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A Text Book of Livestock and Poultry Management

Dr. Gitam Singh, et. al.

Based on the Syllabus of Sixth Dean's Committee Report of ICAR

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Message from the Hon'ble Chairman' Desk

It gives me immense pleasure to introduce this insightful book, **A Text book of Livestock and poultry Management,** which serves as a valuable resource for students, researchers, and professionals in the field of animal husbandry. The livestock and poultry sectors play a crucial role in ensuring food security, rural livelihood, and economic growth. Therefore, scientific knowledge and modern management practices are essential for sustainable development in this field.

This book comprehensively covers essential topics such as breeding, nutrition, disease management, housing, and advanced farming techniques, making it a vital guide for those engaged in livestock and poultry farming. I am confident that this book will greatly benefit readers by providing both theoretical concepts and practical applications to enhance productivity and efficiency in animal management.

I congratulate the author for their dedicated efforts in compiling this valuable work and hope that this book serves as an important learning tool for all its readers.

Prof. (Dr.) Raj Kumar Rana
Hon'ble Chairman, Madhav University
Sirohi, Rajasthan



Message from the Author

It is with great pleasure that I present this book, **A Text book of Livestock and poultry Management**, which aims to serve as a comprehensive guide for students, farmers, and professionals in the field of animal husbandry with objectives:- 1**.** Provide basic knowledge to the students about scientific livestock and poultry rearing practices
2. Entrepreneurship development through Livestock/poultry and Agriculture Integrated Farming System

The growing demand for sustainable and efficient livestock and poultry production has made it essential to adopt scientific management practices to ensure productivity, animal welfare, and profitability.

This book covers key aspects of livestock and poultry management, including breeding, nutrition, housing, health care, and modern farming techniques. It is designed to provide both theoretical knowledge and practical insights that can be applied in real-world farming situations.

I hope this book serves as a valuable resource for those looking to enhance their understanding and skills in managing livestock and poultry efficiently. I express my gratitude to all who contributed to this work, and I welcome feedback and suggestions for future editions.

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Chapter 1.

Role of Livestock in the National Economy

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Livestock plays an important role in Indian economy. About 20.5 million people depend upon livestock for their livelihood. Livestock contributed 16% to the income of small farm households as against an average of 14% for all rural households. Livestock are capital assets, produced in the past and contributing to future product output. Investment in, or the acquisition of, livestock involves saving or borrowing, justified by the expected future return on capital. Apart from durable capital embodied in the animals, circulating capital is needed to meet current costs of production. Investment in livestock raises farm production through

(a) Extension of the area of land area that can be utilized

(b) Diversification of the productive activity on a crop farm and

(c) Intensification, i.e. by raising livestock value of output and hence total production per hectare of agricultural land increases.

The latter involves increased inputs of labour and/or capital and may be achieved by increasing the stocking rate, increasing yield per head of livestock or changing to a more intensive production system. Scope for extending production onto unused, virgin land is limited since there is little remaining that is usable. There is also limited scope for increasing stocking rates under pastoral systems, since pastoralists already make effective use of available grazing. Livestock production systems are broadly categorised into

i) 'grassland-based' pastoralism and ranching

ii) 'mixed-farming', either rainfed or irrigated, and

iii) 'landless', mainly pig and poultry production systems.

The ‘landless’ livestock production systems represent labour-using technology, in that labour requirements per hectare (devoted to feed production) are higher than for other systems. Conversely, the use of animal draught power is labour-saving, in reducing hand-labour requirements particularly at peak work periods. Use of the plough may allow a larger proportion of the farmed area to be cultivated each year, to increase cropping intensity. Mixed crop-livestock production systems are important as the source of the bulk of ruminant livestock production and the home of the majority of the world’s poor. Complementary relationships exist with livestock, fed on crop by-products and other plant material, contributing draught power, manure, additional sources of food and income, savings and buffer against risk. As intensity and livestock numbers rise, croplivestock interactions become increasingly competitive, for the use of land and other resources. There is little, or no, interaction between crops and supplementary, landless livestock systems. Landless livestock systems provide most of the world’s production of pig and poultry meat. The majority is produced in developed countries and from large-scale commercial enterprises, now spreading in the developing countries. These products make up two thirds of all meat production world-wide, while, in the developing countries, poultry meat now accounts for more than half of all meat produced. Ruminant fattening is less important. Concerns arise regarding limited benefits to the rural poor, risks of environmental pollution and use of cereals to feed animals. Poor producers may participate, possibly by co-operation or vertical integration. Use of feed-grains does not compete directly with human consumers, while pig and poultry production converts feed efficiently and provides a cheap source of animal protein. Inter-regional differences in livestock production systems depend upon agro-ecological features, human population density and cultural norms.. The change from pastoralism to cropping is seen as a land-saving technology, or the substitution of labour for land. The move to mixed farming is capital using and land-saving; capital is substituted for land. Animal draught power, as an innovation, involves the substitution of capital for labour. Industrial development also affects technological change in agriculture, in different ways. In the Americas and Oceania industrialization occurred while population was sparse; labour-saving mechanisation technology change was induced. In Japan industrial innovations occurred with a dense rural population, and therefore a land-saving bias, with improved seeds and agri-chemicals, was induced.

Livestock resources

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 second 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

Source : 20th Livestock Census

Contribution of livestock to people

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

1. **Food:** The livestock provides food items such as Milk, Meat and Eggs for human consumption. India is number one milk producer in the world. It is producing about 230.58 million tonnes during 2022-23. The per-capita availably of milk is 459 grams per day. Similarly it is producing about 138.38 billion numbers eggs and 9.77 million tonnes of meat in a year. The per-capita availability of egg is 101 eggs per annum. The total fish production in India is estimated at 175.45 lakh tonnes.
2. **Fibre and skins:** The livestock also contributes to the production of wool, hair, hides, and pelts. Leather is the most important product which has a very high export potential. India is producing about 33.61 million Kgs of wool.
3. **Draft:** Bullocks are the back bone of Indian agriculture. Despite lot of advancements in the use of mechanical power in Indian agricultural operations, the Indian farmer especially in rural areas still depend upon bullocks for various agricultural operations. The bullocks are saving a lot on fuel which is a necessary input for using mechanical power like tractors, combine harvesters etc. Pack animals like camels, horses, donkeys, ponies, mules etc are being extensively used to transport goods in different parts of the country in addition to bullocks. In situations like hilly terrains mules and ponies serve as

the only alternative to transport goods. Similarly, the army has to depend upon these animals to transport various items in high areas of high altitude.

4. **Dung and other animal waste materials:** Dung and other animal wastes serve as very good farm yard manure and the value of it is worth several crores of rupees. In addition it is also used as fuel (bio gas, dung cakes), and for construction as poor man's cement (dung).
5. **Storage:** Livestock are considered as 'moving banks' because of their potentiality to dispose off during emergencies. They serve as capital and in cases of landless agricultural labourers many time it is the only capital resource they possess. Livestock serve as an asset and in case of emergencies they serve as guarantee for availing loans from the local sources such as money lenders in the villages.
6. **Weed control:** Livestock are also used as Biological control of brush, plants and weeds.
7. **Cultural:** Livestock offer security to the owners and also add to their self esteem especially when they are owning prized animals such as pedigreed bulls, dogs and high yielding cows/ buffaloes etc.
8. **Sports / recreation:** People also use the animals like cocks, rams, bulls etc for competition and sports. Despite ban on these animal competitions the cock fights, ram fights and bull fights (jalli kattu) are quite common during festive seasons.
9. **Companion animals:** Dogs are known for their faithfulness and are being used as companions since time immemorial. When the nuclear families are increasing in number and the old parents are forced to lead solitary life the dogs, cats are providing the needed company to the latter thus making them lead a comfortable life.

Role of livestock in farmers' economy

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

1. **Income**: Livestock is a source of subsidiary income for many families in India especially the resource poor who maintain few heads of animals. Cows and buffaloes if in milk will

provide regular income to the livestock farmers through sale of milk. Animals like sheep and goat serve as sources of income during emergencies to meet exigencies like marriages, treatment of sick persons, children education, repair of houses etc. The animals also serve as moving banks and assets which provide economic security to the owners.

2. **Employment:** A large number of people in India being less literate and unskilled depend upon agriculture for their livelihoods. But agriculture being seasonal in nature could provide employment for a maximum of 180 days in a year. The landless and less land people depend upon livestock for utilizing their labour during lean agricultural season.
3. **Food:** The livestock products such as milk, meat and eggs are an important source of animal protein to the members of the livestock owners. The per capita availability of milk is around 459 g / day; eggs is 101 / annum during 2022-23.
4. **Social security:** The animals offer social security to the owners in terms of their status in the society. The families especially the landless which own animals are better placed than those who do not. Gifting of animals during marriages is a very common phenomenon in different parts of the country. Rearing of animals is a part of the Indian culture. Animals are used for various socio religious functions. Cows for house warming ceremonies; rams, bucks and chicken for sacrifice during festive seasons; Bulls and Cows are worshipped during various religious functions. Many owners develop attachment to their animals.
5. **Draft :** The bullocks are the back bone of Indian agriculture. The farmers especially the marginal and small depend upon bullocks for ploughing, carting and transport of both inputs and outputs.
6. **Dung:** In rural areas dung is used for several purposes which include fuel (dung cakes), fertilizer (farm yard manure), and plastering material (poor man's cement).

Growth of markets and international trade

Agricultural markets have expanded with the growth of international trade over the last 50 years. Trade in LPs, though increasing, represents only a small proportion of the total by value, and 80% is between developed countries. In recent years developing countries, as a group, have switched from being net exporters to being net importers of agricultural produce including all

livestock products. Milk is the largest imported item by weight, while imports of poultry and pig meat are growing fastest. There are differences between continents and countries, with South Asia and Latin America and the Caribbean being net exporters, the former of buffaloes and their meat in particular, and the latter of poultry meat, cattle and honey. Patterns of trade reflect international differences in comparative advantage. Every country benefits, under free trade, by producing goods for which it has a comparative advantage (or low opportunity cost) and importing other goods. Patterns of comparative advantage, and trade, shift over time with changes in production technologies and consumer preferences. They are also influenced by trade regulations. Tariffs, or taxes on imports, are imposed along with other trade barriers, by the European Union, the USA, Japan and other countries, both developed and developing. In the developing countries, trade barriers against manufactured inputs raise costs to farmers. Trade barriers against imports of livestock products, support domestic producers in Europe, the USA and Japan, but make it difficult for producers in other countries to compete. Associated 'dumping' of low-priced surplus beef in West Africa, in the early 1990s disrupted local trade. However, low-priced exports of surplus skimmed milk powder to India contributed to the growth of the local dairy industry. The Lomé/Cotonou Agreement of the EU sets low concessionary tariff rates for certain African, Caribbean and Pacific (ACP) countries. The World Trade Organisation (WTO) aims at promoting a phased reduction in trade barriers. Developed countries, like Australia and New Zealand where trade barriers and farmer support are already low, are predicted to benefit most. Developing country exporters may also gain, other than those currently benefiting from the Lomé/Cotonou Agreement. Tariff barriers remain high and the WTO is criticised as failing the poorer nations. However, the overall gains from trade liberalisation for developing countries are expected to be small. Sanitary and phytosanitary (SPS) measures, aimed at protecting human, animal and plant health, affect trade flows. Rules imposed by the developed countries act as barriers to exports from poorer countries with lower SPS standards. The SPS Agreement of the WTO is aimed at harmonising different national standards. For developing country exporters to developed countries, the high cost of meeting the required SPS standards may be justified. For others, although the protection of human and animal health is important, somewhat lower standards may be appropriate for trade with other developing countries. Consumers in developed countries increasingly seek assurance of ethical methods of

production concerning the environment, animal welfare or intellectual property rights. These issues and their impacts on trade are also subject to international negotiation.

Promoting livestock development The need for increased livestock production is pressing, given the rapidly growing demand for animal products and the important contribution of livestock to the incomes and welfare of the rural poor. Additional physical, or financial capital is needed for the introduction of a new livestock enterprise, but thereafter replacements may be home bred. Human capital in the form of husbandry knowledge and skills is also needed. Technological innovations should be appropriate to the resource base, while access is needed to market outlets and input delivery systems. There is limited scope for increased offtake from grassland-based systems. Options for welfare improvement include provision of water supplies and drought relief. Mixed crop-livestock systems contribute most to ruminant production and income for the rural poor. Nutrient recycling and other beneficial crop-livestock interactions arise, though individual ownership of land and enclosure may be needed to confine livestock and protect crops. Options exist for technical improvements in animal health, nutrition and production systems. The latter may involve greater specialisation, for instance into dairy farming, with the introduction of exotic breeding material. Poultry and pig production systems are the most intensive and fastest growing sources of meat. They are now more important than ruminant meats in developing country diets. Much of the growth derives from large-scale, commercial production companies in peri-urban locations. Concerns, over competition with poor livestock producers, reliance on feed grains, loss of genetic diversity and environmental pollution, must be recognised. However, these systems are the most economically efficient and cheapest sources of animal protein. There is considerable scope for import substitution and saving of foreign exchange. Improvements to traditional ‘backyard’ systems are needed, together with development of an institutional framework to promote equitable contracts between commercial processors and smallholder producers and joint action by smallholders in establishing processing and marketing facilities. Similar issues arise in relation to smallholder dairy development. Livestock development policies include trade and pricing policies, to encourage the developed countries to reduce trade barriers, to reduce domestic protection of industrial sectors and to make limited use of subsidies and taxes. Subsidies may be used for disaster relief or to promote use of innovations. Taxes may be used to recover costs publicly financed services. Institutional development requires strengthening of rural roads and communications, property rights and

contractual agreements, and organisations for the provision of credit, animal health services, and other inputs. Dissemination of timely market information is desirable and promotion of links between producers and processors or of producer groups for processing and marketing. The decline in funding for livestock research must be reversed. More research is needed on animal and veterinary public health, forage crops and the utilisation of crop by-products, improved husbandry and production systems and possibly on breeding. In addition, socio-economic research is needed into existing production systems, and institutions for land tenure, credit, labour hire, input delivery and product marketing together with methods of research prioritisation. Increased funding for well-designed policies for trade, pricing, institutional development, research and technological change should yield substantial returns in terms of growth in agricultural and national income, saving of foreign exchange and rural poverty relief.

Role of agriculture in securing livelihoods, generating employment and income

In terms of the number of people employed, agriculture is the most important industry in the world. The estimated agricultural population, defined as all persons depending for their livelihood on agriculture, hunting, fishing or forestry, of over 2.5 billion, makes up 42 per cent of the total. In the developing countries, over 50 per cent of the population depend upon agriculture. Although the proportion is decreasing, as a result of rural-urban migration, the absolute numbers securing their livelihoods from agricultural production are still increasing in the developing countries. Within this group, only in Latin America and the Caribbean have the numbers in agriculture declined over the last decade (Table 1). In the 'transition economies' of the former Soviet Block, which in this study are not included among the developing countries, agricultural populations are falling rapidly.

Table 1: Agricultural populations in developing countries

	Developed Countries	Developing Countries	Latin America & Caribbean	SubSaharan Africa	North Africa & Near East	South Asia	East & South East Asia (incl. China) *.
Agricultural population as	7.3	51.5	20.4	63.5	32.1	53.7	59.3

% of total (2001)							
Annual growth (%) of agricultural population (1991-2001)	-2.9	0.6	-0.8	1.8	0.5	1.0	0.2
Annual growth (%) of nonagricultural population (1991-2001)	0.8	2.9	2.3	4.4	3.2	3.0	2.7
Agricultural population as % of total (2010)	5.5	46.5	16.3	58.3	27.3	49.0	53.9

* Note: Numbers dependent on agriculture in China, and hence in this group, reached a peak in 1999 and have declined thereafter. Source FAOSTAT 2003

Agriculture and rural poverty alleviation

The importance of agriculture in economic development goes beyond its contributions to growth in national income, the livelihoods of rural people and meeting the nutritional requirements of increasing populations. Agricultural development is also seen as having a key role in the reduction of poverty. This follows from the knowledge that a majority of the poor in most developing countries (with the exception of countries in Latin America) live in rural areas and that food prices are a major determinant of the real income of both the rural and urban poor.

Livestock, development and poverty alleviation

Livestock and livestock products (LLPs) are estimated to make up over half of the total value of agricultural gross output in the industrialised countries, and about a third of the total in the developing countries. The global importance of livestock and their products is increasing as

consumer demand in the developing countries expands with population growth and rising incomes. This growth in consumption is reflected in improvements in the average human nutritional status due to the intake of animal protein. The resultant changes have been dubbed 'the next food revolution' and the growth in developing country consumption of animal products is predicted to continue at least until 2020.

Livestock products such as meat, milk and eggs are more costly, per tonne and per unit of food energy, than staple crop products, so diets in most developing countries generally include lower levels of intake of animal products than those in the developed, or industrialised, countries. To some extent, the lower levels, of meat, egg and milk use, are compensated for by higher levels of cereal supply and consumption per person. However, as incomes rise, in the developing countries, consumers seek more variety and better quality foods in their diets. Hence demand for livestock products rises rapidly, an effect which is also driven by quite rapid growth in the number of consumers. However, in many of these countries, domestic production has failed to keep pace with the growing demand so imports of livestock products have increased.

Livestock as Capital Assets

A capital asset is something that has been produced but has not yet been used up. It should produce a return, in terms of increased income, or welfare, in the future. Livestock fit this definition; they have been produced and should yield returns in the future, directly in the form of meat, milk, eggs, wool or hides/skins, and indirectly through manure or draught power used in raising income from crops. Investment is the acquisition of capital assets. It necessitates saving, or foregoing current consumption. The consumption foregone may be agricultural produce such as eggs kept for hatching, or animals retained for breeding, leisure when a shed or kraal is built by family labour or money. The money used to purchase animals or equipment might otherwise have been used to buy food or other consumer goods. If the asset is acquired on credit, then someone else has done the saving and may require 'interest' to be paid on the loan. Investment in livestock has very low transaction costs, once the first breeding female has been acquired, and mated, since flock or herd growth follows from reproduction. In recent literature, especially that concerned with the environment and sustainable agriculture, the total capital stock is sub-divided into five types: natural capital, social capital, physical capital, human capital and financial

capital. This typology is useful in distinguishing the full range of capital resources needed for development, loosely summarised as follows:

• Natural capital: natural resources of land, water, wild plants, animals and fish;
• Social capital: the institutional framework to facilitate social transactions;
• Physical capital: the physical output of human productive activity in the past;
• Human capital: the stock of accumulated skills and knowledge of individuals;
• Financial capital: stocks of money or sources of funding.

Livestock, diversification, extending and intensifying production

Investment in livestock may raise agricultural production and rural incomes to yield a return on the capital invested in various different ways. These include livelihood diversification, extending the land area utilised or intensifying land use. These are three of the five 'main farm strategies to improve livelihoods' recommended in a FAO/World Bank publication (Dixon *et al* 2001). The other two suggested alternatives are to seek increased off-farm income in other non-agricultural activities, or to leave agriculture altogether. Diversification implies an adjustment to the farming system, usually by introducing a new productive activity such as a dairy unit on a holding previously used only for growing crops. Not only does this add to total farm production and household income, but also may alleviate risk. Provided that the yields of crops and livestock are not positively correlated, diversification should reduce the overall inter-year variation in household incomes. Investment in livestock may allow extension of the land area utilised, either by grazing previously unused areas or by using animal draught power to extend the area under cultivation. Beneficiaries of land reform may be able to expand crop production in this way. Otherwise, scope for expansion of the agricultural frontier is limited except for parts of Latin America and Sub-Saharan Africa and some countries of East Asia. However, as the agricultural frontier is pushed outwards, onto less and less productive land, the benefits of expansion are reduced. In much of Sub-Saharan Africa, the area suited to cattle production is restricted to the semi-arid zones by the presence of the tsetse fly in more humid areas. At the same time there are conflicting aims of conserving the natural environment, vegetation and wildlife of some non-agricultural areas. Given the limited scope for expanding the area of land used for agricultural purposes, the best alternative is to intensify, or increase production per hectare. Intensification generally involves increased inputs per hectare of labour and/or capital and may be associated

with a change in the technology used. The introduction of livestock necessarily involves capital investment and a resultant increase in production value per hectare. Additional labour may also be employed in tending the animals. Extra production is derived directly from the livestock in the form of meat and other products, but also indirectly through the complementary effects of animal draught and manure on cropped area and yields. Intensity of livestock production depends upon *inter alia* a) the stocking rate, b) choice of system and animal species, and c) yield per head (Upton 2002). Growth in livestock production and farm-household incomes can be achieved by increasing stocking rates, changing to more intensive production systems or improving reproduction rates, live-weight gains, and milk, egg, or other product yields. The stocking rate, expressed as the number of (tropical grazing) livestock units per hectare, is an indicator of the intensity of use of grazing or rangeland.1 This measure is therefore only of use in relation to grassland-based systems, such as pastoralism or ranching, where over-stocking may possibly lead to irreversible rangeland degradation. The effect of land tenure on stocking rate will be discussed later under institutional issues.

Animal draught as labour-saving technology

The introduction of livestock on a cropped farm, or a change in the production system, may be viewed as an innovation, or change in technology. Capital is invested to raise the productivity of both land and labour. The effect may be neutral, meaning that the labour use per hectare is unchanged, or there may be a bias in the direction of using more, or less, labour per hectare than before. If more labour is used, the innovation is said to be 'labour using' and 'land saving'. Where the introduction of livestock increases the intensity of land use, it follows that the innovation is 'labour using'. Although the area of land is not reduced, the input of land *per unit of product output* falls. In this sense the effect may be viewed as 'land-saving' or as 'the substitution of labour, and capital, for land'.

Crop-livestock interactions

Crop and livestock interactions occur directly in mixed farming systems from which the bulk of global ruminant livestock production is obtained. Recent estimates suggest that 65% of all beef, 69% of all mutton and 92% of cows' milk is produced from mixed farms (FAO 1996). In addition 84% of the world's rural poor depend on these systems (Thornton *et al* 2002). The

useful complementarities between crops and livestock have already been mentioned. Apart from the draught power inputs to crop production by the cattle, buffaloes or camels, all livestock can contribute to the nutrient cycle by feeding on plant material and returning plant nutrients, in manure, to the soil. Only ruminants can convert fibrous material in grass, browse or forage, which may have no other use, into valuable products. In addition livestock complement crops in providing food and income for the household, risk reduction through diversification and a form of savings. Complementary interactions between crops and livestock mean that increases in livestock production may be accompanied by increased crop production. This situation may arise where livestock are largely supported on crop residues and byproducts or waste land, so little or no cultivated land is devoted to fodder production. Research devoted to improving the quality of crop residues, such as the treatment of straw, and the better utilisation of crop residues may extend the livestock carrying capacity without reducing crop production. The application of animal manure to the crop-land and possibly the use of animal power may contribute to the expansion of cropped area at the expense of fallows or directly to increased crop yields. As a result production from both crops and livestock is increased.

Landless systems and the use of feed-grains

Landless production systems are the source of most of the world's poultry and pig meat production and hence of global meat supplies. It is claimed that China raises more than half the total world pig population and a significant proportion of all poultry3. Even when China's production statistics are omitted, as possibly being inflated, pig and poultry meat each account for about a third of all meat produced world-wide. The developed countries dominate world livestock production from landless systems, but even within the developing country group, excluding China, pig and poultry meat makes up more than half the total meat produced (Bruinsma 2003). In addition some beef and mutton is produced from intensive feedlot operations, the former mostly in North America and the transition states of Eastern Europe. Sheep and goat fattening under landless conditions occurs in the Near East and in much of Africa. Cut-and-carry, zero-grazing dairy production systems frequently practiced in Small-scale backyard pig and poultry systems are common in many parts of the world. There is scope for intensification and a change to more 'open' systems with the introduction of housing, the purchase of concentrate feeds and the sale of produce. Increases in scale and capital investment

allow improved housing, mechanisation and automation of feeding, watering and husbandry, the introduction of exotic breeds, specially formulated concentrate feeds and veterinary drugs. Production of poultry and pigs in the developed countries is concentrated in large-scale commercial units and their application is spreading in peri-urban areas of the developing world. The importance of landless poultry and pig systems in meeting growing demands for livestock products in human diets, and some of the reasons for their importance were discussed above. There are three potential areas for concern over the growing importance of such systems. First there may be few advantages to the rural poor. The main beneficiaries are the relatively higher income consumers and commercial producers, processors and traders. Second there are environmental problems of manure disposal, pollution and loss of bio-diversity resulting from increasing dependence on a narrow range of hybrid breeds. The third is the extent to which staple cereal crops are used for animal feed. The use of purchased cereals and oilseeds for feed allows separation of crop production and use. These concentrate feeds are less perishable and easier to transport than the livestock products. Even if several kg of concentrates are needed to produce one kg of meat, it is still cheaper to establish the production system near the market and to transport the feeds to the animals. Hence most of the intensive landless systems are established in peri-urban regions, in the vicinity of markets in

centres of high human population density. Concentrate feeds may be produced from the wider hinterland or imported from overseas. It is estimated that about 40% of the net exports of cereals from developed to developing countries are feed grains for livestock.

Diversity of livestock systems, the impact of climate and human population density on their world-wide distribution

The choice of livestock production system varies between different countries and different regions within countries. It is influenced by agro-ecological features, particularly climate and topography, human population density and cultural norms, such as avoidance of pig meat in Islamic society, and of beef in India and very limited milk consumption in East Asia. On the basis of climatic differences, the four main categories of livestock production system, grassland based, mixed rainfed, mixed irrigated and landless, may be further sub-divided into arid, humid and temperate zones. These three zones are defined as follows:

- arid, and semi-arid; average length of growing period of less than 180 days,

• humid and sub-humid; average length of growing period of more than 180 days,

• temperate/tropical highland; average growing-season temperature between 5oC and 20oC or one month or more with average (sea level) temperature below 5oC.

Trade in livestock and livestock products

International trade in livestock products represents a further expansion of market boundaries. Cross-border trade in live animals has occurred ever since national boundaries were defined. However, only since the introduction of steam ships with refrigeration, towards the end of the 19th Century, has international trade in livestock products grown, along with that of cereals and other commodities. The growth in total trade, has accelerated over the last 50 years, but trade in agricultural products has grown more slowly and declined as a proportion of the total. Trade in livestock and livestock products (LLPs), although growing represents only about one sixth of the total value of agricultural trade. Within this broad context, the developed, OECD member countries are responsible for over 80% of world trade in LLPs. Over the past 50 years, the developing countries have, as a group, changed from being net exporters of agricultural produce to net importers from the developed countries. For LLPs, the developing countries are net importers of all categories and, for dairy products and meat; imports are growing to meet the increasing demand.

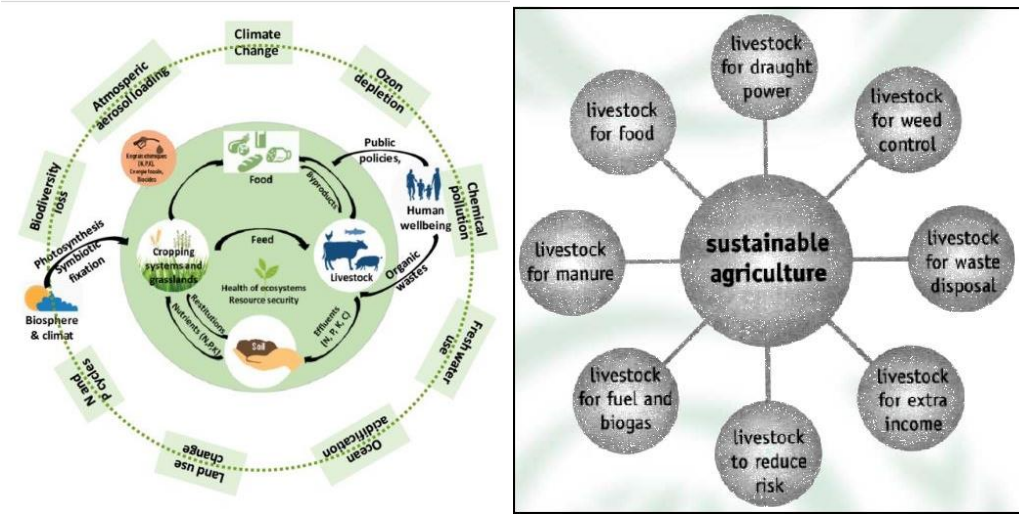


Fig. Role of Livestock in the National Economy

India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and

biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and

Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e).

The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat,

draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

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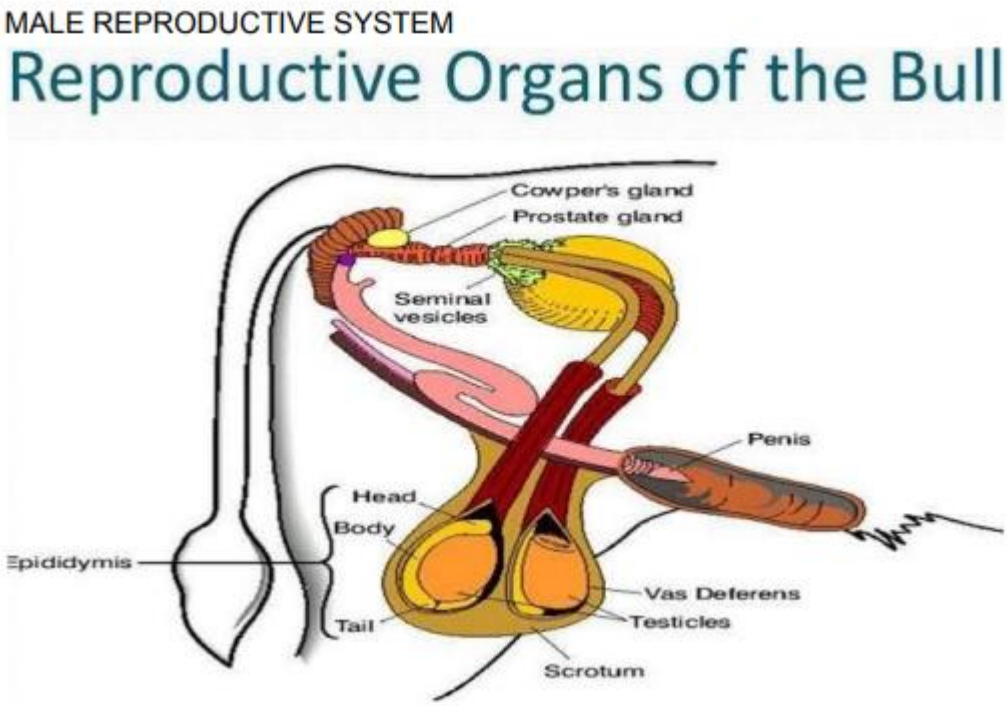
Chapter 2.

Reproduction in farm animals and poultry

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MEANING OF REPRODUCTION - This is the ability of animals to give birth to young ones. This is aimed at ensuring continuity of life. The reproduction system includes all the organs and tissues associated with reproduction in farm animals Farm animals reproduce by sexual means and are mostly viviparous because they give birth to their young ones alive but poultry bird on the other hand are oviparous because they reproduce by laying and hatching of eggs after incubation period. The male reproductive system includes the testis which produce the spermatozoa and sex hormone called testosterone which helps in the development of the male sex secondary characteristics. It is especially produced in the seminiferous tubules of the testes during meiotic cell division by a process called spermatogenesis. The testes are suspended or protected by the scrotal sac (scrotum) outside the abdominal cavity to help sperm cells to be produced at desired temperature. The epididymis ensures the storage and maturation of sperm cells in the testes. The testes are connected to vas deference which transports sperm from the testes to the uterus. The accessory glands (cowper's gland, seminal vesicle and prostate gland) are located along the urethra, they produce slimy alkaline fluid which helps the movement of spermatozoa, this fluid together with the spermatozoa results in the formation of sperm as well as removal of urine.

FUNCTIONS OF THE VARIOUS PARTS OF THE MALE REPRODUCTIVE SYSTEM



1. TESTIS:- They are located within the scrotum or scrotal sac. When stimulated by the hormone testosterone it secretes spermatozoa. Removal of the testes is called Castration. The spermatozoa are produced by the process of spermatogenesis.

2. SCROTUM:- The scrotum houses the testes. it also regulates the temperature of the testes and when the day is cold, the scrotum shrinks(Constricts) and when the day, is hot, it drops or falls to a lower level. It does not have hair or very little hair so as to perform its function very well.

3. VAS DEFERENS:- This is responsible for conducting or transporting of the sperm from the epididymitis to the neck of the urethra. The removal of the vas deferens is known as vasectomy. This can only be done when the animal sexual characters have developed and may be to remove its poor quality. Vasectomy is safer than castration because the animal can still be stimulated but the sperm is not allowed to come down.

4. EPIDIDYMIS:- The epididymis ensures the storage and maturation of sperm cells in the testes before it is being used or released.

5. SEMINAL VESICLE:- This region secretes a fluid rich in food substances, this fluid helps in feeding the spermatozoa before fertilization takes place.

6. PROSTATE GLAND:- This secretes a prostrate fluid which helps to inhibit urine formation during copulation and ejaculation.

7. COWPER'S GLAND:- This also secretes the Cowper's fluid which is alkaline and helps to reduce the acidity of the sperm.

8. SEMEN:- This is a mixture of the seminal fluid and the spermatozoa. Only about 25% of the quantity of semen ejaculated is spermatozoa the remaining 75% are the seminal fluids.

9. URETHRA:- This is a narrow tract a urino-genital organ which helps to inject sperms into the vagina as well as the removal of urine. The urethra ends externally in penis.

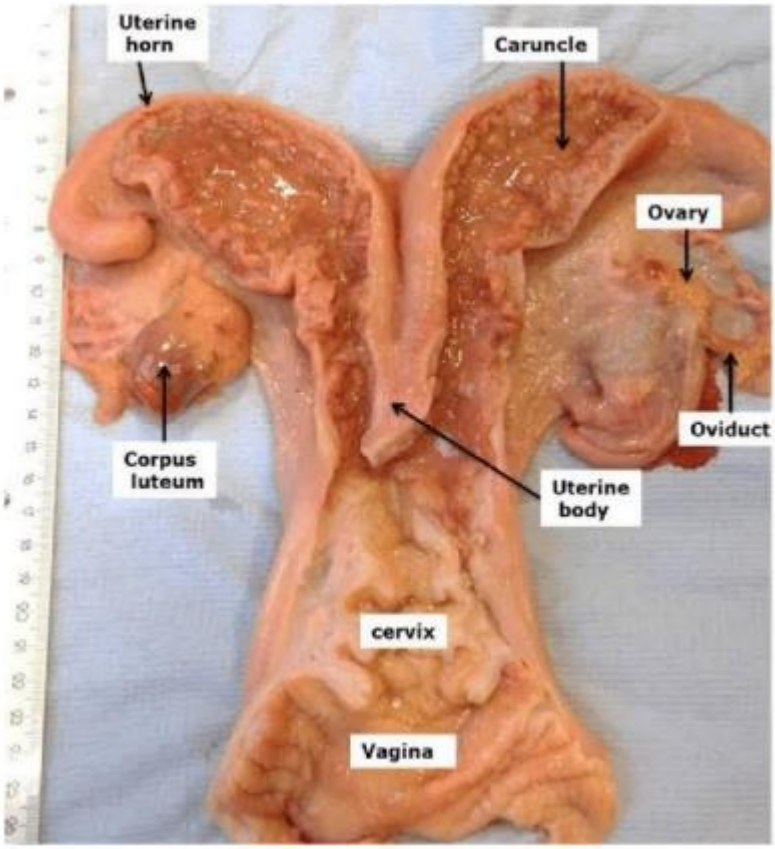
10. PENIS:- This is the organ which is used to introduce the sperm into the vagina. When it stimulated, the arteries expand, the blood flows into the blood vessels thereby making the penis to be turgid that copulation can takes place.

11. COPULATION:- This is mating between the male and female animals.

12. EJACULATION:- This is the release of the sperm by the male during copulation.

FEMALE REPRODUCTIVE SYSTEM.

REPRODUCTIVE ORGAN OF A COW



The female reproductive system includes the ovaries which produce the ovum or ova (egg) enclosed by the graffian follicles and some hormones such as the oestrogen. A mature egg or ovum when released from the graffian follicle in the ovary into the oviduct the process is called OVULATION. As soon as the egg or ovum is released from the ovary, the female animal comes on heat and is the fusion of the male and female sex cells takes place in the walls of the uterus. The process is called IMPLANTATION. The development of the foetus takes place in the uterus. Below the uterus is the vagina which receives the spermatozoa during corpulation. The female reproductive system end with the vulva an external opening. REPRODUCTIVE SYSTEM IN BIRDS The male bird has two testes located inside the body. They are connected to the cloaca with a narrow tube which ends as a raise papilla. In the female, the single ovary produces ova (egg) in capsules attached to the ovary by short stalks. The ovary also produces the yolk. The infundibulum receives the yolk released by the ovary. Albumen and chalaza (holds the yolk and germ cells in position) are formed in the magnum(takes 3 hours). The two shell formed in the isthmus(takes 1 hour),. the egg shell is finally formed in the uterus(takes 20 hours)after which the egg is laid through the cloaca. Fertilization of the egg takes place as soon as the egg enters the oviduct when spermatozoa are present. It occurs before the formation of the albumen.

TERMS ASSOCIATED WITH ANIMAL PRODUCTION

OESTRUS CYCLE: This is the interval from the end of one heat period to the beginning of another. It is under the influence of hormones. It varies from animals.

Cow 20-21 days

Ewe 17-21 days

Sow 14-28 days

Doe (goat) 17-21 days

Doe (Rabbit) spontaneous

HEAT PERIOD: This is the period when the female animal shows signs of its readiness to mate. It is the period of ovulation and it varies in animals e.g

Cow 5-24 hrs

Ewe 35-36 hrs

Sow 40-48 hrs

Doe (goat) 40-50 hrs

SIGNS OF HEAT PERIOD

The vulva becomes large, red and swollen

This is undue noise making or grunting

A clear viscous secretion comes from the vagina which arouses and excites the male

Restlessness

Shows tendency to be ridden or mounted by another animal

Loss of appetite

Abnormal high temperature

Frequent urination

Standing still to be mounted

Frequent tail shaking e.g (goat)

MATING: This is also called coitus or corpulation. It is also the terms when the penis of a male animal is inserted into the vagina of a female leading to the ejaculation of the spermatozoa.

TYPES OF MATING

There are two types of mating; they are Natural mating and artificial mating

NATURAL MATING: This occurs when a male animal identifies a female animal on heat period and mounts the female for mating. Under natural type of mating there are methods e.g

1. Flock mating where the male and female animals are allowed to move freely together and mate freely.

2. Pen mating where very few numbers of males are kept with few number of females so that they can mate at any time the female is on heat e.g four males together with twelve females.

3. Stud or hand mating where the males are kept separately to be mated with individual females when on heat period after which the male is taken away.

ARTIFICIAL MATING: This is called artificial insemination which involves the injection of spermatozoa artificially into the vagina of female animal on heat period The sperms are collected from a male animal with desirable character such as spermatozoa is stored at 196 degrees centigrade under liquid nitrogen until it is used.

GESTATION PERIOD: This is the period between conception and birth of the young one. it is the period of pregnancy in animals. It is the period of swelling of the abdomen. It is the period of swelling of the udder, there is increase in life weight. It is under the control of the hormone progesterone (pregnancy hormone) and it varies in animals.

Gestation period

Range Cow=283 days

275-285 days

Ewe =114 days 112-116 days

Sow =150 days 145-155 days

Doe (goat) 151 days 150-155 days

Doe (Rabbit) 31 days 30-31 days

LACTATION: This is the period of milk letdown. It is the period during which the female animal release milk from its udder immediately after parturition and thereafter. The milk is used to feed the young one, it is under the influence of hormone i.e. decrease in progesterone and increase in estrogen and oxytocin.

PROCESS OF EGG FORMATION

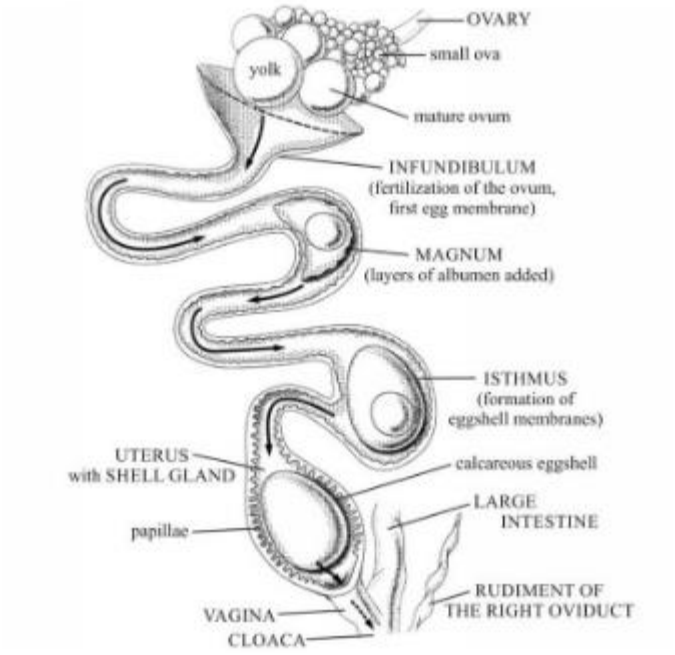


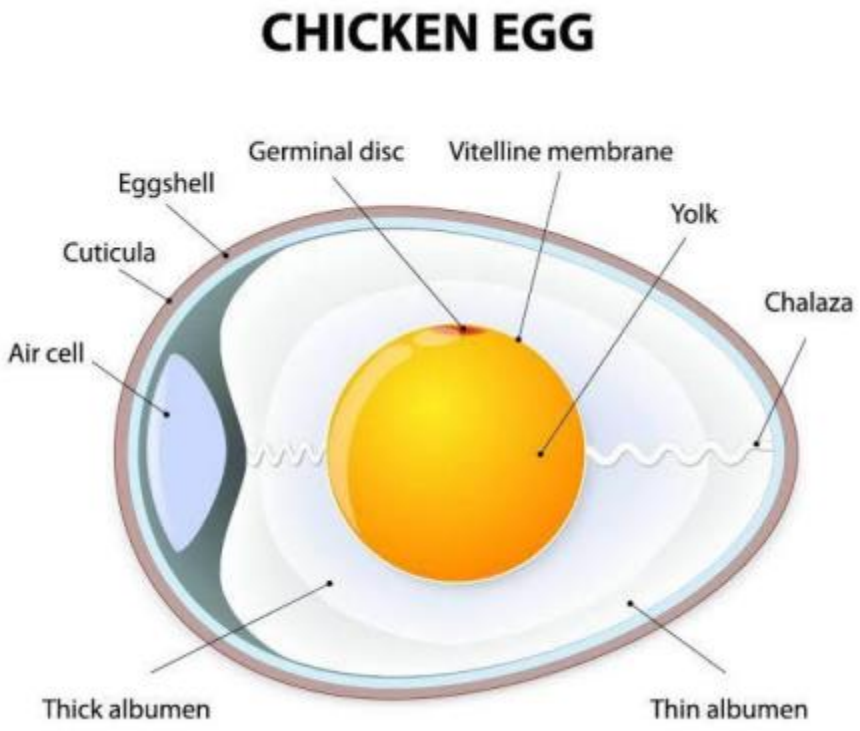
Fig. The internal terminal part of the oviduct

This process is controlled by hormones. The egg is formed partly in the oviduct. The yolk is secreted by the ovary and enclosed in the follicle. The yolk increases in size by accumulating yolk materials carried from different parts of the bold by blood stream. The germinal disk is attached to the top of the yolk. The follicle burst to release the yolk. The yolk release by the ovary is taken up by the infunidibulum.

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Fertilization occurs here before the other components are added. However the complete formation of the egg is independent of whether the egg is fertilized or not. The egg stays 15 minutes in the infundibulim and travels to the magnum and part of the albumen is secreted on egg moves to the albumen is secreted on the told, chalaza is also formed here, the egg moves to the to the isthmus and spends 75 minutes and the two egg shells membranes are formed, the shape of the egg is also formed here after which it moves to the uterus and spends 19-20 hours and the egg shells are formed from calcium caldonate secreted by grants of the uterus, mineral solutions are also added to the egg after which it moves to the vagina and stayed for a short time is laid through the cloacae. It takes almost 24hours for a complete egg to be formed.

Diagram of an egg



MAIN REPRODUCTIVE HORMONES AND THEIR FUNCTIONS

Hormones are chemical substances that coordinate the activities of the body. They are secreted by ductress glands in the body and transferred through the blood to the targeted organ on which they exert their effect.

MALE REPRODUCTIVE HORMONES

Testosterone (Androgen) Functions : It initiates spermatogenesis. It is responsible for the initiation of male secondary sex characteristics, increases libido, it enhances muscular and skeletal growth, it reduces fat deposition, sustains the life of sperm in the epididymis, it promotes the growth of accessory sex glands.

FEMALE REPRODUCTIVE HORMONES

Oestrogen- Functions- Stimulates the development 9of female secondary sex characteristics eg heat behavior, promotes the promotion of egg through oogenesis, it is responsible for preparing of the uterus living for the reception of the fertilized egg or ovum, it increases blood supply as

well as the water content of the uterus, stimulates the growth of the duct system in the mammary gland (udder), induces the rapid multiplication of epithelium in the vagina, it increases cilliary activities and mucus secretion Follicle stimulation hormone (FSH) It stimulates the growth of the ovarian follicle

Luteinizing hormone (LH)- It causes the rapture of the follicle and subsequent release of ova (ovulation). It stimulates the secretion of ovarian hormone ie oestrogen and progesterone.

Progesterone (pregnancy hormone)- It ensures the development of uterus and implantation of the fertilized ovum, it prevents the ripening of more follicle, causes the development of alveoli in mammary gland, ensures continuance of pregnancy.

Oxytocin- Aids the contraction of the female uterine muscles during pregnancy. It causes milk let down after birth, promotes transportation of spermatozoa in the female genital tract.

Relaxin- It causes the relaxation of the pelvic ligament during parturition for easy passage of the young ones.

Assignment

1. Define reproduction
2. Write the function of these hormones (a) Oestrogen (b) Progesterone (c) Relaxine
3. Describe the process of the egg formation
4. Write the gestation period for these animal (a) cow (sheep) (c) sow
5. Explain (a) heat period (b) Gestation period

India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management,

feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of

people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a).

The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals

should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

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Chapter 3.

Housing Principles, Space Requirements for Different Species of Livestock and Poultry

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India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that

constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and

translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture,

contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Dairy farm – Buildings

Milch Animal Shed

The milch animal shed should have the following parts

1. Feeding passage

2. Manger
3. Standing space
4. Gutter or drainage channel
5. Milking passage

The milch animals can be housed according to number of animals available.

Single row system: In single row system, 12-16 numbers of animals can be kept.

Double row system

- If it is greater than 16, then double row system is preferable.
- In double row system up to 50 animals can be maintained in a single shed.
- The distance between two sheds should be greater than 30 feet or it should be twice the height of the building.

In double row system two methods available. They are

1. Tail to tail system (out-method)

Advantages

- Cleaning and milking of animals easy.
- Supervision of milking also easy.
- Less chance for transmission of diseases from animal to animal.
- Animals can get more fresh air from outside.

2. Head to head system (in-method)

Advantages

- Getting animals into the shed is easy.
- Feeding of animals also easy.
- Disinfection of gutter will be more due to the direct fall of sunrays over the gutter.
- Animals are better exhibited to visitors

Disadvantages

- Milking supervision is difficult.
- Possibilities of transmission of disease are more.

Milking Barn / Milk parlour

- This is a barn where milch animals are milked and is fully covered.
- It should be located at the centre of the farm with all other farm buildings arranged around it.
- There shall be an individual standing in the milking barns and the number of standings required should be 25% of total number of milch animals in the herd.
- The milking operation should be carried out in batches.

Dimensions of milking barn

- Length of standing space : 1.5 – 1.7 m
- Width of standing space : 1.05 – 1.2m (80% of length, of standing space)
- Width of central passage : 1.5 – 1.8 m
- Width of feed alley : 0.75 m
- Width of gutter : 0.30 m
- Overhang : 0.75 m

Down calver shed/ calving pen

- Pregnant animals are transferred to a calving pen 2 to 3 weeks before the expected date of calving.
- Calving pen of 3m x 4m (12 m^2) is essential to keep the animals in advanced stage of pregnancy.
- It should be located nearer to the farmer's quarters for better supervision.
- The number of calving pens required is 10% of the number of total breedable female stock in the farm.

Calf pen

- This is meant for housing young calves separately.
- It can be located either at the end or on the side of the milking barn.
- This facilitates taking calves to their dams quickly.
- If there are large numbers of calves, the separate unit of calf shed should be arranged and located nearer to the milking barn.

Young stock/ heifer shed

- It is meant for housing young heifers separately.
- Older heifers calves from about six months of age to breeding age are to be housed separately from the suckling calves.
- When a large number of young stocks are there, they should be divided into different age groups and each group housed separately.

Dry animal shed

- In large farms, milch and dry cows are housed separately.
- The floor in the covered area should preferably be made of cement concrete.
- Under Indian conditions, in smaller farms, milch and dry animals can be housed together.
- Normally, one third of the animals in a farm will be in dry or in dry cum pregnant stage.

Bull shed

- It is meant for housing bulls separately in a farm.
- It should be constructed towards one end of the farm.
- There shall be one shed for each bull.
- The number of bulls required being one for every 50 breedable females on the farm, if natural breeding is practiced.
- When artificial insemination service facilities are available, no necessary to keep the bulls on the farm.

- The bull shed shall have covered 3x4 metre dimensions, leading into a paddock of 120 square metres.

Isolation shed

- It is the separation of sick animals from apparently healthy animals to avoid transmission of diseases to healthy stock.
- It should be located at the corner of the shed so that these sheds are inaccessible to other animals.

Quarantine shed

- It should be located at the entrance of the farm.
- The newly purchased animals entering into the farm should be kept in quarantine shed for a minimum period of 30 to 40 days to watch out for any disease occurrence.

Accessory buildings

Store room

- All the four walls should be closed and it should be rat proof.
- There should be one concrete store room with feed mixing unit at a distant place and a smaller feed store room behind the milking parlour.

Milk room

- It is essential to keep the milk and also to chill the milk in larger dairies having 400 to 700 litres production capacity that requires 3.7 m x 5m size of room and an additional 0.37 m^2 for every 40 litres of milk production.
- For a smaller dairy unit below 100 litres a small room with a dimension of 3.75m x 3m can be sufficient for storing milk and concentrate feed.

Hay or straw shed

- An adult animal consume about 5 to 10 Kg of hay or straw per day, while young stock consume about 2 to 5 kg of hay or straw per day.
- The annual requirement can be calculated and the space requirement can be arrived.

Common housing methods for dairy animals

Loose Housing

- It is a system of housing in which animals are kept loose in an open paddock throughout the day and night except at the time of milking and treatment.
- In this system, shelter is provided along one side of open paddock under which animals can retire when it is very hot or cold or during rains.
- Common feed manger and water tank is provided and concentrates are fed at the milking time which is done in a separate milking barn or parlour in which cows are secured at milking time and are milked.
- The open paddock is enclosed by means of half walls or plain wire fences of convenient height.

Advantages

- Cost of construction is cheaper.
- Future expansion is possible.
- The animals will move freely so that it will get sufficient exercise.
- The animal can be kept clean.
- Common feeding and watering arrangement is possible.
- Clean milk production is possible because the animals are milked in a separate milking barn.
- Oestrus detection is easy.
- At least 10-15 percent more stock than standard can be accommodated for shorter period.

Disadvantages

- It is not suitable for temperate Himalayan region and heavy rainfall areas.
- It requires more floor space.

- There is competition for feed.
- Attention of individual animal is not possible.
- A separate milking barn is needed for milking of animals.

Conventional Barns or Stanchion Barns

- In this system of housing, the animals are confined together on a platform and secured at neck by stanchions or neck chain.
- The animals are fed as wells as milked in the same barn.
- These barns are completely covered with roofs and the sidewalls are closed with windows or ventilator located at suitable places to get more ventilation and lighting.
- It is applicable for temperate and heavy rainfall region.
- The same type of housing can be utilized for tropical region with slight modification.

Advantages

- The animals and men caring for animals are less exposed to harsh environment.
- The animals can be kept clean.
- Diseases are better controlled.
- Individual care can be given.
- Separate milking barn is not required.

Disadvantages

- Cost of construction is more.
- Future expansion is difficult.
- Not suitable for hot and humid climatic conditions

Housing Space Requirements for Crossbred cattle

Age-group	Manger Space (mtr.)	Standing or covered area (sq.mtr.)	Open Space (sq.mtr.)

Age-group	Manger Space (mtr.)	Standing or covered area (sq.mtr.)	Open Space (sq.mtr.)
4-6 months	0.2-0.3	0.8-1.0	0.8-1.0
6-12 months	0.3-0.4	1.2-1.6	5.0-6.0
1-2 years	0.4-0.5	1.6-1.8	6.0-8.0
Cows	0.8-1.0	1.8-2.0	11.0-12.0
Pregnant cows	1.0-1.2	8.5-10.0	15.0-20.0
Bulls*	1.0-1.2	9.0-11.0	20.0-22.0

Floor space requirements for cattle and buffalo shed

Type of animal	Covered area	open area	No of pens required
Cattle	3.5m^2	7.0m^2	50 / pen
Buffaloes	4.0m^2	8.0m^2	50 / pen
Down calver	12.0m^2	12.0m^2	1 / pen

Know the feeding and watering space requirements for your animals		
	Feeding space	Watering space

Cattle	75 cm / animal	75 cm/ animal
Buffalo	75 cm / animal	75 cm/ animal

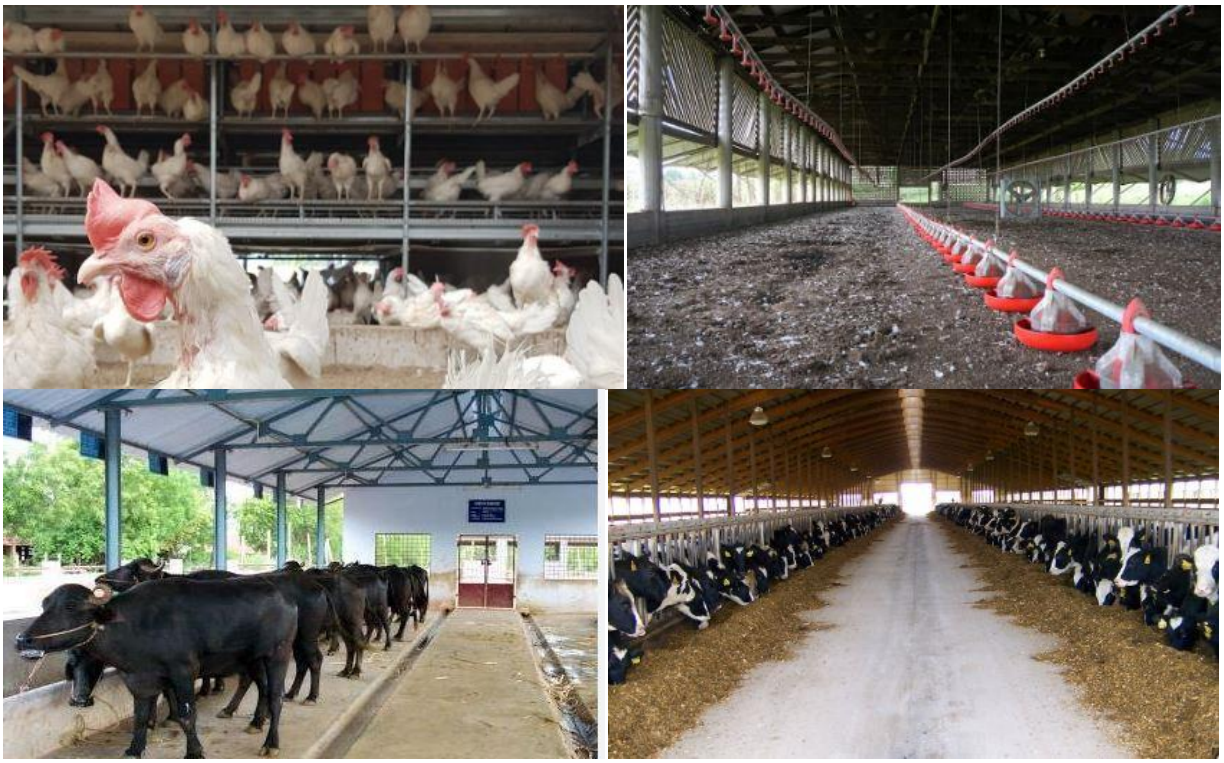


Fig. Housing of livestock and poultry

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Chapter 4.

Management of calves, growing heifers and milch animals

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Care and management of the New-Born calf

Remove the mucus from the nose and mouth and clean it. If the calf does not start breathing, artificial respiration should be used by pressing and relaxing alternatively, the chest walls with hands. Another method is to hold the calf by the rear legs and lift from the floor with the head down. This may be repeated several times and helps in restoring respiration.

As soon as the calf starts breathing, observe as to whether the navel cord is still attached. The navel cord should be disinfected. The navel cord of the calf is tied about 2.5 cm away from the body and cut about one centimetre below the ligature. Apply tincture of iodine to the cut end and repeat it 2-3 days. This will prevent infection. Then, if the cow does not lick the calf dry, or if the weather is cold, the herdsman should wipe the calf to clean and dry. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment

(Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success

(Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived

from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

The next important step to follow is to feed the Colostrum within 15 minutes of calving, the calf should be fed with colostrum at the rate- 1/10th of body weight and buffalo calves at the rate - 1/15th of body weight. Colostrum containing low fat, high protein, vitamins and minerals forms a balanced feed for new-born calves. This helps to protect the calf against various diseases as it contains antibodies. Colostrum also helps to eliminate the material accumulated in the digestive tract before it was born.

If muconium (first faecal matter) is not voided out, mild enema by dissolving soap in a liter of warm water should be given.

Weaning: If weaning at birth is followed care should be taken to see that adequate colostrum is fed for the first 3-4 days. If weaning is practised 4 days after calving, then further ration has to be fed as per the schedule described.

Calf rearing system varies with the facilities available to farmers. They may be reared indoors or outdoors or partly indoors and partly outdoors. The important factors to be considered are:

1. Availability of quality fodder.

2. The humid tropical environment is ideal for the proliferation of internal parasites and it is very difficult to keep the calves free from massive infection if they are grazing.

3. Outside grazing may not provide sufficient nutrients from optimum growth.

4. Climatic stress affects growth and utilization of feed nutrients. In humid tropics, it may be desirable to keep the calves indoor in day time and outdoor at night. This will reduce parasitic infection also. Thus, it is advantageous to keep new born calf in individual pen for the first 3-4 weeks of age. Calves that are running in batches often suckle or lick each other after feeding and it is a good animal's practice to keep them in their ties for some time after milk feeding. Hair swallowed by the calves after suckling each other often form a hard ball in the abomasum and this is a constant cause of digestive disturbances. Cleaning the mouth of the calves after each milk feeding is a sanitary practice. The calf pens should provide comfort and easy cleaning.

Identification : This is essential for good management, especially in breeding farms. The best method of permanent identification is by tattooing the inside of the ear with indelible ink. Metal ear tags or button with letters and numbers may be inserted in the ear as a means of

identification. Neck strap or neck-chain with a number plate attached, make an easy method of identification.

Body weight: of the calf is recorded on a balance along with length, breadth and height for the computation of milk allowance. Well fed cross bred calves on an average should gain 400 grams a day or 2.5 to 3 kilograms per week.

Removal of supernumerary teats is also important and this has to be carried out before development begins. This is usually done in the first month of age with the help of a short pair of sterile scissors. If the extra teat is at the base of the normal teat, veterinary help may be resorted to remove it. Dehorning or disbudding: Disbudding is carried out either by the use of hot iron, caustic sticks and electrical dehorning cone. Both the buds are destroyed at the early age (within 3 to 10 days).

Feeding Management: Utensils in which whole milk or milk replacer is fed to calves, must be clean and should be cleaned after each feeding. Severe digestive upsets can results from such contamination of the feeding parts. Either the nipple pail or the open type bucket are satisfactory for feeding milk or milk replacer. It may take less effort to teach a calf to nurse from a nipple pail than to drink from an open pail. Also, a rapid consumption of milk from an open pail may at times cause digestive upsets.

To teach a calf to drink from an open pail, place your fingers in its mouth and after it starts to nurse lower its head into a pail of warm milk or milk replacer. It may be necessary to repeat the process several times. A stubborn calf may need to be backed into a corner and restricted by standing aside its neck. Maintaining the temperature of the milk as removed from the cow is not necessary. However, it should be aimed to feed the milk at this temperature itself. However, cold milk at 350 to 400 F may cause calves to shiver and chill. At any rate, calves should not be overfed.

Care and management of heifers.

1. Heifers are reared indoors, outdoors- 9-12 months.
2. Outdoors-protection from the adverse climatic condition ,rain, hot sun, snow, heavy winds biting flies , parasitic infestation.

3. Exotic breeds-Heifers performance is slow in tropical areas in the outdoors.

4. Small breeds –Age at first breeding -15 months. Large breeds-18 months.

5. Adequate live weight would be 200-225 kg for smaller breeds and 275 kgs for the larger breeds.

6.Cross bred heifers show signs of heat as early as 10 months of age but none of them are mated until attain the body weight of 225/275 body weight or a minimum of 14 months age.

7. Age at first calving 25-28 months.

8. Feeding of Heifers.

A. Concentrate feed :

a. 3 months- 1 year : 1 kg.

b. Above one year : 2 kg.

c. Pregnant Heifers : 3-3.5 kg.

B. Green Fodder

a. Leguminous fodder : 10 kg.

b. Non Leguminous fodder : 25 kg.

C. Dry fodder: 3 kg.

9. Vaccination Schedule.

Brucell Strain 19 –to prevent abortion due to Brucellosis-Vaccinated at the age of 4-6 months of Calf.

Other Contagious Disease Vaccination are done accordingly prior to the prevalence of disease and prior to rainy season

Foot and Mouth disease : Once in 4 months/9 months/12 months.

Rinderpest : 1-3 years.

Haemorraghic Septicaemia: 1 year.

Anthrax : 1 year.

Black Quarters : 1 year.

Housing : Already discussed in the housing Class.

a. Outdoor system / Grazing method b. Indoor method

a. Reared chiefly of grazing

1. Care to be taken not to overstock on limited grazing land.
2. Rotational grazing.
3. Arrangement of shade and drinking water – pasture land
4. Concentrate feed is to be provided – Centrally located feed trough.
5. Protect from rain.

b. Indoors

1. Management in covered area.
2. Sufficient concentrate feed and fodder provided.
3. Steaming up of heifers.

Feeding grains to pregnant heifers prior calving at 1.5 Kg. per day. It helps in their growth, bear the stress of foetus. It produces more milk after calving and increases lactation length.

Training of heifers.

Heifers in early stage should be lead with halter to make them docile.

Pregnant Heifers are to be housed along with milking cows atleast a month prior to calving.

The udder should be washed warm water and mopped with cloth to accustom her to feel the hands in this place. Just few days prior to calving pulling teats slightly may be practiced so that heifer would not excited.

Control of Parasites – Dewormed periodically – 4 – 6 months intervals

Grooming is to be practiced to avoid ecto- parasites.

Care and Management: Lactating animals.

1. Protection against inclement weather.
2. Housing – Discussed earlier – space requirement.
3. Hygiene and sanitation of cattle shed and animals grooming, washing, disinfection etc.
4. Feeding a) concentrate – DM, DCP TDN b) Roughages – GF – L, NL – DF

Thumb Rule : 450 –500 g Concentrate / Kg. milk production

DCP 15% : TDN 75% : M.33% GNC : 25% Wheat Bran : 40% Mineral Mixture : 1%

Salt : 1%

Green Fodder – 1/3 L : 2/3 NL

5. Peak yield – 6 week – ‘ca’ definition 1-1-1.3/1.18 g ca : 1.1/1.0 g ‘p’

Supplemented : Lime coat manger : ca i/v injection

6. Breeding – 60 days after calving does not come to heat – check with veterinary Doctor.

7. Artificial Insemination – Pregnancy verification – 90 days

conception delayed – 2 A.I : check – 13-14 month calf.

8. Pregnant – 45 – 60 days period.

9. Drying – withdraw concentrate : feed dry fodder : milking alternate M/E –4 days.

10. Periodical vaccination

RP, Bq, Hs, Anthrax Once in a year.

Foot and mouth – once – 4 months.

11. Isolation of pregnant animal

Gilmore (1952) reproductive efficiency

RE = 12 x No.of calves born/(age of cot (month) – Age at 1st breeding) + 3 x 100 = 12 x 4 / (60-15) + 3 x 100 =

12 x4/48 x 100 = 100%







Fig. Management of calves, growing heifers and milch animals

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Chapter 5.

Management of Sheep, Goat and Swine

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Goat is a multi-use animal which is commonly reared for the meat (chevon). In the different parts of the world, goat is raised for the meat, milk, wool and leather. Goat is also called "the poor man's cow". The goats can be reared in different ecological zones; hence, people are adopting goat farming as an enterprise. Sheep and goat are belonging to different species, but their management is almost similar. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally

homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair,

yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for

the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Management (fodder, feed, shed, disease and parasite control)

After purchasing goats, an entrepreneur needs to manage shed construction as per the suitable to climate, nutritious feeding, treatment of diseases and vaccinations, control and timely treatment of goats from internal and external parasites.

Reproduction

After ensuring appropriate management of doe, it becomes ready for reproduction. The mating should be ensured that parturition does not fall in the month of Ashad/Shrawan (July/August) and Poush/Magh (November/December), as it would be difficult to take care of new born kids.

Feeding Management for goats

Feeds of goats and habits of searching feed

Goats have larger belly comparatively to other cattle, and can eat smaller grasses which other cattle cannot. Goats can also eat bitter grasses. Goats can eat dry matter equivalent of 4% of its own body weight. Goats can produce more meat, milk by taking substandard grass than other cattle. Goats do not like to eat wet and filthy things.

Feeding Management for smaller kids

Offspring needs to be fed with milk for 2-3 times in a day so that kids can be protected from diseases. After two weeks, progeny can have soft grass and feeds. Kids must be weaned from its mother after 10-12 weeks, and feed more forage and feeds with protein.

Feeding Management for adult goats

After 4 months of parturition, Doeling and Buckling should be kept in separate from preventing unnecessary mating behaviors from bucks to doeling. It is necessary that growth of Boer cross kids should be 50-150 grams per day; if it is not measured, it should be learnt that there is a problem in feeding management. As possible as for the whole 24 hours, green forage and fodders should be kept in the place of stall. Salt and other multi-nutrients minerals cake and clean water adequately needs to be fed to goats. Diet of goats and kids based on its weight has been given as followings:

Necessary feed of goats based on its weight

Weight of goat (kg)	Milk intake (ml per day)	Concentrate feed (gm. per day)	Green fodder (kg per day)
22	400		
33	500		
4	600		
5	600	50	as much as the consumed amount
6	700	100	“
7	700	150	“
8	600	200	“
9	500	250	“
10	300	350	“
15	200	350	“
20		350	about 2kg)
30		350	about 4kg
more than 30		400	about 5kg

Source: Central Sheep and Goat Promotion Office, Harihar Bhawan

Tagging kids for identification

For the proper management of Commercial Goat Farming, to identify goats, tagging is necessary. Tagging helps to identify productive and unproductive goats from the herds and thus helpful in managing feeding and culling. When kids become 1-2 weeks older, it would be better to tag

appropriately. In kid's ears, such plastic or metal tags can be given. Or, kids can be given the number in the ear by using color tags.

The benefits of tagging are given below:

• Helpful to keep the record and identify the goats.

• Helpful to keep the record of reproduction and health record of goats.

• Helpful for appropriate management of goats.

• Easy for searching in case of theft or missing.

• Easy to submit as evidence to Insurance Company for insurance or claim

Management of goat shed

Introduction of farm shed/barn

As for living human needs house; goats do also need shed/barn. Some people have raised goats together with barn of cattle; but for commercial goats farming, it is good to have goats shed constructed separately for better care. By using local materials, goat farming shed should be constructed resilient to earthquake. As per ages of goats, separate spaces should be allocated within the shed. Kids should be kept into clean, dry and warm spaces to protect from potential pneumonia. It is appropriate to lay dry and soft grass in the floor. A space from 0.2 to .5 square meters is necessary from parturition to 3 months older per kid. Problem due to internal parasites for the kids arises in wet and damp places, therefore shed should be maintained dry and warm.

Important things to be considered in shed management

• It has to be covered the shed with Jute sacks to protect goats from cold in the winter, but at day time (except during rainy and cloudy day); it is hygienic to let the sun-light enter inside the shed by rolling up the sacks.

• It has to be removed the dung deposited under the shed at least twice in a week. If dung deposit is not removed time to time, with the gas emission and filth, it will adversely affect health, growth and reproduction capability of goats, and it rises death rate of small kids also.

• It has to be cleaned regularly feed container for goats.

• It has to be applied fencing wires for the safety of livestock.

• It has also to be disinfected the shed by limes to control external parasites for goats.

Plan for feeding safety

For the livestock raising and production purpose, management of feeding should be carried out appropriately. Best feed for livestock is green grass. Grasses from grounds obtained from pastures, edges of farmlands, forage and fodder plants are the major sources of feeding for livestock in Nepal. Therefore, availability of different types of grasses from grounds should be ensured throughout the year, and forage and fodders have to be planted. Similarly, while grazing goats, it is better to take cyclic order than to graze in one place, so that new leaves can grow up. At the time of availability of adequate grasses, it's better to make hay and silage for storage and feeding in winter.

Basic feeds for Goats

(A) Pure water: 5 liter is necessary for a goat per day

(B) Forage and fodder: There are different goats based on its weight. The required forage and fodder for goats based on its weight is as followings:

Table No. Required forage and fodder for goat based on weight

Goat	Forage and Fodder
Growing kids (Up to 10-15 kg)	2- 3 kg per day
Small goat (Up to 20 kg)	4 kg per day
Medium goat (Up to	5 kg per day
Big goat (Up to 30 kg)	6 kg per day

Source: Central Sheep and Goat Promotion Office, Harihar Bhawan

(C)Concentrate Feed (Balance diet):

Compulsorily concentrate feeds are given to especially sick goats, recovering doe, pregnant and growing young kids in shed.

Materials used for making goat's feed

Raw materials		Raw protein in percent
Non-leguminous crops	Maize	10

	Wheat	10
	Rice bran	12
	Wheat bran	14
	Jai	9
	Barley	10
	Millet	11
Leguminous crops	Soybean or bi-product of Soya (PINA)	41
	Bi-product of oilseeds (TORIKO PINA)	27

(D)Salt and minerals block: Method of making salt and minerals block/cake are as followings:

• Necessary materials:

- Red clay – 2 kg
- Salt – 0.5 kg
- Wheat Floor – < 0.5 kg, as per need
- Egg shell – 25-30 pieces
- Water- as per need

• Preparation method:

- Mince red clay into dust, screen it before use.
- Mince egg shell to dust
- Mixed dust of red clay, dust of egg shell, salt and white floor in a pot. Add adequate water to shape it as cake/block, otherwise thinner mixture, it is difficult to prepare a cake/block.
- The volume of mixture is enough for making 2-3 cakes/blocks.
- Shape of Cake/blocks should be made rectangular or circle; and in the middle, there should be made small hole for hanging.
- After 4-5 days, the prepared mineral cakes/blocks are ready for use.
- Mineral cake/block should be placed where goats can easily lick it, and it should be placed for goat to lick it at once in a day.

Feeding method

- For easy feeding to goats, forage and fodder are always given in stall-fed, and if stall-fed remains empty, it shows inadequacy of forage and fodder to goat.
- Twice in a day, goats should be fed in the morning and evening; and changing of water and feeding time table should be maintained at the same time.
- Unnecessarily, feed should not be over fed to goat. Over feeding may cause bloat out stomach and sometimes goat can die.

Reproduction/Breeding Management

Introduction to reproduction of goats

The estrous cycle for doe is 21 days; in 21 days doe gets in heat, and searches buck for mating. After mating, doe gets pregnancy for 5 months or 150 ±5 days. Breeding of doe is not fixed on season/time. The crossbreed of Boer and Khari, it gives birth to single kid in its first parturition, and second time onward, it can give birth to two kids. Well fed, well-nourished does can have estrous cycle in the winter and summer too. Availability of adequate forage and fodder; and in environment moderate with temperate, in between the month of Bhadra (July/August) to Kartik (October/November) more cases of does are found in heat. In high hill and Mountainous belts, always does do get heat in hot months.

Major signs of does in heat

• Wagging her tail
• Less willing to take feeding, forage and fodder
• Suddenly reduced milk production
• Continuous bleating
• Mucus seen in the vagina
• Reddish and swollen valve
• Mounting to buck and goat whatever comes in front

Reproduction Age (For Boer Cross)

• Doe – >18 kg (approximately 7 month to 7 years)
• Buck - >25 kg (approximately 8 month to 5 years)

Doeling usually are in estrous cycle before 7 months, but as it has no physical growth, it is not good for mating. In 3 months, doeling do get in heat but considering its maturity, mating with buck is prevented.

Management of Buck and Doe

Importance and introduction of buck and doe management

The farm management activities have special role, and taking care of buck and doe for obtaining maximum benefit from commercial goat farming. Therefore, good management of doe and buck is important. Comparatively buck needs more feeds and exercise than does, and as according to time, it needs special care for doe (pregnant doe, expecting doe, parturition doe, dry doe). Generally, does can be used up to 7 years; whereas, buck can be used up to 5 years for breeding purpose in case of Boer cross breed. If any problems occurred in this period, the goats can be used as meat. And, its productive period can also be extended if it has good reproductive capacity.

Feed and hoof management for buck

• Feed management – During mating, buck usually runs after doe without eating. Therefore, farmers need to pay heeds to buck's weight. If weight gets lesser, then buck is given more feeds. If buck gets heavy, reproduction becomes difficult; in such case weight needs to be loosened. If breeding capacity of buck is decreased or in-active, the eggs with flour should be mixed and feed to buck so that it helps to resumes its health condition.

• Hoof management –Time to time, goat's hoof must be trimmed otherwise it may start rotting on. Due to long hoof, it may face difficulty in walking and at the time of mating also. If goat is reared in the shed only, trimming of hoof may be necessary, but in open grazing, it may not be required.

Health and Nutrition Management

Health: Introduction and Importance

Health management is an important and integral part in goat farming. Through goat management, it is necessary to improve the productivity of goats, such as: general health management, parasite control, vaccine management, environment management and proper record

keeping. Health management in farm level includes proper care taking of health of pregnant doe, newborn kids, youth and adults. Similarly, health management help to reduce the mortality rate of newborn kids, and it provides knowledge, skill and practice of control of infectious diseases. 'Prevention is better than cure', the statement best fits for livestock too. In healthy livestock, better immunity and recovery is quicker. But, if livestock fall sick, farmer must buy medicines, and it increases cost also. Treatment of disease must be faster; otherwise it will be very difficult to treat.

Methods of recognizing sick and ailing goats

Ailing goats show different symptoms as per the nature of diseases. But, normally sick goat shows as followings:

• Droopy, poor or no appetite
• Stays aloof from herd
• Loss of smartness and hair get risen, standing hunch
• Coarse and dull skin
• Low physical growth rate
• Red eye, runny and watery eyes
• Pulse speed (it can be felt by touching interior side of rear thigh), breathing, variant temperature than usual and stinking breathing
• Loose feces, mixed with blood or mucus
• Dark yellow pee and sometime blockage of urine,
• Floating saliva from mouth etc.

Tasks to keep the goats healthy

• Feed adequately and quality feeds along with clean water
• Know major diseases and vaccinated against those diseases
• Control of internal and external parasites
• Keep ailing goat/s separately and do not mix with healthy goat/s
• Thoroughly screen at the time of bringing new livestock/goat
• Construct good shed to protect from unsuitable climate

Major diseases in goats

Bloat in goat

• Causes:

- By overeating damp and very old fodder
- By overeating legume pastures or crops
- By overfeeding the concentrate feeds

• Symptoms:

- In the beginning of this disease, seems depressed, loss of appetite and bulging starts from left flank of belly,
- Difficulty in breathing, striking legs, bleating,
- In some cases, goat death is found in pasture also.

• Treatments:

- Hold frontal legs of goat and massage in left flank of belly
- Drench oil or feed paraffin liquid to goat
- Contact to technician if these treatments do not heal
- Do not feed more crops or leguminous forage to goat

Diarrhea (Loose feces)

• Causes:

- Small kids usually get affected.
- Causes of diarrhea are consuming impure milk, too much milk or colostrums.
- Certainly, changes in environment may also cause diarrhea.
- Diarrhea can also be caused by virus and internal parasites

• Symptoms:

- Looks like in pain in belly, not interested in feeding and watery feces
- If diarrhea persists for long time, body may go with dehydration, cannot stand, and goat's eye and temple get sunken

• **Treatment:**

- Diagnose the real diseases and do the treatments accordingly,
- Goats are in dehydration, so feed enough water and liquid. If necessary, give intravenous treatment by giving saline water.
- If it is due to cause of virus, then as per advice of technician, medication to be started.

Pneumonia

• **Causes:**

Virus, Bacteria, parasites and environmental effects etc.

• **Symptoms:**

- Droopy goat/s in the beginning
- Raised temperature-fever and coughing
- Dark discharge from nose
- Difficulty in breathing and fast breathing

Treatment and control:

- With the help of technician, administer injection of antibiotic
- Keep separately the sick goat/s from herd
- Manage transportation of goats with less stress
- Keep shed dry and cover with jute sacks in cold
-

Method of feeding newborn kids

• Newborn kids must be fed colostrums within 1 hours of birth. It provides immunity to kids, helpful for defecation of first soft feces, and helpful in intestinal cleansing. But, if kids are let feeding more milk, then diarrhea may occur.

• After 3-4 months, soft legumes grass should be started to give to kids

Sheep Management

- Your primary goal is to reduce stress through good management, nutrition and proper health care.
- Observe animals daily by looking at their behavior and their movement — watch for any limpers (catch, examine and treat if necessary) and for animals hanging back or that don't get up to feed.
- Gently handle all sheep, refrain from yelling, yanking legs and horns and pulling wool.
- When handling sheep, squeeze them into a small space with a gate.
- Sheep typically move away from a rattle and a crook. There is no need to hit.
- Facilities should include an easy way to catch and restrain animals for observation or treatment.
- Provide adequate space for each animal based on its size, breed and other recommendations.
- Manage facilities with sanitation and disease prevention in mind.
- Clean out pens at least yearly.
- Provide dry pathways for sheep to move to and from pasture.
- Provide daily outside access to a well drained area for sheep not on pasture (no mud).
- Move animals to new pasture based on the condition of the current pasture, its regrowth and parasite control. The average stocking density is five sheep per acre.
- Provide adequate fencing to keep sheep in and predators out.
- Permanently identify all animals with an ear tag or tattoo.
- If you plan to castrate ram lambs, do so before 14 days of age. If ram lambs are kept intact, separate rams from ewe lambs by 5 months of age.
- Dock (remove tails from) lambs before 14 days of age, if included in management system.
- Plan for breeding ewes based on your lamb market or your management system.
- Wean lambs at approximately 60 to 80 days of age.
- Consider checking ewes' pregnancy by ultrasound, if available.
- Dry ewes after weaning by feeding lower quality roughage, reducing water intake and not providing concentrate (grain).
- Observe or feel ewes' udders at weaning and daily for two weeks after weaning.

- Evaluate ewes with body condition scores two months before breeding and adjust feeding accordingly.
- Evaluate ewes with body condition scores after weaning and adjust feeding accordingly.
- Select replacement ewes from ewe lambs at 120 days of age, using records.
- Select replacement ewe lambs at 80 pounds.

Health

- Contact your certifier before using any product that is not included on your Organic System Plan (OSP).
- Have visitors use booties or foot baths to clean and disinfect footwear before entering barns or pastures.
- Provide a quarantine pen for at least three weeks for animals that are new to the farm. Be sure to trim and check all hooves of new sheep..
- Consider participating in the National Scrapie Eradication Program (www.aphis.usda.gov/animal_health/animal_diseases/scrapie/).
- Consider a vaccination program.
    - Vaccinate lambs for CD-T (clostridial diseases, including tetanus) two times, 21 to 28 days apart.
    - Vaccinate ewes with a CD-T booster annually.
    - Vaccinate with tetanus antitoxin before any surgery.
- Have a parasite management procedure in place.
    - Perform FAMACHA weekly or biweekly through the grazing season to check for parasite infection.
    - Keep sheep off feed for 12 hours before deworming with herbal or synthetic products.
    - Deworm sheep on a dry lot and keep them off new pasture for 24 hours.
    - Deworm only sheep that show signs of anemia.
    - Slaughter stock and breeding stock that are in the last third of gestation, as they cannot be treated with synthetic parasiticide.
    - Rotate pasture to reduce contact with parasite larvae.
    - Breed genetically resistant animals; cull susceptible animals.

- Trim hooves of all mature sheep one or two times per year, depending on growth. (Hooves are typically trimmed after shearing.)
- Give sheep a foot bath in 10 percent zinc sulfate solution weekly through the grazing season. Use junk wool or shavings in the foot bath to minimize splashing of solution. Protect your eyes by using safety glasses when mixing the foot bath solution.

Nutrition

- Provide minerals formulated for sheep free choice.
    - Selenium must be provided.
    - Copper should not be part of a mineral mix as it is toxic to sheep.
- Provide fresh water, free choice, 24/7.
- Provide adequate roughage (hay, silage or pasture).
- Provide adequate nutrition (pasture, high quality forage or grains) to brood ewes during the last third of gestation and until their lambs are weaned.
- Provide adequate nutrition (pasture, high quality forage or grains) to growing lambs via creep.
    - Creep feed of 20 percent protein is recommended.
    - Start lambs on creep feed at 10 to 14 days of age.
- Secure your hay source well before the hay is needed.
    - Line up the source early in the season.
- Test the nutritional content with a forage test in order to balance the ration and save on grain purchases.

Lambing

- Provide protection to the hands and arms of human females of child-bearing age if they assist ewes at lambing.
- Allow ewes adequate space to move about freely during pregnancy.
- Check ewes regularly before, during and after lambing.
- Identify lambs with ear tags or tattoos at birth or soon after.

- Observe lambs daily, watching for robust activity, full bellies (not starving), pneumonia and scours. Listen for possible wheezing and coughing.
    - Provide colostrum in the first 12 hours at a rate of 5 percent of body weight – e.g., a 10-pound lamb should receive 8 ounces.
- Keep ewes with their lambs in jugs (pens) for two to five days.
- Check each ewe's udder to be sure lamb(s) are using both sides.
- Clip; dip; strip (clip umbilical cord about an inch from the belly; dip it in iodine by tipping a bottle against the stub; strip the ewe to be sure she has milk and to remove possible plugs).
- Consider giving lambs 1/2 cc BoSE (selenium) when ear tagging.
- Separate ewes raising single lambs from ewes raising multiple-birth lambs and feed accordingly.

Breeding

- Flush ewes by providing a higher level of nutrition before and during breeding.
- Select rams based on soundness and traits sought.
- Evaluate rams for soundness 30 days before breeding.
- Turn in teaser ram two weeks before turning in ewes with breeding ram.
- Leave the breeding ram in with ewes for 36 days; every ewe will have cycled at least twice during that time span.
- Change the color of the breeding harness crayon or raddle every 18 days.

Wool and Shearing

- Shear sheep at least once per year. Some breeds are shorn twice annually.
- Have shearer disinfect equipment, electrical cords, cutter and combs before shearing.
- Have shearer wear clean clothing before handling and shearing your sheep.
- Keep sheep off feed for 12 hours before shearing.
- If you see any lumps on sheep while shearing, be sure to disinfect machinery before the next sheep, then cull that sheep. Lumps could indicate Caseous Lymphadenitis (CL), a contagious bacterial infection.

- Shear all white sheep first, then colored.
- Avoid second cuts when shearing.
- Skirt fleeces as they are removed from the sheep.
- Label wool to distinguish it from others (using sheep ewe tag numbers).
- Store wool in appropriate containers in a dry place.



Fig. Management of sheep, goat and swine

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Chapter 6.

Incubation, Hatching and Brooding

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Incubation, hatching, and brooding are three crucial stages in poultry production that determine the successful development of chicks from fertilized eggs. Proper management of these stages ensures high hatchability rates, healthy chicks, and efficient poultry farming. This chapter explores the science and techniques behind incubation, hatching, and brooding in poultry. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein

agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al.,

2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also

be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd’s man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Incubation

Natural vs. Artificial Incubation

Incubation refers to the process of providing the right environmental conditions for a fertilized egg to develop into a chick. There are two main types:

- **Natural Incubation**: The mother hen sits on the eggs to provide warmth and turn them periodically until they hatch.
- **Artificial Incubation**: The use of incubators to maintain optimal conditions for hatching eggs.

Requirements for Successful Incubation

To achieve a high hatchability rate, the following factors must be controlled:

1. **Temperature**: The ideal temperature for incubation is **99-100.5°F (37.2-37.8°C)**.
2. **Humidity**: Proper humidity prevents dehydration of the embryo. It should be **50-55%** during the first 18 days and **65-75%** in the last three days before hatching.
3. **Ventilation**: Fresh air supply is needed for oxygen exchange, as the developing embryo requires oxygen and releases carbon dioxide.
4. **Egg Turning**: Eggs should be turned **3-5 times daily** to prevent the embryo from sticking to the shell.
5. **Sanitation**: The incubator must be clean to prevent bacterial contamination.

Important incubation factors -

Obtain the best hatch by keeping the temperature at 100° F. throughout the entire incubation period when using a forced-air incubator. Minor fluctuations (less than ½ degree) above or below 100 degrees are tolerated, but do not let the temperatures vary more than a total of 1 degree. Prolonged periods of high or low temperatures will alter hatching success. High temperatures are especially serious. A forced-air incubator that is too warm tends to produce early hatches. One that runs consistently cooler tends to produce late hatches. In both cases the total chicks hatched will be reduced.

Maintain a still-air incubator at 102 degrees F. to compensate for the temperature layering within the incubator. Obtain the proper temperature reading by elevating the bulb of the thermometer to

the same height as the top of the eggs when the eggs are laying horizontal. If the eggs are positioned in a vertical position, elevate the thermometer bulb to a point just below the top of the egg. The temperature is measured at the level where the embryos develop (at the top of the egg). Do not allow the thermometer's bulb to touch the eggs or incubator. Incorrect readings will result.

Humidity is carefully controlled to prevent unnecessary loss of egg moisture. The relative humidity in the incubator between setting and 3 days prior to hatching should remain at 58-60 percent or 84-86° F., wet-bulb. When hatching, the humidity is increased to 65 percent relative humidity or more.

Frequently there is confusion as to how the measurement of humidity is expressed. Most persons in the incubator industry refer to the level of humidity in terms of degrees F., (wet-bulb) rather than percent relative humidity. The two terms are interconvertible and actual humidity depends upon the temperature (F.) as measured with a dry-bulb thermometer. Conversion between the two humidity measurements can be made using a psychrometric table.

Rarely is the humidity too high in properly ventilated still-air incubators. The water pan area should be equivalent to one-half the floor surface area or more. Increased ventilation during the last few days of incubation and hatching may necessitate the addition of another pan of water or a wet sponge. Humidity is maintained by increasing the exposed water surface area.

Ventilation is very important during the incubation process. While the embryo is developing, oxygen enters the egg through the shell and carbon dioxide escapes in the same manner. As the chicks hatch, they require an increased supply of fresh oxygen. As embryos grow, the air vent openings are gradually opened to satisfy increased embryonic oxygen demand. Care must be taken to maintain humidity during the hatching period. Unobstructed ventilation holes, both above and below the eggs, are essential for proper air exchange.

Eggs must be turned at least 4-6 times daily during the incubation period. Do not turn eggs during the last 3 days before hatching. The embryos are moving into hatching position and need

no turning. Keep the incubator closed during hatching to maintain proper temperature and humidity. The air vents should be almost fully open during the latter stages of hatching.

The eggs are initially set in the incubator with the large end up or horizontally with the large end slightly elevated. This enables the embryo to remain oriented in a proper position for hatching. Never set eggs with the small end upward.

In a still-air incubator, where the eggs are turned by hand, it may be helpful to place an "X" on one side of each egg and an "O" on the other side, using a pencil. This serves as an aide to determine whether all eggs are turned. When turning, be sure your hands are free of all greasy or dusty substances. Eggs soiled with oils suffer from reduced hatchability. Take extra precautions when turning eggs during the first week of incubation. The developing embryos have delicate blood vessels that rupture easily when severely jarred or shaken, thus killing the embryo.

Hatching

Hatching occurs after approximately **21 days** in chickens (varies for other poultry species). The process involves:

1. **Pipping**: The chick breaks the inner shell membrane and starts breathing air from the air cell inside the egg.
2. **Zipping**: The chick gradually cracks the eggshell in a circular motion.
3. **Emerging**: The chick pushes itself out of the shell completely.

Factors Affecting Hatching Success

- Incorrect temperature or humidity levels
- Poor egg quality (thin shells, cracks, or infertility)
- Failure to turn eggs regularly
- Bacterial contamination

Post-Hatching Care

Once hatched, chicks should be left in the incubator for **12-24 hours** to dry and gain strength before being transferred to a brooder.

Brooding

Brooding is the early stage of a chick's life where artificial or natural heat is provided to keep them warm and ensure survival.

Types of Brooding

- **Natural Brooding**: The mother hen keeps the chicks warm and protects them.
- **Artificial Brooding**: Heat sources such as infrared lamps, gas brooders, or electric brooders provide warmth.

Brooder Setup and Management

1. **Temperature Control**
    - Week 1: **95°F (35°C)**
    - Reduce by **5°F per week** until reaching **70°F (21°C)**
2. **Lighting**
    - Provide continuous light for the first few days to encourage feeding and drinking.
    - After the first week, a cycle of **16 hours light, 8 hours dark** can be used.
3. **Ventilation**
    - Proper airflow is necessary to prevent respiratory issues.
4. **Feeding and Watering**
    - Provide clean, fresh water at all times.
    - Start with high-quality chick starter feed with at least **18-20% protein**.
5. **Litter Management**
    - Use materials like wood shavings to keep the floor dry and comfortable.

Common Brooding Problems

- **Chilling** (due to low temperature) leads to weak chicks.
- **Overheating** causes dehydration and stress.

- **Coccidiosis** (a parasitic disease) spreads due to poor hygiene.



Fig. Incubation, hatching and brooding

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Chapter 7.

Management of Growers and Layers

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Effective management of poultry at different stages of growth is crucial to ensuring optimal productivity and profitability. Growers and layers represent two critical phases in the life cycle of egg-laying chickens. Proper care, nutrition, housing, and disease control at these stages can significantly impact egg production, bird health, and overall farm efficiency. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al.,

2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was

a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry

has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd’s man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Management of Growers

Growers are pullets (young female chickens) between 9 and 20 weeks of age. This period is critical for the development of a strong skeletal system and body weight necessary for optimal egg production later on.

Housing and Space Requirements

- Growers should be housed in a well-ventilated area with sufficient space to prevent overcrowding.
- The recommended floor space is 0.09-0.12 square meters (1-1.3 square feet) per bird in deep litter systems and 0.18-0.2 square meters (1.9-2.1 square feet) per bird in cage systems.
- Temperature control should be maintained at around 18-24°C (64-75°F) to prevent stress.

Nutrition and Feeding

- A balanced diet with appropriate protein, energy, vitamins, and minerals is crucial.
- Grower feed should contain 14-16% protein and a proper balance of calcium and phosphorus to support skeletal development.
- Birds should have access to clean drinking water at all times.
- Feeding should be consistent, with daily monitoring to avoid underfeeding or overfeeding.

Health and Biosecurity

- Vaccination programs should be followed to prevent common diseases like Newcastle disease, infectious bronchitis, and Marek's disease.
- Regular deworming and external parasite control should be implemented.
- Proper sanitation and biosecurity measures, such as footbaths and restricted farm access, should be in place to prevent disease outbreaks.

Lighting Program

- A controlled lighting program should be followed to prevent early sexual maturity and ensure proper growth.
- A gradual increase in light duration should be implemented starting from 8 hours per day to 12-14 hours by 18-20 weeks.

Management of Layers

Layers are mature hens from 20 weeks of age onward that are in their peak egg production phase. Proper management ensures maximum egg yield, quality, and longevity of the birds.

Housing and Space Requirements

- Layer birds can be housed in cage systems or deep litter systems.
- In cage systems, each bird should have a minimum space of 450-500 cm^2 (70-77 in^2) per bird.
- In deep litter systems, a minimum of 0.18 square meters (2 square feet) per bird is recommended.
- Nesting boxes should be provided in deep litter systems at a ratio of 1 nest box per 5-6 hens.

Nutrition and Feeding

- Layer feed should contain 16-18% protein with increased calcium (3.5-4.5%) for eggshell formation.
- Supplementation of vitamins A, D, E, and B-complex is important for maintaining productivity.
- Birds should have free access to clean water, with at least 500 ml of water consumption per bird per day.

Health and Biosecurity

- Regular vaccination against common poultry diseases should continue during the laying period.
- Routine checks for common health issues such as egg-bound conditions, feather pecking, and parasites should be conducted.
- Proper culling of unproductive or sick birds should be done to maintain flock efficiency.

Egg Collection and Handling

- Eggs should be collected 2-3 times daily to prevent breakages and contamination.
- Nesting areas should be kept clean to maintain egg hygiene.

- Eggs should be stored in a cool, dry place at around 10-15°C (50-59°F) and 70-80% humidity.

Lighting Program

- Layers require at least 14-16 hours of light daily to maintain consistent egg production.
- Artificial lighting should be used during shorter daylight periods to ensure uniform laying cycles.




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Chapter 8.

Important Indian and Exotic Breeds of Cattle, Buffalo, Sheep, Goat, Swine and Poultry

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1. Cattle Breeds

Cattle are an essential part of Indian agriculture, providing milk, meat, and draft power. They are broadly categorized into Indian (indigenous) and exotic breeds. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is

naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair,

yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for

the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

A. Indian Breeds

a) Milch Breeds (Dairy Cattle)

1. **Sahiwal** – Originates from Punjab; high milk yield with good fat content.
2. **Gir** – Found in Gujarat; known for high milk production and disease resistance.
3. **Red Sindhi** – Originates from Sindh (now in Pakistan); high adaptability and good milk yield.
4. **Tharparkar** – From Rajasthan; dual-purpose but primarily known for milk production.

b) Draft Breeds (Work Cattle)

1. **Amritmahal** – From Karnataka; known for endurance and strength.
2. **Hallikar** – Karnataka breed; ideal for plowing and transport.
3. **Kangayam** – Tamil Nadu breed; used for draft purposes.

c) Dual-Purpose Breeds

1. **Ongole** – Andhra Pradesh breed; good for milk and draft.
2. **Kankrej** – Gujarat and Rajasthan; good milkers and powerful draught animals.
3. **Hariana** – Haryana breed; moderate milk production and good draft capacity.

B. Exotic Breeds

1. **Holstein Friesian** – High milk yield; low-fat percentage.
2. **Jersey** – High butterfat content in milk; smaller size.
3. **Brown Swiss** – Adaptable to Indian conditions; good milk yield.
4. **Ayrshire** – Moderate milk yield; good adaptability.

Rare Cattle Breeds


Vaynol


Ankole-Watusi


Chillingham Wild


Canadienne


Kerry


Droimeann


Old Gloucester


Irish Moiled


Florida Cracker


Ancient White Park


American Milking Devon


Miniature Zebu


Panda Cow

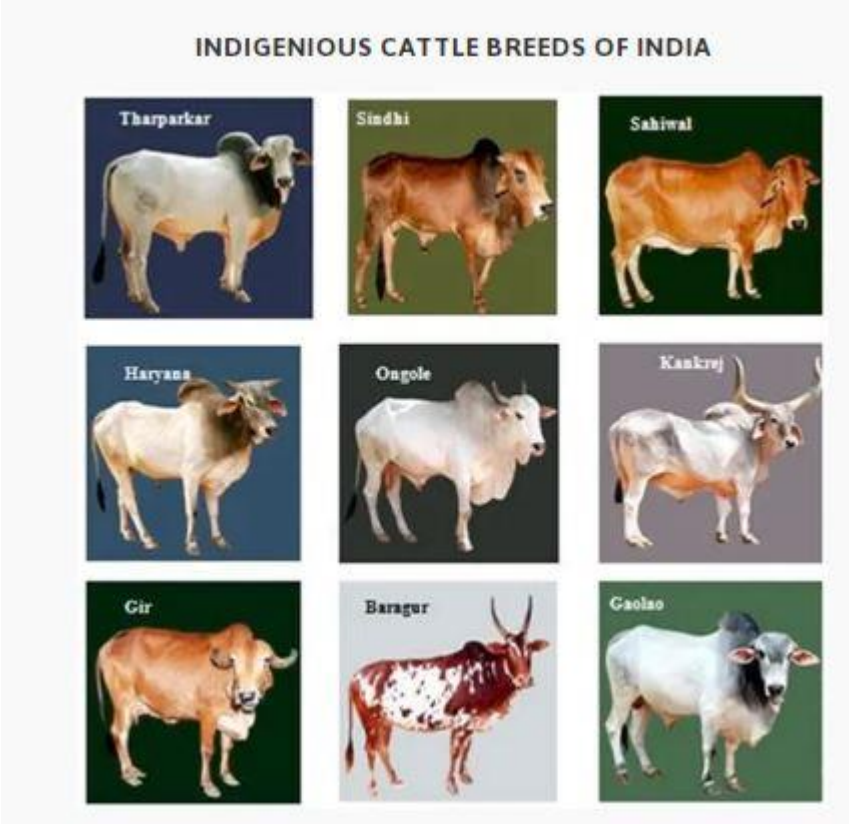

Vechur


Miniature Jersey


Pineywoods


Shetland


Whitebred Shorthorn



2. Buffalo Breeds

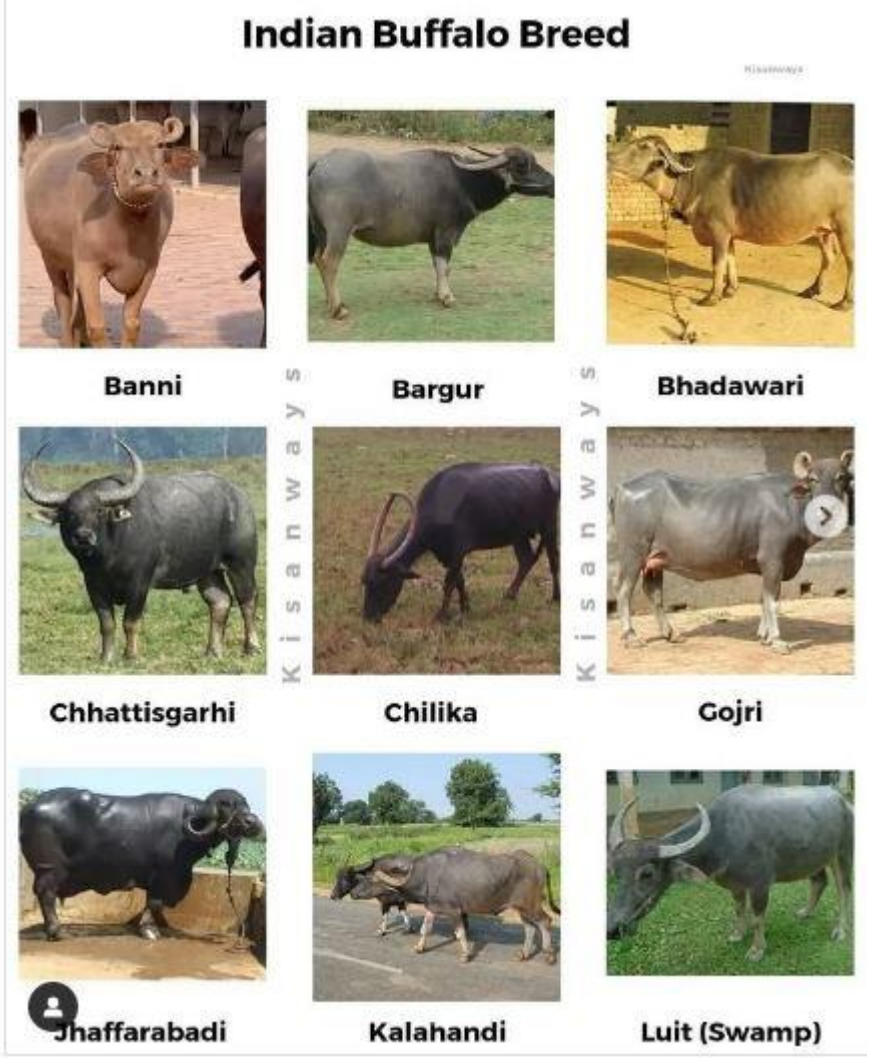
Buffaloes are widely reared for milk and draft purposes. They are more heat tolerant and resistant to diseases.

A. Indian Breeds

1. **Murrah** – Haryana, Punjab; best milch breed, high-fat content.
2. **Mehsana** – Gujarat; high milk yield.
3. **Jaffarabadi** – Gujarat; large-sized breed with good milk production.
4. **Banni** – Found in Gujarat; known for adaptability and high milk yield.

B. Exotic Breeds

1. **Nili Ravi** – Originates from Pakistan; excellent milk producer.
2. **Mediterranean** – Found in Italy and Egypt; moderate milk yield.



3. Sheep Breeds

Sheep are raised for wool, meat, and milk.

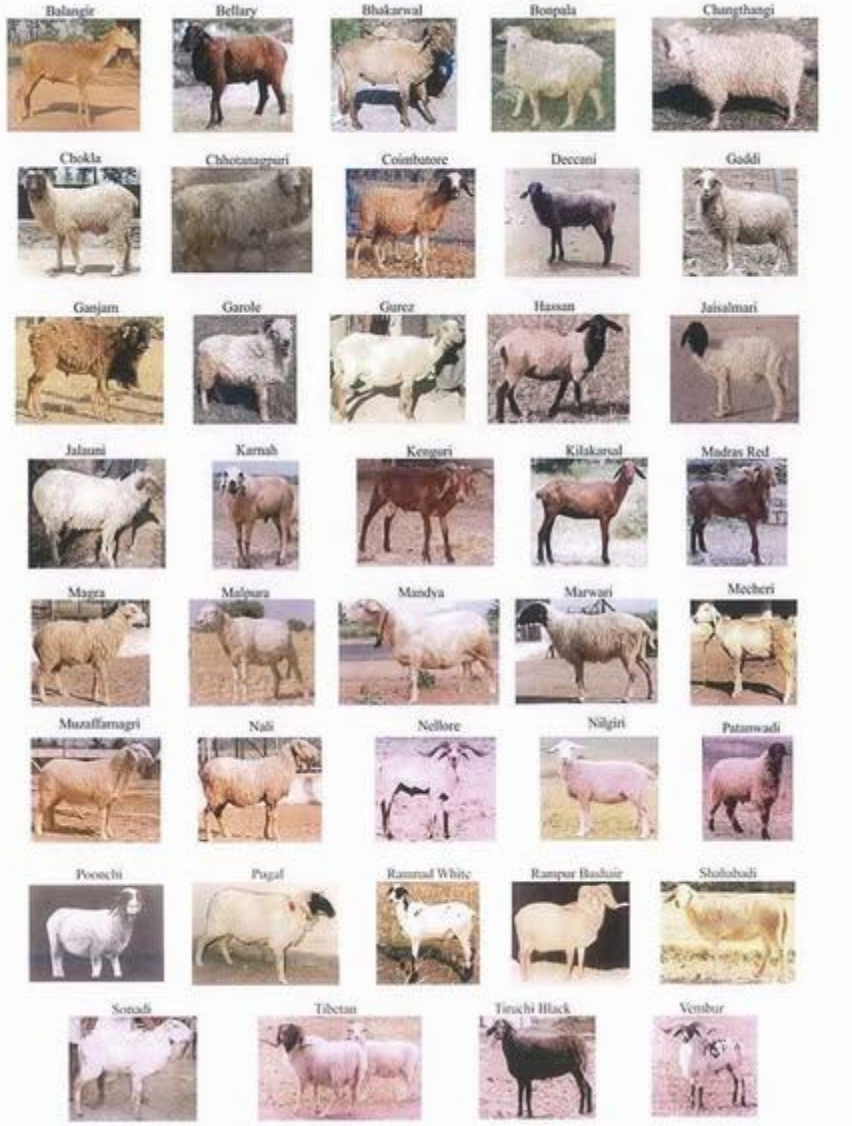
A. Indian Breeds

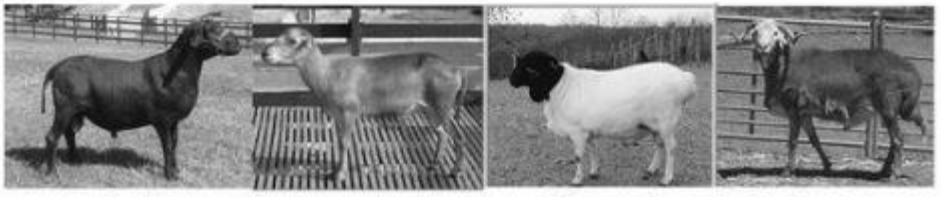
1. **Deccani** – Maharashtra, Telangana; hardy, used for mutton.
2. **Mandya** – Karnataka; good meat quality.
3. **Nellore** – Andhra Pradesh; fast-growing meat breed.
4. **Marwari** – Rajasthan; produces coarse wool.

B. Exotic Breeds

1. **Merino** – Fine wool; common in Australia and Spain.
2. **Rambouillet** – High wool quality.
3. **Dorset** – High meat production.
4. **Corriedale** – Dual-purpose breed for wool and meat.

Registered Breeds of Sheep in India





Santa Inês | Mora Nova | Somális Brasileira | Rabo Largo



Cariri | Bergamácia Brasileira | Crioula Lanada | Pantaneira

4. Goat Breeds

Goats are highly adaptable and provide milk, meat, and fiber.

A. Indian Breeds

1. **Jamunapari** – Uttar Pradesh; high milk yield.
2. **Beetal** – Punjab; good for milk and meat.
3. **Black Bengal** – West Bengal; excellent meat quality.
4. **Malabari** – Kerala; dual-purpose.

B. Exotic Breeds

1. **Saanen** – Switzerland; high milk yield.
2. **Alpine** – France; high adaptability.
3. **Boer** – South Africa; superior meat quality.



5. Swine Breeds

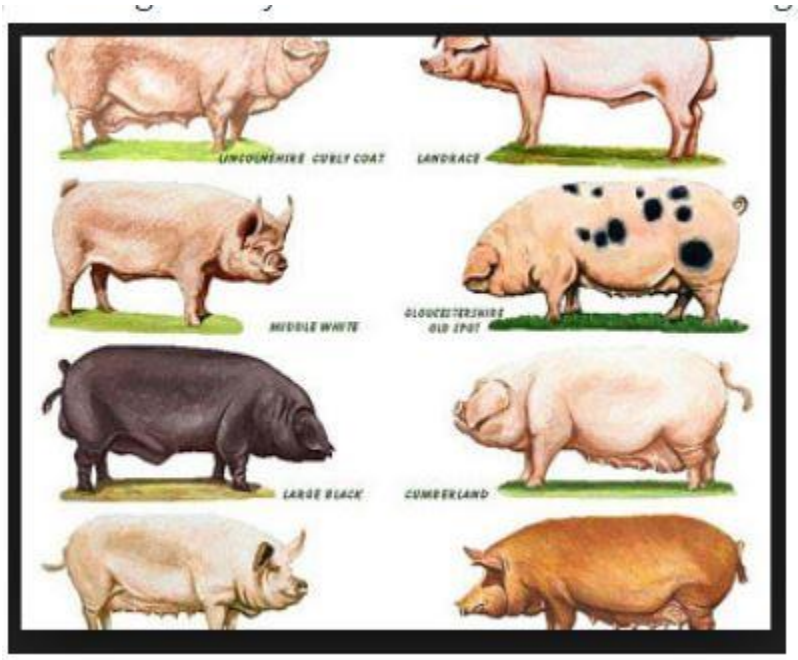
Pigs are reared for pork production.

A. Indian Breeds

1. **Ghangaru** – Found in Uttar Pradesh.
2. **Desi** – Indigenous breed; lower productivity but hardy.

B. Exotic Breeds

1. **Large White Yorkshire** – High meat production.
2. **Landrace** – Excellent mothering ability and high litter size.
3. **Duroc** – Fast-growing breed with good meat quality.
4. **Hampshire** – Known for good carcass quality.



6. Poultry Breeds

Poultry farming is vital for egg and meat production.

A. Indian Breeds

1. **Aseel** – Fighting breed; low egg production.
2. **Kadaknath** – Black meat breed from Madhya Pradesh.
3. **Chittagong** – High meat quality.
4. **Busra** – Found in western India; moderate production.

B. Exotic Breeds

1. **White Leghorn** – High egg production.
2. **Rhode Island Red** – Good dual-purpose breed.

3. **Sussex** – High adaptability and good egg production.
4. **Plymouth Rock** – Good for both meat and eggs.





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Chapter 9.

Improvement of Farm Animals and Poultry

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The improvement of farm animals and poultry is essential for enhancing productivity, profitability, and sustainability in animal husbandry. Farmers and breeders continuously strive to enhance desirable traits such as growth rate, disease resistance, fertility, and feed efficiency. Various methods, including selective breeding, genetic engineering, nutrition optimization, and improved management practices, contribute to the advancement of livestock and poultry. The improvement of farm animals and poultry is a continuous process that integrates selective breeding, genetic technologies, better nutrition, disease control, and enhanced management practices. By adopting modern techniques, farmers can increase productivity, improve profitability, and ensure sustainable animal husbandry. The future of livestock improvement lies in harnessing biotechnology, precision farming, and sustainable agricultural practices for global food security. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise

(Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953

they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al.,

2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd’s man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of

an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Principles of Animal and Poultry Improvement

1. **Selective Breeding**
   Selective breeding is the process of choosing superior animals with desirable traits to be parents of the next generation. This practice enhances productivity and genetic potential over time. It includes:
   - **Inbreeding**: Mating closely related animals to stabilize desirable traits.
   - **Outbreeding**: Mating unrelated individuals to introduce genetic diversity and reduce hereditary defects.
   - **Crossbreeding**: Combining two different breeds to create offspring with hybrid vigor (heterosis), which enhances growth rate and disease resistance.
2. **Genetic Engineering and Biotechnology**
   Advances in biotechnology enable genetic modifications to improve livestock characteristics. Key techniques include:
   - **Artificial Insemination (AI)**: Efficient breeding method that allows the use of superior male genetics without physical mating.
   - **Embryo Transfer Technology (ETT)**: Produces multiple offspring from elite females.
   - **Genetic Modification (GM)**: Alters DNA to enhance specific traits such as disease resistance and improved meat or milk production.
3. **Nutritional Improvements**
   Proper nutrition is vital for maximizing genetic potential. Improvements include:
   - **Balanced Diets**: Providing essential proteins, vitamins, and minerals for optimal growth.
   - **Feed Conversion Efficiency**: Developing feeds that are easily digestible and enhance weight gain.
   - **Supplementation**: Use of probiotics, prebiotics, and enzymes to improve digestion and immunity.

4. **Disease Control and Biosecurity**

   Disease outbreaks can severely affect productivity. Strategies for disease control include:

   - **Vaccination Programs**: Preventing viral and bacterial infections.
   - **Hygiene and Sanitation**: Maintaining clean housing facilities.
   - **Quarantine and Culling**: Isolating new or infected animals to prevent disease spread.

5. **Improved Housing and Management**

   Proper housing and management play a critical role in enhancing productivity and welfare. Key improvements include:

   - **Climate Control**: Providing optimal temperatures for growth.
   - **Space Management**: Avoiding overcrowding to reduce stress and aggression.
   - **Automation and Technology**: Using automated feeding, milking, and egg collection systems to improve efficiency.

Improvement of Specific Farm Animals

1. Cattle

- Selective breeding for higher milk yield (e.g., Holstein Friesian for dairy and Angus for beef).
- Use of high-quality fodder to increase weight gain and milk production.
- Disease-resistant breeds to reduce losses.

2. Poultry

- Crossbreeding for faster growth and higher egg production (e.g., broilers and layers).
- Improved housing systems like battery cages for increased egg yield.
- Disease prevention through vaccination and biosecurity measures.

3. Sheep and Goats

- Breeding programs for better meat and wool quality.
- Rotational grazing to optimize pasture use.

- Disease-resistant breeds to minimize mortality.

4. Pigs

- Genetic improvement for leaner meat and faster growth.
- High-energy diets for efficient feed conversion.
- Advanced breeding techniques such as AI.

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Chapter 10.

Digestion in Livestock and Poultry

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Digestion is a crucial physiological process in livestock and poultry, as it ensures the breakdown of complex food materials into simpler forms that can be absorbed and utilized for growth, reproduction, and maintenance. The digestive systems of various livestock species differ based on their dietary habits, anatomical structures, and digestive mechanisms. This chapter explores the digestion processes in ruminants (such as cattle, sheep, and goats), monogastric animals (such as pigs and horses), and poultry. Understanding the digestive systems of livestock and poultry is essential for optimizing feeding strategies and improving animal health and productivity. Ruminants rely on microbial fermentation, monogastric animals depend on enzymatic digestion, and poultry possess a specialized system for rapid feed processing. Proper nutrition and management practices tailored to each species' digestive system can enhance their overall performance and well-being. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this

enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent.

Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al.,

2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd’s man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of

an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Digestion in Ruminants

Ruminants have a specialized digestive system adapted for processing fibrous plant material. Their digestive tract consists of a four-chambered stomach, which includes the rumen, reticulum, omasum, and abomasum.

1. The Rumen

The rumen is the largest compartment and serves as a fermentation vat. It houses a diverse microbial population, including bacteria, protozoa, and fungi, which help in the breakdown of fibrous plant material. Microbial fermentation produces volatile fatty acids (VFAs) like acetate, propionate, and butyrate, which serve as the primary energy source for ruminants.

2. The Reticulum

The reticulum works closely with the rumen and is involved in the formation of cud. It helps trap foreign objects and facilitates regurgitation for further chewing (rumination), which enhances digestion efficiency.

3. The Omasum

The omasum functions as a filter that absorbs water and some nutrients. It also helps in grinding food particles before they pass into the abomasum.

4. The Abomasum

Also known as the "true stomach," the abomasum secretes gastric juices, including hydrochloric acid and digestive enzymes such as pepsin, to break down proteins. Digested material then moves into the small intestine for further absorption.

Digestion in Monogastric Animals

Monogastric animals, such as pigs and horses, have a single-chambered stomach. Their digestive system is similar to that of humans.

1. The Mouth

Digestion begins in the mouth, where enzymes like amylase in saliva start breaking down carbohydrates.

2. The Stomach

The stomach secretes hydrochloric acid and enzymes (such as pepsin) that aid in protein digestion. Unlike ruminants, monogastric animals rely primarily on enzymatic digestion rather than microbial fermentation.

3. The Small Intestine

The small intestine is the primary site of nutrient absorption. Enzymes from the pancreas and bile from the liver further break down carbohydrates, proteins, and fats.

4. The Large Intestine

The large intestine absorbs water and houses some microbial fermentation, which helps digest remaining fibers and produces essential nutrients.

Digestion in Poultry

Poultry have a unique digestive system adapted for processing grains and other feed components quickly.

1. The Beak and Esophagus

Birds lack teeth, so they use their beaks to pick up food, which then moves down the esophagus to the crop, a storage organ where food is moistened.

2. The Proventriculus

This glandular stomach secretes digestive enzymes and acids that begin breaking down food.

3. The Gizzard

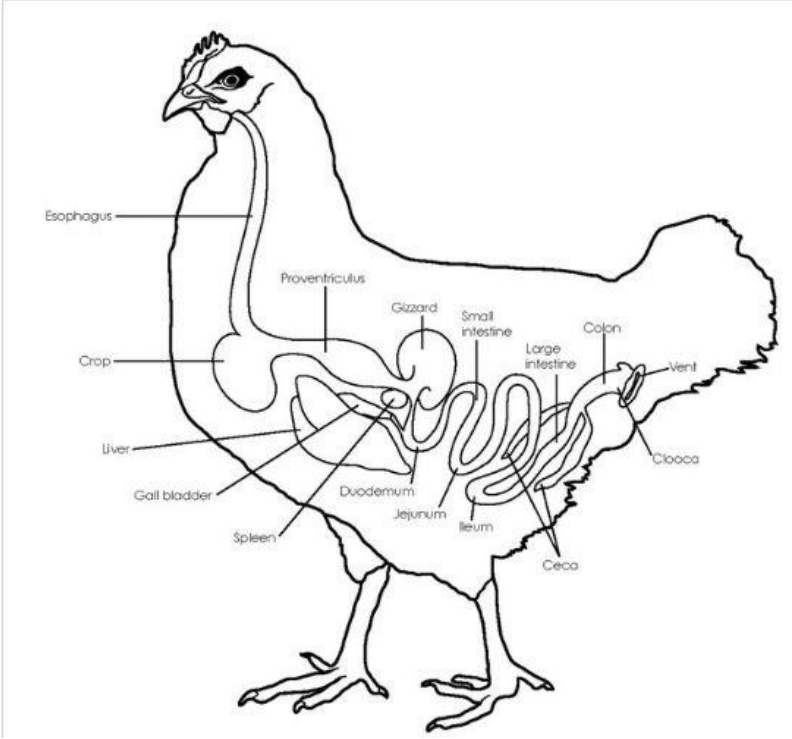
The gizzard is a muscular organ that grinds food using ingested grit or stones, aiding in mechanical digestion.

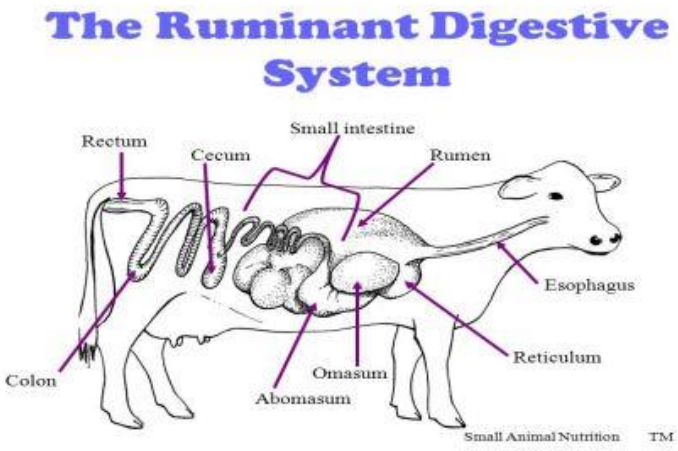
4. The Small Intestine

Enzymatic digestion and nutrient absorption occur in the small intestine, with assistance from the pancreas and liver.

5. The Ceca and Large Intestine

The ceca are two pouches that host bacterial fermentation, aiding in fiber digestion. The large intestine absorbs water and prepares waste for excretion.





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Chapter 11.

Classification of Feed Stuffs

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Feedstuffs refer to any material used as food for livestock and poultry to provide essential nutrients required for growth, reproduction, and production. Proper classification of feedstuffs is crucial for efficient animal nutrition management, ensuring a balanced diet that meets the specific needs of different species. Feedstuffs can be classified based on their origin, nutrient composition, and purpose in animal diets. Proper classification of feedstuffs is essential for formulating balanced diets that optimize animal health and productivity. Understanding the different categories based on origin, nutrient composition, and functional purpose helps farmers and nutritionists make informed feeding decisions. Efficient feed selection and utilization contribute to sustainable livestock production and improved economic returns. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921

million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and

Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al.

2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Classification Based on Origin

Feedstuffs can be categorized based on their source of origin as follows:

1. **Plant-based Feedstuffs**
    - **Cereal grains** (e.g., maize, wheat, barley, oats, rice)
    - **Legume seeds and pulses** (e.g., soybean, peanut meal, field peas, lentils)
    - **Forages and roughages** (e.g., pasture grasses, alfalfa, hay, silage)
    - **Crop residues and by-products** (e.g., rice bran, wheat bran, molasses, oilseed meals)
2. **Animal-based Feedstuffs**
    - **Animal protein sources** (e.g., fish meal, meat meal, bone meal, blood meal)
    - **Dairy by-products** (e.g., whey powder, skim milk powder)
3. **Synthetic and Mineral-based Feedstuffs**
    - **Synthetic amino acids** (e.g., lysine, methionine)
    - **Mineral supplements** (e.g., limestone, dicalcium phosphate, salt)
    - **Vitamin supplements** (e.g., vitamin premixes, probiotics)

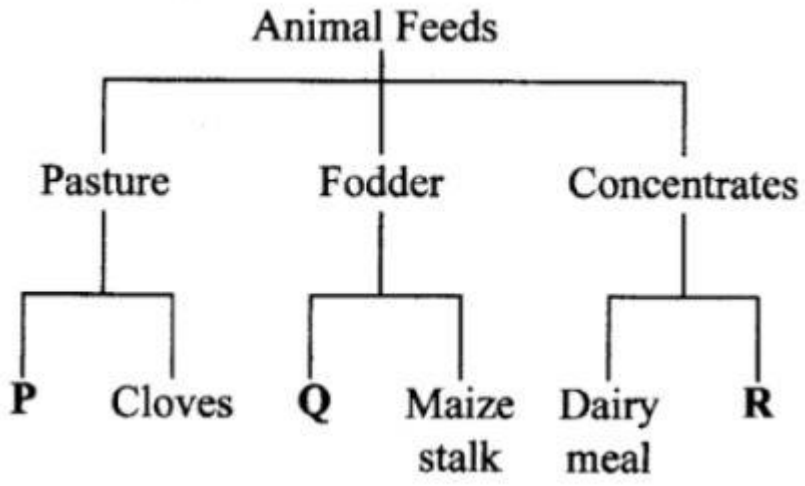
Classification Based on Nutrient Composition

Feedstuffs can also be classified according to the predominant nutrients they provide:

1. **Energy-rich Feeds**
    - Cereal grains (e.g., corn, wheat, barley)
    - Roots and tubers (e.g., cassava, sweet potatoes)
    - Fats and oils (e.g., vegetable oils, tallow)
2. **Protein-rich Feeds**
    - Leguminous seeds (e.g., soybean meal, peanut meal)
    - Animal-derived protein sources (e.g., fish meal, blood meal)
    - Non-protein nitrogen sources (e.g., urea for ruminants)
3. **Roughages and Forages**
    - Fresh forages (e.g., pasture grasses, clovers, lucerne)

- Preserved roughages (e.g., hay, silage, straw)
- High-fiber by-products (e.g., rice bran, wheat bran)

4. **Mineral and Vitamin Supplements**
    - Macrominerals (e.g., calcium, phosphorus, sodium)
    - Microminerals (e.g., zinc, copper, selenium)
    - Vitamins (e.g., vitamins A, D, E, K, B-complex)



Classification Based on Purpose in Animal Diets

Feedstuffs are also categorized based on their functional role in livestock diets:

1. **Maintenance Feeds**
    - Provide sufficient energy and nutrients to maintain body functions without supporting growth, reproduction, or production (e.g., pasture, hay, silage).
2. **Growth Feeds**
    - High in protein and energy to support growth and development in young animals (e.g., soybean meal, fish meal, cereal grains).
3. **Production Feeds**
    - Designed for animals in production phases, such as lactating dairy cows, laying hens, or meat-producing livestock (e.g., high-energy and protein-rich concentrates, vitamin and mineral supplements).

4. **Reproductive Feeds**
    - Nutrient-dense feeds formulated for breeding animals to ensure optimal fertility and fetal development (e.g., legumes, mineral-rich feeds).
5. **Medicated Feeds**
    - Contain added pharmaceuticals to prevent or treat diseases (e.g., feeds with antibiotics, anti-parasitic agents, or probiotics).

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Chapter 12.

Proximate Principles of Feed

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Feed plays a vital role in livestock nutrition, providing essential nutrients required for growth, maintenance, reproduction, and overall animal health. To evaluate the quality of feed, it is necessary to analyze its composition, which is systematically categorized using the proximate analysis method. This method classifies feed components into six fundamental categories known as the proximate principles of feed. These components include moisture, crude protein, crude fiber, ether extract (fat), ash, and nitrogen-free extract (NFE). Understanding these components helps in formulating balanced diets for animals and ensuring optimal productivity. The proximate principles of feed provide a foundational approach to feed evaluation, ensuring animals receive the necessary nutrients for optimal growth and performance. Although proximate analysis has limitations, it remains a valuable method in animal nutrition research and feed formulation. Understanding these principles allows livestock farmers, nutritionists, and feed manufacturers to make informed decisions in feeding strategies and overall animal management. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are

engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of

goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high

nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd’s man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G.

2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

The Six Proximate Principles

1. Moisture

Moisture content represents the amount of water present in a feed sample. It is a crucial factor in feed storage and preservation, as high moisture levels can lead to microbial growth and spoilage. Typically, moisture content is determined by drying a feed sample at a specific temperature (usually 105°C) until a constant weight is achieved. Dry matter, which includes all the other proximate principles, is obtained by subtracting the moisture content from the total feed weight.

2. Crude Protein (CP)

Crude protein is an estimate of the total protein content in feed, derived by measuring the nitrogen content and multiplying it by a factor (typically 6.25 for most feedstuffs). Protein is essential for growth, tissue repair, and enzymatic functions in animals. Common protein sources include soybean meal, fish meal, and leguminous plants. However, crude protein does not distinguish between true proteins and non-protein nitrogen compounds, which may affect the accuracy of nutritional assessment.

3. Ether Extract (EE) or Crude Fat

Ether extract measures the fat content in feed, which includes lipids, fatty acids, and fat-soluble vitamins. Fats are a concentrated source of energy, providing approximately 2.25 times more energy than carbohydrates. The ether extract method involves dissolving fat in an organic solvent (ether) and measuring the residue after extraction. Fat content is essential for maintaining body condition and supporting reproductive functions.

4. Crude Fiber (CF)

Crude fiber consists of the indigestible portion of plant materials, including cellulose and lignin. It is a significant component of forages and roughages, contributing to gut motility and overall digestive health. The analysis of crude fiber involves acid and alkaline digestion to remove soluble materials, leaving behind the fiber content. While fiber is necessary for ruminants, excessive crude fiber in monogastric diets can reduce nutrient digestibility.

5. Ash

Ash represents the total mineral content of feed, obtained by burning a sample at high temperatures (usually 550–600°C) until all organic matter is oxidized. The residue left behind consists of inorganic minerals such as calcium, phosphorus, magnesium, potassium, and trace elements. Minerals are essential for bone development, enzyme functions, and metabolic activities. However, ash content alone does not provide information about the bioavailability of specific minerals.

6. Nitrogen-Free Extract (NFE)

Nitrogen-free extract is a calculated value obtained by subtracting the sum of moisture, crude protein, ether extract, crude fiber, and ash from 100%. It represents the readily digestible carbohydrate content, including sugars and starches. NFE is a primary energy source for animals, particularly in cereal grains and other concentrated feed sources. While NFE is important, its determination is indirect and does not consider variations in carbohydrate digestibility.

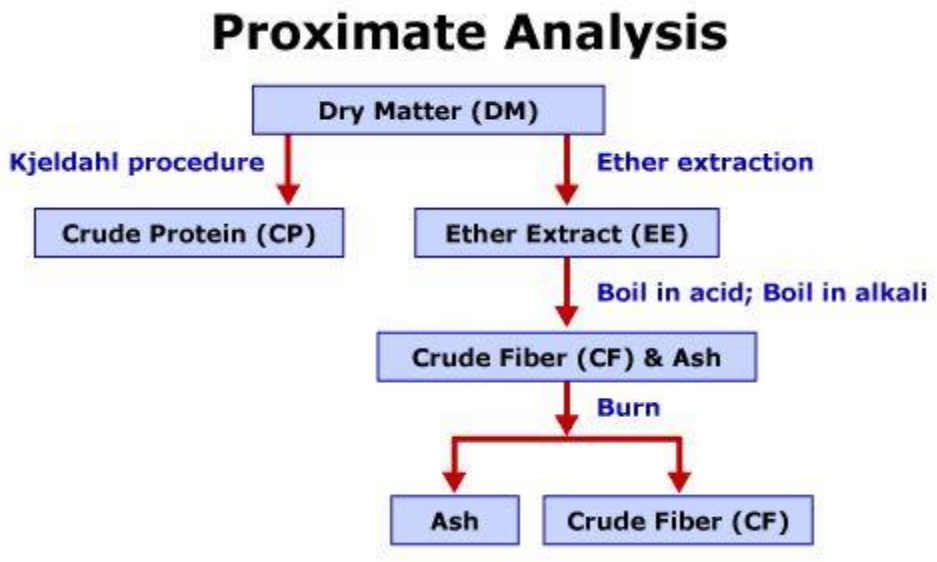


Fig. Flow chart of feed analysis

Importance of Proximate Analysis

Proximate analysis serves as a fundamental tool for evaluating feed quality and ensuring balanced nutrition in livestock. Some key benefits include:

- **Nutritional Assessment**: Helps determine whether a feed meets the dietary needs of animals.
- **Feed Formulation**: Assists in designing balanced diets to optimize productivity.
- **Quality Control**: Ensures consistency in feed composition and detects adulteration.
- **Economic Efficiency**: Prevents wastage by selecting cost-effective feed ingredients.

Limitations of Proximate Analysis

While proximate analysis is widely used, it has certain limitations:

- Crude protein estimation includes non-protein nitrogen (NPN), which may lead to overestimation.
- Ether extract does not differentiate between digestible and indigestible fats.
- Crude fiber analysis may not accurately represent fiber fractions like neutral detergent fiber (NDF) and acid detergent fiber (ADF), which are more relevant for ruminants.

- NFE calculation is indirect and may include errors.

To overcome these limitations, advanced techniques such as **Van Soest fiber analysis**, **amino acid profiling**, and **near-infrared spectroscopy (NIRS)** are used alongside proximate analysis.

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Chapter 13.

Nutrients and their Functions

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Nutrients are essential substances required by living organisms to sustain life, promote growth, and support various physiological functions. In animal nutrition, nutrients are categorized based on their chemical composition and role in metabolism. These include carbohydrates, proteins, fats, vitamins, minerals, and water. Each nutrient class plays a unique role in maintaining health, reproduction, and productivity in animals. Understanding their functions enables better feed formulation and optimal animal performance. Each nutrient class plays a fundamental role in maintaining the health and productivity of animals. A balanced diet ensures that animals receive adequate amounts of these nutrients to support growth, reproduction, and overall well-being. Understanding nutrient functions enables livestock farmers and nutritionists to formulate effective diets that maximize efficiency, enhance performance, and prevent nutritional deficiencies. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat

population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al.,

2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived

from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Major Classes of Nutrients and Their Functions

1. Carbohydrates

Carbohydrates are the primary source of energy for animals, comprising sugars, starches, and fiber. They are classified into:

- **Simple carbohydrates** (e.g., glucose, fructose) that provide quick energy.
- **Complex carbohydrates** (e.g., starch, cellulose) that require enzymatic or microbial digestion.

Functions:

- Supply energy for metabolic activities, growth, and reproduction.
- Serve as building blocks for structural components like cell walls.
- Support gut health through dietary fiber, especially in ruminants.

2. Proteins

Proteins are composed of amino acids and are crucial for tissue formation and enzymatic functions. They are classified into:

- **Essential amino acids** (e.g., lysine, methionine) that must be provided in the diet.
- **Non-essential amino acids** that the animal can synthesize internally.

Functions:

- Build and repair tissues, including muscles and organs.
- Act as enzymes and hormones for metabolic processes.
- Support immune function and antibody production.
- Facilitate growth, reproduction, and milk production.

3. Fats (Lipids)

Fats are a concentrated source of energy, providing more than twice the energy of carbohydrates. They include:

- **Saturated fats**, mostly from animal sources.
- **Unsaturated fats**, primarily from plant sources.

Functions:

- Serve as a dense energy reserve.
- Assist in the absorption of fat-soluble vitamins (A, D, E, K).
- Provide essential fatty acids necessary for cell membrane integrity.
- Improve skin and coat health in animals.



Fig. Nutrients in animal ration

4. Vitamins

Vitamins are organic compounds required in small amounts for metabolic functions. They are classified into:

- **Fat-soluble vitamins** (A, D, E, K) that can be stored in body fat.
- **Water-soluble vitamins** (B-complex, C) that must be regularly supplied in the diet.

Functions:

- Vitamin A: Supports vision, reproduction, and immune function.
- Vitamin D: Regulates calcium and phosphorus metabolism for bone health.

- Vitamin E: Acts as an antioxidant, protecting cells from damage.
- Vitamin K: Essential for blood clotting.
- B-complex vitamins: Aid in energy metabolism and nervous system function.
- Vitamin C: Enhances immune function and collagen synthesis.

5. Minerals

Minerals are inorganic elements essential for structural and metabolic functions. They are divided into:

- **Macrominerals** (e.g., calcium, phosphorus, sodium, potassium) needed in larger amounts.
- **Microminerals (trace minerals)** (e.g., iron, zinc, copper, selenium) required in smaller quantities.

Functions:

- Calcium and phosphorus: Crucial for bone and teeth formation.
- Iron: Essential for hemoglobin production in red blood cells.
- Zinc: Supports immune function, growth, and skin health.
- Selenium: Works as an antioxidant and supports muscle function.
- Sodium and potassium: Maintain fluid balance and nerve transmission.

6. Water

Water is the most important yet often overlooked nutrient. It is involved in nearly every physiological function and is critical for survival.

Functions:

- Regulates body temperature through sweating and respiration.
- Facilitates digestion, absorption, and transportation of nutrients.
- Serves as a medium for biochemical reactions.
- Eliminates waste through urine and feces.

- Maintains cellular hydration and electrolyte balance.

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Chapter 14.

Feed Ingredients for Ration for Livestock and Poultry

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Proper nutrition is essential for optimal growth, reproduction, and production in livestock and poultry. The formulation of balanced rations depends on the selection of appropriate feed ingredients, which provide essential nutrients such as carbohydrates, proteins, fats, vitamins, and minerals. The choice of ingredients varies based on species, physiological stage, and production purpose. This chapter discusses the various types of feed ingredients commonly used in livestock and poultry diets. A well-balanced ration for livestock and poultry ensures productivity, health, and economic efficiency. Understanding the role and availability of different feed ingredients aids in formulating rations that meet the specific needs of different species and production stages. Further research and innovation in alternative feed resources will continue to enhance sustainable livestock and poultry nutrition. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture,

particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a

local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding

strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of

an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Classification of Feed Ingredients

1. Energy Sources

Energy is a crucial component of animal diets, necessary for maintenance, growth, and reproduction. Common energy sources include:

- **Cereal Grains:** Maize, wheat, barley, sorghum, and rice provide high amounts of starch and digestible energy.
- **By-products:** Wheat bran, rice bran, molasses, and bakery waste are often included to enhance energy content.
- **Roots and Tubers:** Cassava and sweet potatoes are used, but their anti-nutritional factors must be managed.
- **Fats and Oils:** Vegetable oils, animal fats, and fish oils improve energy density and palatability.

2. Protein Sources

Protein is vital for muscle development, reproduction, and immune function. Protein sources include:

- **Animal-Based Proteins:** Fish meal, meat and bone meal, blood meal, and dairy by-products (such as whey powder) are rich in essential amino acids.
- **Plant-Based Proteins:** Soybean meal, groundnut meal, canola meal, cottonseed meal, and sunflower meal are widely used.
- **Non-Protein Nitrogen Sources:** Urea and ammonium salts can be used in ruminant diets due to their ability to synthesize microbial protein in the rumen.

3. Fiber Sources

Fiber is important for ruminants to maintain proper rumen function and for poultry to aid in gut health. Common fiber sources include:

- **Forages and Roughages:** Alfalfa hay, silage, grass hay, and legume hays.
- **Crop Residues:** Straw, corn stover, and sugarcane bagasse.



Fig. Feed ingredients for ration for livestock and poultry

4. Mineral and Vitamin Sources

To prevent deficiencies, minerals and vitamins must be incorporated into diets. These include:

- **Macrominerals:** Calcium (limestone, dicalcium phosphate), phosphorus (bone meal, rock phosphate), sodium (salt), and potassium (potassium chloride).
- **Microminerals:** Zinc, copper, iron, manganese, iodine, and selenium, often provided through mineral premixes.
- **Vitamins:** Fat-soluble (A, D, E, and K) and water-soluble (B-complex and vitamin C) vitamins are supplemented through premixes or natural sources.

5. Feed Additives

Feed additives enhance feed efficiency, health, and production performance. These include:

- **Enzymes:** Phytase, protease, and amylase improve nutrient digestibility.
- **Probiotics and Prebiotics:** Support gut health and immune function.
- **Antioxidants and Preservatives:** Prevent feed spoilage.

- **Growth Promoters:** Include antibiotics (where legally permitted), organic acids, and herbal extracts.

Considerations in Feed Ingredient Selection

Selecting feed ingredients requires an understanding of nutritional composition, availability, cost, and potential anti-nutritional factors. Ingredients must be:

- **Nutritionally Balanced:** Providing essential nutrients in required proportions.
- **Economically Feasible:** Cost-effective and locally available.
- **Free from Contaminants:** Mycotoxins, pesticide residues, and heavy metals should be absent or within safe limits.
- **Palatable and Digestible:** Should be acceptable to animals and easily digestible.

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Chapter 15.

Feed Supplements and Feed Additives

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Livestock nutrition plays a crucial role in determining animal health, growth, reproduction, and productivity. To meet nutritional requirements effectively, farmers and animal nutritionists often use feed supplements and feed additives. These substances enhance the nutritional value of animal feed, promote better health, and improve overall performance. This chapter explores the types, benefits, and applications of feed supplements and feed additives in animal nutrition. Feed supplements and feed additives play a vital role in modern animal nutrition by enhancing feed quality, improving growth, and preventing nutritional deficiencies. Their proper use ensures better productivity, animal health, and economic benefits for farmers. Understanding the different types of supplements and additives, their benefits, and best practices for their use is essential for sustainable and efficient livestock farming. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment

(Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success

(Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived

from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

1. Feed Supplements

Feed supplements are products added to the diet of livestock to provide essential nutrients that may be lacking in their regular feed. These supplements ensure that animals receive a balanced diet, which is vital for optimal growth and productivity.

1.1 Types of Feed Supplements

Feed supplements can be categorized based on the type of nutrients they provide:

a) Protein Supplements

Protein is an essential nutrient required for muscle development, milk production, and overall growth. Protein supplements are derived from plant and animal sources, including:

- Soybean meal
- Cottonseed meal
- Fish meal
- Meat and bone meal
- Alfalfa

b) Mineral Supplements

Minerals are necessary for bone development, enzyme functions, and overall metabolic processes. Some commonly supplemented minerals include:

- Calcium (Ca) and Phosphorus (P) for bone strength
- Iron (Fe) for oxygen transport in blood
- Zinc (Zn) and Copper (Cu) for immune function
- Magnesium (Mg) for nerve function

c) Vitamin Supplements

Vitamins are essential for various physiological functions, including reproduction, immunity, and metabolic activities. Important vitamin supplements include:

- Vitamin A for vision and immune function
- Vitamin D for calcium absorption and bone health
- Vitamin E for antioxidant support
- B-complex vitamins for energy metabolism

d) Energy Supplements

Energy-rich supplements provide additional calories for high-producing animals, especially dairy cattle and poultry. Common energy supplements include:

- Cereal grains such as corn and barley
- Molasses
- Vegetable oils

1.2 Benefits of Feed Supplements

- Ensures balanced nutrition and prevents deficiencies
- Improves growth rate and weight gain
- Enhances milk and egg production
- Boosts immune function and overall health



Fig. Feed additives

2. Feed Additives

Feed additives are non-nutritional substances added to animal feed to improve feed efficiency, growth performance, and overall health. They play a significant role in modern livestock production by enhancing digestibility, preventing diseases, and increasing productivity.

2.1 Types of Feed Additives

Feed additives can be broadly classified into several categories:

a) Antibiotics

Antibiotic feed additives are used to prevent bacterial infections and promote growth. However, their use is regulated due to concerns about antibiotic resistance. Examples include:

- Tylosin
- Bacitracin
- Virginiamycin

b) Probiotics and Prebiotics

Probiotics are beneficial bacteria that improve gut health and digestion, while prebiotics are non-digestible fibers that promote the growth of good bacteria. Common probiotics and prebiotics include:

- Lactobacillus
- Bifidobacterium
- Fructooligosaccharides (FOS)

c) Enzymes

Enzymes help break down complex feed components, improving digestion and nutrient absorption. Commonly used enzymes include:

- Phytase (breaks down phytic acid and improves phosphorus availability)
- Protease (enhances protein digestion)
- Cellulase (aids in fiber digestion)

d) Growth Promoters

Growth promoters enhance weight gain and feed conversion efficiency. Some natural and synthetic growth promoters include:

- Hormonal growth promoters (e.g., bovine somatotropin, BST)
- Beta-agonists (e.g., ractopamine)

e) Antioxidants

Antioxidants prevent oxidation of feed and protect animals from oxidative stress. Examples include:

- Vitamin E
- Selenium
- Butylated hydroxytoluene (BHT)

f) Flavors and Sweeteners

Flavors and sweeteners improve feed palatability, encouraging animals to consume more feed. Commonly used additives include:

- Molasses
- Vanilla extract

2.2 Benefits of Feed Additives

- Enhances feed efficiency and nutrient absorption
- Reduces the risk of diseases and improves immunity
- Promotes faster growth and better production
- Minimizes feed spoilage and oxidation

3. Practical Considerations

When incorporating feed supplements and additives into livestock diets, several factors must be considered:

- **Quality and Purity**: Ensure that supplements and additives are of high quality and free from contaminants.
- **Dosage and Administration**: Proper dosing is crucial to avoid toxicity or inefficacy.
- **Regulatory Compliance**: Adhere to government regulations regarding feed additives, especially antibiotics and growth promoters.
- **Cost-effectiveness**: Balance the cost of supplementation with the expected benefits to maximize profitability.

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Chapter 16.

Feeding of Livestock and Poultry

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Feeding is a crucial aspect of livestock and poultry management. Proper nutrition ensures optimal growth, reproduction, and production of meat, milk, and eggs. Different species of animals have varying nutritional needs based on their physiological stages, breeds, and environmental conditions. This chapter explores the feeding requirements of livestock and poultry, types of feeds, feeding strategies, and best practices. Proper feeding of livestock and poultry is fundamental to their health and productivity. A well-balanced diet, combined with good management practices, ensures efficient animal production, economic sustainability, and food security. Farmers should adopt scientifically formulated feeds and feeding strategies to maximize output and profitability. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in

developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and

Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al.

2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Feeding of Livestock

Livestock such as cattle, sheep, goats, and pigs require a balanced diet that includes carbohydrates, proteins, fats, vitamins, minerals, and water. The quality and quantity of feed directly impact their growth rate, health, and productivity.

1. Feeding of Cattle

Cattle can be categorized into dairy and beef cattle, each requiring a different feeding regimen.

- **Dairy Cattle**: Require high-energy and protein-rich diets to maintain milk production. They are commonly fed a combination of roughages (hay, silage, pasture) and concentrates (grains, oilseed meals, mineral supplements).
- **Beef Cattle**: Need diets that support muscle growth and fat deposition. They are typically fed forage-based diets supplemented with grains and protein sources to improve weight gain.

2. Feeding of Sheep and Goats

Sheep and goats are ruminants that rely primarily on forages such as grasses, shrubs, and hay. Their diet should include:

- High-quality roughages to support digestion and prevent bloating.
- Concentrates for enhanced growth and reproduction.
- Mineral supplements, especially calcium, phosphorus, and salt.

3. Feeding of Pigs

Pigs are monogastric animals with high energy and protein requirements. Their diet consists of:

- Energy-rich grains (corn, wheat, barley).
- Protein sources (soybean meal, fish meal, meat and bone meal).
- Vitamins and mineral supplements for proper growth and reproduction.
- Clean water for hydration and metabolic functions.

Feeding of Poultry

Poultry species such as chickens, turkeys, ducks, and quails require a nutritionally balanced diet to support egg production and meat yield. Their diet consists of:

- **Starter Feeds**: High-protein feeds for young chicks to promote growth.
- **Grower Feeds**: Moderate protein feeds to sustain development.
- **Finisher Feeds**: Energy-dense feeds for meat birds to enhance weight gain.
- **Layer Feeds**: Calcium-rich feeds for laying hens to support eggshell formation.
- **Supplementary Feeds**: Grits for digestion, vitamins for immune support, and probiotics for gut health.



Fig. Feeding of livestock, poultry and Swine

Types of Livestock and Poultry Feeds

1. **Roughages**: Grasses, hay, silage, and crop residues used mainly for ruminants.
2. **Concentrates**: Cereal grains, protein meals, and industrial by-products rich in nutrients.
3. **Supplements**: Minerals, vitamins, and additives that improve feed efficiency.
4. **Water**: Essential for digestion, metabolism, and body functions.

Feeding Strategies and Management Practices

- **Balanced Rationing**: Ensuring animals receive a diet that meets all nutritional needs.
- **Feed Formulation**: Mixing feeds to optimize nutrient intake and cost-effectiveness.

- **Proper Storage**: Preventing feed contamination by storing it in clean, dry conditions.
- **Regular Feeding Schedule**: Providing consistent feeding times to maintain animal health.
- **Disease Prevention**: Using quality feeds and clean water to reduce the risk of infections.

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Chapter 17.

Introduction, Prevention and Control of Important Diseases of Livestock and Poultry Diseases

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Livestock and poultry play a crucial role in the global economy and food security. Diseases affecting these animals can lead to significant economic losses, decreased productivity, and threats to public health. Understanding common diseases, their prevention, and control measures is essential for farmers, veterinarians, and policymakers. This chapter provides an overview of livestock and poultry diseases, their impact, and strategies for prevention and control, including vaccination schedules. Livestock and poultry diseases pose significant challenges to animal health and productivity. Implementing a robust disease prevention and control strategy that includes biosecurity, vaccination, good management practices, and therapeutic interventions is crucial. By adopting these measures, farmers can safeguard their animals, reduce economic losses, and ensure a sustainable and profitable livestock and poultry industry. India today, stands first in the area of milk production at the world level, with an annual growth rate of about 4% (Singh et. al., 2012). The productive improvements among dairying animals can be made through proper management, feeding and handling, etc (Singh et. al., 2013). Goat population of our country increased from 47.14 million in the year 1951 to 124.5 million during 2005 (Singh and Sharma, 2013a). Improvement can be made through proper management, feeding, handling and other environmental conditions which will influence expression of characters but a limit of which is set by heredity of individual (Singh et. al., 2013b). Goats are integer part of livestock production and play a vital role in the socio-economic structure of rural poor (Singh and Sharma, 2014). Various government and non-government organization have also recognized the importance of poultry farming as employment generating enterprise and are engaged in motivating more and more entrepreneurs to take up this enterprise (Singh et. al., 2014a). Goats

play a vital socio-economic role in Asian agriculture, particularly for resource poor people living in harsh environment (Singh et. al., 2014b). The global goat population currently stands at 921 million, of which over 90% are found in developing countries (Singh et. al., 2014c). This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh et. al., 2014d). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance. The milk is naturally homogenized since it lacks the protein agglutinin (Singh et. al., 2014e). The goat was domesticated as early as 6-7 BC, as evidenced by archaeological remains collected in western Asia (Singh et. al., 2014f). Major population of India is primarily depends on agricultural based system for their daily life including goat keeping that constitute an important rural business of small marginal farmers and landless labours (Singh et. al., 2014g). Reproductive management of an animal is governed through a number of parameters, viz. age at first conception, age at first calving and first gestation length etc (Singh et. al., 2014h). Goat milk contains less lactose than cow's milk, so is less likely to trigger lactose intolerance (Singh and Sharma, 2015). It has since played a significant socioeconomic role in the evolvement of human civilization around the world (Singh and Sharma, 2015a). Farmers preferred Deda over Kona because it has more biomass (Singh and Sharma, 2015b). A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016a). The nutritional value of milk is closely related to its composition, which is affected by factors such as breed, diet, stage of lactation, season etc (Singh and Sharma, 2016b). Livestock production is backbone of Indian agriculture contributing 7% to national GDP and source of employment and livelihood for 70% population in rural areas (Singh et. al., 2017). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et. al., 2017a). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries (Singh and Sharma, 2017b). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments (Singh et. al., 2025e). Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide (Singh et. al., 2025d). Asia contributes approximately 59% to world goat milk production (Singh et. al., 2018). Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a

local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success (Singh et. al., 2025c). The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangaladesh) of India and Bangladesh (Singh et al. 2025). There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck (Singh et. al., 2024e). The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et. al., 2017c). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types (Singh et. al., 2024d). These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017d). There is a large commercial chicken industry that provides us with eggs and meat (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes permanent damage to the udder occurs (Singh et. al., 2024c). Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security (Singh et. al., 2025a). The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020a). India is endowed with a significant share of the world's livestock population growing steadily and continuously (Singh et. al., 2025b). Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses (Singh et. al., 2024b). In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G., 2019a). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range (Singh et. al., 2024a). Originating in Asia, goats have spread over all the continents and inhabit almost all -climatic zones from arctic - circle to the equator (Singh, G., 2024). Goat milk is rich in essential proteins, vitamins, and minerals (Singh et. al., 2023). Goat milk is widely consumed due to its high nutritional value and medicinal properties (Singh et. al., 2024f). Effective management practices, nutritional interventions, and adaptive breeding

strategies can mitigate these challenges (Singh et. al., 2025e). The term Agriculture is derived from two Latin words ager or agri meaning soil and culture meaning cultivation (Singh, et., al. 2025g). The composition of mastitis milk approaches that of blood (Singh and Rodricks 2025). Feed alone constitute 60 per cent of the production cost of milk (Singh and Rodricks 2025a). The nutrient requirements are generally expressed separately for each function or an overall figure for the combined functions may also be expressed (Singh and Rodricks 2025b). The poultry industry has developed into a highly organized and scientific sector, contributing significantly to the global food supply (Singh, G. 2025q). The poultry industry in India is one of the fastest-growing sectors in agriculture, contributing significantly to food security, employment, and economic growth (Singh, G. 2025p). Livestock nutrition depends on a variety of feeds and fodders, which can be classified based on their composition, digestibility, and utility (Singh, G. (2025o). Livestock nutrition is a crucial aspect of animal husbandry, directly affecting growth, reproduction, milk production, and overall health (Singh, G. 2025n). Distributed in Salem, Erode, Karur, Namakkal, and fewer parts of Dharmapuri districts of Tamilnadu (Singh, G. 2025m). This is otherwise called as Delhi, Kundi and Kali (Singh, G. 2025l). A cattle farming is an integral part of Indian agriculture, providing milk, meat, draft power, and manure (Singh, G. 2025k). This breed is otherwise known as Desan, Gujarati, Kathiawari, Sorthi, and Surati (Singh, G. 2025j). Goats are the number one producer of milk in the world (Singh, G. 2025i). Many farmers in India depend on animal husbandry for their livelihood (Singh, G. 2025h). Mixed farming is an agricultural practice that combines crop cultivation with livestock rearing or other supplementary enterprises like fisheries, agroforestry, or poultry (Singh and Mishra 2025r). Fisheries play a vital role in India's economy, providing livelihood to millions, contributing to food security, and earning foreign exchange (Singh, G. 2025s). Fish production plays a significant role in global food security, employment, and economic development (Singh, G. 2025t). A person working with animals should have proper knowledge of the different parts of the animal body (Singh, G. 2025u). The weight of farm animals can be work out without weighing machine (Singh, G. 2025v). While taking work from farm animals or while milking, treatment, castration, applying identification mark (Singh, G. 2025w). If a herd's man has only few animals, recognizing each animal separately is possible for differentiating them according to their external appearance (Singh, G. 2025x). Ageing means to determine the approximate age of

an animal (Singh, G. 2025y). Livestock feeds are generally classified according to the amount of specific nutrients they furnish in the ration (Singh, G. 2025z).

Common Livestock and Poultry Diseases

1. Livestock Diseases

Livestock, including cattle, sheep, goats, pigs, and buffaloes, are susceptible to various infectious and non-infectious diseases. Some of the most common diseases affecting livestock include:

a) Bacterial Diseases

- **Anthrax**: A fatal disease caused by *Bacillus anthracis*.
- **Brucellosis**: A reproductive disease affecting cattle, goats, and pigs.
- **Black Quarter (Blackleg)**: Caused by *Clostridium chauvoei* leading to severe lameness and death.
- **Mastitis**: Inflammation of the udder due to bacterial infection.

b) Viral Diseases

- **Foot and Mouth Disease (FMD)**: A highly contagious disease affecting cloven-hoofed animals.
- **Rabies**: A fatal disease affecting all warm-blooded animals.
- **Peste des Petits Ruminants (PPR)**: Affects sheep and goats, causing fever and respiratory distress.
- **Bovine Viral Diarrhea (BVD)**: Causes reproductive losses in cattle.

c) Parasitic Diseases

- **Trypanosomiasis**: Caused by *Trypanosoma* species, transmitted by tsetse flies.
- **Coccidiosis**: Affects the intestinal tract, especially in young animals.
- **Helminthiasis**: Infestation with roundworms, tapeworms, or flukes.



Fig. Livestock disease

2. Poultry Diseases

Poultry diseases can significantly impact productivity and profitability. The major poultry diseases include:

a) Bacterial Diseases

- **Fowl Cholera**: Caused by *Pasteurella multocida*, leading to high mortality.
- **Salmonellosis**: Causes foodborne illness in humans and affects poultry health.

b) Viral Diseases

- **Newcastle Disease (ND)**: Highly contagious, causing respiratory distress and nervous signs.
- **Infectious Bursal Disease (IBD/Gumboro Disease)**: Affects the immune system of young chicks.
- **Avian Influenza (Bird Flu)**: Highly pathogenic strains can cause widespread mortality.

- **Marek's Disease**: Affects the nervous system and leads to paralysis.

c) Parasitic Diseases

- **Coccidiosis**: A common protozoan disease affecting the intestines.
- **Ectoparasites (Lice, Mites, and Fleas)**: Cause stress, anemia, and reduced egg production.

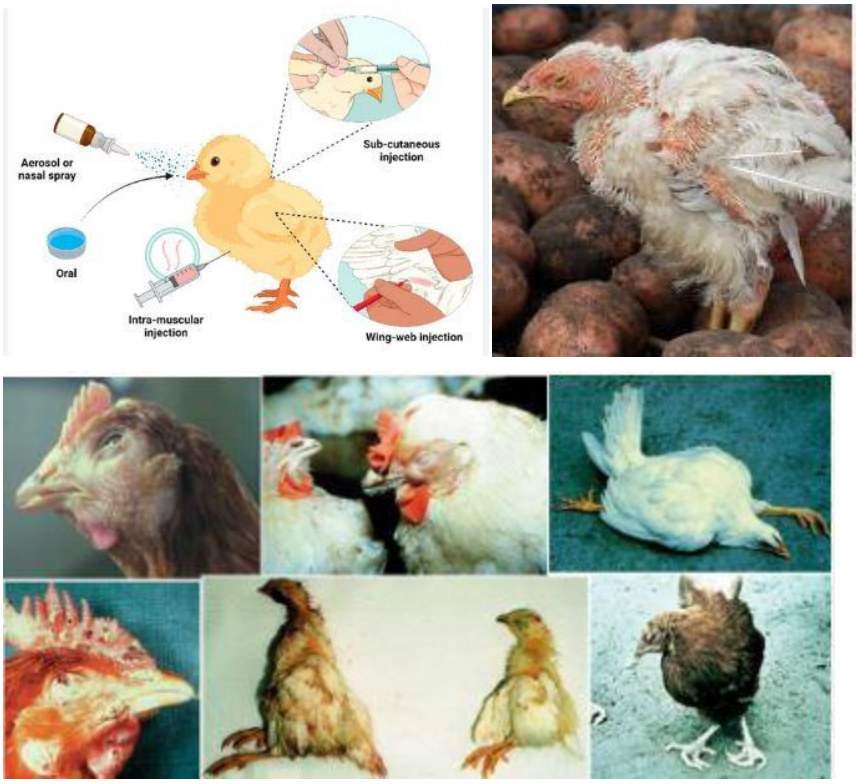
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Fig. poultry diseases

Prevention and Control Strategies

Preventing and controlling livestock and poultry diseases requires an integrated approach that includes biosecurity, vaccination, management practices, and therapeutic measures.

1. Biosecurity Measures

- Restrict movement of animals and personnel between farms.
- Proper sanitation and disinfection of housing facilities.
- Control of rodents, insects, and other disease vectors.
- Quarantine and screening of new animals before introduction to a herd or flock.
- Proper waste disposal and manure management.

2. Vaccination Schedule

Vaccination is a critical tool for disease prevention. The following are recommended vaccination schedules for livestock and poultry.

a) Livestock Vaccination Schedule

Disease	Species	Age of First Dose	Booster	Frequency
FMD	Cattle, Sheep, Goats	4 months	6 months later	Annually
Brucellosis	Cattle, Goats	4-8 months	No booster	Once in lifetime
Black Quarter	Cattle, Sheep	6 months	Annually	Annually
PPR	Sheep, Goats	3 months	No booster	Every 3 years
Anthrax	Cattle, Sheep, Goats	6 months	Annually	Annually

b) Poultry Vaccination Schedule

Disease	Age of First Dose	Booster	Frequency
Marek's Disease	1 day	No booster	Once
Newcastle Disease	5-7 days	3-4 weeks later	Every 3 months
Infectious Bursal Disease	10-14 days	3-4 weeks later	As needed
Fowl Pox	4-6 weeks	No booster	Once
Avian Influenza	2-3 weeks	4-6 weeks later	As required

3. Management Practices

- Proper nutrition and feeding management to boost immunity.
- Hygienic milking and handling practices to prevent mastitis.
- Timely culling of diseased or unproductive animals.
- Stress reduction through proper housing and ventilation.

4. Therapeutic Measures

- Use of antibiotics under veterinary guidance for bacterial infections.
- Deworming and parasite control programs.
- Use of supportive therapy such as vitamins and electrolytes.

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