICKEN

Aves: are the birds, which possess paired wings for flying and are oviparous – lay eggs. Poultry: All domesticated species of birds reared for economic purpose.

Flock: A group of chickens.

Chick: A young one of chicken below 8 weeks of age

Grower: Chicks of either sex between 9 to 18 weeks of age.

Pullet: A young maturing female fowl between 18-22 weeks of age.

Cockerel: A young maturing male fowl above 18 weeks but below 1 year of age.

Hen: A female fowl above 21 weeks of age, which has started laying eggs. Cock /
Roaster: An adult male chicken used for breeding purpose over 1 year of age
Capon: A castrated male chicken, generally caponized at 3-4 weeks of age.

Broiler: Broilers are the birds of either sex, up to 5 to 6 weeks of age and weighing 1.5 to 2.5 Kg body weight with soft pliable skin, tender meat and well developed breast bone cartilage. Used for chicken meat purpose.

Laying: It is an act of deposition of eggs by female bird.

Cull bird: The adult hen which is in the end phase of laying and marketed\killed.

Dubbing: Trimming or removing of comb of breeder males to improve their vigor. Done at day old age.

De-beaking: the partial removal of the beak of poultry, especially layer hens reduce damage caused by injurious pecking such as cannibalism, feather pecking.

Table bird: 'Meat bird' which are specially bred for this purpose. E.g. Broiler, Turkey etc.

A breed may have several strains differ on performance basis. E.g. Vencob 400, Vencob 400Y.

FCR (Feed conversion ratio): Amount of feed needed for per unit of body weight gain.

FCR = Feed taken / Body weight gain.

Addled egg: A fertile egg containing a dead embryo, which has died during the early period of incubation.

Air sac: Expandable membranes communicating with the lungs and the hollow bones. Help in respiration of birds and also gives lightness to birds.

Blood spot: A small blood clot attached to the membranes surrounding the yolk or to the chalaza or noticed in the albumen as a result of hemorrhage during ovulation. It can be detected at candling.

Bloom: A layer of protective coating on the external surface of egg, also called cuticle.

Brood: A group of chicks hatched out from the same batch of eggs.
Candling: Visual examination to test eggs for freshness and embryo development by holding them between eye and source of light.
Cannibalism: Vice that may occur in chickens of all age. It includes feather picking, toe picking, vent picking, egg eating etc.
Clutch: Term expressing numbers of eggs laid on consecutive days.
CARI: Central Avian Research Institute. Izatnagar, U.P. Dead in shell: Embryo that died at any stage of incubation Down: Initial hairy covering of chicks.
Inbred line: A bird resulting from four or more generation of inbreeding.
Keel bone: Breastbone of birds, the sternum.
Morbidity: Sick rate, number of birds affected by disease out of total birds.
Mortality: Death rate, Number of birds died due to any reason out of total birds.
NECC: National Egg Co-ordination Committee.
Oviposition: Act of laying of eggs.
Breed: A group of birds that have usually the same general body shape, they are true to type, carriage and characteristics of the name of the breed they carry. E.g. Leghorn, RIR, Aseel etc.
Variety: It is a sub division of a breed distinguished either by plumage color, plumage pattern or comb type. E.g. White leghorn, Single comb white leghorn, Black Minorca etc.
Strain: Closely related inbred flocks with definite economic characters. Name is given by breeder.

DUCK

Duck: Adult female duck
Drake: Adult male Duck
Duckling: Young one of Duck

GOOSE

Goose: Adult Female Goose
Gander: Adult Male Goose
Goosling: Young one of Goose

PRESENT STATUS AND IMPORTANCE OF POULTRY INDUSTRY IN INDIA

Poultry has influenced man's civilisation in many ways. Egg and meat of birds are being consumed since pre-historic times. Compared to eggs, there is no other single food of animal origin which is eaten and relished by so many people in the world.
Study of principles and practices involving production, processing and marketing of poultry and its products is called Poultry Science. The study of other species of birds not classified as poultry is called 'Ornithology'

Importance of Poultry Industry

Source of Income

If proper atmosphere is provided, this industry can yield annual growth of 26000 crores to gross national product for next 30 years. It provide jobs to 3.7 million people in India. It is very versatile industry and can provide jobs to all categories of people. For example it can be adopted

as whole time business on large scale, it can fit very well in mixed farming system to provide additional income to farmers engaged in arable farming, it can be taken as part time business on small scale by under-employed persons involved in service profession. Even housewife and children can look after a small flock of birds in their extra time for small earning.

Source of Food

Biological Value is defined as the percentage of absorbed (retained) protein which is utilized by the body. Biological value of egg is 94 % (13gm/100gm). Chicken meat and Eggs are cheapest source of animal protein to fight protein malnutrition in India. Poultry products are not only highly nutritious but it is palatable, easily digestible and can be used in many appetising ways.

Industrial Use

Almost all parts of poultry have one or other kind of use. For E.g. Fertile eggs – Chick, Vaccination preparation. Inedible eggs – Animal feed protein source. Albumen – Pharmaceuticals, Paints etc. Egg yolk – Soaps, Paints and Shampoos. Egg shell – Mineral Mixture for livestock. Feathers – Millinery goods. Endocrine glands – Preparation of Hormones and other biological products.

Use in Research work

Poultry can be Good laboratory animals because of their small size, low feed intake, easy in handling and sensitive metabolism.

PRESENT STATUS OF POULTRY INDUSTRY IN INDIA

The scientific poultry keeping in India was first initiated by Christian missionaries. They introduced small flocks of improved breeds from their countries. The performance of these birds were certainly better than 'desi' fowls and thus attracted the attention of government officials to introduce several model poultry farms in various parts of the country. A modest beginning towards commercial poultry farming was made during the first five year plan (1951-55) in which 2.5 crores was spent on poultry development.

Livestock sector contributes 4.11% GDP and 25.6% of total Agriculture GDP. **Total Poultry Population 851.81 million Numbers, Seventh in World. Total Chicken Population Fifth in world. Total Poultry Population of Gujarat 21.77 million Numbers.**

Egg Production - Third largest producer of eggs in the world next to China and USA

- 103.32 billion numbers with Growth rate @ 8.5 % per annum
- Availability of eggs 79 eggs/Person/Year
- NIN (ICMR) recommendation 180 eggs/ person/year

Top egg producing states in India (2018-19)

Rank	State	Lakh Nos.	% Share
1	Andhra Pradesh	197545	19.12
2	Tamil Nadu	188422	18.24
3	Telangana	136868	13.25
4	West Bengal	85998	8.32

5	Haryana	60576	5.86
6	Karnataka	59994	5.81
13	Gujarat	18543	1.79
	Rest all state	285230	27.61
	Total	1033176	100.00

Chicken Meat Production - Fourth largest producer of chicken in the world next to USA, China and Brazil

- **4.06 million tonnes** with **Growth rate @ 7.8 % per annum**
- Availability of chicken meat @ 3.11 kg/ person /year
- NIN (ICMR) recommendation 11 kg meat / person /year

Top Chicken meat producing states in India (2018-19)

Rank	State	000 tones	% Share
1	Maharashtra	632.32	**15.57**
2	Haryana	478.63	11.78
3	West Bengal	475.42	11.70
4	Tamil Nadu	455.51	11.21
5	Uttar Pradesh	359.44	8.85
6	Telangana	336.33	8.28
17	Gujarat	31.13	**0.77**
	Rest all state	1293.01	31.83
	Total	4061.79	100.00

UNIT – 2 POULTRY HOUSING

Housing constitutes second largest component of cost of poultry housing. An ideally located and well planned poultry farm is an essential requirement for efficient egg and meat production. **Objectives:**

- Provides shelter and protection to the birds
- To ensure scientific feeding
- To provide health care measure
- For easy and economic operations
- To facilitate proper micro climate
- For proper supervision

FACTORS TO BE CONSIDERED FOR PLANNING A POULTRY FARM Selection of Site

The farm should be located on high elevated area and porous land to facilitate natural drainage and protection from flood. It should be away from residential area to avoid any public objections concerning environmental pollution and housefly problems.

Good quality drinking water should be available at the site.

It should be connected with a good link road to facilitate easy transportation. But should be located reasonably away from the main public roads to avoid unnecessary disturbance to the birds from vehicular noise.

It should have access to good electricity and telephone connections.

The land area should be large enough to provide space for future expansions.

Orientation of Poultry Houses

The direction of poultry house in tropical area should be placed with long axis facing east to west. This will facilitate proper use of sun light and to keep farm warm in winter. Whereas during summer, it prevents entry of direct sunrays into the house, thus helps in keeping the house temperature low. But for environment controlled poultry houses, the direction of the house is not significant.

Layout of Operations

The layout plan will vary with size and type (Meat and Egg) of operation, the management system followed and the flow of materials (manual / automated).

For Egg farming – Brooder / Chick house, Grower house and Layer house.

For broiler farming – No need of separate house

Brooding house should be isolated from growing and adult birds to avoid cross infections. The poultry houses must be located approx. 100 feet away from each other to facilitate proper ventilation, reduce risk of disease and fire spread. This also provide space for plantation of trees in between houses.

The Feed / Egg store and day old chick delivery points at the farm should be located such way that vehicles don't require to enter main farm premises. The Reception office should be located near to main gate so that the visitors don't enter the rearing area. The entire complex secured by construction of a boundary wall.

Design and Construction

Poultry are most comfortable when the temperature varies between 10 to 24^{o} C and the relative humidity between 50 to 75%. Proper ventilation of the house is important for flow of fresh air into the house and for removal of moisture, carbon dioxide, ammonia and other harmful gases from the house. The ammonia level inside the house must be less than 25 ppm. Litter (Material spread on the floor of poultry house mainly in deep litter system) should have 15-25% Moisture.

- Foundation must be strong enough to support the weight of the structure and it should be rodent proof.
- Floor should be smooth, concrete made, impervious to moisture with a reasonable slope for easy cleaning and washing.
- Walls must be smooth finished and water proof for easy cleaning and disinfection. The lopng axis wall in the open sided houses have window opening for proper ventilation with wire mash security. The wire mash netting may cover up to 90% of wall area with only concrete column supports in the northern plains for cage housing.

- The doors must be wide enough to allow free to and fro flow of materials into the house. It should be minimum 4' × 7' size.
- Width of poultry house should not be more than 30-32 ft. to allow movement of natural air through the house. Assisted air movement with provision of inlet / outlet fans will be required in houses which are wider than this.
- The length can be adjusted to any size depending upon availability of space. Too long sheds must be partitioned into pens of convenient size for better management.
- Height of the house should be enough for proper ventilation and convenience of the worker (minimum 9 ft. in deep litter system). The height, however depends upon roof type used.
- Roof should be water proof with proper slope. The roof type may be plain concrete laid or made of asbestos sheets in monitor, shed, gable and other forms. A roof extension of one meter beyond the walls should be provided as overhang to prevent entry of rain water.
- Economy in construction should be given due consideration with the use of locally available materials.

TYPES OF POULTRY STRUCTURES

1. Hatchery
2. Poultry Farm Facility (Broiler farm, Layer farm, Breeder farm)

HATCHERY

Hatching: cause an egg to break in order to allow a young animal to come out. Generally in chicken it takes 21 days.
Hatchery: It is a place where artificial hatching of chicks is carried out. It is preferably located away from the commercial poultry farms to prevent cross infection. A well designed hatchery has two divisions.

1. The Administrative wing 2. The operational wing

The administrative wing consists of the offices for keeping all records of the hatchery, enquiry office, and waiting room.

The operational wing is the actual work place for hatching operations. The hatchery operation facilities are arranged in such a way that it provides efficient work flow through the hatchery in order of egg room, setter room, hatcher room, chick room and bus bay. The auxiliary rooms such as tray wash, clean room, disposal area, box storage and utility should be strategically located to support the main work effort.

Egg Room

Design the egg room to be large enough to provide space for storing, traying and grading of eggs. Ceiling height of 12 ft. (3.65m) is ideal. The layout of this room depends on how many eggs are received. For calculating egg room size, provide 4 sq. ft. for 1000 eggs stored. The minimum egg room size should not be less than 600 sq. ft. (55.74 sq. m.)

Fumigation Room

The fumigation room should be large enough to as accommodate one-half of the cases and buggies used in a day. A fan should be used to circulate the air and exhaust the fumigant.

Pre-warming Room

It is located next to egg room. Provide 15 sq. ft. (1.4 sq. m.) floor space per egg buggy. It is important to provide airspace around all buggies and good air circulation around all eggs to maintain even temperature.

Setter room

The Setters (incubators) are kept in this room. The room should be sufficient large to permit easy access around the setters. Usually 24 to 30 inches (60 to 75 cm) space between ends and back of the setters and room wall is adequate. Minimum 10 to 12 ft (3.05 to 3.65m) wide space from front of setter to a facing wall or a facing row of setters should be available free to allow temporary storage of loaded buggies without interfering the normal work. Ceiling height should be 14 ft (4.27m).

Egg candling room

Candling is a method used in embryology to study the growth and development of an embryo inside an egg. The method uses a bright light source behind the egg to show details through the shell, and is so called because the original sources of light used were candles. This room is usually constructed in between setter and hatcher room for candling eggs. Candling is usually practiced when eggs are transferred from setter to hatcher. Provisions should be made to dark the room to facilitate easy candling.

Hatcher room

Hatchers must have at least 10 to 12 ft. (3.05 to 3.65m) wide from aisle. Place hatchers 24 to 30 inches (60 to 75 cm) from end and back of wall for cleaning purpose. Ceiling height of the room should be 14 ft. (4.27m).

Chick room

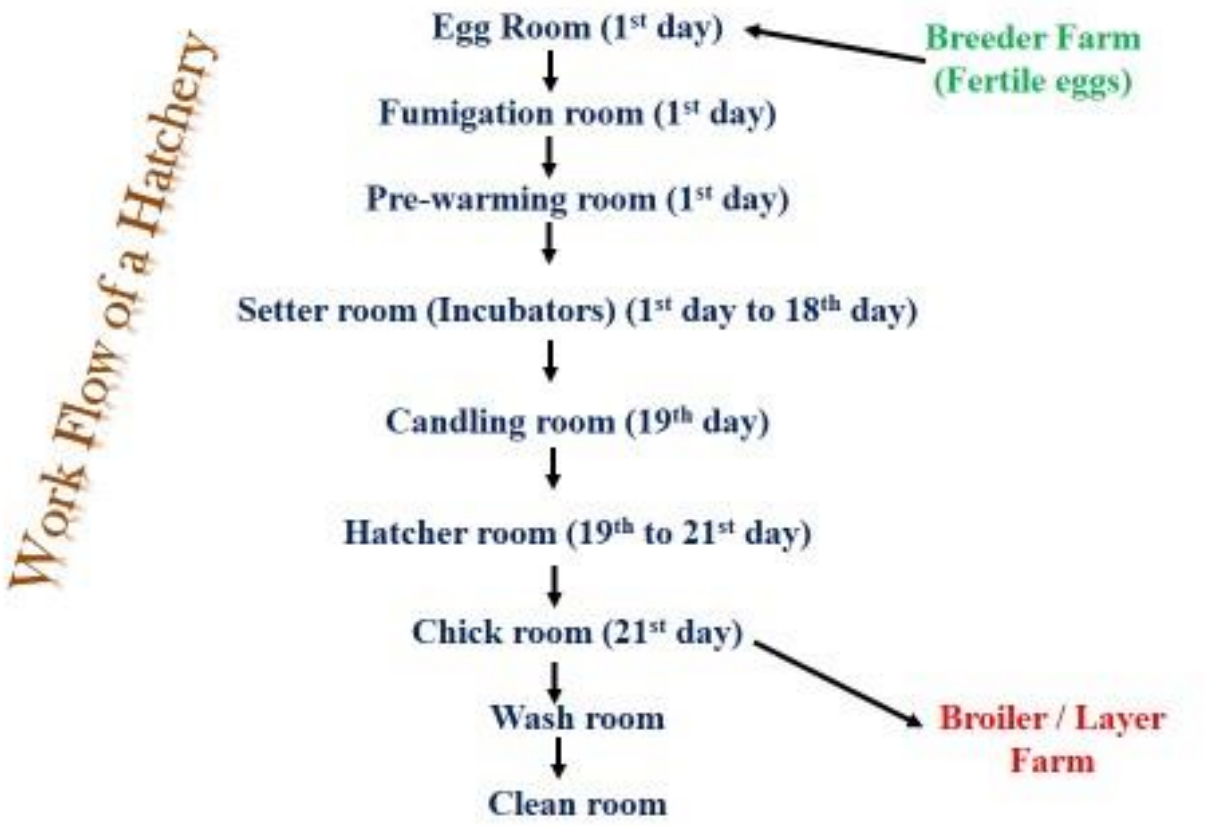
Next to hatcher room, chick-holding room is present. A relative humidity of 65% is maintained to prevent excessive chick dehydration. Size depend on maximum numbers of chicks processed daily. Provide adequate space to accommodate all chicks of a single hatch. The chick storage room or holding area should be separated from chick service area. Additional space will be required for sexing, vaccination, beak trimming if done at hatchery. Generally 12 to 20 sq. ft. (1.12 to 1.86 sq. m.) floor is required per 1000 chicks. Then chicks are placed in chick boxes and transported to farms.

Wash room

The room size for this area depends on maximum numbers of hatcher buggies that will be stored in it at any time. The trays and buggy are washed in the washroom. Space should be sufficient for tray washer, buggy washer and other automation equipments.

Clean tray room

This room is adjacent to the tray wash room. After the trays are washed, they are placed in their trolleys and moved to the adjacent cleanroom. It should be of sufficient for storage of all the clean tray and buggies for one day's hatch. 15 sq. ft. (1.4 sq. m.) area per buggy stored should be allowed.



POULTRY FARM FACILITIES

General rearing facilities required at the poultry farm are:
For Layer Farming (Egg production)

1. Brooder house / Chick house
2. Grower house / Pullet house
3. Layer house

For Broiler Farming (Meat production)

1. Broiler house

BROODER HOUSE / CHICK HOUSE

Brooding: Management of chicks from one day old to 8 weeks of age, it involves provision of heat and other necessary care during early growing stage. Brooder house is not essential in small farms. A small portion of the broiler / layer house may be used for brooding purpose. However, for large poultry farms, a separate brooder house must be constructed for continuous brooding of chicks.

It is a compact unit with little side wall surface opening. It may be divided in compartments according to needs of farm. The chicks may be reared on floor, in batteries or in cages for brooding.

Two types of heating system can be employed. In the cold room brooding system, different types of brooders are used to keep chicks warm. Whereas in the hot room brooding system, entire house gets heated and temperature is thermo statistically regulated.

GROWER HOUSE / PULLET HOUSE

Large poultry farms require isolation of growing flocks (from 8 to 18 weeks) from older ones for disease prevention. Generally the pullets / growers are shifted at 6-8 weeks of age from brooder house and kept until 16-18 weeks and then shifted to the layer house.

With better disease control programs, more and more growing birds are reared in 'broodgrow' housing arrangement for economic reasons. The commercial egg type pullets are kept in same house from day one till 16 weeks than shifted to layer house. This system is favored because majorities of pullets are moved to cages than deep litter laying houses.

LAYER HOUSE

Layers: Adult hens kept for egg production for human consumption.
Breeder bird: Adult hens and roasters kept together for production of fertile eggs (reproduction)
Most of large commercial egg laying flocks (layers) are kept in cages here. Deep litter system is common for only small sized flocks.

Layers perform well at any temperature up to 30^{o}C in a dry, well ventilated house free from ammonia, dust and air-borne pathogens. Confining breeding birds in same house from day one to end of laying is also common. This is called as 'brood-grow-lay' house arrangement. Necessary equipments are changed according to age and requirement of birds. However, the space remains unutilized during brood-grow stage.

BROILER HOUSE

Chicks are kept from day one to 5-6 weeks until it reaches to 1.8-2.5 kg body weight and sold. Generally no need for separate brooder and grower house as laying farming system. It should provide clean, dry and comfortable surroundings for the birds throughout the year. It must meet the following requisites

- ❖ Enough warm
- ❖ Litter (bedding material spread on floor) should be dry ❖ Circulation of fresh air ❖ Free from dust, pathogens.

Raising broilers in tunnel ventilated house is becoming popular and is the most preferred in many countries. In this system, whole house is converted into a wing tunnel. In the tunnel ventilation system, all exhaust fans are kept in one side and all air inlets on other side. Ventilating air is drawn uniformly through length of house at velocity of 350 to 400 feet per minute (4 to 4.5 mph). This provide sufficient cooling for birds. This system is most suited in warm weather. The combination of tunnel ventilation and evaporative cooling can be effective for reducing hot weather heat stress.

Broiler Farm (Meat Purpose)	**Layer farm (Egg Purpose)**
Broiler House (Day 1 to 6th week, 1.8 to 2.5 kg body weight)	Brooder / Chick house (day 1 to 8th week)
	Grower / Pullet house (8th week to 18th week)

	Layer house (19th week to 72nd week / until gives egg)

POULTRY REARING SYSTEMS

1. Extensive or Free range system 2. Semi-intensive system

3. Intensive system: Deep litter system, Cage System, Slatted floor, Slat and litter.

EXTENSIVE OR FREE RANGE SYSTEM

Before commercial farming, all poultry birds were reared by this system. This system permits birds to roam freely over a large area where they can find their own food by scavenging.

Only small movable shelter is provided for protection from rains and heat. A range provides shelter, greens, feed, water and shade. Only 100-120 birds can be kept in one acre of land, providing 34-41 sq. m. space per bird. However the birds need protection from natural enemies and parasitic infestations. This system is most suited for organic poultry farming, being advocated forcefully in many countries. All categories of birds can be reared in this system. This system is most preferred for organic egg production.

Advantages

- Able to express natural behaviour, free and comfortable.
- Exposed to natural sunlight, bone development is better. ➢ Less capital investment ➢ Cost of housing is least.
- Feed requirements are less since birds can consume fairly good amount of feed from grass land.
- Fertility of soil can be maintained.
- Labour requirement is less.

Disadvantages

- Large land are required
- The scientific management practices cannot be adopted.
- Eggs are lost when laid inside the dense grasses unless special nests are provided, Egg production is lower.
- Losses due to predatory animals are more.
- Wild birds may induce diseases unless proper care is taken. ➢ Birds lose more energy in activities.

SEMI-INTENSIVE SYSTEM

As the name indicates birds are half-way reared in houses and half-way on ground or range, i.e. birds are confined to houses in night or as per need and they are also given access to runs. This system is adopted where space is limited. The houses are with solid floors while runs are fields only. A permanent shelter is provided with floor space 1 sq. ft. per bird. In addition outside run (space) of 16-24 sq. m. per bird is provided. Preferable, the run out should be divided equally on both sides of the house to permit the bird to avail fresh ground. The feeding and watering facilities are provided in the pen.

Advantages

- More economical use of land compared to free range system
- Protection of birds from extreme climatic conditions
- Control over scientific operation to some extent is possible

- Family labour can be utilized
- Investment is less than intensive system.
- Eggs and birds are more protected than free range.
- Sunlight and natural behavior

Disadvantages

- High cost for fencing.
- Need for routine cleaning and removal of litter material from the pen.
- More land area than intensive system.
- Problem of bad smell and flies in rainy season
- High risk of disease
- Eggs and birds get dirty in rainy season

INTENSIVE SYSTEM

In this system, Birds are totally confined to houses either on ground / floor or on wire-netting floor in cages or on slats. They have no direct access to outside environment. It is the most efficient, convenient and economical system for modern poultry production with huge numbers of birds can be reared at same time. Different intensive systems are as under

1. Cage system
2. Deep litter system
3. Slat floor system
4. Slat and litter system

CAGE SYSTEM

This system is most common for laying birds, where the birds are kept in small wire cages placed side by side. Mostly the cages are arranged in 3 rows (Three tire system) in open sided house.\ Sometime 2 rows (two tire system) up to five rows is arranged. The cage rows are arranged on each side of aisle which is 30-36 inches wide. The cages are placed at a convenient working height. Commonly feeding and water tunnel is attached on side at outside of the cage. The floor area allowance per bird in cage depend on cage size and stocking density.

Advantages

- More birds than deep litter system
- Problems of internal parasite eliminated
- Better maintenance of records
- Broodiness is eliminated ➢ Egg production is high, clean eggs ➢ Better feed efficiency.
- Culling is easy
- Vices like cannibalism and egg eating controlled
- Feed wastage is avoided ➢ Less labor requirement ➢ Automation is easy.

Disadvantages

- Initial investment is high
- Unable to express natural behavior
- Higher incidence of leg problems, osteoporosis, cage layer fatigue
- Flies and obnoxious gases
- Require perfect balance feed
- Manure handling is problem
- Natural ventilation is a problem

The use of conventional cages has become a controversial issue with animal welfare groups raising voices against this system. Keeping in view of this cage modification have been implicated. Now a days the enriched cages must have at least 45 cm height and minimum 750 cm*cm of space for hen.

DEEP LITTER SYSTEM

In this system, a 3-4 inches (7.5-10 cm) deep layer of a good litter material which should be dry, absorbent, free from mold growth and cheap is spread on floor. The feeders and waterers are placed on the litter. The nests are lined on one or both sides of the house (only for layer birds if kept in deep litter). The droppings of birds go on mixing with the litter material and pile up to depth of 1 to 1.5 feet in a year. Litter must be replaced after every batch. This system is mainly used for broiler production. In layer farming, this system is used in brooder and grower house.

Advantages

- Birds are free, able to express their natural behavior such as dust bathing, scratching
- Investment per bird is less as compare to cage system
- Fly control is easy
- Manure is of good quality
- Litter provide warmth in winter and keeps house cool in summer ➢ Deep litter is source of certain vitamins B2, B12 etc.

Disadvantages

- Cannibalism and egg eating is problem
- More chances of disease
- Manure management is problem in humid season and winter
- Deworming of birds is required regularly
- Floor and Soiled eggs
- More floor space than cage system

Other systems under intensive systems are Slatted floor system, Slat and Litter system and Environmentally closed house etc.

Generally Broilers are kept in deep litter system while in case of layer farming, chicks and growers are kept in deep litter system while layers are kept under cage system.

UNIT – 3

HATCHERY OPERATIONS AND INCUBATION

Hatchery: A place where artificial hatching of eggs take place.

SELECTION OF HATCHING EGGS

Size of Egg: The size of the eggs used for hatching is important because the size of the chick hatched highly depends on the size of the egg. Mainly depends on breed and strain. The eggs for setting should be neither too big nor too small because it creates hindrance in setting in incubation trays and do not hatch well. Medium sized eggs are preferred. Uniform sized and oval shaped eggs are good. Chicken – 53 g, 50-55 g Avg.

Size of Chicken Egg	Hatchability
Medium sized (50 to 59 g)	87 %
Small Eggs (45 g or less)	80 %
Extra Large Eggs (65 g or More)	71 %
Slightly Cracked Eggs	53 %
Misshappened Eggs	49 %
Rough or Thin Shell Eggs	47 %

Shape of Egg: Uniform sized and oval shaped eggs are good. Shape also effect hatchability. Duck and Turkey eggs may be less oval.

Shell Quality: Eggs with sound shell, Clean and thick shell, cracked eggs are detected at candling and discarded

Interior Quality: Hatching eggs with good albumen, Good yolk quality, Free from blood and meat spot

CARE AND STORAGE OF HATCHING EGGS BEFORE INCUBATION

Important to handle hatching eggs carefully for higher hatchability and strong, viable chicks.
Collection of eggs: Gather as frequently as possible in harsh weather, three or four gathering of eggs from shed is necessary to avoid undue effect of weather on embryos. Fresh eggs should be cooled to temp. Below the physiological zero level as quickly as possible.

Fumigation: Pre-incubation fumigation of eggs should not adversely effect. Proper gas concentration not more than 20 minutes. Should be properly ventilated before putting in

Cleanliness of Shell: Clean eggs hatch better than soiled eggs. Dry cleaning of soiled eggs by dry rough cloth or sand paper with proper care

Transportation of hatching eggs: Eggs which have been shaken or jarred in transit should be allowed to settle for 24 hrs. before setting in incubator. Proper care should be taken while transport.

STORAGE OF EGGS

Hatching eggs should be put in setter (Incubator) immediately to reduce storage problem. Some storage is always necessary. Duration, storage temperature, storage humidity and other factors effect hatchability 0.5 % reduction in hatchability / day of storage.

Temperature during Storage

- ❖ Temperature during storage period and Prewarming temperature just prior to incubation
- ❖ After eggs is laid, it cools down to environmental temperature of storage room, embryo development slow down and stops when it reaches below physiological zero temperature
- ❖ Physiological zero temperature of Hen eggs – 20-21^{o} C, some suggest 28^{o} C ❖ Shorter storage period higher optimum temperature

Storage time (In days)	Temperature
Less than 3 days	18 to 30^{o}C
3 to 7 days	16^{o} to 17^{o}C (Below physiological zero)
More than 7 days	10^{o} to 12^{o}C (Below physiological zero)

Pre-warming of Eggs

- ❖ It improves hatchability, particularly when stored at low temperature for long period
- ❖ 23 C for 18 hours is suggested before incubation
- ❖ In another approach, stored eggs are daily expose to high temp. for short time. ❖ One hour at 37.6 C

Relative Humidity during storage

- ❖ High RH produces optimum hatchability provided condensation on the surface of eggs does not occur
- ❖ 90% RH is better than 60-70%, but it is not recommended because of danger of condensation on eggs , condition favorable to bacteria and mold
- ❖ High energy required for production of high humidity, uneconomical
- ❖ Weight loss of eggs is highly influenced by RH, Temp., and Air movement in storage environment.
- ❖ Water finds its way from the egg as vapor by diffusion process through air space in shell membrane and pores in space.

Orientation and Position of Egg

- ❖ Normally hatching eggs are packed and held before incubation in the small-end down position, help to maintain air space (air sac) into original position and provide highest rate of embryo survival.
- ❖ Some evidence provide that eggs packed and stored narrow (small) end upward without turning having given better hatchability even up to 4weeks of storage period.
- ❖ Turning of eggs during pre-incubation period (storage) had beneficial effect if eggs were packed in usual small end down position and stored for more than 2 weeks and not for eggs packed in upright position.
- ❖ Eggs stored small end up position keep yolk in center compare to small end down position. In later case, yolk progressively move upwards and touch shell membrane after 28 days of storage, reduce hatchability.

- ❖ Therefore, storing in the small-end up position may be beneficial because it keeps yolk near the albumen and in center, provide greater protection from dehydration and adhesion to the inner shell membrane.

Controlled atmospheric storage

- ❖ Plastic containers with or without use of egg flushing have been used for storage in order to reduce chemical and enzymatic activities of hatching eggs.
- ❖ With high holding temperature, storing eggs in plastic packs improves hatchability by reducing moisture and CO2 loss if storage is prolonged.
- ❖ Hatchability is higher in bags with low permeability. Chemical stability of eggs found when nitrogen flushed in plastic packs.

METHODS OF INCUBATION

Natural Method: Use of broody hens for incubation of eggs. Still popular in small poultry keepers mainly in rural area

Broody hen: Healthy, quiet, good sitter, good body size, Tested with dummy eggs for interest to sit on eggs, Treated for internal and external parasite before use.

Nests: Saucer shaped nest made of bamboo basket or wooden box fitted with bedding material like clean cut grasses or chopped straw should be provided at safe and comfortable place.

Management of Broody Hen

- ✓ 10-15 eggs placed under one hen depend upon size
- ✓ Should be taken out twice a day for 30 minutes to be fed and watered
- ✓ During summer, sprinkle of water on eggs to maintain humidity
- ✓ Candling done at 7^{th} day, infertile eggs removed
- ✓ Hen will take care of chicks if kept with hen

Artificial Method: This method is known for more than 2000 years, originated in china and Egypt. Earlier using heat of rotting manure, later charcoal fire in cylindrical oven made of earthen materials with smoke hole, no evidence of turning of eggs

Modern Hatchery: Control of temperature, RH, ventilation, turning of eggs under extreme hygienic condition

FACTORS ESSENTIAL FOR INCUBATION OF EGG

Desired level of Temp., RH, Ventilation, Frequent turning of Eggs are essential for proper incubation during incubation period. In natural method, provided by Broody hen. In artificial method, incubators are operated manually or by using automatic devices to maintain condition

TEMPERATURE

Most critical factor during incubation. Slight variation cause reduction in hatchability and quality of chicks. Temp. have direct effect on duration of hatch, size of embryos, abnormalities in embryos, viability of chicks after hatching. Adverse effect of abnormal temperature depends on extent, duration of deviated temp. and stage of incubation

Abnormal Temp. during crucial period of incubation more injurious than other stage. Temperature req. varies according to species of birds. For chicken, temp. varies from 37.2 to 37.7 C. In incubator cum hatcher, same temp. is maintained. Where hatcher is separate, Temp. reduce to 35.5 to 36.5 C. High Temperature during early stage of incubation cause mortality near to end, smaller chicks, lack of alertness in chicks, crooked toes, spraddled legs, crooked necks. Exposure of eggs to 46 C, 3 hours or 49 C, 1 hour kill all embryos.

Thermostats controlling temp. should be checked regularly with thermo meters. Both dry bulb and wet bulb thermometers should be used. Temp. should be checked when pilot light goes off, thermostatic controls cut off heat. Temperature in incubator and hatcher should be watched even after pilot light goes off, because growing embryos in eggs become exothermic after 13 days or so. Heat generated by eggs them self-increase temp. beyond critical level. Sub-optimal incubation temp., late hatch and poor hatchability. Normal incubation period increase by 4 days at low temp. of 34.5 C. Fluctuation of temp. with certain range has less adverse effect in 2nd week as compare to 1st and 3rd week.

HUMIDITY

During incubation, hatching eggs must lose some weight through moisture loss in order to produce strong chicks. In chicken eggs, loss of weight is 10.5% in 19 days of incubation. Low weight loss = large size chicks. High weight loss = small size chicks. Specific req. of humidity depends on species, egg size and shell quality. For chicken eggs

First 18 days – 60%
Last 3 days – 70%

Humidity is measured by comparing wet and dry bulb thermometer readings. Effect of variable humidity on embryonic development. Slight errors in humidity in setter or hatcher will not be as detrimental as fluctuation in temp. Low humidity in setter – more water loss from eggs, small and hard chicks. Low humidity in hatcher – High incidence of pipped eggs, embryos dried out or dead in shell. Effect of variable humidity on embryonic development. Low humidity in incubation – less moisture loss from eggs, large and soggy chicks. Delayed hatch and reduce hatchability. Chicks with poorly healed navel. Shell will be sticking to chicks.

VENTILATION

All living beings require oxygen. Same is applicable to hatching eggs. Best result is obtained when the oxygen content is same as atmosphere 21%. Above or below level will reduce hatchability, lower level is more dangerous for hatchability. Every 1% reduction in O2 level = 5% reduction in Hatchability. Every 1% increase in O2 level = 1% reduction in Hatchability.

CO2 is given off by developing embryos during later stage of incubation, its conc. 0.3 to 0.5% for maximum hatchability. Conc. Above 1% increase embryonic mortality, 5% Conc. For long period = All embryos dead. Usually, no limitation of supply of O2 and removal of CO2 in forced draft type incubators. Most of the machine take more air than required so care should be taken to avoid hyper ventilation. Developing embryo start liberating heat from 13th day so fans must be there to remove extra heat from 13th day to 21st day beside removal of CO2. Failure of electricity / fan is not serious for first 13 days because high energy requirement but situation becomes serious after 13 days when fans stop working

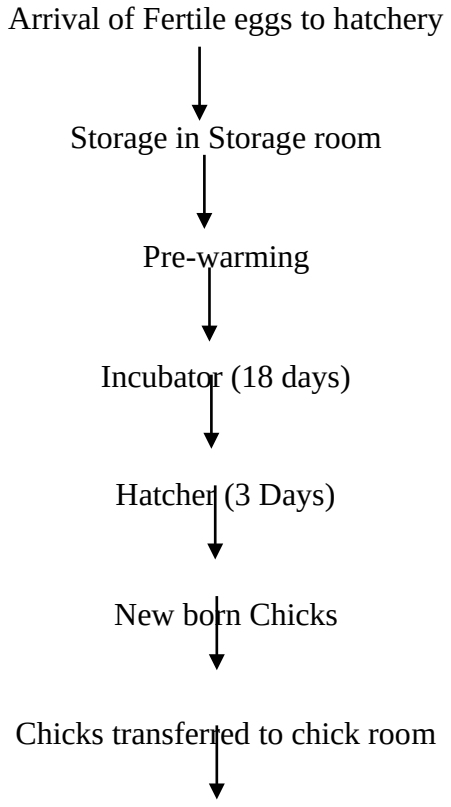
SET EGGS LARGE END UP

Universal practice. Keeps air sac in normal position, reduce malposition of embryo. Permits embryos to develop with head towards large end near the egg sac. Chicks ready to hatch break in air cell to initiate respiration. Reverse setting of eggs reduce hatchability by 10%, reduce quality of chicks

TURNING EGGS DURING INCUBATION

Necessary to Gentle and frequent turning of embryos in eggs to prevent its setting and adhering to other structure of eggs. In air still type of incubators, turning ensures uniform heating and ventilation. Turning of eggs at 45 degree in both direction or 90 degrees in one gives best results. Improved hatchability when turning per 3 hours. Frequent turning also necessary to overcome faulty control of temp. and ventilation. Turning should be continued for 18 days (Till in Setter / Incubator). No need of turning during last 3 days. Eggs should be transferred to hatcher from setter when about 1% eggs are slightly pipped (breakage in egg shell).

HATCHERY OPERATION



UNIT – 4 MANAGEMENT OF CHICKS (BROODING)

Chick: Young of chicken up to 8 weeks of age

Brooding is the art and science of rearing baby chicks. A newly hatched chick does not develop the thermoregulatory mechanism fully and takes about two weeks to develop this mechanism and homeostasis. Therefore, they cannot maintain the body temperature properly for the first few weeks of life; and may be subjected to chilling, if not properly taken care of.

Brooding: It is a mechanism of providing auxiliary or supplementary heat to chicks through artificial heat using brooders.

Brooding can be classified into natural and artificial brooding.

1. Natural brooding: By broody hen
2. Artificial brooding: By artificial brooders

Location of Brooder house: Brooder house should be away and isolated from other poultry houses. The distance between brooder house and other poultry houses should not be less than 100 meters.

BROODERS

Consists of: Heating source and Chick Guard / Brooder Guard

Essentials of Good Brooders: A dependable mechanism, Supply of fresh air, Dryness, Adequate space, Easy for cleaning and disinfection, Protect against enemies, Safety from fire and Economy

Brooder Guard / Chick Guard

They are used to prevent chicks from straying too far away from heat supply until they learn the source of heat. We have to provide brooder guard with a diameter of 5 feet, height of the brooder should not exceed 1.5 feet. For this purpose, we can use materials like cardboard sheet, GI sheet, wire mesh, and mat etc. depending upon the season of brooding. During summer season, brooding is done for 5-6 days. In winter season it is 2-3 weeks.

TYPES OF BROODERS

Hover Brooder: Such brooders are most widely used in India when electricity is available. They maintain uniform temperature, convenient for operation and require little attention. However, electric brooders do not heat house well in very cold weather. Wet litter may be another problem requiring frequent stirring and renewal of litter

Infrared Brooder: This is relatively new method in which infrared bulbs used. Infra-red lamps are kept 20-25 inches above litter. These do not heat whole room but warm chicks therefore comfort of chicks and not the thermometer is the guiding factor. A single 250 watts infra-red bulb provide warmth for 60-70 chicks. Multiple units are used for brooding of large numbers of chicks.

Central Heating System: Very large commercial operations require central heating system for large scale operation. Several different systems has been developed which use gas, charcoal, oil, gas as fuel. Under this system heated air or water is circulated in pipe lines underneath the building to maintain warmth inside house.

Battery Brooders: It is another type of confinement brooding provided with thermostat for easy control of temperature. It will have usually 4 tires provided with feeders and waterers. The battery brooders must be kept in room at a temperature of 21-24ºC. Battery brooders are being extensively used in experimental purpose. Heated batteries (Chick batteries) are used for brooding up to 4 weeks. Whereas unheated batteries (Grower batteries) meant for chicks after 4 weeks.

Gas Brooders: Commonly LPG is used for production of heat. Gas is connected to heating element which is hung 3-4 ft. above chick level. Advantage of this system is that it can be taken to any location, even where electricity is scarce.

Kerosene or Charcoal Stove Brooders: Ordinary kerosene or charcoal stove is used to provide supplementary heat where electricity is not available. The stove should be covered with plate or pan to dissipate the heat, however care should be made that there is adequate ventilation in shed and toxic gases produced by stove should not be accumulated.

Arrangements before Arrival of Chicks

- 10 days before arrival clean, wash and white wash brooder / chick house.
- Brooders, Feeders, Waterers should be washed with disinfectants.
- Put right kind of litter over floor up to 4 inches.
- Arrange brooder one day in advance and check whether it is running properly or not.
- Spread newspapers over litter and under the brooder to avoid chicks eating litter material.
- Arrange feeder in cart wheel manner with waterers alternately around brooder.
- Sprinkle ground maize or starter feed on newspapers to facilitate chicks to pick up and eat easily.
- Arrange chick guards 2-3 feet around brooder to a height of 18 inches either with cardboard or wire.

Arrangements after Arrival of Chicks

- Chicks should have been vaccinated against Marek's disease on first day of life at hatchery itself.
- While leaving chicks under brooders, train few chicks as how to eat and drink by dipping their beaks in feeders and waterers.
- The chick feed should have been supplemented with coccidiostats.
- Follow vaccine schedule strictly.
- Extend chick guards as the chicks grow but remove them ultimately at 10^{th} day.
- Block corners of brooder room after removing the chick guards.
- Change the size of feeder and waterers as chick grows.
- Photoperiod of 23 hours light and one hour of darkness.
- Take care of litter for dampness.

IMPORTANCE OF ENVIRONEMNT DURING BROODING

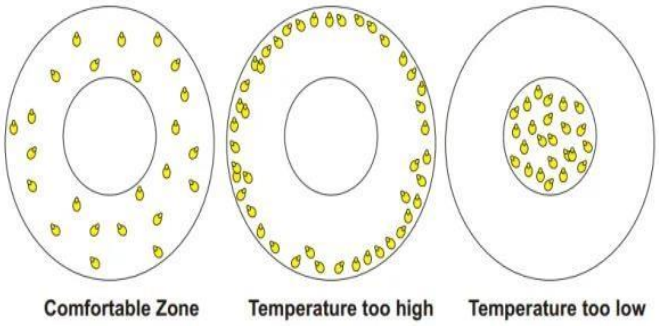
Temperature

Chicks require auxiliary / supplementary hear for first 3-4 weeks since they are unable to adjust or regulate body temperature. Proper temp. is essential for normal growth. Both high and

low temperature is harmful to chicks and may slow growth and cause mortality. The chicks feel comfortable between 16 - 35°C. Since it is difficult to meet individual requirement, a range of temperature between 16 - 35°C is to be provided allowing the chicks to adjust to the amount of temperature they need. Chicks immediately after hatching require 35°C for 1st week and thereafter hatching temperature requirement decrease by 2.5 C per week until equal with environmental temp. of 21°C

Brooding is done for 2-3 weeks in hot climate and 3-4 weeks in cold climate. In very hot parts of day, brooder are turn off. In very cold days, brooders are kept running day and night. After 2-3 weeks chicks usually don't require brooding in daytime. Chilling of chicks often occurs due to fault in brooding when there is lacuna in brooder management. However, effect of high temperature seldom occurs because chicks will move away from heat source if they find it uncomfortable.

High lethal temp. for chicks is 47°C. Movement of chicks is good guide about temperature under brooder than a thermometer. If temp. is overheating in brooder, chicks will move away from heating source and if temp. is very low in brooder, chicks will crowd under heating source. If temp. is properly maintained in brooder, chicks will distribute uniformly under brooder.



Humidity

Both high and low humidity in brooder house is undesirable. A relative humidity (RH) of 50-60% may be considered suitable. If the humidity is high it leads to wet litter condition and certain diseases like parasites, coccidiosis. On other hand low humidity may cause very dried up atmosphere and result in poor feathering.

Ventilation

It is essential to provide fresh air which is essential for developing chicks. It is also necessary to keeps house dry and free from odors. It removes poisonous gases like Carbon monoxide produced due to defective combustion of fuels like gas, coal oil etc. A concentration of 0.01% of carbon monoxide can initiate slow process of poisoning. Ammonical fumes produced under deep litter system are irritating to chicks in ill ventilated house

Floor Space

It varies according to size and age of chicks. For Broilers, 0.75 to 1.00 sq. ft. / bird is required until market age. For layers, floor space requirement under deep litter system is as under:

Age (In Weeks)	Space req. (In Sq. ft.) / Chick
0-4 Weeks	0.5 sq. ft.
4-8 Weeks	1.0 sq. ft.

8-16 Weeks	1.5 sq. ft.
16-20 Weeks	2.0 sq. ft.
20-72 Weeks	2.5 sq. ft.

Cleanliness and Sanitation

It is essential to clean brooders, brooder room and rearing equipments. Proper sanitation is also required for opting success. Thorough scrubbing, cleaning, washing and disinfection of brooder and grower house as well as equipments necessary in order to obtain good results in brooding, performance and protection against disease. Disinfectants act better in the absence of dust and debris. Lysol solution, Coal tar derivatives, Chlorine compounds may be used.

FEEDING

Brooder chick feed (mash) with 22 % Crude protein (CP) and 2700 Kcal/kg metabolizable energy (ME) has to be prepared and provided. Good quality, potable medicated water must be provided in waterers. Look for health of chicks at time of arrival. Lighting for brooding has to be provided 23 hours depending upon seasonal requirement. However layer chicks should not be provided light note more than 12 hours after 4 weeks till they start laying at 20 weeks. If day light is about 10 hours, do not give any additional light at all

If chicks reared during winter and the natural day light increases as the age of bird advances, then add giving light so as to maintain 10-12 hours per day constantly until birds start laying. If the total length of light hours are increased day by day up to start of lay, laying will start earlier resulting in small eggs, will remain so for longer time thus will result in fetching lesser price and consequent loss. The required numbers of feeders and waterers are calculated and provided. Initially small size feeders and waterers with lesser depth will have to be provided which should be changed to large size with greater depth after 3 week. Adjust the height of feeders and waterers to match the height of growing birds to avoid wastage. Feed and water the bird at least twice daily at regular intervals. Watch the growth of birds and feed-water consumption regularly.

Feed and Water intake by 1000 birds

Age in Weeks	Feed intake / Week (Kg)	Water intake / day (Liter)	Body weight at end of the week (g)
1	40	10	60
2	80	25	105
3	140	45	160
4	200	65	230
5	250	80	300
6	300	95	370
7	350	105	440
8	390	120	510

To avoid feed wastage, the chicks are debeaked first at 7-10 days of age. Their beaks have to be cut short by debeaking machine applying electrical cauterization. It may also be performed at end of second week and repeated 12^{th} – 14^{th} week. The Upper beak has to be cut $2/3^{rd}$ and the lower beak $1/3^{rd}$ portion. The Cut portion has to be cauterized by touching on hot plate. The tongue should be carefully held back. Undertake debeaking during cooler parts of day. Provide anti-stress B-complex vitamins and Vitamin-K in drinking water before, during and after day of debeaking.

Since layer chicks are more active, they tend to peck at each other's back (cannibalism), cause injury and death, debeaking prevents such.

VACCINATION

Vaccination is important during this brooder stage. Always buy quality vaccine stored under proper storage. Ensure proper dosage as per specification. Vaccinate the birds with minimum stress. Medication for layer chicks include glucose and electrolytes on first day and a mild antibiotic / antibacterial along vitamin tonics for first five days, later no medication is required unless warranted. Chicks also can be reared in cages from 0-8 weeks. For 100 chicks, dimension of the cage should be 180 × 90 × 30 (L × B × H) cm, which can be kept 75 cm above floor level. One 100 watt bulb is sufficient on the top of the cage providing heat for first 3 weeks. For first 2 weeks, small feeders and waterers are provided in cage, after that they are fixed outside on the sides of cages. Vaccine schedule for broilers, layers and breeders are given in last unit.

UNIT – 5 MANAGEMENT OF GROWERS / PULLETS

GROWER MANAGEMENT UNDER DEEP LITTER SYSTEM

Grower: Growing chicken from 9 to 20 weeks of age

Generally growers / pullets in layer farms are raised under deep litter system. Grower management essentially remains same as that of chick (brooding) management except for the additional space required space for floor, feeders and waterers and no need for brooding.

Floor Space – 1260 sq. cm (1.4 sq. ft.) per bird
Feeder Space – 6 - 8 cm per bird. One linear feeder of 120 cm length and 8 cm depth for 40 growers.
Waterer Space – 2 cm per bird. One circular waterer of 36 cm length and 8 cm depth of 6 liters capacity for 50 growers. Growers are to be provided with fresh, cool and palatable water at least twice a day in case of manual watering system. Water req. increase in hot days, care must be made not to spill water on litter.

Lighting management – No artificial lighting is given other than natural day light since they require only 9 hours of light per day.

Growers are fed with mash feed containing 16 % CP (Crude Protein) and 2600 Kcal/kg ME (Metabolic energy). A bird may take 60-80 g feed per day. The height of feeder and waterer should be adjusted at shoulder level of birds. It is not advisable to give feed *ad libitum*, during growing stage as the bird may put high amount of fat on body affecting laying rate in future. Therefore, restricted feeding program should be adopted which will delay early sexual maturity so as to improve egg quality.

The litter is often raked to remove moisture from it. If necessary, super phosphate may be mixed with litter 2kg / 100sq.ft. area to reduce ammonia level. Birds are dewormed at 16th week of age with appropriate de wormer. For efficient use, 2 hour withdrawal period is practiced before offering medicated water. The poorly grown birds are culled at this time. The mortality rate during growing period must be lower than 3% during growing period

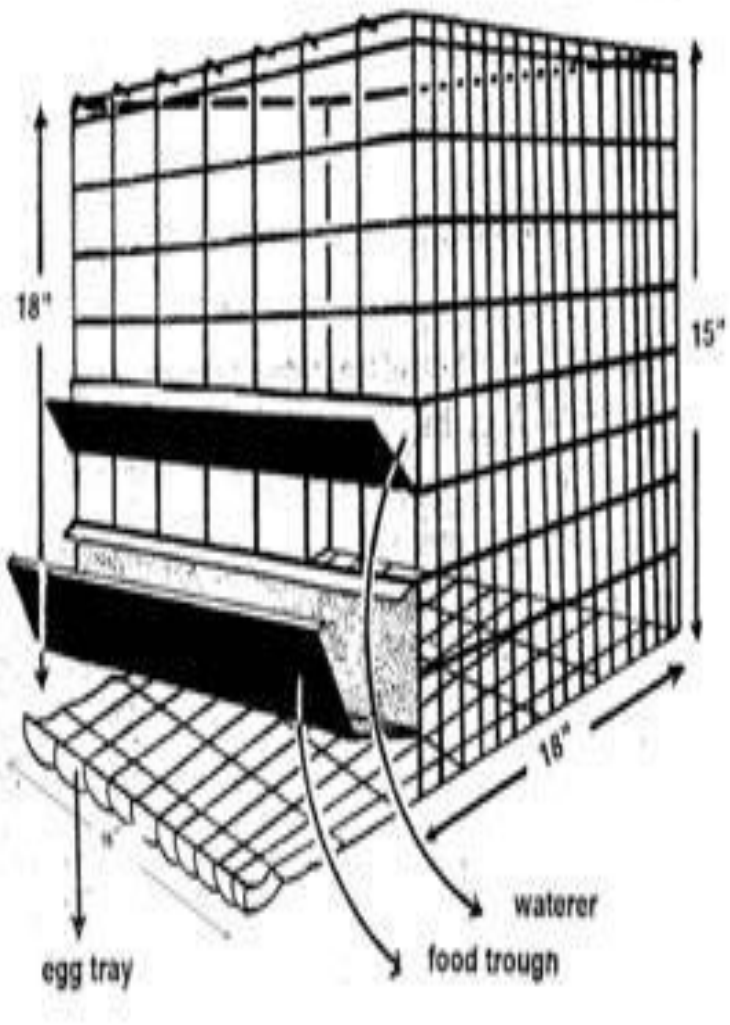
FEEDER

WATERER

GROWER MANAGEMENT UNDER CAGE SYSTEM

For caged growers, the floor may be made up to welded mesh of 1.25 × 5.0 cm size. In a cage of 180 × 90 cm size, 50 growers can be reared with a space allowance of 325 sq. cm per bird. Feeders and waterers can be fitted lengthwise on the outside one below other. Nipple drinkers also can be fitted inside the cages.

Adequate care should be made to maintain uniformity of growth in the flock. Sample weight should be taken once in week to find out average body weight as per breeder recommendations.



COMMONLY USED CAGE IN CHICKEN

UNIT – 6 MANAGEMENT OF LAYERS

MANAGEMENT OF LAYER (21-72 WEEKS) UNDER DEEP LITTER SYSTEM

LAYER: Adult female of chicken which have started laying eggs

At end of 18th week, growers are transferred to layer house to take special care for optimum egg production. Generally, layers are raised under cage system but some farmers raised them under deep litter system also. They are reared on good quality litter of 5-6 cm height with floor space allowance of 1800 sq. cm. (2 sq. ft. / bird). In high humid area like north east the floor space allowance may be increased to 2200 sq. cm. (2.5 sq. ft. / bird)

Feeder space allowance of 10-12 cm / bird and water space allowance of 2.5 cm / bird is given to birds. A linear feeder of 180 cm length and 10 cm depth will be sufficient for 35 birds. A circular waterer with 45 cm diameter and 7 cm depth is required for 50 birds.

They are fed with layer mash feed containing 18 % CP and 2700 Kcal/kg ME, 2.75 % Ca and 0.80 % available P, all the time, *ab libitum*. Waterer guard on waterers and grill on linear feeders will prevent birds from standing on edges or on top of them and spoiling contents. Provide fresh water at least twice a day in case of manual system of watering. During laying stage, 1000 birds will consume 250 liters water and 110-120 kg feed daily. During hot days, water consumption increase and feed consumption decrease while during cold season, feed consumption increase. Feeders and waterers are arranged alternatively at equal distance, keeping their height at bird's shoulder level feeling only 2/3rd level to avoid wastage / spoilage. Wastage is 25-30% when filled full, while only 10% when filled 2/3rd. The feeders should be distributed such that birds don't have to walk more than 3 meters (10 ft.) for feed.

Usually at least one nest box for every 5 layers is sufficient. The boxes are made of GI, aluminum, wood and adjusted at about 45 cm height and kept in darker part of the shed. The mouth of box should be 30 cm width with depth of 20 cm. Always clean litter material should be spread inside box every time for clean egg production. It is better to provide community nest than individual nest. The nest should be closed in night so as to prevent birds from sitting in it. In deep litter system, litter material should be treated chemically once in a month to reduce ammonia emission. Litter material preferably be raked in evening, daily after collection of eggs. Deworming should be done regularly at interval of 6-8 weeks

Light Management

From 20th week or from the commencement of 5% egg production, which is earlier, artificial lighting should be commenced. For every week, the light period should be increased 15 minutes per day until it reaches maximum of 16 hours of total photo period (Natural + Artificial) per day which is known as set up lighting program. Beyond 16 hours of total photo period has no beneficial effect. Never decrease photo period during laying stage and never increase during nonlaying stage.

1 watt per 3 sq. ft. is recommended. Bulbs of 25 to 40 watt firmly attached 7 ft. above floor and 812 ft. apart. The distance between 2 tube lights (florescent) should be 15 ft. if used in place of bulbs. Reflectors should be used to direct all light downward and be cleaned regularly to remove dust from bulbs. Light intensity should be uniform throughout the layer house. A light intensity of 0.5 to 1 foot candle sufficient for egg production but normally 0.9 to 1.2 foot candle is provided. Unlike incandescent bulb, florescent bulbs produce a lower intensity of light as they age. The use of compact florescent lamp (CFL) may not only saves energy but does not produce heat as comparison to incandescent bulbs.

MANAGEMENT OF LAYER (21-72 WEEKS) UNDER CAGE SYSTEM

Generally in layer farming, layers are raised under cage system. Cages of various size are available to keep 3-5 birds in one cage. Currently, reverse cages are commonly used with their longer side fitted to remain in front. Further raised platform houses are constructed to facilitate quick drying of drooping and their easy removal

Cage of following sizes may be made and fitted in rows

Size	No of birds kept in one cage
45 × 30 cm	3

45 × 40 cm	4
50 × 35 cm	4
55 × 45 cm	5
60 × 37.5 cm	5

These cages are arranged in two or three rows one above the other or on either side. If they are arranged in staircase manner, then they are termed as Californian cages. A floor space of 420 – 450 sq. cm is allowed within cages. Conventionally, the lower most row cages are fitted 75 cm height above floor. Now a days, they are fitted at 120-240 cm height above floor with walking platform constructed on sides.

The Layer cages will be 40 cm height. The floor of cage is fitted with 2.5 × 5 cm size weld mesh of 14 gauge thickness. On sides of cage, 7.5 × 7.5 cm size mash with 16 gauge thickness is fitted. The bottom floor with 1/6 slope downwards to the front to facilitate easy rolling of eggs from cages to the front in egg collection tunnel. The mesh rails on cage floor should run on from back to front not sideways otherwise they will block free roll of egg from cage. Waterers are fitted above feeders in the front. Automatic waterer nipples/buttons and feeders may be provided inside cage.

Cages are fitted in two or three rows on either side of the row under Californian system of arrangement. Two or three such rows of cages are arranged in a layer house. Depending on numbers of rows and numbers of tiers in each row, the breadth of caged layer house ranges from 15-17’ (5-8 m). There is no stipulation of length of such house, can be adjusted as per the numbers of birds to be housed. No side walls are required for cage houses with the mesh being stretched down to the floor level to facilitate better ventilation for drying moisture of the drooping.

THREE TIER CALIFORNIA CAGE

Advantages Of Cage system over Deep litter system: Easy management, Lesser space requirement, Easy collection of eggs, Less % of broken eggs, Better egg weight, Clean egg production, Easy culling, Less mortality levels.

Egg laying starts at 21st week and rate of laying (percentage production) increases every week to reach at level of 90% and above after 28 weeks of age. This rate is maintained well beyond 36 weeks of age even up to 40-42 weeks of age. After that it slumps down slowly to reach 70% or below by 72 weeks of age. When egg production is below 65%, it is uneconomical to retain them unless the egg price is exceptionally high. Egg percentage can be calculated as percentage on total number of birds available at 21st week (hen-housed-egg production)

Hen day egg production (HDEP)

$$\text{HDEP} = \frac{\text{Total number of eggs produced on a day}}{\text{Total number of hens present on that day}} \times 100$$

Hen-Housed Egg Production (HHEP)

$$\text{HHEP} = \frac{\text{Total number of eggs laid on a day}}{\text{Total number of hens housed at the beginning of laying period}} \times 100$$

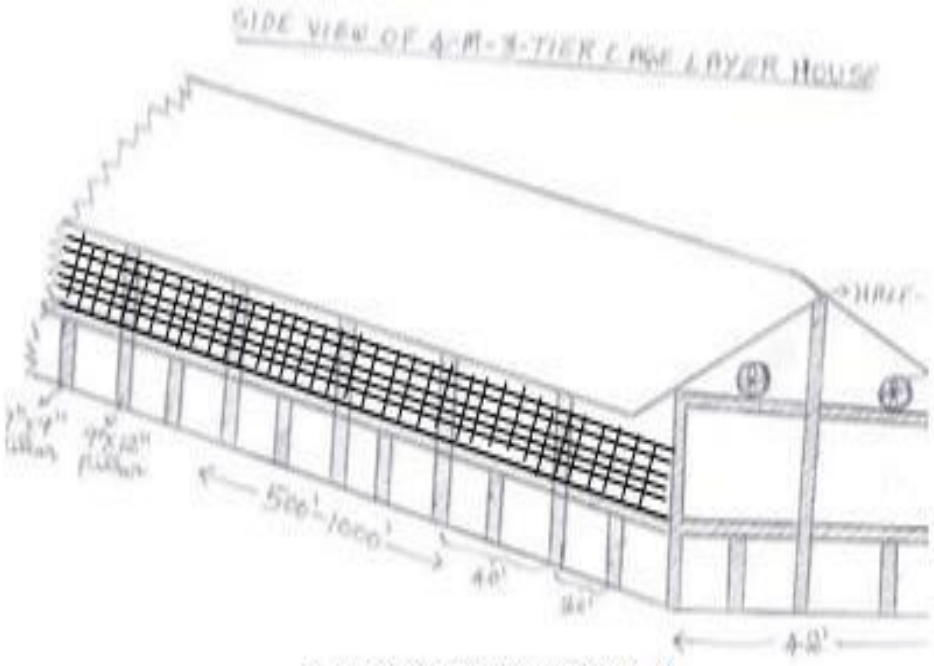
Satisfactory egg production levels at different ages during laying stages

Age in Weeks	Hen-day egg production (%)	Feed intake / 1000 birds (kg)	Water intake / 1000 birds (liter)
21	10	75	160
22	18	85	180
23	34	96	210
24	55	105	240
25	68	109	260
26	76	113	280
27	84	115	290
28	88	115	300
29	90	115	310
30	92	115	320
31	94	115	320
32-39	92	110	310

40-47	86	107	290
48-59	82	105	270
60-64	76	103	260
65-70	70	101	240
71-76	65	96	240

The layer type chicken lay eggs mostly during forenoon. Eggs may be collected twice in morning and once in afternoon. The frequency of egg collection has to be increased to four to five times during peak summer. In very large layer farm, it is preferable to have air-cooled room for storage of eggs. Specially designed plastic / cardboard trays have to be used to collect eggs. Usually 30 eggs capacity collecting trays (filler flat) are used. It is not advisable to collect eggs in baskets.

IDEAL BROILER HOUSE



IDEAL LAYER HOUSE

UNIT – 7 MANAGEMENT OF BROILERS

BROILER MANAGEMENT UNDER DEEP LITTER SYSTEM

Broiler: Broilers are the birds of either sex, up to 5 to 6 weeks of age and weighing 1.5 to 2.5 Kg body weight with soft pliable skin, tender meat and well developed breast bone cartilage. Used for chicken meat purpose

Brooding

The brooding may be carried on floor (by using hover or infrared brooder) or on cages (battery brooder). The hover brooder may be made of galvanized iron, wood or bamboo. Brooding management of straight-run (unsexed) day old broiler chick is similar to that of layer chicks. Newspapers which is spread on litter before arrival of chicks are removed after 3-4 days. Chick guard is removed at 9-10 days, however the corners of room is covered by dismantled chick guard so that during dark night in cold weather chicks are not freighted, piled up and died in corners and removed after 15 days.

For each broiler chick floor space allowance is 450 sq. cm. (0.5 sq. ft.) for first 18 days and 1000 sq. cm. (1.0 sq. ft.) afterwards till market age. Feeder space allowance is 3 cm / chick (For first 18 days), 6-7 cm/chick (afterwards till market age). Waterer space allowance is 1.5 cm / chick (For first 18 days), 3.0 cm/chick (afterwards till market age). As the chick grows, smaller feeders and waterers are replaced by larger ones.

Every morning, waterers are cleaned, filled with fresh, clear and potable drinking water. Watering is done twice a day, but feeding must be done four times a day in manual feeding and watering system. The feeders and waterers are filled only 2/3rd capacity to reduce wastage.

Feeding Feeding of broilers is generally done in 2 phases

Age	Type	CP%	ME (Kcal/kg)
0-4 Weeks (Broiler Starter)	Mash / Pellet / Crumble	21	2900
4-8 Weeks (Broiler Finisher)	Mash / Pellet / Crumble	21	2900-3000

Alternately, broiler also may be feed by 3 phases: 0 – 2 Weeks = Pre Starter, 3 – 5 Weeks = Broiler Starter, above 5 Weeks = Broiler Finisher. Feeding and Watering can be done at same time. During summer, feed consumption decrease and water consumption increases while during winter / monsoon, Feed consumption increase and Water consumption decreases

Feeders and waterers are positioned at appropriate height so that birds find it comfortable for feeding and watering. Make provisions to adjust the height of feeder / waterers so that their brim is hiked to level of the back of the bird. The growth of the birds has to be monitored weekly, for this 10 birds are randomly selected and weighted and compared with standard

Standard Growth Performance and Feed Efficiency

Age (Wk.)	Average body weight (g)	Feed intake / 1000 birds / day (kg)	Cumulative feed intake / bird (g)	Feed Efficiency (FCR)	Water intake / 1000 birds / day (liter)

0	42	-	-	-	-
1	170	19	146	0.86	46
2	380	37	426	1.12	89
3	720	68	945	1.31	165
4	1170	102	1730	1.48	245
5	1680	134	2720	1.62	320
6	2220	168	3996	1.80	405

Feed Conversion Ratio (FCR, Feed Efficiency)

$$FCR = \frac{\text{Feed consumed (kg)}}{\text{Body weight gain (kg)}}$$

If growth rate is lower, the farmer has to check quality of feed, managemental lacks or any subclinical infection. Also watch out daily feed and water consumption as any drastic change has to be investigated.

Litter Management

Broilers are mostly reared on litter. The commonly used litter materials are paddy husk, groundnut husks, saw dust, bagasse, chopped straw etc. To start with a litter the thickness of 5 cm is sufficient. The litter practically maintained dry (75-80 % dry matter). If the moisture level exceeds 25%, ammonia production will increase. After 2 weeks, everyday litter material has to be raked with help of spade / spike so that caked material is broken up. Before raking, all feeders and waterers are removed from floor. Ammonia level if more than 25 ppm inside house, causes stress, younger birds suffer most. There will be irritation of eyes and nasal membrane leading to poor feed consumption, growth and lameness. The Broiler will be predisposed to respiratory and coccidiosis problem. To assess moisture level in litter, take a handful of it and squeeze. If it makes a cake than moisture is high, and if it crumbles into fine dust, moisture is low which will make environment dustier. It has to remain loose mass, if moisture level is appropriate.

Lighting Management

Normally 23 hours of continuous lighting (day light + artificial lighting) is used inside the house with one hour of darkness each day throughout 6 weeks is provided to prevent the birds from becoming frightened and resulting in piling ups and smothering, if power failure should occur. A high intensity of light is usually given during first 14 days to help the chicks get started on feed and water

BROILER MANAGEMENT UNDER CAGE SYSTEM

California system of cages is the most commonly used in commercial egg production (Layer production). In high humid area like north-east India, battery cage would be more appropriate for broiler production. Just below the cages, a shallow pit of 6-8 inches is dug to accommodate all the fecal materials to fall in it. The accumulated materials must be removed regularly from the pit. The cages are fitted 2-3 tiers on either side of the walk way. 'Elevated or high raised cage houses' are preferred in which cages are fitted above 5-6' height from the platform. This arrangement widens gap between birds and their droppings, facilitates quicker drying and easy removal of drooping. In such houses, droppings are removed even after several years using lorry or JCB. In such houses smell, disease spreading and fly problem become minimal.

Cage System

Advantages	Disadvantages
Increased production and feed efficiency	More broken eggs are produced if cage structure is not proper
Lesser incidences of cannibalism (Cannibalism is a condition in which birds of a flock attack their pen mate and eat its flesh, which may impose deep wounds and heavy mortality)	Cage layer fatigue
Less labour requirement	Fly problem
Culling is easier	No nutrients from litter (Vitamin B2 and B12)
Clean egg produced	Initial investment is higher
No problem of wet litter	High space required per bird
Higher stocking density	
Better sanitation and hygienic environment	
Broodiness is eliminated	
Parasitic problems are lessened	

UNIT – 8 IMPORTANT INDIAN AND EXOTIC BREEDS OF CHICKEN

Breed: A group of birds that have usually the same general body shape, they are true to type, carriage and characteristics of the name of the breed they carry. E.g. Leghorn, RIR, Aseel etc.
Variety: It is a sub division of a breed distinguished either by plumage color, plumage pattern or comb type. E.g. White leghorn, Single comb white leghorn, Black Minorca etc.
Strain: Closely related inbred flocks with definite economic characters. Name is given by breeder. E.g. Wencobb 400 etc.
Class: Used to designate a group of birds - developed in certain regions or geographical areas. They are American, Asiatic, Mediterranean and English. **Scientific**

name of Chicken = ***Gallus gallus domesticus***

CHICKEN BREEDS BASED ON CLASS

1. Asiatic - Eg. Brahma, Langshan, Cochin
2. American - Eg. Plymouth Rock, Rhode Island Red, Wyandotte
3. Mediterranean - Eg. Leghorn, Minorca, Ancona
4. English - Eg. Orpington , Sussex, Cornish
5. Continental - Eg. Houdans, Hamburg, Polish, Campines, Lackvelders
6. Oriental - Eg. Malaya, Yokohama, Sumatra, Cubalayas
7. French, South American (or) Latin American - Eg. Araucana
8. African - Eg. Negro, Jago

American Class: Body size - Medium to heavy, Egg shell color – Brown, Shanks - Clean and yellow, Skin - yellow (except Jersey Black giant, where the shanks are black) Ear lobes -Red, Comb Shape - Rose or Single. Eg. Plymouth rock, Wyandotte, Rhode Island Red, Jersey Black giant, New Hampshire

Asiatic Class: Body size – Heavy, Egg shell color - Brown, Broody with motherly instinct, Ear lobes - Red, mostly, Shank - feathered and yellow, Skin - Yellow (except Langshan). Eg: Brahma, Cochin, Langshan

English Class: Body size - Medium to large, Egg shell color – Brown, Ear lobes – Red, Shank - Clean and White, Skin – White, Comb shape - Single (except Cornish with pea comb). Eg: Australorp, Cornish, Dorking, Orpington and Sussex

Mediterranean Class: Body size – Small, Egg- type, non-broody, Egg shell color – White, Ear lobes – White, Shanks - Clean and yellow/slate colored, Skin -Yellow or White. Eg: Leghorn, Minorca, Ancona, Andalusian

CHICKEN BREEDS BASED ON UTILITY

1. Egg-type: Leghorn
2. Meat-type: Cornish, Plymouth Rock
3. Dual purpose: Rhode Island Red, New Hampshire
4. Game type: Aseel
5. Fancy variety or Exhibition - type: Silky, Frizzled, Bantams
6. Desi type: Kadaknath, Naked neck, Chittagong

IMPORTANT INDIAN CHICKEN BREEDS

ASEEL OR INDIAN GAME

- Class: Asiatic. The literal meaning of *Aseel* is real or pure.
- Aseel is well known for its pugnacity, high stamina, and majestic gait and dogged fighting qualities. The name *Aseel* appears to have been given to this indigenous breed because of its inherent qualities of fighting. The remarkable endurance of an Aseel even during the most critical stages of fight is proverbial as it prefers death to dishonor. The Aseel is, therefore, known to every game lovers all over the world for these specific characteristics.
- Aseel produce plenty of well flavored meat, but not good layers. Andhra Pradesh is said to be the home of this important breed. The best specimen of this breed, although rare, are encountered with the fanciers and the people engaged in cock-fighting show throughout the country.
- Aseel is larger inbuilt with noble looking and dignified appearance. A good specimen of an Aseel cock usually measure 28 inches from back to toe. The standard weight varies from 4 to

5 kg for cocks and 3 to 4 kg for hens. The standard weight varies from 3.5 to 4.5 kg for cockerels and 2.5 to 3.5 kg for pullets.

- Comb: Small and Pea shaped. The wattles are rudimentary and almost imperceptible. The beak is short and well curved. The face is long and not covered with feathers. The eyes are compact, well set and present bold looks. The neck is long, uniformly thick but not fleshy.
- The general feathering is close, scanty and almost absent on the breast. The plumage has practically no fluff and the feathers are tough. The tail is small and the legs are strong, straight, and clean and set well apart. The birds as a rule present upright material gait suggestive of strength and alertness. Aseel is larger in built with noble looking and dignified appearance.
- Most popular varieties are: Peela (Golden red), Yakub (Black and red), Nurie (White), Kajal (Black), Chitta (Spotted blade and white), Jawa (Black), Teekar (Brown) Etc. Best are found in U.P. and Rajasthan.

Performance Profile

- Body weight at 20 weeks : 1220 g
- Age at sexual maturity : 196 days
- Annual egg production : 92
- Egg weight at 40 week : 50 g
- Fertility : 66 %
- Hatchability : 63 %

KADAKNATH

- Class: Asiatic.
- This breed is otherwise known as “Kalamasi” which means “fowl with black flesh” and is native of Madhya Pradesh. The color of the day old chicks is bluish to black with irregular dark stripes over the back. The adult plumage varies from silver to gold spangled to blue black without any spangling.
- The skin, beak, shank, toes and soles of feet of males and females are dark gray color. Even the comb: Single, wattles and tongue also show a purplish hue. The shining blue tinge of the earlobes add to its unique features. Mostly found in tribal area of Jhabua and Dhar districts of M.P.
- The peculiarity of this breed is that most of the internal organs show the characteristic black pigmentation which is more pronounced in trachea, thoracic and abdominal air sacs, gonads, elastic arteries, nerves, tendons, at the base of the heart and mesentery. Varying degree of blackish coloration is also found in the skeletal muscles, tendons, nerves, meninges, brain and bone marrow. The black color of muscles and tissues is due to the deposition of melanin pigment, a genetic condition called "Fibromelanosis".

Performance Profile

- Adult Cock : 1.5 kg, Adult Female : 1.0 kg
- Body weight at 20 weeks : 920 g
- Age at sexual maturity (days) :180
- Annual egg production (number) : 105 (Medium)
- Egg weight at 40 week : 49 g (Brown color)
- Fertility : 55%
- Hatchability : 52%

IMPORTANT EXOTIC CHICKEN BREEDS

WHITE LEGHORN

- Class: Mediterranean. Origin: Italy, Out of total 12 varieties of leghorn, White leghorn is highly reputed as large, white egg producer.
- Type: Egg type. Popular as layer because of small body size, less feed and space for maintenance.
- Comb: Single, Medium (Males – Erect with 5 points, Female – First point erect remaining of comb drop on one side.)
- It is the world's no-1 egg producer. It has small, oval and compact body. It has relatively long neck, prominent breast and long shanks. All varieties have yellow beaks, skin, shanks and Toes. Plumage may be white, dark and brown or light Brown.

Performance Profile

- Cock – 2.4 - 2.7 kg, Hen – 1.8 – 2.3 kg
- Cockerels weigh 2.7–2.95 kg and pullets 2–2.25 kg
- Annual hen-housed egg production per bird - 290-320 eggs. (Avg. – 55 g, White color)

RHODE ISLAND RED

- Class: American. Origin: Rhode Island in New England after crossing with the Red Malay Game, Jawa and Asiatic black red fowls of Shanghai. No breed has become so popular in short time as RIR.
- Type: Dual purpose. Comb: Single. It was developed from, Malay and Jawa types, bred on farm of Rhode Island. Long rectangular body, Plumage color – rich brownish red, sometime black color on lower webs of the primaries. The upper web of secondary are partly black but sickle and main tail feathers are black. Back is flat and the breast is carried well forward. The plumages is rich dark or brownish red in color. Skin and shanks are yellow and the earlobes are red. Several breeders have tried to develop egg laying strains of this breed.

Performance Profile

- Cock – 3.8 kg, Hen – 2.9 kg
- Annual egg production: 225 to 260 eggs hen housed per bird (Brown color).

UNIT – 9 FORMATION OF EGG

A hen requires about 24 to 26 hours to produce an egg. After the egg is laid, the hen starts all over again about 30 minutes later. The hen's reproductive system consists of the ovary, the organ where the yolk develops, and the oviduct (infundibulum, magnum, isthmus, uterus also called as shell gland and vagina) where the egg is completed.

Parts of an Egg

Yolk: This is the most obvious part of the egg contents—the yellow part near the center (34% of total egg).

Albumen: This is the clear part we call the egg white. It's called this because it turns white when cooked. There are two layers of albumen: thick (inner thick also known as chalaza and outer thick) and thin (inner thin and outer thin) (55% of total egg).

Chalaza: Located in the thick albumen, chalaza is simply albumen that is twisted tightly. It is also called as inner thick albumen. It keeps the yolk in the middle of the egg and prevents it from sticking to the inside of the shell.

Shell membranes: The egg contents are surrounded by two thin membranes called the inner and outer shell membranes. (Shell + Shell membranes = 11% of total egg). **Shell:** This is the outer covering of the egg holding everything together.

Yolk (Ova) formation

Formation of egg inside hen starts with yolk formation. The hen, unlike most animals, has only one functional ovary - the left one. The ovarian tissue appears as a cluster of tiny ova or yolks. At the time of hatching, the female chick has up to 4000 tiny ova (reproductive cells), from some of which full-sized yolks may develop in follicle when the hen matures. During the early stages of yolk formation, the oocyte grow very slowly by gradual accumulation of light yolk.

The ovum (yolk) is enclosed in a thin membrane, called as 'Vitelline membrane'. The yolk and its Vitelline membrane are in turn enclosed in a highly vascular coat of connective tissue termed as 'The follicle' attached to the ovary. Food material is carried to the developing ovum by blood circulation in the follicle.

Each yolk grows very slowly for about 10 days before it is ready to leave the ovary. When a diameter of about 6 mm is reached, a few ova start to grow at an enormously increased rate. They add 4 mm to their diameter every 24 hours, until full size of about 40 mm is reached. It is during the period of rapid growth that the concentric layers of light and dark yolk are formed. The thickness of each layer of light and dark layers representing the growth in a 24 hours period, from 1.5 to 2 mm. The visible white and yellow bands result from periodic deposition of different amounts of carotenoid pigment. The size of the yolk influence the size of finished egg.

Ovulation

When the yolk has reached maturity, the follicle ruptures along a definite line, **the stigma**, where there are normally no blood vessels. In most instances the ovum probably is discharged into the body cavity and is later engulfed by the funnel of the oviduct called as 'infundibulum', through repeated movement of the edge of the infundibulum over the surface of the ovum. Once yolk (ovum) is completely enclosed by infundibulum, it is transported to the oviduct.

If the yolk fails to get back in to the oviduct the bird is known as internal layer. In this case, the yolk may rupture and the liquid is reabsorbed into the circulation, leaving am abnormal deposit of yellow solids, or the yolk may dry up, leaving masses of caked egg yolk material in the body cavity.

Fertilisation

Fertilisation usually takes place shortly after ovulation in the funnel of oviduct, if the hen is mated, and the sperm cells have enough time to move to the funnel of the oviduct. Sperms will remain in the oviduct for 2-3 weeks after mating, but the newest sperms is the one most likely to fertilise egg. It is possible to fertilise egg within 24 hours after mating.

Since the sperm must penetrate the Vitelline membrane, which surround the yolk, in order to reach the germinal disc. The Vitelline membrane of freshly ovulated yolk will be about only 4 microns thick. But after short time in the oviduct, membrane become swollen and thickens, as a result of the contact with secretion of the oviduct. The complete Vitelline membrane of the yolk of laid egg is about 48 microns.

Embryo Development

The fertilised ovum starts cell division and embryo development soon after fertilisation. It continues during the period of about 24 hours when the egg remains in the oviduct. The germ spot or blastoderm increases in size and there is some change in the consistency of the white and yolk. Unless the fertile egg is held below 82^{o}F after it is laid, there will be further germ development. It is therefore desirable to produce infertile eggs at all-time except when they are not needed for hatching.

Secretion of Thick White

Immediately upon being grasped by mouth of the oviduct the ovum or yolk is forced through the oviduct by ciliary action or by peristaltic movements of the wall of oviduct to the magnum region. It requires about 3 hours to pass through this region. The inner surface of the magnum of the oviduct is lined with goblet cells that secrets albumen. At this region the yolk acquires the mass of firm white albumen, which makes up about one-half of the total white, by volume. Hens that lay eggs containing a relatively high percentage of thick white have more goblet cells. The thick white percentage tends to decrease from about April to July in most flocks.

Formation of Shell Membranes

The yolk, surrounded with its thick white, passes from the magnum to a short section of the oviduct known as the isthmus. Here two shell membranes (Inner and Outer) are added and the shape of the egg is determined. An isthmus of large diameter tends to result in thick round eggs while on of small diameter tends to result in long slender eggs. This membranes are so formed that it enclose the yolk and thick white loosely. They don't plump out until the egg receives its final quota of white in uterus.

Addition of Thin White and Shell

The developing egg passes from the isthmus into the uterus (also called as shell gland), where it remains for about 21 hours. The inner layer of thin white, between the inner thick white (chalaza) and outer layer of thick white, becomes apparent while the egg is in the uterus as a result of the albumen rotating around the yolk and due to addition of water and a mineral solution consist largely of sodium, calcium and potassium. The inner and outer layers of thin white each comprise about 20-25% of the total white.

In addition to the formation of inner and outer layers of thin white, the uterine glands also secrets material for shell, consisting largely of calcium carbonate. Calcium carbonate is carried to the uterus by the blood circulation. The calcium level in blood is nearly double at the lying stage. High temperatures always tends to reduce shell thickness.

Only if mating is done of hen, than and then there will be fertilisation and embryo development, otherwise procedure of egg formation will remain same in layers also (which are kept for production of infertile eggs for human consumption).

A laying hen can produce eggs for a number of years, but it is only economical to keep layers for age up to 18 months (72 weeks). Egg production starts at age of 22 weeks, rises sharply reaching peak at about 32-35 weeks than gradually declines at rate of 0.5% per week. Thus it is not advisable to keep layers for more than 72 weeks. Egg production is divided is three phases.

Phase – 1: From 22 weeks to 42 weeks, egg weight increases from 36 Gms to 58 Gms.

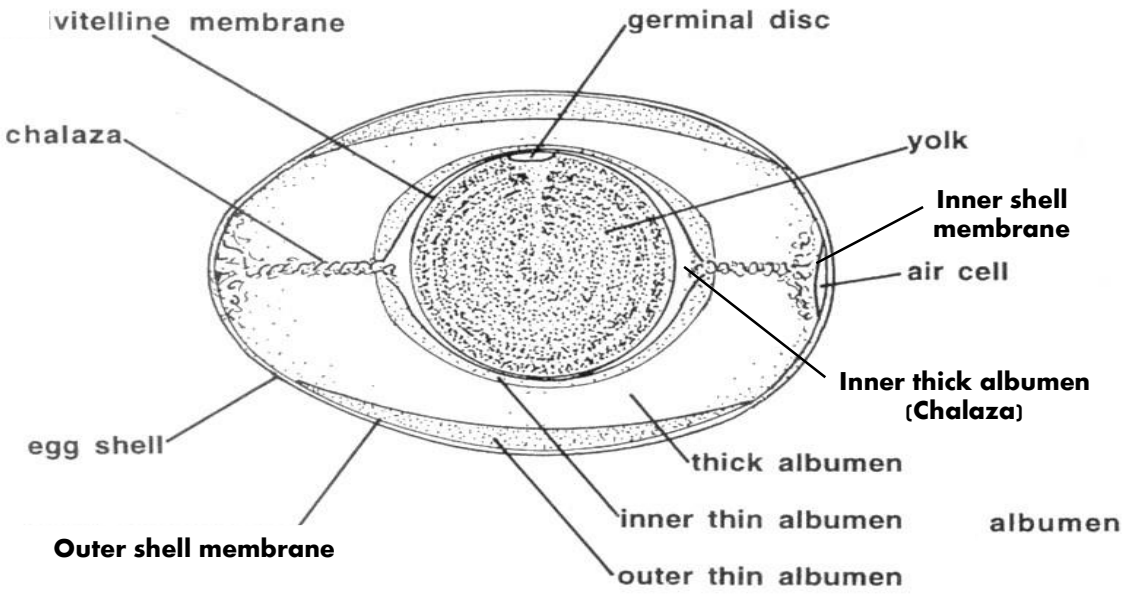
Phase – 2: From 43rd week to 62nd week, egg production declines to 65%.

Phase – 3: From 62nd week to 72nd week, egg production is less than 65%.

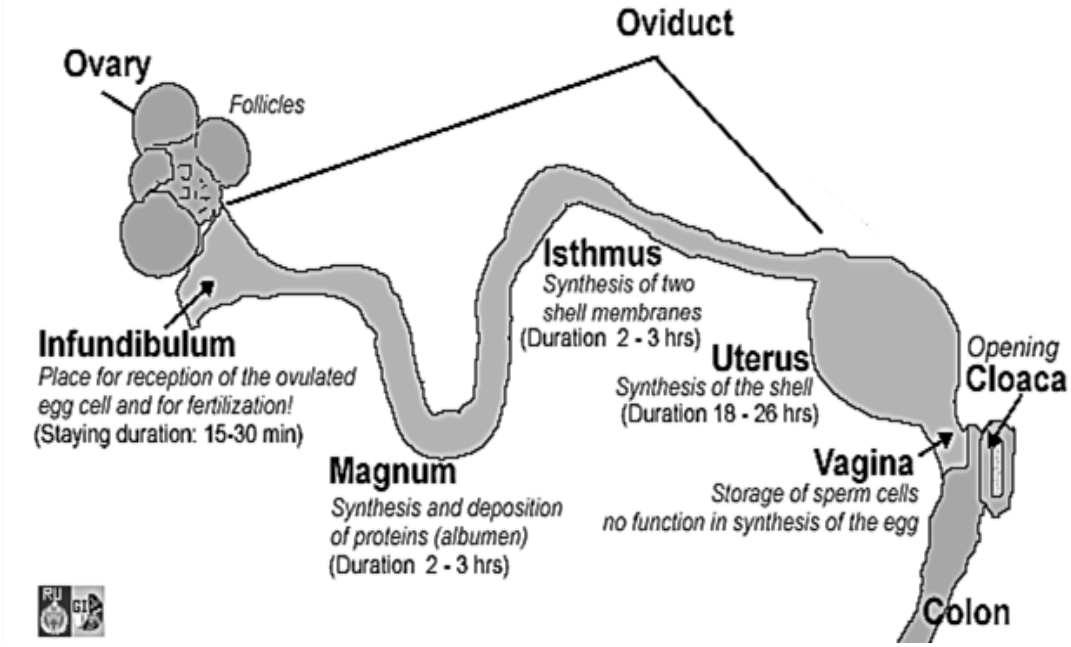
Generally a hen will give egg continuously for 4-5 days after there will be rest for 1-2 days and again this will be repeated. Number of eggs given by a hen continuously without rest is call as clutch, for example if a hen gives 5 egg continuously for 5 days than clutch size is five.

Section of oviduct	Approximate time egg spends in this section	Functions of section of oviduct
Ovary		Yolk formation in follicle
Funnel (infundibulum)	15 minutes	Receives yolk from ovary. If live sperm present, fertilisation occurs here (commercially produced table eggs are not fertilised)
Magnum	3 hours	Albumen (white) is secreted and layered around
Isthmus	1 hour	Inner and outer shell membranes are added, as are some water and mineral salts
Shell gland (uterus)	21 hours	Initially some water is added, making the inner and outer albumen thin. Then the shell material (mainly calcium carbonate) is added. Pigments may also be added to make the shell brown in some breeds.
Vagina / cloaca	less than 1 minute	Till now egg is formed with its narrow end towards vagina. But here egg is turned and egg is deposited with its broader egg will come first. Secretion of cuticle for easy egg deposition.

ANATOMY OF CHCKEN EGG



HEN REPRODUCTIVE SYSTEM



UNIT – 10 IMPROVEMENT OF POULTRY

In modern poultry farm, successful management relies on accurate and complete daily record keeping. Some of the traits may influence the profit of farm, thereby affecting the economics of the farm hence they are called as Economic Traits. Improvement in these traits would increase profit of the farm. Some of the economic traits are as follow:

EGG TYPE CHICKEN

1. Egg Production

Egg production is result of many genes. With appropriate environmental conditions (nutrition, light, ambient temperature, water, free from disease etc.), the many genes controlling all the processes associated with egg production can act to allow the chicken to fully express its genetic potential. Egg production is influenced by five factors: Age at sexual maturity, Intensity of production or rate of laying, broodiness, clutch size and pauses in laying and persistence of production. The egg production is measured by

Hen-Housed Egg Production per bird

$$HHEP = \frac{\text{Total number of eggs laid}}{\text{Total number of hens housed at the beginning of laying period}}$$

Hen-Housed Egg Production percent (HHEP)

$$\text{HHEP} = \frac{\text{Total number of eggs laid on a day} \times 100}{\text{Total number of hens housed at the beginning of laying period}}$$

Hen day egg production per bird

$$\text{HDEP} = \frac{\text{Total number of eggs produced on a day} \times 100}{\text{Average hen days}}$$

Hen day egg production percent (HDEP)

$$\text{HDEP} = \frac{\text{Total number of eggs produced on a day} \times 100}{\text{Total number of hens present on that day}}$$

Average Hen Days

$$= \frac{\text{Total hen days} \times 100}{\text{Number of days}}$$

Egg production is a lowly heritable trait. To produce hybrid cross having good egg production with egg weight, one of the parent lines (usually female) is selected exclusively for egg numbers and other line is selected for both egg weight and egg production. **i) Age at sexual maturity (ASM)**

It is defined as the age in days when the bird laid its first egg. In chicken it is about 150 days. Very early maturity is not desirable as it result in small eggs, uterine prolapse and other complications. While late maturity cause less numbers of egg. This is reason in growers / pullets restricting feeding and lighting is practiced to prevent early maturity. ASM is moderately heritable trait ranging 0.15-0.25.

ii) Intensity of laying (rate of lay)

This is important for annual egg record. This is the ability of birds to lay at a high rate at any given point or a period of time. Birds with high intensity of lay, produce more numbers of eggs per clutch and are better layer then layers with fewer eggs per clutch. It is also less heritable trait.

$$\text{Rate of lay (\%)} = \frac{\text{Total number of eggs produced up to that day or age} \times 100}{\text{Total Numbers of days or age that day}}$$

iii) Broodiness

When the bird is in brooding they are not laying. Hence, a minimum of broodiness is desired. Mediterranean breeds like white leghorn, Minorca, Ancona are non-broody, while Asiatic heavy breeds are very broody. English and American breeds are intermediate in broodiness. The trait is highly heritable so can be eliminated by selection. Broodiness has high negative correlation with egg production. Modern commercial laying strains are avoid of this character. However broodiness and mothering ability is desirable for backyard poultry farming.

iv) Persistency

It is measure of length of lay year. The laying is terminated at 72 weeks, called as laying cycle or biological cycle. After that the bird will enter into moulting, replacing old feathers with new ones. In commercial farming, birds are culled after first biological cycle as they are uneconomical. The good layer moult late and rapid, while poor layer moult early with slow feathering.

Fecundity, termed as total numbers of eggs produced in a period of time regardless other characters like egg size, hatchability etc. In practice is considered as pullet year. **v) Clutch size and pause**

The numbers of eggs laid in sequence without any break is called as clutch size. After giving 5-7 eggs in continuation, bird will take break for one or two days before entering in next clutch. In good layer, clutch size is big with less clutch interval. When the break interval is long, it is considered as pause. Pause is not desirable in layers. The bird may pause egg production in extreme winter and summer. Selection for high annual egg production eliminate this character from the flock. The low producers and *desi* birds usually have frequent pauses, during these pauses they exhibit maternal character or broodiness.

2. Egg size

It is measured in terms of egg weight. There is direct relationship between body size of bird and egg size. Eggs are smaller in beginning of laying than gradually increase in size for 6 to 7 months. The egg weight varies from 40 to 60 grams according to breeds, strains and lines. Heritability of the trait is 50%. So improvement can be bought easily by selection. However it has strong negative correlation with egg numbers so selection must be careful in breeding program. In cross breeding, pressure of egg weight is given to male line.

3. Egg colour

The Mediterranean class chickens lay white eggs while other class of chicken lay brown eggs. The cross between them will produce tinted or light brown shell colour. Shell colour in Andalusian chicken is blue. To evolve a white egg layer, the common breed used is White Leghorn. For brown eggs, breeds like RIR, Plymouth Rock and New Hampshire is used.

4. Feed Efficiency (Feed Conversion Ration = FCR)

In commercial layers, FCR of per kilogram egg mass and of a dozen egg is around 2.53 and 1.70 respectively. Measuring feed intake per bird is difficult so selection for breeding on this basis is impractical. Both egg production and egg weight have high positive correlation with feed efficiency. So selection on these traits will improves feed efficiency.

5. Body weight

The body weight at maturity (20 weeks) as well as of adult (40 weeks) are of significance in layer breeding. The optimum mature and adult body weights for medium egg type layer are 1.2 and 1.6 respectively. Selection of population for breeding for egg weight tends to increase body weight of future generations as they are positively correlated. Restricted selection index is used to check any untoward change in body weight.

6. Egg Quality Traits

Egg quality characters like shell thickness, albumen index, haugh unit and blood / meat spots are lowly heritable traits. So they are not included is selection program also. Shell thickness is the only trait having economic importance and is negatively correlated with egg weight.

7. Viability

Most serious problem in layer farming is the mortality among pullets. Both genetic defects and infectious diseases cause this. Gross genetic defects are usually eliminated. However, efforts are required for breeding and selection of strain resistance to diseases. Mortality in case of growers 5% and in growers / pullets 3% is allowable. In layer stage, mortality rate 1% per month is permissible.

$$\text{Mortality (\%)} = \frac{\text{Numbers of chicks died} \times 100}{\text{Total Numbers chicks born}}$$

8. Fertility and Hatchability

It is difficult to distinguish between low fertility and high incidence of embryonic death. Therefore, fertility and hatchability of fertile eggs are usually considered to gather as hatchability of eggs. Heritability of both traits is low.

$$\text{Fertility (\%)} = \frac{\text{Numbers of fertile eggs} \times 100}{\text{Total Numbers of eggs set}}$$

$$\text{Hatchability (\%) (TES)} = \frac{\text{Numbers of chicks hatched} \times 100}{\text{Total Numbers eggs set}}$$

$$\text{Hatchability (\%) (FES)} = \frac{\text{Numbers of chicks hatched} \times 100}{\text{Total Numbers fertile eggs set}}$$

9. Sex-linked dwarfism

Dwarfism, which cause an animal to be smaller in size is common in chicken. Hens that carry the sex-linked dwarf genes are about $1/3^{rd}$ smaller than normal birds, but their egg size is 8% smaller. In these types of layers, there will be lower body maintenance requirement and increase feed efficiency.

MEAT TYPE CHICKEN

In broilers, most importance trait is body weight at market age or birth weight. Other traits are body conformation and hatching egg production in parent (breeder) line. In broiler breeding, the female line should be one which produces high numbers of chick. Compared to layer, broiler breeding much easier because selection for reproduction can be done at early as 6 weeks of age.

1. Body Weight

It is most important trait in broiler production, and it is highly heritable at marketing age. Therefore, it is relatively easy to make genetically improvement in broiler by individual selection. It is positively correlated to body conformation, feeding efficiency and dressing loss. Hence if growth rate is improved other carcass quality characters also improve. However, body weight is negatively correlated with egg production.

2. Feed Efficiency

In modern commercial farming, a feed efficiency of 1.6 – 1.8 is achieved at 6^{th} week. Measurement of individual feed efficiency is difficult to measure so it is not included in selection program. Selection for growth rate automatically increase feed efficiency as they are highly positively correlated.

$$\text{Feed Efficiency (FCR)} = \frac{\text{Amount of feed consumed in a period}}{\text{Total body weight gain in that period}} \times 100$$

3. Meat yield

It is expressed as carcass yield or dressing percentage, yield of specific carcass parts and yield of specific tissue such as lean, fat, skin and bone. Meat quality can be expressed by several methods: by carcass confirmation or grade, sensory evaluation or flavor, juiciness and tenderness of cooked carcass or its parts and by chemical composition of the carcass to determine the amount or proportions of protein, fat, ash, moisture.

$$\text{Dressing Percentage} = \frac{\text{Dressed weight}}{\text{Pre-slaughter live weight}} \times 100$$

4. Viability

In commercial broiler farming, under standard management, mortality rates of 3% and 2% is allowed at starter (0-3 weeks) and finisher (4-6 weeks) phase respectively. Mortality in broilers involve diseases like pullorum, coccidiosis and New Castle Disease.

5. Body Conformation

It includes breast angle, keel length, shank length, breast meat yield, abdominal fat percentage, overall appearance etc. This trait improves when the stock is selected for body weight as both are positively correlated. The ideal meat bird is having plump body with a long, broad and heavily fleshed breast. The back must be broad with minimal fat. If breast is low in fat, it fetches high price than other meat cut. So breeders are selected with higher % of breast muscle yield.

6. Skin colour

The skin colour is inherited where white colour is dominant on yellow colour. The common breeds used in evolving commercial broilers such as Cornish, Ply Mouth Rock and New Hampshire are yellow skinned. So developing a yellow skinned broiler is simple. For developing white skinned broiler, Sussex breed can be used in breeding program.

7. Plumage colour

Both melanin and carotenoids contribute to plumage colour, but it is melanin that determine plumage colour and pattern in domestic fowl. Coloured plumage had disadvantage because pin feathers and filo plumes give unpleasing appearance to dressed carcass. Pin feathers of white plumage bend well with carcass colour. Pin feathers are feathers which are early stage of its growth and yet to erupt out from their follicle.

8. Rate of Feathering

Slow feathering birds have large numbers of pin feathers. Early feathering is one of the desirable characteristic in broiler avoiding problems of pin feathers at time of processing. Rate of feathering is inherited by sex-linked dominance in which slow feathering is dominant over fast feathering. Making all lines involved in crossing as homozygous recessive for rate of feathering can ensure this character in all the progenies.

9. Fertility and Hatchability

All reproductive characters like fertility and hatchability are low heritable. Both these traits are less important to broiler as these are negatively correlated with body weight. English breed Cornish is the common male line in broiler breeding. Though this breed is good in body conformation characters, reproductive traits are lowest in it. Therefore special attention has to be given to improve fertility in breeding programmes.

UNIT – 11 DIGESTIVE SYSTEM OF CHICKEN

A bird have digestive system similar to simple stomach animal. Very little digestion take place by bacterial action and poultry can digest small amount of fiber than other farm animals. It includes mouth, esophagus, crop, proventiculus, gizzard, duodenum, small intestine, caeca, large intestine and cloaca.

Mouth part

There is absence of lips and teeth. These parts are replaced by a horny mandible on each jaw, forming a beak. The tongue is shaped like barbed head on an arrow with point directed forward. The barb like projection serve the purpose of forcing grain in esophagus when tongue is moved from front to back. The amount of saliva is less.

Esophagus

It is also known as gullet, is distinguished by its enormous expansibility. Food passes from the mouth through esophagus to crop and onwards.

Crop

The crop is an enlargement of esophagus. It is used for storing and softening of food. Food is gradually sent forward in tract as per need by contractions of crop muscles.

Proventiculus

Two or three inches beyond the crop, an enlarged muscular portion of the esophagus will be seen with ½ to ¾ inch in diameter and 1.25 to 2 inches in length. This is proventiculus which receives food from crop. On the inner surface of this, there are openings of glands which secrets gastric juices and some acids. This liquids mixes with food and further soften it. This glandular stomach does not appreciably detain food for long time.

Gizzard

The gizzard is heavily muscled, reddish-green colour and located just after proventiculus. Some gastric digestion occurs in gizzard, but this organ act chiefly for crushing and grinding of food. It is the largest single organ in body. It is composed of two pairs of thick powerful muscles covered internally with thick epithelium. It also act as filter. Only fine material will enter the

duodenum in about one minute of ingestion of feed by a fowl, while coarse material is retained much longer to be ground.

Duodenum

It is a part of small intestine which forms a fold immediately after the digestive canal leaves the gizzard, this loop is called duodenum which supports pancreas. Gastric and Pancreatic digestion occurs here.

Pancreas

Placed between fold of duodenum, it is longer in fowl as compare to other mammals. It secrets a fluid known as pancreatic juice, which contains proteolytic, amylolytic and lipolkytic enzymes. Pancreatic juice empties in duodenum.

Liver

This is a large, lobed, dark red organ. It is somewhat flat. It is the largest gland of body which secrets bile. Two ducts each from one lobe transport bile from liver to end part of duodenum. One duct from right lobe is enlarged to form gall bladder which store the bile temporary. Both ducts enter the duodenum together. The gall bladder can be easily identified by its green colour. Bile aids in digestion of fat.

Spleen

This round reddish body is found neat liver. It is usually 0.25 to 0.5 inch in diameter. Its function is little known.

Small Intestine

It makes up digestive tract from gizzard to the caeca. It is about 2.5 feet long in mature bird. The inner surface is lined with mature villi, which can be seen easily. Besides its digestive function, the small intestine also act as an organ of absorption of nutrients.

Caeca

At the junction of small and large intestine, are two blind sacs 5-7 inches in length. These open into small intestine as on end. They act for temporary storage of fecal material, absorption and aids in digestion of fiber.

Large Intestine

It lies between junction of caeca and short in length, extends up to the exterior opening of cloaca. Main function of it is absorption by small villi present in it. (In mammals, villis are absent)

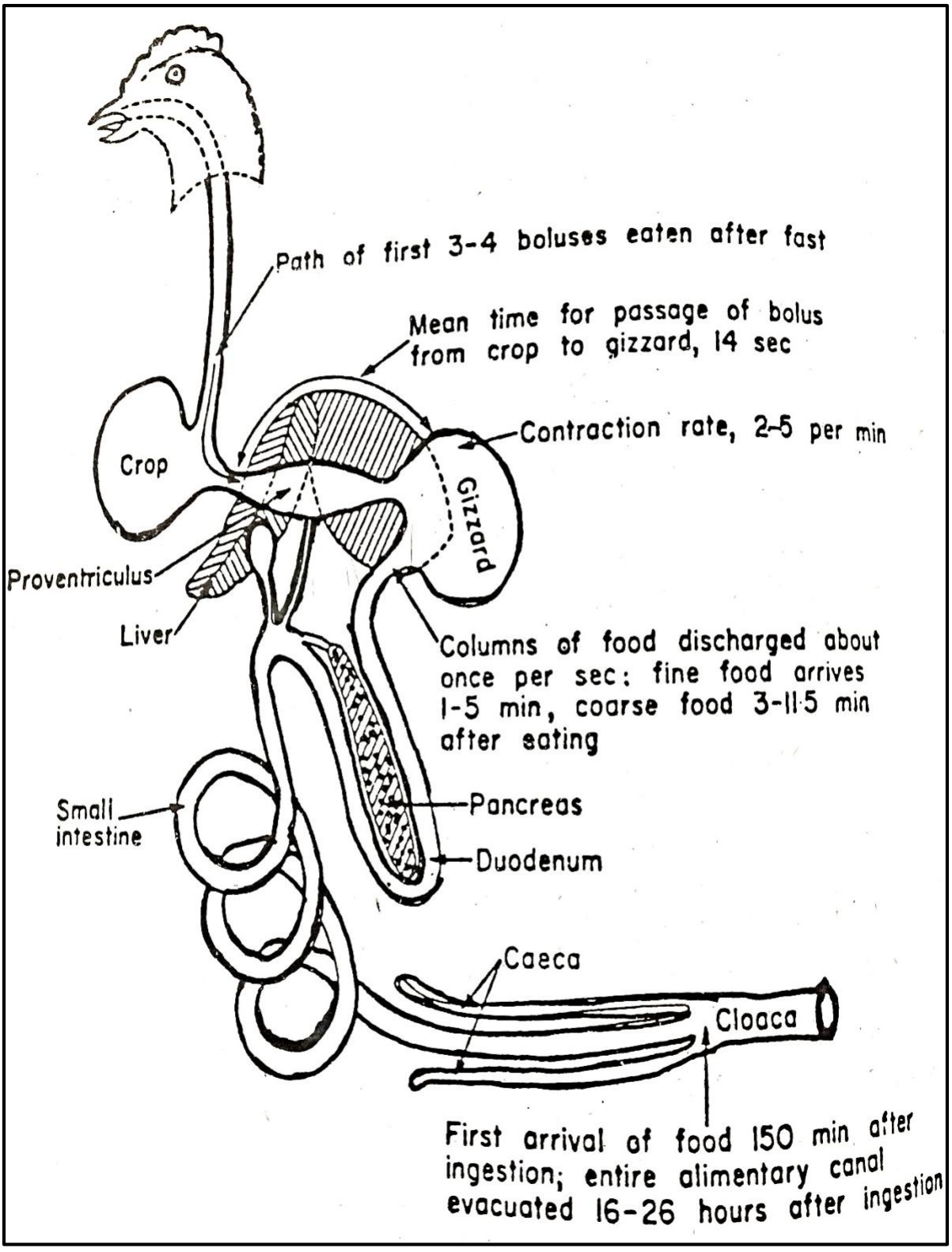
Cloaca

Faecal material from the rectum and urine from the kidneys pass into this organ. The materials are mixed and excreted through the vent.

Urinary System

From each kidney, urine in form of white pasty material passes through ureters to the cloaca, and voided from vent with faecal material.

DIGESTIVE SYSTEM OF CHICKEN



UNIT – 12 REPRODUCTIVE SYSTEM OF CHICKEN

MALE

REPRODUCTIVE SYSTEM

Male reproductive system produces male reproductive cells (spermatozoa) and hormone which influence sex characters. Male reproductive system in chicken consists of testes, vas deferens, and papillae or rudimentary copulatory organs.

Testes

The testes are two small ovoid organs situated at interior end of the kidneys. The left testes is usually larger than right one. Each testes consist of seminiferous tubules in which spermatozoa are produced. The spermatozoa then carried out of testes by seminal fluid, which is also produced in the testes.

Vas Deferens

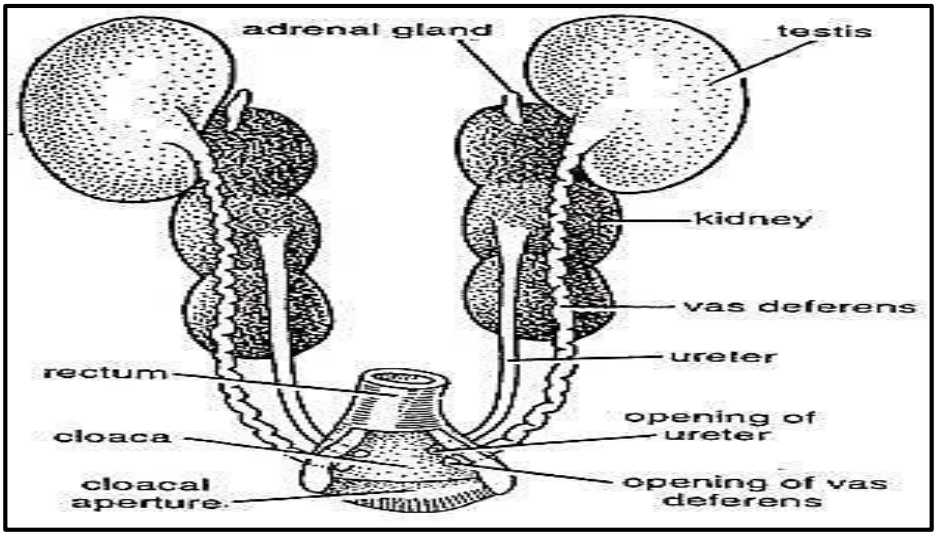
The vas deferens are the two tubes carries spermatozoa and seminal fluid from testes to cloaca.

Papillae

This is rudimentary copulatory organ of the male located in fold of cloaca. At the time of mating, sperm is introduced by papillae in to female reproductive system.

Cloaca

The enlarged section of digestive tract that connects large intestine and vent is called cloaca. The vent is external opening of cloaca. Sperms from testes, faecal material from large intestine and urine from kidneys all pass through the cloaca and eliminated.



FEMALE REPRODUCTIVE SYSTEM

The female reproductive system of fowl differs from mammals. The female reproductive cell, is known as ovum or egg or yolk in fowl produced mainly by food nutrients. Female reproductive

system in chicken consists of primary sex organ – Ovary and secondary sex organ – oviduct with five parts of it (Infundibulum, Magnum, Isthmus, Uterus and Vagina).

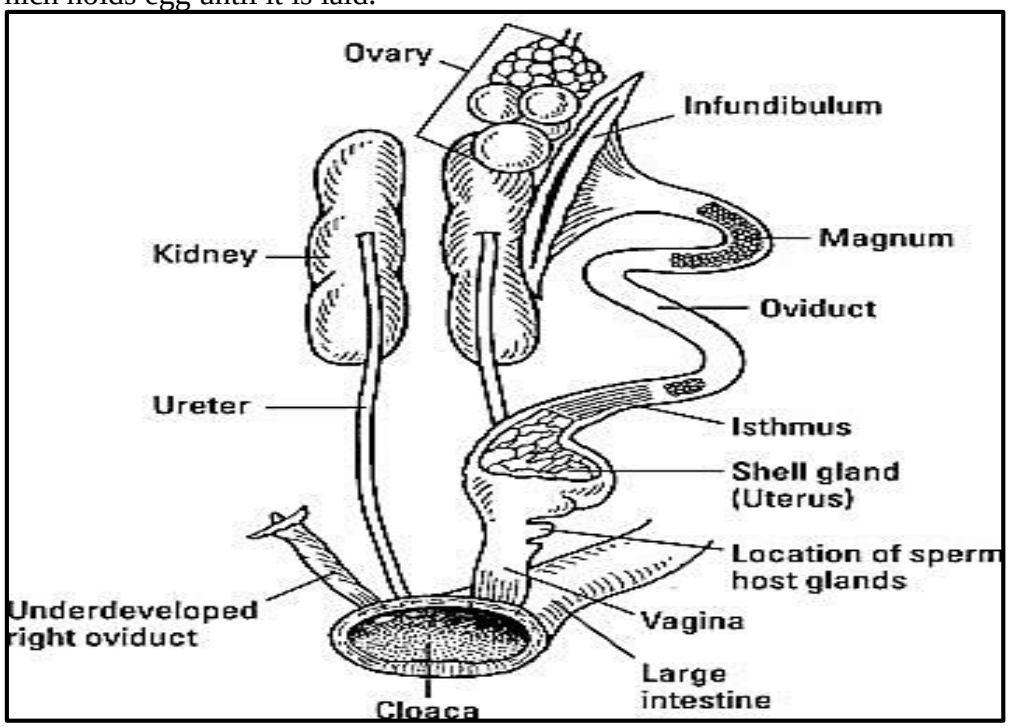
Ovary

At hatching time the female chick has two ovaries and two oviduct. Normally, only one the left one develops, the right one remains only functionless rudiment. In very few cases, both are functional but it is very rare.

The functional ovary appears as a cluster of spheres (ovum / yolk), each is independently attached by stalk. Each sphere is more or less developed ovum or yolk enclosed in thin membrane called as follicle. The yolk vary in colour from pale straw to deep reddish-yellow or orange. Each yolk contains a germinal disc, from which the embryo develops if mating done. In a hen in laying stage, 900 to 3600 ova have been counted. Many are so small that they cannot be seen by naked eye.

Oviduct

In female it corresponds to vas deferens of male. In laying hen it is large, coiled tube which occupies much of the left side of abdominal cavity. It is covered with blood vessels. It is divided in five regions: **1.** The funnel or infundibulum, which receives yolk from the ovary, **2.** The magnum, which secrets thick or white albumen, **3.** The isthmus, which secrets the two shell membranes, **4.** The uterus, which secrets the thin white albumen, shell and shell pigments, **5.** The vagina, which holds egg until it is laid.



UNIT – 13 FEED INGREDIENTS AND ADDITIVES FOR CHICKEN

POULTRY NUTRITON

Nutrition is a process by which food is transmitted in to nutrients which are transported to the cell of the body. It involves ingestion, digestion of food, absorption of nutrients, and transport of nutrients to the cells and elimination of undigested food.

PRINCIPLES OF POULTRY FEEDING

Food cost only comprise 60-65% of total cost of production. So it is in the interest of each poultry farmer that they get much chicken meat and egg on every rupee he spends on food. The problems in poultry feeding now a days because of farm conditions are: increased cost of raw feed ingredients, confinement of birds, and inclusion of agro industry by products, increased flock size and high density.

While computing ration for poultry, following points must be considered

1. They don't have teeth, so ration must be grinded / concentrated.
2. Digestive system is simple and short, digestion is quite rapid. It takes only 2 and half hour for food to go from mouth to cloaca in laying hens, while 10 hours in non-laying hens. So nutrition requirement of bird must be full filled.
3. Poultry completely depends upon the dietary source of some nutrients, such as all essential amino acids, Vitamin – B complex etc.
4. Birds are not fed individually.
5. Due to high rate of metabolism, poultry require more exact ration.

NUTRIENTS REQUIRED 1. Water

Water is essential for metabolic activities, transport of other nutrients and elimination of waste material. Water makes 85% of day old chick, 55% in mature chicken (42 weeks). Water content of egg is 65%. Ordinary, chicken consume 2 to 2.5 grams of water each gram of feed consumed during chick and grower stage, while 1.5 to 5 grams of water each gram of feed in laying stage. A good poultry ration does not contain water (moisture) more than 10%. Clean drinking water must be supplied.

2. Proteins

Poultry product high content of protein. On dry basis, the carcass of 8 week old broiler contains more than 65% protein and egg about 50% protein. Broiler ration contains 22 – 24% protein and layer ration about 16-17% ration. Amino acids that make protein are more essential nutrients rather than protein. In chicken, there are twelve essential amino acids (which cannot be synthesized in body, must be there in feed) are there. Essential amino acids such as lysine, methionine, arginine, glycine and tryptophan are referred as 'critical amino acids', because they are usually deficient in ordinary poultry ration. This is because cereal grains which are low in these critical amino acids contents makes large part of poultry feed. So it is thus must to include a good proportion of animal protein like fish meal etc. in poultry ration.

3. Carbohydrates

Main function of it is to provide energy. The polysaccharides of main importance are starch, cellulose, pentons and several others. Cellulose is undigestible due to simple stomach. Cereal grains and their byproducts are rich in starch and make large part of ration.

4. Fats

Fat makes 40% of dry egg and 17% of dry carcass. Although fats provide high energy (2.25 times more energy than CHO and protein), but due to high cost and rancidity true fats and oils are less included in ration. Most feed ingredients contain 2-5% fat and is enough for the inclusion of

essential fatty acid (Linoleic acid) in growing chicks for proper growth. Laying hens with diet deficient in linoleic acid will lay small egg which do not hatch well.

5. Minerals

The body of chicken contains 4% minerals and egg excluding shell contains 1%. Elements required for poultry are calcium, phosphorus, sodium, potassium, manganese, chlorine, iodine, copper, zinc etc. Usually grains and vegetable protein ingredients are low in minerals than animal origin protein. The common mineral supplements used in poultry feed are: Limestone, Bone meal, Oyster shell, Sodium Chloride, Dicalcium Phosphate (DCP), Super phosphate etc.

6. Vitamins

Main functions of vitamins are act as coenzyme and regulation of metabolism. 13 vitamins require by poultry are: A, D, E, K, B1, B2, B6, B12, Pantothenic acid, Nicotinic acid, Folic acid, Biotin, Choline. Apart from natural sources, commercial vitamin mixture is also added in ration. Diet deficient in any one vitamin for long time have different adverse effect on bird, egg and meat.

7. Feed Additives

These are group of ingredients which do not supply any nutrient directly but help the bird or product by indirect way are called as feed additives. E.g. Antioxidants, Flavoring agent, Pellet binder, Enzymes, Probiotics, Antibiotics, Hormones, Anti coccidial etc.

COMMON FEED ADDITIVES USED IN POULTRY RATION

ADDITIVES THAT PROMOTE FEED INTAKE OR SELECTION 1. Antioxidants

Feed with high fat content are prone to rancidity and produce oxidants. If birds each such feed, there will be digestive disturbance and other adverse effects. So antioxidants are added to protect birds from oxidants.

Antioxidants are compounds which prevent oxidative rancidity of fat. Rancidity causes destruction of Vitamins A, D, E and some B complex, decrease protein and energy content of feed. Commonly used antioxidants are: BHT, Ethoxyquin, BHA, and DPPD. They are added at 0.01% level.

2. Flavoring Agent

These increase palatability and feed intake. These are added at time of addition of medicine in feed, attack of disease, during stress etc. 'Poultry Nector' is added at 0.05% level.

3. Pellet binder

They are essential to bind all ingredients of pellet. Commonly used are: Sodium bentonite, Molasses, Guar meal etc. They are added at 2.5% level.

ADDITIVES THAT ENHANCE COLOUR OF PRODUCTS

Many consumers have miss understanding that broilers having a deep yellow coloured shank are of top quality. In egg also deep yellow colour yolk is considered highly desirable. So xanthophyll are routinely incorporated into broiler feed. Canthaxanthin at rate of 2-10 grams / tonne of feed to produce orange – yellow colour in shank and skin of broilers and of yolks in layers.

ADDITIVES THAT FACILITATE DIGESTION AND ABSORPTION 1. Grit

Due to lack of teeth, grinding of feed take place in gizzard. Grit is supplied in feed to enhance grinding inside gizzard. Oyster shell, limestone are common grits. Gravel and pebbles have been used as long lasting sources of grit.

2. Chelates

Chelating agents such as EDTA, are added to increase availability and absorption of certain minerals. In chicks, zinc absorption is enhanced by EDTA.

3. Enzymes

These are complex proteins which act as catalyst of different compounds. Generally enzymes produced by digestive tract is sufficient, but when there is high amount of barley, oats, wheat, rice bran and sunflower in feed then enzymes are added. Beta glucans present in barley and wheat interfere with activities of other digestive enzymes. Small concentration of beta glucans 0.75 to 1% can have adverse effect. The beta glucanase present in commercial enzyme additives breaks this beta glucans of feed and enhance digestibility. Cellulase of enzyme additives act on cellulose present in cereals and it's by products and improve availability of nutrients from these. Common enzyme preparations are: Agrozyme, Diazyme, Porzyme and Avizyme etc.

4. Probiotics

One of the most important additive used in poultry feed. Probiotics are culture of beneficial bacteria such as *Lactobacillus spp.* and *Streptococcus spp.* Feeding of these beneficial bacteria will increase their own population and population of other beneficial bacteria and reduce population of harmful bacteria such as *E.coli* inside the digestive tract, thus save birds from their toxins.

5. Antibiotics

These are substance which kill harmful pathogens. They are produced from living organism (molds, bacteria, green plant). It is observed that chickens fed with vegetable protein gain more weight when antibiotics 5-10 mg are added in feed. The mode modes of action are: Kill harmful pathogens, Increase feed / water intake, Inhibit growth of organisms which produce toxins, Improves digestion and absorption etc.

Normal level of inclusion are 4 grams per tonne of feed for narrow spectrum such as penicillin, streptomycin etc. For broad spectrum antibiotics such as tetramycines, auromycine are added 10 grams per tonnes.

ADDITIVES THAT ALTER METABOLISM 1. Hormones

Hormones are chemicals released by certain body parts and are transported to other parts for specific physiological response. Hormones are added in feed to alter metabolism result in increased egg and meat production. There are different categories of these.

i. Anabolic compounds: Progesterone and other steroids increase protein metabolism. ii. Estrogens: Diethylstilbestrol (DES) was injected in subcutaneous tissue of broiler to increase carcass tenderness. However, since hormone residues are found in egg and meat its use is prohibited. Dienestrol diacetate is only hormone permitted to be added in feed at level of 0.0023 to 0.0035% of feed for last 4-10 weeks. It must be discontinued 48 hours before slaughter. It must not be fed to layers and breeders. iii. Thyroxin and related compounds: It stimulates growth and egg production during later part of laying. They are given in form of iodinated casein at level of 100 to 200 grams per tonne of feed (110 to 220 mg / kg). A slight excess in dose induce moulting and reduce egg production.

ADDITIVES THAT ALTER HEALTH 1. Antifungal additives

They destroys fungi. It adversely affect feed intake and subsequent production. Once contaminated by fungi, they cause problems by production of toxins, chemical alteration of feed, alteration of metabolism etc. Production of aflatoxin produced by *Aspergillus spp.* Is carcinogenic (produces cancerous tumor).

Best method for controlling fungi is to dry feed at lower than 12% moisture. Mold inhibitors can be added in high moisture feed. Sodium propionate, Sodium benzonate, Acetic acid or copper sulphate etc. are added in feed to prevent growth of fungi / mold. Toxicity of aflatoxin contaminated feed can be reduced by irradiation of ultra violet light or exposed to anhydrous ammonia.

2. Anticoccidial (Coccidiostat)

These are the drugs which protects birds against coccidiosis caused by a protozoa known as coccidia. They generally live in the cells of intestinal lining of livestock. Eight species of coccidian affect chicken: *Eimeria tenella, E. necatrix, E. maxima* etc. Commonly used coccidiostat are: Embazin, Zonamix, Furazolidone, Amprol 25% etc.

3. Anthelmintic Drugs

Chickens are subject to infections of wide variety of internal and external parasite. They can be eliminated by using this drug. Four most common internal parasites are *Ascaris, Heterakis, Capillaria, Taenia.* Anthelmintics require more than one dose to be given to birds. First dose will kill those worms present inside body and subsequent deworming kills those new born worms hatched from eggs.

COMMONLY USED FEED INGREDIENTS FOR POULTRY RATION

Energy Feed (Cereals)	Protein Feed	Mineral and Vitamin Supplement	Feed Additives
Yellow maize	Groundnut cake	Bone meal	Probiotics
Oat	Cotton seed cake	Oyster shell	Coccidiostat
Bajra	Soyabean meal	Limestone	Enzymes
Ragi	Berseem meal	Vitamin Mixture	Antimicrobial
Vegetable oil	Fish meal	Mineral Mixture	Anthelmintic

Barley	Blood meal	Salt	Enzymes
Maize gluten meal	Meat meal	Manganese sulphate	
Molasses			
Rice			
Rice polish			
Wheat			

UNIT – 14 NUTRITION REQUIREMENT FOR CHICKEN

Nutrition requirement differs depending on the type and age of poultry as well as the purpose for which they are fed. In India, poultry requirement has been calculated by BIS (ISI), New Delhi. But many farmers and feed manufacturers still use requirement given by NRC – USA.

NUTRITION REQUIREMENT FOR LAYERS

While calculating ration, it may be safer to give 100% extra Vitamin – A & D and 50% extra for most of Vitamin – B and Minerals.

Nutrient	**Starting Chick**		**Growing Pullets**		**Laying Hens**		**Breeding Hens**	
	BSI	**NRC**	**BSI**	**NRC**	**BSI**	**NRC**	**BSI**	**NRC**
Moisture (%)	11	11	11	11	11	11	11	11
Metabolized energy (Kcal / kg)	2700	2900	2600	2900	2700	2850	2700	2850
Crude Protein (g / kg)	220 (22%)	180 (18%)	160 (16%)	150 (15%)	180 (18%)	150 (15%)	180 (18%)	150 (15%)
Crude Fiber (g / kg)	70 (7%)	-----	80 (8%)	-----	80 (8%)	-----	80 (8%)	-----
Ash (%)	4	4	4	4	4	4	4	4
Calcium (g / kg)	10	9	10	6	7.5	2	7.5	7.5
Phosphorus (g / kg) Avai.	5	-----	5	-----	5	-----	5	-----
Lysine (g / kg)	10	8.5	7	6	5	6	5	6

Methionine (g / kg)	3.5	3.2	2.5	2.9	2.5	5	2.5	5
Vitamin - A (IU / kg)	4000	1500	4000	1500	8000	4000	8000	4000
Vitamin – D (IU / kg)	600	200	600	200	1200	500	1200	500

Types of Poultry Feed: Mash, Crumbles and Pellets

NUTRITION REQUIREMENT FOR BROILERS

Broilers are generally reared in two phases: Starter (0 - 3 weeks) and Finisher (4 - 6 weeks). Some famers follow three phase: Pre-starter, Starter, and Finisher. Generally broilers are provided with *ad libitum* feeding.

Nutrient	**Starting broiler**		**Finisher broiler**		**Breeding broiler**
	BSI	**NRC**	**BSI**	**NRC**	**NRC**
Moisture (%)	11	11	11	11	11
Metabolized energy (Kcal / kg)	2900	3200	3000	3200	2850
Crude Protein (g / kg)	220 (22%)	230 (23%)	190 (19%)	200 (20%)	150 (15%)
Crude Fiber (g / kg)	60 (6%)	-----	60 (6%)	-----	-----
Ash (%)	4	4	4	4	4
Calcium (g / kg)	10	9	10	9	27.5
Phosphorus (g / kg) Avai.	5	-----	5	-----	-----
Lysine (g / kg)	9	12	9	10	6
Methionine (g / kg)	3.5	5.0	3.5	3.8	2.7
Vitamin – A (IU / kg)	6000	1500	6000	1500	4000
Vitamin – D (IU / kg)	600	200	600	200	500

COMMON FEED INGREDIENTS WITH ITS MAXIMUM INCLUSION LEVEL

Ingredients	Inclusion level %	Ingredients	Level of inclusion (%)
Maize	60	Rice .Polish	10-30
R.P (Deoiled)	10-20	Wheat Bran	10-15
Molasses	0-5	Animal & Veg. fat	10
Rice bran	10-20	D.O.R.B	10-20
G.N.C (deoiled)	20	G.N.C	40
Soya bean meal	40	Sesame meal	20
Linseed meal	04	Linseed meal	4
M.O.C	10	Fish meal	10
Meat meal	10	Meat & bone meal	05
Blood meal	03	Silk worm Pupae meal	6
Sunflower cake	10-20	Sorghum (Jower)	10-20
Bajra	10-20	Oats	10-20
Wheat	50	Lucerne meal	5
Maize gluten	0-10	Fat	2-3
Cotton seed cake	0-10	Salt	0.5%
Mineral mixture	2.0%	Lime stone	3.0 (layer)

UNIT – 15 IMPORTANT CHICKEN DISEASES AND PREVENTION

Prevention is better than cure. There are two types of losses occurs due to disease in poultry: Direct – Loss of bird, Indirect – Loss in production. The most important predisposing factors for occurrence of disease are: Faulty feeding practices, Poor ventilation, Lack on sanitation, Overcrowding, Stress etc.

WAYS OF DISEASE TRANSMISSION

1. EGG TRANSMISSION (EMBRYONIC)

Disease can be spread through embryo are: Adeno virus, Avian Encephalomyelitis, Chronic Respiration Disease, Egg Drop Syndrome, Salmonellosis Etc. Special care is required for breeders to prevent spread of these.

2. PREMISE CONTAMINATION

The pathogens of some disease are always present in bird environment. At chick stages, diseases like Gumboro disease (Infectious Bursal Disease, IBD), Marek's Disease and Salmonellosis can occur. Chicks reared on deep litter may become infected with coccidiosis. These infections can be prevented by vaccinations and proper management practices.

3. HATCHERY DISSEMINATION

Aspergillosis (Brooder Pneumonia) may originate from hatchery contaminated with *Aspergillus fumigatus*, the cause of disease. Aspergillosis also may spread from prolonged storage of bagged feed in humid climates. Staphylococcosis also can occur from same way.

4. RESPIRATORY OR AIR BORNE

Respiratory diseases are present in the respiratory tract and organisms are discharged into the air. Healthy birds can be infected by inhaling these organisms. Common respiratory disease are: Avian Influenza, Chronic Respiratory Disease, Infectious Bronchitis (IB), Laryngotracheitis, New Castle Disease (Ranikhet Disease). Respiratory disease spread very rapidly. To prevent this, there must be 100 meter distance between two houses in farm.

5. CARRIER DISEASE

In these diseases, organisms causing disease remain in healthy, recovered birds. These bird can transmit disease when they come in contact with non-infected birds. Carrier diseases like Fowl Cholera, Fowl Coryza, Salmonellosis, and Chronic Respiratory Disease can remain for lifelong in carrier state. The carrier state of Infectious bronchitis and Laryngotracheitis is more limited, remain only for 4 – 10 weeks.

6. VECTOR

A vectors is anything which serves to carry disease from one premise to another. Vectors are major importance of respiratory disease and external parasites such as mites. Important vectors are

a) **Man:** Contamination occurs in two ways. The agents of respiratory disease are present in air and contamination may occur on clothing, hand etc. The agents of other disease are present in drooping so contamination may occur on shoe or foot, Use of foot bath can prevent these disease.
b) **Contaminated Equipments:** Any equipment which circulates between farms such as feed sacks, egg cartons, bird crates etc. can transmit diseases.
c) **Others:** Mosquitoes are the sole source of new outbreaks of Fowl pox. Ticks transmit spirochaetosis. Free flying birds can transmit external parasites such as lice, mites etc.

7. CONTAMINATED FEED AND WATER

The most important disease in this group is mycotoxicosis due to formation of toxins in feed stuff, mainly in corn due to mold growth. Contamination of water with disease producing agents may occur with Fowl cholera and Fowl Coryza.

PREVENTION OF POULTRY DISEASES VACCINATION

Vaccination is most effective way to preventing specific disease by building immunity. Not all vaccines gives lifelong immunity, so it is important to know period of immunity, the age at which birds should be vaccinated, dosage, route of administration and storage condition of vaccine.

Types of vaccine available: Live vaccines with mild strain and killed or inactivated vaccines adjuvanated with oil emulsion to produce sustained higher antibody production are available.

METHODS OF VACCINATION Intranasal or Intraocular Method

Common method of vaccination in young chicks to give primary vaccine at every stage. The freeze dried, live attenuated vaccines are reconstructed with diluents and instill one or more drops either in nostrils or in eyes or in both is a common practice.

Intramuscular or Subcutaneous

In cage system, live vaccine such as RDVK and Fowl pox intended for subcutaneous or wing web method respectively, are to be administrated by intramuscular route. This facilitate easy administration, less handling and minimum stress to birds. In deep litter system, subcutaneous route is followed for vaccination.

Wing Web Method

To prevent Fowl Pox, vaccine is given through wing web puncture. 7 to days after vaccination, flock should be examined for 'takes', a swelling of skin or scab at the site where vaccine is applied and this is evidence of successful vaccination. Immunity will develop normally 10 to 14 days post vaccination.

Drinking Water

It is most easy and adopted method of vaccination. Drinking water in which vaccine is mixed should be free from disinfectant and water sanitizers. Dried skim milk powder if needed is added to protect vaccine. Water vaccination must be followed after sufficient withdrawal time.

Aerosol Spraying Method

To ease the vaccination procedure and induce less stress, this method is preferred. The spraying should be evenly distributed.

Compatibility of Vaccine with Medicines

Sometimes antibiotics are added with vaccine, however it is not advisable. The antibiotics may alter pH of vaccine and effect its potency. Combinations of vaccines also must be tested before they are used indiscriminately.

VACCINATION PROGRAM IN A POULTRY FARM

There are three common philosophies regarding timing of vaccination

1. High level of antibodies are produced in breeder hen. These maternal antibodies are transferred from hen to the chicks through yolk (passive immunity), so as to make chick vaccination programme to minimal.
2. Chick must be vaccinated, if breeder hen antibody levels are low.
3. *In ovo* vaccination (active acquired immunity prior to hatching).

Vaccination Schedule for Commercial Broilers

Sr. No.	Age in days	Type of Vaccine	Remarks
1	First day (Day old)	Marek's disease (at hatchery)	Subcutaneous (S/C) at neck at hatchery
2	5-7th day	RDVF/B1/LaSota (Ranikhet / New castle disease)	Occulonasal (I/O or I/N)
3	14 - 16 days	IBD Vaccine (Infectious Bursal Disease)	Intraocular (I/O)
4	24 - 26 day	IBD Vaccine (Booster)	Intraocular (I/O)
5	30th day	RD LaSota	Intraocular (I/O)

Vaccination Schedule for Commercial Layers

Sr. No.	Age in days	Type of Vaccine	Remarks
1	0 day	Marek's vaccine (Hatchery)	S/C at neck at hatchery
2	5 - 7 days	RDVF / B1 / LaSota (Ranikhet / New castle) disease)	Occulonasal (I/O or I/N)
3	14 - 16 days	IBD (Infectious Bursal Disease) vaccine (Intermediate / Killed)	Intraocular (I/O)
4	20th day	IB (Infectious bronchitis) vaccine	Intraocular (I/O) / Water
5	24 - 26 days	IBD vaccine (Intermediate)	Intraocular (I/O)
6	30th day	RD LaSota vaccine	Intraocular (I/O)
7	35 - 40 days	IBD vaccine (Intermediate)	Intraocular (I/O)
8	8th Week	RDVK / R2B	S/C or Intramuscular (I/M)
9	10th Week	Fowl Pox Vaccine	Intramuscular (I/M) / Wing Web
10	13th week	IB vaccine	Intraocular (I/O) / Water
11	18th Week	RDVK / R2B	S/C or Intramuscular (I/M)
12	After 30th Week	RDVK / R2B	S/C or Intramuscular (I/M)

Vaccination Schedule for Breeders

Sr. No.	Age in days	Type of Vaccine	Remarks
1	0 day	Marek's vaccine (Hatchery)	S/C at neck at hatchery
2	1st Day	IBH	Intraocular (I/O)
3	4th Day	Leechi - Inactivated	Sub cutaneous (S/C)
4	5 - 7 days	RDVF / B1 / LaSota (Ranikhet / New castle) disease)	Occulonasal (I/O or I/N)
5	14 - 16 days	IBD (Infectious Bursal Disease) vaccine (Intermediate / Killed)	Intraocular (I/O)
6	20th day	IB (Infectious bronchitis) vaccine	Intraocular (I/O) / Water
7	24 - 26 days	IBD vaccine (Intermediate)	Intraocular (I/O)
8	30th day	RD LaSota vaccine	Intraocular (I/O)
9	35 - 40 days	IBD vaccine (Intermediate)	Intraocular (I/O)
10	8th Week	RDVK / R2B	S/C or Intramuscular (I/M)
11	9th Week	Fowl Cholera and AE	Sub cutaneous (S/C)
12	10th Week	Fowl Pox Vaccine	Intramuscular (I/M) / Wing Web
13	10th Week	Infectious Coryza	Intramuscular (I/M)
14	11th Week	Reo	Sub cutaneous (S/C)
15	12th Week	Fowl Pox	Intramuscular (I/M) / Wing Web
16	13th week	IB vaccine	Intraocular (I/O) / Water
17	14th Week	FC + IC	Intramuscular (I/M)
18	18th Week	RD + IBD + IB + Reo	Sub cutaneous (S/C)
19	19th Week	Leechi - Inactivated	Sub cutaneous (S/C)

PRE AND POST VACCNATION CARE

1. Before making vannination schedule, maternal antibody level in day old chicks must be monitored.
2. Use proper method of shipping, storage, mixing and administration of vaccine.
3. Perform vaccination in healthy flock only.
4. All birds with in house must be vaccinated same day.
5. During outbreak of any disease, vaccination must be postponed.
6. Vaccination should not be done in flock affected with other disease.
7. Keep stress factor minimum.
8. Until ready to use, keep all vaccines under refrigeration. At the time of vaccination, reconstructed live vaccines must be kept in ice.
9. Use speed but don't sacrifice accuracy and thoroughness.
10. Destroy all empty vials, bottles and unused vaccines. Clean up and disinfect all equipments and clothing after vaccination.
11. Vaccination does lead some reactions and stress among birds. These are signs of successful vaccination.
12. For minimizing stress in summer, vaccination must be done at night or early in the morning.
13. During vaccination, use one needle for only 500 birds and then change. Correct gauge size needle should be used to minimize injury to muscles.
14. A stabilizer such as skim milk powder must be used in drinking water when vaccine is given by this route.
15. Vaccination must be performed by trained personnel under the guidance of qualified veterinarian.
16. Keep record of brand, kind, and batch number of vaccines and date of vaccination.

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