Includes Color Photos And Diagrams

TextBook of Animal Science

As per ICAR UG Syllabus

D. Sreekumar
P. V. Sreenivasaiah

WRITE & PRINT

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TEXTBOOK
OF
ANIMAL SCIENCE

Dr. D. Sreekumar obtained his B.V.Sc & A.H and M.V.Sc (LPM) degrees from Kerala Agricultural University, Thrissur, Kerala and Ph D (LPM) from the National Dairy Research Institute, Karnal, Haryana. He worked as Assistant Professor at the College of Veterinary & Animal Sciences, Mannuthy and was Head of Station at Cattle Breeding Farm, Thumburmuzhi, Thrissur. He later worked as Associate Professor and Professor & Head of the LPM department at the Rajiv Gandhi College of Veterinary & Animal Sciences, Puducherry and is at present the Professor and Head of the Instructional Livestock Farm Complex at the Rajiv Gandhi Institute of Veterinary Education and Research (RIVER), Puducherry. He has published many articles in journals of national and international importance and is the author of a book "Understanding Farm Animals – a basic guide". He is at present the chapter secretary of ISAPM and a member of the editorial committee of the Indian Journal of Animal Production Management.

Dr. Sreekumar is the recipient of the award "Fellow National – Animal Production Management" instituted by the Indian Society of Animal Production and Management. Dr. P.V. Sreenivasaiah, born 28th Feb, 1955, currently working as Professor and Head, Department of Livestock Production Management, Rajiv Gandhi Institute of Veterinary Education and Research, Pondicherry, graduated from Veterinary College, UAS, Bangalore, during 1975. He obtained his Master's (at IVRI, during 1977) and Ph.D (From APAU,

Hyderabad during 1985) with I Rank in both with ICAR fellowships specializing in Poultry Science.

Dr. P.V. Sreenivasaiah has been one of the earlier workers on basic Physiology and Management of Japanese quails when the species was introduced to our country during 1974. He established a Japanese quail breeding unit and was associated in the development of "Giriraja" while working in the All India Coordinated Research Project on Poultry for meat at UAS, Bangalore. Establishment of Department of Poultry Science at Veterinary College, Bidar (Karnataka) and Department of Avian Production and Management at his current work-place are also notable contributions of the author. He is involved in the field of Poultry Science for the past 37 years contributing about 50 research papers in various accredited journals.

His books include (a) Scientific Poultry Production (2 Editions, 1987 and 1998) (b) Scientific Poultry Production – a unique Encyclopedia (2006), (c) Veterinary Biostatistics (2007) (d) Small-scale Broiler Production (2008) and (e) Small-scale Layer Production (2008). All the books have been received well by the readers. He has also published 50 research papers, 15 popular articles and a farmer's bulletin.

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(As per ICAR UG Syllabus)

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Contents

Preface

Indian Council of Agricultural Research (ICAR) has mandated a course on Animal Production for undergraduate (UG) students pursuing towards a degree in Agricultural Sciences (Agriculture, Horticulture, Forestry etc.). The course is being offered in all the Agricultural Universities in India. The syllabus embraces a variety of theory and applications in general livestock management.

Many publications, both Indian and foreign, are available on Animal Sciences; but, they are either very descriptive on all or some of the topics included in the syllabus. Some of them are expensive and some others do not include all topics envisaged in the ICAR UG syllabus. Therefore, it is in the fitness of things that a concise textbook including the UG course on animal production is prepared to facilitate both the teacher and the taught.

With this in the background, this book is prepared for UG students of Agricultural Sciences on the basis of ICAR syllabus. The information on different management practices with respect to cattle, buffaloes, sheep, goats, pigs and poultry and an overview of the livestock industry have been compiled and presented in a very simple and condensed form for the benefit of students and teachers. Further, to help learning and evaluation processes, each chapter contains exercise with both Objective and Subjective questions; answers for the former are given separately. Many other types of questions, in general, and objective questions, in particular can be formed limited only by the imagination of the teachers/evaluators.

A list of reference books is provided to help the reader to obtain further knowledge on various aspects of animal production. The principles of Livestock management presented in this publication are not exclusive for the UG students of Agricultural Sciences; hence, this book can be a valuable reference source for all students and research workers in other fields of Biological Sciences as well.

Keeping in view the background of students pursuing studies in the field of Agricultural Sciences, practical / applied aspects of livestock production are

given a priority over theoretical considerations. It is believed that the practices described in this publication can be applied in the farm as well as field.

The authors thank the Dean, Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry for providing facilities for bringing out this edition. The authors particularly thank Sri Arvind Kumar Mittal and Sri Hitesh Mittal, Write & Print Publications, New Delhi who not only invited them to prepare the book and also has brought out the book in a very elegant way.

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UNIT-1

Livestock Industry

Livestock sector plays an important role in socio-economic development of rural households. Livestock rearing has significantly positive impact in terms of income and poverty alleviation in rural population. In India, over 70% of the rural families own livestock and a majority of them are small, marginal and landless population. Small animals like ovines (sheep and goats), pigs and poultry are mainly kept by the landless poor whereas large animals like bovines (cattle and buffaloes) are kept by small and marginal farmers.

In the last decade, demand for various livestock products has increased significantly due to increase in earnings, urbanization, preference and awareness about food. Livestock sector may emerge as an important sector in the coming decades. It is also a potential sector to get foreign exchange through export.

Livestock sector contributes about 6% to the Gross Domestic Product and 25% to the Agricultural Gross Domestic Product. Over the last two decades, livestock sector has grown at an annual rate of 5 to 6%, which is higher than the growth of agricultural sector (3.3%). The bullocks, although being replaced by tractors, still form the main source of draft power for various agricultural operations like ploughing, irrigation, thrashing and transportation (draught animal power, DAP). Besides DAP, it also provides a) manure to crop farming and b) hides, skin, bones, blood and fibres to the industrial sector.

Livestock sector provides sustainable and supplementary income in

addition to crop income in integrated farming. It generates employment opportunity to rural people and efficiently utilises the crop residues which are otherwise a waste. About 70% of rural population are landless and marginal families which are below the poverty line (Taneja and Birthal 2004). Several studies indicate that livestock rearing has positive impact on income, employment and poverty alleviation in rural areas (Singh and Hazell 1993)

1. Livestock wealth of India

1.1. Distribution among farmers

Livestock holdings stratified by land holdings by the farmers are given in Table 1. It is clearly evident that most of the livestock (about 90%) is in the hands of landless, small and medium farmers

Table 1.1. Distribution of livestock holdings in India 2002-03

Category	Landless, <0.002ha	Marginal, 0.002-1.0 ha	Small, 1.0-2.0 ha	Medium, 2.0-4.0 ha	Large, >4.0 ha	All
% households	31.9	47.1	11.2	6.2	3.4	100.0
		Distribution of livestock, %				
Bovine	0.6	51.3	21.2	15.0	11.9	100.0
Ovine	2.1	61.5	15.7	9.6	11.0	100.0
Poultry	4.4	62.7	17.4	6.8	8.6	100.0
Pigs	3.2	76.2	12.0	5.5	3.0	100.0
		Size of livestock holdings, no/100 households				
Bovine	3	169	293	374	535	156
Ovine	4	84	90	99	203	64
Poultry	17	164	191	136	306	123

Pigs	0.3	5.3	3.5	2.9	2.9	3.3

Source: NSS Report No. 493, Livestock Ownership Across Operational Land Holding Classes in India 2002-03, Ministry of Statistics and Program Implementation, GOI.

Source: NSS Report No. 493, Livestock Ownership Across Operational Land Holding Classes in India 2002-03, Ministry of Statistics and Program Implementation, GOI.

Table 1.2. Livestock Population in India by Species (in m numbers)

Species	**1987**	**1992**	**1997**	**2003**
Cattle	199.7	204.6	198.9	185.2
Adult Female Cattle	62.1	64.4	64.4	64.5
Buffalo	76.0	84.2	89.9	97.9
Adult Female Buffalo	39.1	43.8	46.8	51.0
Total Bovines	275.7	288.8	288.8	283.1
Sheep	45.7	50.8	57.5	61.5
Goat	110.2	115.3	122.7	124.4
Pigs	10.6	12.8	13.3	13.5
Total Livestock *	445.2	470.9	485.4	485.0
Poultry **	275.3	307.1	347.6	489.0

* Includes other species like horses, donkeys, camels etc.
** Includes Chicken, ducks, turkey & other birds
Source : Livestock Census 2003

India has enormous livestock population (Table 1.2); Out of the total livestock population, about 38.2 % are cattle, 20.2 % are buffaloes, 12.7 % are sheep, 25.6 % are goats and 2.8 % are pigs. All other animals are less than 0.50 % of the total livestock population.

1.3. Products

Livestock sector contributes a variety of food and non-food products. The major livestock products are milk, meat, wool and eggs (Table 1.3). India is the largest producer of milk in the world with an annual production of 100 m tonnes in 2006-07. Milk and milk products alone provide 63% of income from the livestock sector.

Table 1.3. Milk Production in India

Year	Production (m tonnes)	*Per Capita* availability (g/day)
2000-01	80.6	220
2001-02	84.4	225
2002-03	86.2	230
2003-04	88.1	231
2004-05	92.5	233
2005-06	97.1	241
2006-07	100.9	246
2007-08	104.8	252
2008-09	108.5	258

Source: Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, GoI

Milk production is continuously increasing since the initiation of Operation Flood in the early seventies. However, the productivity of Indian cow is low as compared to many other countries and the world average. Buffalo and cow are important milch animals which shared 55 and 43%, respectively in total milk output, and goats account for the rest. The milk production grew at a rate of 4.4 % per annum during the period of 1980-2003. The growth in meat production has been faster as compared to milk production. Total meat production in the country has increased from 0.9 m tonnes in 1980-81 to 5.9 m tonnes in 2003-04 at an annual rate of 9.3 %. In early 1980s small

ruminants were the major suppliers (44%) of meat, followed by large ruminants (35%), and poultry (19%).

Egg production in the country has increased from 10.06 billion numbers in 1980-81 to 40.4 billion numbers in 2003-04. During 1980-2003, egg production has increased at the rate of 5.8 % a year. About two third of the total egg production in the country, come from improved layers. Average egg yield of an improved layer is 232 eggs/ annum, which is more than double the yield of an indigenous layer.

Wool production in India has increased from 32.0 m kg in 1980-81 to 48.5 m kg in 2003-04. Annual growth in wool production was 1.7 % per annum during 1980-2003, which was much lower as compared to annual growth in other livestock products.

1.4. Value of livestock output

Table 1.4. Value of Output from Livestock sector (At current prices in Rs. Crore)

Item	2003-04	2004-05	2005-06	2006-07	2007-08
1 Milk Group	110447	121505	132811	143869	162136
2 Meat Group	27337	31805	32548	35936	40399
3 Eggs	5186	5965	6354	7187	8630
4 Wool & hair	343	361	346	373	361
5 Dung	12868	13176	16142	17064	18498
6 Silk Worm Cocoons and Honey	1837	1689	1577	1576	1523
7 Increment in Stock	4903	5731	6614	7979	9054
Total Value	162921	180231	196392	213984	240601

Source: Central Statistical Organisation, Dept. of Statistics, GOI (2009)

Agriculture is the major source of livelihood in rural India accounting for about one-fourth of Gross Domestic Product (GDP). The gross domestic product from agriculture sector has increased significantly; its share in GDP has declined from 35.7% in 1980-81 to 24 % in 2003-04. Livestock contributes nearly 25% to the gross value of agricultural output, and it has been increasingly consistently. In fact, the growth in livestock sector has always remained higher than the growth in crop sector. Though in absolute terms, value of output of various livestock products increased during 1980-81 to 1990-91 and 1990-91 to 2003-04, the annual growth has decelerated during 1990-91 to 2003-04 for almost all the products (Tables 1.4 and 1.5). The annual growth in pork, poultry meat and eggs is higher than the growth in milk and meat from other animals.

Table 1.5. Share of Agriculture and Livestock Sector in GDP (At current prices in Rs. Crore)

Year	GDP (Total)	GDP (Agriculture)		GDP (Livestock Sector)	
		Rs.	% Share	Rs.	% Share
1999-00	1,786,526	409,660	22.93	94698	5.30
2000-01	1,925,017	408,932	21.24	104,745	5.44
2001-02	2,097,726	442,464	21.09	109,254	5.21
2002-03	2,261,415	425,521	18.82	114,872	5.08
2003-04	2,538,170	483,030	19.03	118,316	4.66
2004-05	2,877,701	501,415	17.42	136,108	4.73
2005-06	3,282,385	567,897	17.30	150,268	4.58

2006-07	3,779,385	625,161	16.54	165,169	4.37
2007-08	4,320,892	718,278	16.62	189,990	4.40

Source : National Accounts Statistics-2009; Central Statistical Organisation;GOI

2. Livestock trade

2.1. Exports

India's export earnings from livestock products have remarkably increased from US$ 90.9 m in 1980-82 to US$ 469.6 m in 2002-04 (Table 1.6). The exports of meat and meat products, dairy products and eggs registered a remarkable increase during this period. These accounted for 72.8%, 13.4% and 10.4% of total livestock exports in 2002-04, respectively. The export of live animals grew until mid-1980s and thereafter declined gradually. There was wide fluctuation in export of hides, skin and animal fats.

Table 1.6. Value of livestock exports (in 1000$)

	1980-82	1990-92	2002-04
Live Animals	8895	5748	3658
Dairy Products	1414	3076	63144
Meat and Meat Products	75244	90484	342002
Wool and Hair	1626	724	3933
Hides and Skins	399	465	3179
Animal Fats	14	15	4873
Eggs	3293	3647	48858
Livestock Products, Total	90876	104149	469648

Source: FAOSTAT

2.2. Imports

India's import of livestock products declined from US$ 261.6 m in 1980-82 to US$ 257.4 m in 2002-04. In 1980-81 dairy products worth US$ 166.6 m were imported, which comprised 63.6% of the total livestock imports (Table 1.7).

Table 1.7. Value of livestock imports (in 1000$)

	1980-82	1990-92	2002-04
Live Animals	703	2869	802
Dairy Products	166656	10417	17253
Meat and Meat Products	302	143	446
Wool and Hair	54876	110724	184173
Hides and Skins	1008	26784	52995
Animal Fats	38290	249	1116
Eggs	27	0	701
Livestock Products, Total	261861	151185	257485

Source: FAOSTAT

3. Livestock development programs in India

Government of India has introduced many strategies and programs for livestock development since independence. They are briefly outlined below:

3.1. Key Village Scheme (KVS)

This scheme was started during the I Five Year plan at the cattle breeding farms to produce superior bulls for breeding purposes (stud bulls). Each key village block was aimed to cover 5000 breedable cows and later on extended to cover 10000 animals. Initially natural service was adopted and later Artificial Insemination (AI) was introduced. During the III Five Year plan, there were 600 key village blocks to cover 6 m cows. In addition to this,

scientific feeding and health cover, mass castration (sterilizing of males) of non-descript bulls were undertaken for better development of cattle and buffalo. By the end of III Five Year plan, KVS ran short of infrastructure for future development and hence, paved the way for Intensive Cattle Development Project (ICDP).

3.2. Intensive Cattle Development Project (ICDP)

This project was started in the dairy project areas which provided inputs like fodder distribution, health cover, AI service and milk collection. Exotic cattle breeding farms were established for Holstein-Friesian (HF), Brown Swiss (BS) and Jersey (JS) for cross breeding in these areas. During the IV Five Year plan, Central Cattle Breeding Farms (CCBF) were established to preserve well-defined native breeds in their home tract. State governments were encouraged with Central assistance to form their breeding farms. At present, there are 330 cattle and buffalo breeding farms throughout India.

3.3. NDDB and Operation Flood Program

The National Dairy Development Board was established in 1965 to undertake the dairy development program in India on Anand model in Gujarat to promote, plan, and organize dairy development through cooperatives, to provide consultations, and to set up dairy plants which were then returned to the cooperatives. There were more than 63,000 Anand-style dairy cooperative societies with some 7.5 m members in the early 1990s. The milk produced and sold by these farmers brought Rs 320 m a day, or more than Rs 10 trillion a year. The increase in milk production permitted India to end imports of powdered milk and milk-related products. In addition, 30,000t of powdered milk were exported annually to neighboring countries.

3.4. Hill cattle development scheme

Cross breeding program was launched by Indian Council of Agricultural Research (ICAR) in hilly and heavy rain fall areas to find out crossbred animal(s) suitable for hilly regions. Various crossbreds were developed using JS bull and JS crossbred bulls with varying levels of JS contribution (¼, ½, ¾ and 7/8). From the field studies, it was noticed that milk production increased to two to three fold and age at first calving was reduced; however, crossbreds

with > 50% JS inheritance were difficult to maintain due to high mortality.

3.5. *Gaushala / Goshala*

The government of India in 1952 founded the Central Council of Govsamvardana. Many Gaushalas are formed throughout the country for protection and rehabilitation of deserted/disowned/orphan cattle. These Gaushalas can also provide good quality heifer/cow/bull and they are well equipped for treatment of animals and AI. Some of the Gaushalas have been working for decades. Mahatma Gandhi in 1915 founded Sabarmati Ashram Gaushala near Ahmedabad which is now being maintained by NDDB.

3.6. Foreign-aided bilateral Projects

The GoI has several internationally funded collaborative projects; some of them are outlined below:

3.6.1. Indo-Swiss Project

This Project was started in Kerala and Punjab by using BS bulls on cross local cows to improve productivity. However, this project was closed in Punjab due to farmers' preference to HF and its crosses. In Kerala crosses of 50%, 62.5% and 75% were developed and crosses of 62.5% have been bred inter se (among themselves) followed by selection to develop a new breed called Sunandini. Large scale testing of Sunandini breed is in progress in Kerala.

3.6.2. Indo-Danish Project

The Project was started in Karnataka in 1964 using Red Dane (RD) bulls on Red Sindhi, locals and Hallikar. At Bangalore, an exotic RD farm was formed to cater the need of RD bulls. The performance of RD x Red Sindhi RD x Hallikar is very satisfactory.

3.6.3. Indo-German Project

With the assistance of German government, this project was launched in Himachal Pradesh. German Mountain Spotted- German Flekvich-bulls were

used on local cows. This project was discontinued because of large size of bulls used which resulted in difficulty in parturition (calving) and also non-availability of feed resources. However, this project aided to establish production recording system and also paved way to use frozen semen for AI.

4. Summary

Livestock production is a viable and vibrant industry in India. Most of the livestock are maintained by landless / small / medium farmers. Cattle and buffaloes form an integral part of Agriculture in India assisting the farmer in many ways. Livestock sector contributes 4 to 5% of GDP and about ¼ of Agricultural output. Exports of livestock and livestock products are also increasing considerably during the previous decade. Several livestock development programs are in vogue to help maximize the returns to the farmers and simultaneously help improve the economic, health and welfare status of the entire population of India.

Exercise

I. Fill-up the blanks with appropriate answers:

1. In India, ……. % of the rural families own livestock.
2. Livestock sector contributes about …… % to the Gross Domestic Product of our country.
3. Livestock sector contributes about …… % to the Agricultural Gross Domestic Product of our country.
4. During the last two decades, livestock sector has grown at an annual rate of ……..(5 to 6%).
5. The livestock population of our country as per the latest census is …….. (185 m).
6. The per capita milk availability in our country is……(258 g).
7. Meat production in India has grown by …… % during the last two decades.(9.3 %)
8. Over the last two decades, egg production in our country has grown at an annual rate of ……..% (5.8%).

9. Central Cattle Breeding Farms were established during the ……. Five year plan period. (IV).
10. The National Dairy Development board was established in the year, …… (1965).
11. The Indo-Danish Project for the development of cattle was established in the year …… (1964)
12. The breed of cattle evolved as a result of Indo-Swiss project in Kerala is …….

II. Define the following:

1. Marginal farmer
2. Small farmer
3. Operation flood
4. Key village scheme
5. GDP

III. Write short notes on:

1. Anand pattern milk co-operative society.
2. Hill Cattle development scheme
3. Value of livestock sector in India.

UNIT-2

Domestication, Species and Terminology

1. Common definitions

The following are the common terminologies used in Animal Science:

1. Livestock: Livestock means stock (items of property) that is live and is used for the production of items of commercial importance or for domestic consumption. It includes in a broad sense, all animals, birds and other living creatures used for the production of items/commodities that are useful to man. In a narrow sense, it includes generally farm animals.

2. Production: is doing or performing all that is necessary for the efficient and economic results from livestock, their handling and marketing.

3. Livestock Production Management: is carrying out a large number of operations aimed at making the animals produce more at lower costs. This involves organizing different activities perfectly and at the proper time involving different/many people. Here, a judicious use of men, material and money should be done so as to obtain the best result and maximum profit.

4. Domestic animal: is one that has entered in to a state of permanent partnership with man. This includes control of breeding and feeding. A domestic animal can be defined as an animal that has been bred in captivity for the purpose of economic profit for man who maintains a total control over its breeding and feeding.

5. Companion animal: Those animals associated very intimately with man so that they are subjected to very affectionate human care.

6. Farmed animals: are those animals that are farmed by man throughout the world and are used for the production of important items for man.

7. Specialized farming system: is one in which 50 % or more of the receipts (output) are obtained from a single source. Eg. A specialized dairy farm is one in which the main source of income is milk, even though, income comes from other subsidiary sources like sale of manure, sale of fodder etc. a specialized farm specializes in the production of a single item / product for market.

8. Diversified farming system: is otherwise called a general purpose farming system. This is one in which the farmer derives income from several items or sources. The income from a single source should not exceed 50 %. If the farmer fails in one enterprise, the others will prevent a total financial loss.

9. Mixed faring system: is one in which crop production is combined with livestock production. Here, livestock production is complimentary to crop production and vice versa. There is inter-dependence and interaction between the components resulting in a synergistic effect. For a farm to be called as a mixed farm, at least 10- 15 % of the gross income must be contributed by livestock components. Here, more than 10 % of the feed provided to animals should come from crop residues or byproducts.

10. Subsistence farming system: is one in which the farmer utilizes all the items produced in the farm for his family use/ home consumption

11. Semi-subsistence farming system: is one in which the farmer uses most of the items produced in the farm for home consumption and only some are used for sale outside.

12. Commercial farming system: is one in which the farmer generally rears only a single livestock species and all the products are sold for cash. These are large units in which large numbers of animals are reared. All kinds of labour saving devices like automatic feeding and watering units, automatic milk / egg collection etc are used.

13. Extensive farming system: is one in which the animals are let out for grazing in large areas of land that are not suitable for agriculture. This is the most popular system of livestock rearing in the tropics.

14. Intensive farming system: is one in which livestock is reared in confinement with limited access to land. Here, most of the feed provided to livestock comes from outside the production unit (purchased). Mostly, hired labour is used.

15. Semi-intensive farming system: is one in which there is limited grazing and stall feeding of cut grass or tree leaves. This system is in between extensive and intensive production systems and is largely dependent up on the availability of land.

16. Ley farming system: (rotational livestock – forage – crop production system) is one in which temporary pastures are rotated with crops while livestock utilize the pasture and crop by=products. Here, pastures are usually grazed for 3 – 5 years and then ploughed and used for crop production, then again re-sown with pasture.

17. Sustainable farming system: is one in which there is improved environmental quality and economic efficiency in the production of high quality products with less amount of off-farm purchased inputs like pesticides, fertilizers etc. Sustainable farming is often referred to as farming that is ecologically healthy and economically efficient.

The foundation of sustainable farming is a comprehensive understanding of the land, the farm resources and operations and potential markets. Characteristics of sustainable farming include:

1. Sustainable systems are generally mixed or diversified systems
2. The components offer high economic benefits and environmental benefits.

2. Domestication of animals

Domestication means, to adapt the behavior of an animal to fit to the needs of people. The domestication of animals began when early human beings had contact with wild animals, which they hunted for food and clothing. After a period of time, these early human beings began to confine some of these animals to ensure a steady supply of food and clothing. These animals were then bred in captivity to replace those that were used. Later on, man selected some animals with certain desirable characters and used them for breeding. As a result of this selective breeding, different breeds of animals began to be

developed. These animals started breeding true for those characters that were found to be desirable. Dog was the first animal to be domesticated by man. Sheep and goats were probably the first farm animals to be domesticated followed by cattle, pigs and horse.

2.1. Taxonomic classification of animals

Taxonomy is the branch of biology concerned with the naming and classification of living organisms (plants and animals). The word has come in to existence from the Greek word *taxis* (meaning 'order', 'arrangement') and *nomos* ('law' or 'science').

Caroleus Linnaeus (1707 – 1778), the Swedish Botanist is considered as the Father of Taxonomy. He devised the system of Binomial Nomenclature for classification of living organisms in which each species of animal or plant is given a Latin name consisting of two parts. These **two parts consist of the name of the genus and the species.** This is termed as **zoological name in the case of animals and botanical name in the case of plants.** Thus, the zoological name of goat is *Capra hircus*, *Capra* – being the name of the genus in which goat is classified and *hircus* – the name of the species.

2.1.1. Classification of domestic animals

Table 2.1. Binomial nomenclature

Animal	Order	Sub-order	Family	Genus	Species
Zebu cattle				*Bos*	*indicus*
Exotic cattle				*Bos*	*taurus*
Buffalo	Ungulata	Artiodactyla	Bovidae	*Bubalus*	*bubalis*
Sheep				*Ovis*	*aries*
Goat				*Capra*	*hircus*
Pig			Suidae	*Sus*	*domesticus*

Note: Genus and Species name together makes the zoological name

3. Body parts of different Species of animals

3.1. Body points of animals

The body of any animal can be broadly divided into the following major regions:

1. Head
2. Neck
3. Trunk
4. Limbs (forelimb & hindlimb)
5. Tail

3.1.1. Parts of head

1. **Poll region:** is the region present in between the horns.
2. **Forehead:** is the upper part of the head region towards the front (anterior side) and in between the eyes.
3. **Face:** the lower part (half) of the head region on the anterior aspect.
4. **Bridge of the nostril / Nasal bridge:** is the area found on the face (below the forehead) in between the eyes, extending up to the muzzle.
5. **Nostrils:** is the external opening of the nasal passage / respiratory system situated on either side of the muzzle.
6. **Muzzle:** is the soft portion below the nasal bridge in between the nostrils.
7. **Upper lip:** is the upper border of the opening of the mouth.
8. **Lower lip:** is the lower border of the opening of the mouth.
9. **Chin:** is the anterior portion of lower jaw formed by the body of the mandible.
10. **Jowl:** is the soft area in between the two parts of the bone forming the lower jaw (mandible).

11. **Throat:** is the region at the posterior aspect of the jowl where the head meets the neck.
12. **Brisket:** Lower aspect of the throat region at the anterior aspect.
13. **Upper eyelid:** is the skin covering of the upper portion of the eyeball.
14. **Lower eyelid:** is the skin covering of the lower portion of the eyeball.
15. **Third eyelid or Nictitating membrane:** is the membrane situated on the medial (inner aspect) of the inner corner (can-thus) of the eye.
16. **Inner eye canthus:** is the medial aspect (inner corner/ angle) of the eyelids.
17. **Outer eye canthus:** is the lateral aspect (outer corner/ angle) of the eyelids.
18. **Eye lashes:** are hairs growing on the border of the eyelids.
19. **Horn:** the protuberance on either of the poll region.

3.1.2. Parts of the neck

1. **Apex of the neck:** is the part or region where the head joins the neck.
2. **Base of the neck:** is the part or region where the neck joins the body.
3. **Body of the neck:** is the region in between the base and apex of the neck.
4. **Crest of the neck:** is the top line (dorsal aspect) of the neck region.
5. **Jugular furrow:** is the longitudinal depression in which the jugular vein is situated and runs parallel to the lower (ventral) aspect of the neck.

3.1.3. Parts of the trunk

1. **Withers:** the highest point on the top line.
2. **Back:** is the portion behind the withers up to the point where the last rib gets attached.
3. **Loins:** the region found between the back and the point of croup.

4. **Point of croup:** the region behind the loin, formed by two internal angles of ilium.
5. **Croup:** is the region behind the point of croup to the base of the tail.
6. **Flank region:** is the triangular depression behind the last rib.
7. **Flap of the flank:** is the fold of skin in front of the hind limbs, on the ventral (lower) aspect of the abdominal wall.
8. **Rump:** is the rectangular region area present on either sides of the croup.
9. **Buttocks:** the muscular region found behind the rump.
10. **Point of buttocks / pinbone:** is the prominence found in the middle of the buttocks.
11. **Umbilicus or navel:** is the depression found on the ventral aspect (lower side) of the trunk, in the middle of the abdominal wall.
12. **Prepuce:** is the fold of skin present on the ventral aspect of the abdomen in male animals. The penis opens out through the prepuce.
13. **Scrotum:** is the pouch of skin at the inguinal region of male animals, in which the testicles are present.
14. **Perineal region:** is the region in between the prepucial opening and anus in male animals and inbetween the anus and vulva in female animals.

3.1.4. Parts of the forelimb

1. **Shoulder region:** is the triangular area outlining the scapula.
2. **Shoulder joint:** is the joint formed at the glenoid cavity of the scapula and the head of the humerus.
3. **Point of shoulder:** is the bony prominence in front of the shoulder joint.
4. **Arm region:** is the region between the shoulder joint and the elbow joint.
5. **Elbow joint:** is the joint formed between the lower part of the humerus

and the upper part of radius and ulna.

6. **Point of elbow:** is the bony prominence found at the elbow joint.
7. **Fore arm:** is the region between the elbow joint the knee joint.
8. **Knee joint:** is the joint formed below the elbow joint.
9. **Fore shank:** is the region between the knee joint and fetlock joint.
10. **Fetlock joint:** is the joint at the lower extremity of the forelimb.
11. **Pastern region:** is the region below the fetlock joint
12. **Coronet ring:** the ring formed at the junction where the skin joins the hoof.
13. **Hoof:** the horny covering at the lower extremity of the limb.
14. **Dewclaw:** two horny projections at the ventral aspect of the pastern region, situated above the hoof.

3.1.5. Parts of the hindlimb

1. **Hip joint:** is the joint formed at the hip.
2. **Thigh:** is the region between the hip joint and the stifle joint.
3. **Stifle joint:** is the joint formed between the lower end of femur and upper end of tibia and fibula. The patella is present at this joint.
4. **Lower thigh:** the muscular region between the stifle joint and hock joint.
5. **Hamstring / Tendo Achilles / Achilles Tendon:** is the thick muscular tendon located at the posterior aspect (back) of the lower thigh.
6. **Hock joint:** is the joint formed by lower end of tibia and tarsal bone and upper end of metatarsal bone.
7. **Point of hock:** is the bony prominence present behind the hock joint.
8. **Hind shank:** is the region formed between the hock joint and the fetlock joint.
9. **Fetlock joint:** is the joint at the lower extremity of the hind limb.

10. **Pastern region:** is the region below the fetlock joint.
11. **Coronet ring:** the ring formed at the junction where the skin joins the hoof.
12. **Hoof :** the horny covering at the lower extremity of the limb.
13. **Dewclaw:** two horny projections at the ventral aspect of the pastern region, situated above the hoof.

3.1.6. Parts of tail

1. **Tail head or base of the tail:** is the point where the tail gets connected to the body of the animal.
2. **Body of the tail:** is the main structure of the tail.
3. **Switch of the tail:** is the bunch of hairs present at the tip of the tail.

Fig. 2.1. A crossbred cow with good conformation

Fig. 2.2. An indigenous cow with good conformation

Fig. 2.3. A buffalo with good conformation 3.2. Differences between Cattle and Buffaloes

Table 2.2 Cattle *Vs* Buffaloes

Characters	Cattle	Buffaloes
Colors	Many colors and patterns	Usually black
Cross section of horn	Circular	Angular
Brisket region	Not prominent	Prominent
Tolerance to heat	Less	More
Quantity of milk produced	More	Less

3.3. Differences between Sheep and Goats

Table 2.3 Sheep *Vs* Goats

Characters	Sheep	Goat
Structure	Stocky	Tall, Thin and slender
Horns	Spirally twisted	Long and straight
Beard and tassels	Generally absent	Generally present
Males	No odor	Have strong goaty smell
Scent glands	Present in face and feet	Not present

4. Common Technical Terms

4.1. Cattle and buffaloes

1. **Cattle:** term used to denote the animals coming under the species *Bos indicus* and *Bos taurus* and their wild counter parts.
2. **Buffalo:** term used to denote the animals coming under the species *Bubalus bubalis* and their wild counter parts.
3. **Calf:** Young one of either sex of cattle.
4. **Buffalo calf:** Young one of either sex of buffalo.

5. **Heifer:** Growing female animal of above 6 months of cattle and buffaloes.
6. **Cow:** Adult breeding female of cattle.
7. **Buffalo cow/She buffalo:** Adult breeding female of buffalo.
8. **Bull:** Adult male of cattle used for breeding.
9. **Buffalo bull:** Adult male of buffalo used for breeding.
10. **Bullock:** Adult male cattle that is castrated and used for work purpose.
11. **Steer:** Adult male cattle that is castrated and used for meat purpose.
12. **Buffalo bullock:** Adult male buffalo that is castrated and used for work.
13. **Serving:** the act of mating in cattle and buffaloes.
14. **Calving:** the act of giving birth in cattle and buffaloes.
15. **Bellowing:** sound produced by cattle and buffaloes.
16. **Herd:** group of cattle / buffaloes.

4.2. Sheep and Goats

1. **Sheep:** term used to denote animals coming under the species *Ovis aries*.
2. **Goat:** term used to denote animals coming under the species *Capra hircus*.
3. **Kid:** young one of a goat of either sex.
4. **Lamb:** young one of a sheep of either sex.
5. **Ram:** adult male sheep used for breeding.
6. **Ewe:** adult female sheep used for breeding.
7. **Buck:** adult male goat used for breeding.
8. **Doe:** adult female goat used for breeding.
9. **Ram lamb:** male growing sheep.
10. **Ewe lamb:** female growing sheep

11. **Buckling:** male growing goat.
12. **Doeling:** female growing goat.
13. **Flock:** group of sheep.
14. **Band:** group of goats.
15. **Serving:** the act of mating in goat.
16. **Tupping:** the act of mating sheep.
17. **Kidding:** the act of giving birth in goat.
18. **Lambing:** the act of giving birth in sheep.
19. **Bleating:** the sound produced by goat.

4.3. Pigs

1. **Pig:** term used to denote animals coming under the species *Sus domesticus*.
2. **Piglet / Pigling:** young one of a pig of either sex.
3. **Boar:** adult male pig used for breeding.
4. **Sow:** adult female pig used for breeding.
5. **Boarling:** young male growing pig.
6. **Gilt:** young female growing pig.
7. **Coupling:** the act of mating in pigs.
8. **Farrowing:** the act of giving birth in pigs.
9. **Grunting:** the sound produced by pigs.
10. **Barrow/shoat:** castrated male pig.
11. **Drove:** group of pigs

EXERCISE

I. Fill-up the blanks with appropriate answers:

1. Performing all functions necessary for the efficient and economic results from livestock is called ……
2. An animal that has been bred in captivity for the purpose of economic profit for man is called a ……..
3. The farming system in which 50 % or more of the receipts (output) are obtained from a single source is ……
4. A general purpose farming system is otherwise called as …….
5. A farming system in which crop production is combined with livestock production is termed …….
6. The farming system in which the farmer generally rears only a single livestock species and all the products are sold for cash is ……..
7. The farming system in which the animals are let out for grazing in large areas of land that are not suitable for agriculture is termed ……..
8. The farming system in which there is limited grazing and stall feeding of cut grass or tree leaves is called as…….
9. Sustainable farming systems are generally …… type systems.
10. Different breeds of animals were developed by…….
11. The first farm animals to be domesticated by man were ……..
12. The Swedish Botanist, who is considered as the Father of Taxonomy is ……..
13. The branch of biology concerned with the naming and classification of living organisms (plants and animals) is ……
14. Cattle/buffalo/sheep/goats belong to the family, …….
15. The zoological name of Indian cattle is. ……
16. The zoological name of European/exotic cattle is ……
17. The zoological name of domestic goat is. ……
18. The zoological name of domestic sheep is. ……

19. The zoological name of domestic buffalo is ……
20. Adult male cattle that is castrated and used for work purpose is called ……

II. Define the following:

1. Domestication
2. Taxonomy
3. Domestic animal
4. Farm animal
5. Subsistence farming system
6. Ley farming system
7. Sustainable farming system
8. Intensive farming system
9. Mixed farming system 10. Livestock

III. Write short notes:

1. Domestication of farm animals.
2. Classification of Indian breeds of cattle
3. Classification of exotic cattle
4. Differentiate between cattle and buffaloes
5. Differentiate between sheep and goats

UNIT-3

Breeds of Domestic Animals

Breed is defined as a group of animals with common ancestry, similar external appearance and breed "true to type". Analogous to plants, each species of animals consists of several breeds with distinctive characteristics.

1. Breeds of Cattle

There are several breeds of cattle in India. These breeds have been evolved over centuries / generations to suit different agro-climatic conditions and farming systems in which they are reared. Many of these breeds have been named after their place of origin and have different synonyms as per the locality where they are found in large numbers.

Breeds of cattle in India are classified into different groups according to their type, place of origin, physical characters etc.

1.1. Classification of zebu cattle:

1.1.1. Based on the type of horns

1. Short-horned zebu, Eg. Hariana, Ongole, Rathi, Nagore
2. Lateral-horned zebu, Eg. Gir, Deoni, Sindhi, Sahiwal

3. Lyre-horned zebu Eg. Kankrej, Tharparkar, Malvi
4. Long-horned zebu Eg. Kangayam, Khilari, Hallikar, Amrithmahal
5. Small, short horned zebu Eg. Ponwar, Punganur

1.1.2. Based on utility

1. Dairy or milk or milch type breeds: Cows of this type are high milk producers. Bullocks are of poor work quality. The animals are generally large in size and have large, pendulous dewlap and sheath. Skin is loose. Eg. Gir, Sindhi, Sahiwal and Deoni.
2. Draught type breeds: Cows of this type produce very less milk. Bullocks are very powerful and good draught animals. The animals generally have a streamlined (well proportioned) body, strong limbs, long barrel, tight sheath and tight skin. They are very fast and active. Eg. Kangayam, Hallikar, Amrithmahal and Khilllari.
3. Dual purpose type breeds: Cows of this type are fairly good producers of milk and bullocks are good for work. In general, these animals are large in size. Eg. Kankrej, Hariana, Tharparkar, Ongole

1.2. Common Breeds of Indian cattle

The description of the common Indian breeds of cattle is given below. The description is not exhaustive as only a few common breeds of cattle are discussed here with specific reference to their very important characteristics and the way by which they differ from each other.

1. Gir (Synonyms: Gujarati, Kathiawari, Surati, Desan)

General features: This is a good milk breed of cattle. The head has a broad and convex forehead. The eyes are large with thick upper eyelids, which gives a sleepy- appearance to the animal. The ears are long, pendulous and having a curled leaf-like appearance with a notch at the tip. Horns are short having a half-moon appearance. Hump is well developed and the dewlap is moderate in size. Tail is long. Udder is well-developed with long teats.

Color: Animals are deep red in Color. Animals with white and dark red patches are also found.

Milk Production comes to 1200 – 1800 kg / lactation. Males of this breed are very slow workers.

This breed is exported to Brazil for crossbreeding to evolve different beef breeds.

Birth weight: 20 – 27 kg; Adult body weight: Male: 545 kg Female: 310 kg

2. Red Sindhi (Synonyms: Sindhi, Red Karachi)

General features: Red Sindhi is a very good milk cattle having its native tract Sindh province in Pakistan. Head is moderate sized. Forehead is slightly bulged with a broad face. Ears are slightly drooping. Horns are short and thick. Hump is very well developed in Males. Tail is long and thin. Udder is large and pendulous with medium-sized teats

Color: is red, varying from light to dark.

Milk production comes to around 1200 – 2600 kg / lactation (average: 1800 kg) with a fat percentage of 4.0 – 5.2. Cows are considered to be the most economic milk producers among the Indian breeds of cattle. Males are average workers.

Birth weight:18–20 kg Adult body weight: Male: 420 kg Female: 340 kg

3. Sahiwal (Synonyms: Montgomery, Lola)

General features: This breed is very good for milk production with Montgomery district of Pakistan as native tract. Animals are heavy with loose skin. Head is long with a massive forehead. Eyes are large with light Colored eye lashes. Ears are medium sized. Horns are short and stumpy. Some Female animals have loose horns. Tail is long with a black switch. The udder is large with large cylindrical teats.

Color: Pale red, sometimes with white spots.

Milk production comes to about 1600 – 2750 kg / lactation with a fat content of 4.8 – 5.1 %. Males are lethargic and are used for slow work

Birth weight: 19–22 kg Adult body weight: Male: 400–500 kg Female:

300–350 kg

4. Deoni (Synonyms: Deccani, Waghyd, Balonkya, Wannera)

General features resemble Gir cattle to a certain extent. The native tract includes Latur district of Maharashtra and adjoining areas of Andhra Pradesh and Karnataka.

Animals are medium-sized with forehead prominent and slightly bulged. Eyes are prominent with black eyelashes. Ears are large and pendant. Horns are thick. Hump massive in Males. Tail is long with a black and white switch. Udder is moderately developed in cows with cylindrical teats.

Color: Usually spotted black and white with black hooves.

Milk production ranges from 600 – 1200 kg per lactation with a fat content of 4.3 %. Bullocks are good for heavy work.

Birth weight: 20 – 25 kg; Adult body weight: Male: 620 – 680 kg Female: 430 – 480 kg

5. Kangayam (Synonyms: Kanganad, Kongu)

General features: Animals are of moderate size, strong and active. Breeding tract is Kangayam in Periyar district of Tamil Nadu.

Animals possess a short head and a straight face. Forehead has a groove in the centre. Eyes are elliptical in shape and prominent. Ears are short. Horns are typical in this breed. They are Cobra hood shaped (strong and long and curve backwards, inwards, outwards and upwards nearly completing a circle). Hump is large in Males and medium – sized in

Females. Skin is tight. Tail is long, broad at the base and narrow towards the tip with a black switch. The udder in Females is small with cylindrical teats.

Color: Males are grey with black Color on the hump, face, forequarters and hind quarters. This dark shade disappears with castration.

Cows are grey in Color. Calves have a red Colored coat at birth, which changes to grey at about 4 – 6 months of age.

Cows produce 600 – 800 kg of milk in one lactation period. Bullocks are

very hardy, strong and active and are used for different agricultural operations and carting.

Birth weight: 21 kg; Adult body weight: Male: 640 kg Female: 380 kg

6. Hallikar

General features: Animals are medium-sized, compact and muscular with good trotting ability. Place of origin is Mysore, Mandya, Tumkur, Hassan, Chitradurga districts of Karnataka.

Head is long and forehead is prominent with a slight bulge at the poll region and a prominent groove in the middle. Eyes and ears are small. Horns emerge very close together at the poll and take a backward sweep to almost half their length and then turn forwards with a gentle sweep. Hump is large in Males. Skin is tight. Tail is long and thin with a black switch. Udder in cows is small.

Color: varies from grey to dark grey with dark shade on the forequarters and hindquarters.

Milk production is about 540 kg with a fat % of 5.7. Bullocks are fast and steady workers. They are used for all types of agricultural work and carting.

Adult body weight: Male: 340 kg Female: 225 kg

7. Khillari

General features: medium – sized, very active and strong animals. Place of origin is Sholapur, Satara and Satpura districts of Maharashtra state and adjoining regions of Karnataka.

Forehead is long and narrow with a slight bulge at the poll region and distinct groove in the middle. Eyes and ears are small. Horns are long, pointed and curve backwards for almost half the length and then sweep upwards. They are placed very close together. Hump is of moderate size. Skin is tight. Tail is long and thin with a black switch. Udder in cows is small.

Color: General Color is grey. Males are dark over the forequarters and hindquarters. Hooves and horns are sometimes pink. New born calves have a rusty-red Colored poll, which changes to grey within two months of age.

Milk production is 240 – 500 kg per lactation. Bullocks are very hardy,

fast and powerful draught animals.

Birth weight: 17 – 21 kg Adult body weight: Male: 450-625 kg Female: 300-350 kg

8. Amritmahal

General features: Animals are small –sized, very active and well – known for hard work having their place of origin as Karnataka state.

Head is narrow and forehead is slightly bulged with a furrow in the middle. Eyes are bright and ears are small. Horns are long and emerge very close together in a backward and upward sweep. Hump is well developed. Skin is tight. Tail is long and thin. Udder in cows is small – sized.

Color: Generally grey, varying from very light to dark.

Milk production average 570 kg per lactation. Bullocks are used for different agricultural operations and carting. They are very good for quick transportation.

Birth weight: 17–21 kg Adult body weight: Male: 500 kg Female: 320 kg

9. Kankrej (Synonyms: Wagad, Wadad, Vagadia)

General features: this is the largest / heaviest Indian breed of cattle originating from Gujarat state. Forehead is broad and slightly dished at the centre. Eyes are large with wrinkles above the eyelids. Ears are large and pendulous. Horns are strong, thick and lyre – shaped and covered with skin up to a certain extent. Hump is very well developed. Tail is long with a black switch. Udder in cows is medium – sized.

Color: silver to iron – grey. In bulls, the fore quarters, hump and the hind quarters are darker in shade. New born calves have rusty-red Colored poll region. This Color disappears by 6 – 7 months.

Milk production is 1000 – 3100 kg per lactation with a fat content of 4.8 %. Bullocks are very good workers and are generally used for carting and field operations.

Birth weight: 23 kg Adult body weight: Male: 500 – 550 kg Female: 325 - 400 kg

The gait of this breed of cattle is generally called “Sawai chal’ (1 ¼ pace)

in which the hind hoof is placed well before the impression of the fore hoof.

10. Hariana (Synonym: Hissar)

General features: Animals are very powerful in nature with Rothak, Jind, Hissar of Haryana state as its breeding tract. Head is normally carried high with a majestic appearance. Forehead is flat with a bony prominence at the centre of the poll region. Eyes are large and bright with black eyelashes. Ears are small and slightly pendulous. Horns are short and thick in Males and thin in Females. Hump is large in Males. Tail is short and thin. Udder is well developed.

Color: White to light grey. Bulls have dark grey markings between the fore quarters and hind quarters

Milk production varies from 700 – 1750 kg per lactation with a fat % of 4.5. Bullocks are powerful and are used for fast ploughing and carting.

Birth weight: 17 – 25 kg Adult body weight: Male: 500 kg Female: 325kg

1.3. Classification of cattle (Exotic)

Exotic cattle are classified according to their utility as follows:

1. Dairy type: Eg. Jersey, Holstein-Friesian, Ayrshire, Red Dane
2. Meat type: Eg. Shorthorn, Angus, Hereford, Brangus

1.3.1. Exotic breeds of Cattle

1. Jersey

Place of origin: Island of Jersey, UK.

Animals are small in size with a straight top line (hump absent) and a double-dished face. Eyes are prominent. Horns are small in the form of a semi-circle. Udder is large, with well spaced teats. Milk is rich in fat. Tail is long.

Milk production comes to about 4000 litres with a fat % of 4.5 – 5.3.

Color: Fawn with or without white markings

Animals are slightly nervous in temperament. They are very well adapted to tropical climate.

2. Holstein – Friesian

Place of origin: The Netherlands (Holland)

Animals are large in size with a long head and straight top line(hump is absent). Females possess large, pendulous udder with long sized teats. Animals produce large quantity of milk. Tail is long with a white switch Milk production comes to about 6000-8000 litres with a fat % of 3.0 – 3.5.

Typical Color is black and white.

3. Ayrshire

Origin: Scotland

This breed is considered as the most beautiful dairy breed of cattle in the world. Animals are large in size with a straight top line. Horns are long and carried upwards. Neck is short and thick.

Udder is well developed. Milk production comes to about5000 litres with an average fat % of 4.0.

Color: Red or brown with a combination of white patches.

Animals are highly temperamental and overactive.

4. Brown Swiss

Origin: Switzerland

This breed is originally a triple purpose animal (for milk, meat and draught) in its native tract. Animals are large and powerful with medium sized horns. Skin is thick and loose. Udder is well developed. Milk production comes to about 5000 litres / lactation with an average fat % of 4.0.

Animals are very docile and easily manageable. Typical Color is brown.

2. Breeds of buffaloes

Asian countries, in general and India and Pakistan, in particular, are native to all breeds of buffaloes and their characteristics are outlined below:

1. Murrah (Synonyms: Delhi buffalo, Kundi)

General features: Place of origin is Haryana state. Animals are massive and stocikily built. This breed is considered as the best milk cum meat breed of buffalo. The forehead is slightly prominent with bright and prominent eyes in females and shrunken eyes in males. Ears are short and thin. Horns are short, flat and tightly curled in the form of a spiral. The word "Murrah" means curled. Body: is long, massive, deep and wedge shaped with a broad hip. Tail is long, almost reaching the fetlock joint with a white switch. Udder is well-developed with long teats.

Colour: Animals are jet black in colour with white markings on the face and tail.

Milk production ranges from 1400 – 1800 kg / lactation with a fat content of 7.0 to 8.3 %.

Birth weight: 26 – 36 kg Adult weight: Male: 530 – 575 kg Female: 430 - 500 kg

2. Surti (Synonyms: Gujarati, Surati, Charotar, Deccani, Nadiadi, Talabda)

General features: animals are medium-sized having Kaira and adjoining Vadodara district of Gujarat state as the place of origin. Forehead is broad and round, bulging at the poll region. Eyes are bright and bulging and ears are medium-sized. Horns are flat and sickle-shaped. Body is medium-sized and wedge shaped with a wide hip. Tail is long and thin with a white switch. Udder is well-developed with squarely placed medium-sized teats.

Colour: Animals are black or brown in colour with white markings below the knee and hock joints and forehead. Two white collars are present, one around the jaw and the other at the brisket region.

Milk production ranges from 1500 – 1700 kg / lactation with an average fat content of 7.9 %.

Birth weight: 24 – 30 kg Adult weight Male: 500 kg Female: 380 kg.

3. Mehsana (Synonyms: Mehsani, Banni)

General features: Mehsana breed of buffalo has been evolved as a cross between Murrah and Surti breeds. Therefore, this breed shows wide variation

in appearance. Animals are in general medium-sized with place of origin, Mehsana town of Gujarat state.

Head is heavy with a long face. Forehead is broad with a slight depression in the middle. Eyes are bright, prominent and bulging and ears are medium-sized and pointed. Horns are black with a loose curl and appears in between coiled to sickle-shaped. Body is long, massive and wedge shaped with a deep chest and broad brisket. Tail is long and thick with a black, brown or white switch. Udder is well-developed, large, bowl-shaped with long, thick teats.

Colour: Animals are black in colour with white markings on the face, legs and the switch of tail.

Milk production ranges from 1000 – 3200 kg / lactation with an average fat content of 7.0 %.

Birth weight: 29 kg (average).

Adult body weight: Male: 400 - 600 kg Female: 315 - 580 kg

4. Jaffarabadi (Synonyms: Gir, Jaffari, Bhavanagari)

General features: animals are massive with a long barrel. This breed is the largest breed of buffalo in India. Place of origin is Gir forest area in Kathiawar, Gujarat state. Head is massive and forehead is very prominent and bulging. Eyes are bright and prominent and Ears are long and mostly horizontal. Horns are flat, broad and heavy with a heavy base. They droop on either side of the neck and turn up at the tip (in an incomplete coil). The base of the horn is very thick and broad and sometimes covers the eyes. Body is long, massive, deep and not so compact. Tail is long, almost reaching the fetlock joint. Udder is well-developed, large and capacious with funnel-shaped teats.

Colour: Animals are black.

Milk production ranges from 1800–2700 kg / lactation with a fat content of of 7–9%.

Birth weight: 30 kg

Adult weight: Male: 590kg Female: 450 kg

5. Bhadawari

General features: animals are medium-sized with a wedge-shaped body. This breed has the reputation for very high content of fat in milk. Place of origin is Agra and Etawah regions of Uttar Pradesh and Gwallior in Madhya Pradesh. Head is comparatively small. Forehead is broad and bulging at the poll region. Eyes are bright with copper coloured or brown eyelids. Ears are medium-sized and horizontal. Horns are flat, growing backwards, upwards and inwards with slightly pointed tips. Body is short with a well developed chest. Tail is long and thick with a white or brown or black and white switch. Udder is not very well-developed with medium-sized teats.

Colour: Animals are in general copper coloured. Two white markings/ collars are present on the lower part of the neck.

Milk production ranges from 700 – 1165 kg / lactation with a fat content of up to 12.5 %. Males are used for work. They have better tolerance to heat when compared to other breeds of buffaloes.

Birth weight: 25–28 kg

Adult weight: Male: 475 kg Female: 385kg

6. Nagpuri (Synonyms: Ellichpuri, Varadi, Berari, Gaulari)

General features: animals are dual-purpose with female animals, fairly good producers of milk and males, good for heavy draught work. The place of origin is Nagpur in Maharashtra state and adjoining areas of Andhra Pradesh. The face is long and thin. Eyes are bright and ears are medium-sized with pointed tips. Horns are long, flat and sword-shaped, nearly reaching the shoulder. Horns are heavier in males than in females. Body: is medium-sized. Tail is comparatively short with a white switch. Udder is medium-sized with long teats.

Colour: Animals are black in colour with white markings on the face and switch of the tail. Milk production ranges from 780 – 1500 kg / lactation with a fat content of 7.0 to 8.5 %. Birth weight: 28 kg

Adult body weight: Male: 520 kg Female: 400 kg

7. Toda

General features: animals are medium in size with a long body and deep and broad chest. This breed is named after an ancient tribe inhabiting Nilgiris hills called as Toda. The place of origin is Nilgiris district of Tamil Nadu in South India. Head is heavy with a broad forehead. Eyes are bright and black. Ears are held horizontally. Horns are set wide apart. They curve inwards, outwards and forwards in a semi-circular shape (crescent shaped). Horns are thick at the base and pointed at the tip. Body is long and medium-sized with thick hair covering all over the body especially the face, neck and fore quarters. Tail is long and thin with a black switch. Udder is not prominent and is with cylindrical teats.

Colour: Adult animals are fawn (light brown) or ash-grey in colour. Calves are fawn coloured at birth. The colour of calves turns to ash grey by two months of age. Muzzle is black in colour.

Milk production: around 500 kg with a mean fat content of 8.2 %.

Birth weight: 23 kg Adult body weight: Male: 390 kg Female: 350 kg

8. Nili Ravi

General features: animals are massive with a deep chest. This breed is almost similar to Murrah in body conformation (except for white markings and wall eyes). Place of origin is Sutlej valley, Ferozpur district of Punjab in india and Sahiwal district of Pakistan. The breeding tract is spread along the Indo-Pak border. Head is long and bulging at the poll region and is depressed in between the eyes. Eyes: wall eyes are common. Ears are medium-sized. Horns are short and coiled lightly. Body is long, massive, deep and wedge shaped with a broad hip. Tail is long, almost touching the ground with a white switch. Udder is well-developed, large and capacious, extending forwards and backwards with long teats.

Colour: Animals are black in colour with white markings on the forehead, face, muzzle and limbs. Milk production is on an average 1850 kg / lactation with a fat content of 5.0 to 8.0 %.

Birth weight: 27 – 39 kg

Adult body weight: Male: 560 kg Female: 450 kg

3. Breeds of Goats

3.1. Indian breeds of Goats

1. Jamnapari: is the largest breed of goat in India having Ettawah district of Uttar Pradesh as its breeding tract.. This is a dual purpose goat breed, good for milk and meat. Animals are large-sized with long, pendulous, leaf-like ears and a Roman nose with a tuft of hairs. Horns are short and flat. Udder is large and well developed with long teats. Daily milk production varies from 2.25 to 2.75 kg with a fat content of 3.5. White with brown/black markings is the common Color pattern. Hindquarters have long, thick hairs.

2. Beetal: resembles Jamnapari to a great extent, but is smaller in size. Punjab is the place of origin. Ears are medium-sized and pendulous. Other features include Roman nose and twisted horns. Common Color is black, tan and white. Average milk production is 1.5 kg per day. Twinning is common in this breed.

3. Barbari: this breed is medium in size with short ears originating fromUttar Pradesh. This is a prolific breeder and a good milk producer. Milk yield comes to about 1.0 – 1.5 kg per day with a fat content of 5 %. Common Color is white with few tan/brown spots.

4. Kathiawari: animals are generally medium-sized with long hairs. North Gujarat is the place of origin. Horns are twisted in appearance. General Color is black with a red-brown marking on the neck. Milk production is 1.2 – 1.3 kg per day.

5. Marwari: animals are medium-sized with small white speckled ears. Breeding tract is Rajasthan. Horns are long and twisted in appearance. Males possess beard. This breed is reared for hairs and meat. Milk production is around 0.9 kg per day.

6. Sirohi: animals are medium-sized with dense, short hairs. Breeding tract is Gujarat and Rajasthan. Animals have long and pendulous ears. Color is white or brown. Animals are mainly reared for meat. Milk production comes to around 0.9 kg per day.

7. Surthi: animals are small in size. Place of origin is Maharashtra. These animals are generally stall fed. Animals are not adapted for grazing as they cannot walk long distances. Milk yield is around 1.2 kg per day.

8. Osmanabadi: Place of origin is Maharashtra state. Animals are large-sized and tall with medium-sized ears and long horns. They are black in Color with brown or white spots. Females are poor milk producers. These animals are reared mostly for meat purpose.

9. Tellicherry (Malabari): Place of origin is North Kerala. Animals are medium-sized with a flat or Roman nose and generally long ears. Horns are small or long and twisted/curved. Some animals are polled. General Color pattern is white, black, brown or a combination of these Colors. Milk production is very less and comes to around 0.5 kg per day.

10. Ganjam: Breeding tract – Orissa. Animals are small-sized with a compact body. Males have beard. Horns are parallel and curve backwards and downwards. Females are prolific breeders. Common Color includes black, white or grey. This is a late maturing breed of goat and a poor milk producer; yielding about 0.4 kg per day. Animals are reared exclusively for meat purpose.

11. Black Bengal: Place of origin is West Bengal. Animals are very small in size and black Colored. Ears are erect. Skin is of superior quality with soft, short hairs. This is a highly prolific breed of goat. Multiple births are very common. Milk production is less. This is a very good meat producer.

12. Kashmiri: Place of origin is Kashmir and Shimla. Animals are small-sized. This breed of goat produces a soft and fine animal fibre used for the manufacture of high quality fabrics. Yield of this fibre comes to around 20 – 56 g per animal.

3.2. Exotic breeds of Goats

1. Alpine: Place of origin – French and Swiss Alps region. This goat is very well adapted to hilly regions. They possess horns and erect ears. Come in different colours like black, tan, white and a combination of all the three colours.

2. Anglo-Nubian: Place of origin – England. This breed is evolved by crossing Nubian bucks from Egypt and Jamnapari from India with native British does. These animals have a Roman nose and long pendulous ears (like that of Jamnapari). The females of this breed produce milk with a very high fat content (4 – 5 %) and hence called “Jersey of the Goat world”. Colour variations include black or black and brown.

3. Angora: Place of origin – Turkey. Breed of goat producing a very fine fibre of economic importance called "mohair". Mohair is used for the manufacture of superior quality fabrics.

4. Saanen: Place of origin – Switzerland. This is a good dairy breed of goat, producing about 2 – 2.5litres of milk per day. Coat colour is mostly white or cream. Animals are generally polled in nature and normally possess beard.

5. Toggenberg: Place of origin – Switzerland. This breed is a good milk producer. Animals are light brown in colour with a white or light brown stripe from the ear to the muzzle. This peculiar marking is a characteristic feature of this breed of goat. Horns are present.

4. Breeds of Sheep

4.1. Indian breeds of Sheep

1. Chokla: Place of origin is Rajasthan. This is a fine carpet wool breed of sheep. Animals are light-medium in size with small to medium sized, tubular ears. Males and Females are polled. Coat is dense, relatively fine. Face is devoid of wool. Color of face and neck is reddish brown or dark brown. Milk yield is very less, therefore, not generally milked. Average fleece weight: 1.37 kg every 6 months.

2. Nali: Place of origin is Rajasthan and parts of Haryana. Animals are medium sized. This is a good carpet wool breed. Ears are large and leaf-like. Males and Females are polled. Fleece is white, coarse, dense and long. Forehead, belly and legs are covered with wool. Average fleece weight: 1.46 kg every six months

3. Marwari: Place of origin is Rajasthan. Animals are medium sized with very small, tubular ears. Males and Females are polled. Fleece is white and coarse. Face is black in Color. Average fleece weight: 0.89 kg every six months

4. Jaisalmeri: Place of origin is Jaisalmer district of Rajasthan. This is the largest breed of sheepin Rajasthan. Animals are tall and well-built with a typical Roman nose. Ears are long and drooping. Males and Females are polled. Face is black or brown in Color. Fleece is white in Color. Produces good quality carpet wool.

5. Sonadi: Place of origin is Rajasthan and Northern Gujarat. Animals are well-built with long legs. Ears are large and drooping. Males and Females are polled. Face is light brown in Color. Fleece is white, coarse and hairy.

6. Muzzafarnagari (Bulandshari): Place of origin is Muzzafarnagar, Bulandshahar, and Meerut of Uttar Pradesh. Animals are medium to large in size with a slightly convex face and long and drooping ears. Males have rudimentary horns and Females are polled. Face is black in Color.

7. Deccani: Place of origin is Maharashtra, Andhra Pradesh and Karnataka. Animals are medium sized with flat, drooping ears. Tassels are present. Rams are horned and ewes are polled. Color is predominantly black or black with white markings. This breed is mainly reared for meat purpose.

8. Bellary: Place of origin is Bellary district of Karnataka. Animals are medium sized and are similar to Deccani sheep. Ears are flat and drooping. Majority of the Males are horned and Females are polled. Color ranges from white to combinations of white and black to black. Fleece is extremely coarse, heavy and black.

9. Mecheri (Maiylambadi): Place of origin is Tamil Nadu. Animals are medium sized with medium sized ears. Males and Females are polled. Body is covered with very short hairs. Animals are light brown in Color.

10. Kilakarasal (Karuvai): Place of origin is Tamil Nadu. Animals are medium sized with medium sized ears. Males have thick, twisted horns and Females are polled. Majority of the animals possess tassels.

11. Nilgiri: Place of origin is Nilgiri hills of Tamil Nadu. This breed is evolved from a crossbred population of Coimbatore, Merino, Cheviot and Southdown. Animals are medium sized, well adapted to the conditions of Nilgiri hills. They produce fine fleece. Animals have Roman nose. Ears are broad, flat and drooping. Males possess horn buds and Females are polled. Fleece is fine and dense. Color is white with brown patches on the face and body.

12. Ramnad White: Place of origin is Tamil Nadu. Animals are medium sized with medium sized ears. Males have twisted horns and Females are polled. Animals are predominantly white in Color. Some animals have fawn or black markings on the body.

13. Madras Red: Place of origin is Tamil Nadu. Animals are medium sized with medium sized, drooping ears. Males have twisted horns. Females

are polled. Body is covered with short hairs and is predominantly brown in Color (varies from light tan to dark brown). Some animals have white markings on the forehead, inside of the thighs and on the lower abdomen.

14. Nellore: Place of origin is Nellore district of Andhra Pradesh. Animals are large in size and tall. This breed is considered as the tallest breed on sheep in India. Ears are long and drooping. Majority of the animals possess tassels. Rams are horned and ewes are polled. Rams possess twisted horns. Color includes brown/tan, white with black.

15. Mandya (Bannur): Place of origin is Mandya district of Karnataka state. Animals are small with a compact body. This breed is considered as the best meat breed of sheep in India. Animals possess slight Roman nose. Ears are long, leafy and drooping. Majority of the animals possess tassels. Males and Females are polled. Color is white. Some animals have light brown face.

16. Rampur Bushair: Place of origin is Himachal Pradesh and Uttar Pradesh. Animals are medium sized with long and drooping ears and a typical Roman nose. Males are horned and most of the Females are polled. Fleece is dense and is of medium quality. Legs, belly and face are devoid of wool. Color of fleece is predominantly white with brown, black and tan Colors.

17. Gurez: Place of origin isGurez region in North Kashmir. Animals are large sized with long, thin, pointed ears. Some animals have short, pointed horns. This breed is the largest of the breeds in Jammu and Kashmir. Fleece is generally white in Color. This breed produces superior quality mutton. Annual grease fleece weight is around 0.5 – 1.0 kg.

18. Kashmir Merino: Place of origin is North temperate regions of India. Animals have originated from crosses of different Merino types with native breeds of the region like Gaddi and Bhakarwal with Merino inheritance of 50 – 75 %. Characteristics are highly variable as a number of native breeds are involved.

4.2. Exotic breeds of Sheep

1. Merino: Place of origin: Spain. This breed is considered as the most popular fine-wool breed of sheep in the world. Merino is commonly known as “Golden-footed sheep”. Animals are white-faced sheep with white feet. Rams are horned with spiral horns and ewes are polled. Head, body and legs are covered by wool. They have many wrinkles / folds of skin. This breed is

extremely hardy and resistant and can survive under adverse weather and poor grazing conditions. They are good grazers and have good flocking instinct. Hence management is easy.

2. Rambouillet: Place of origin: France. This breed also produces very fine wool, like Merino. This is also good for mutton, hence considered as a dual purpose breed. Animals are large in size. Rams are generally horned and ewes are polled. Have good mothering ability.

3. Cheviot: Place of origin: Scotland. This breed is a medium wool breed. Nose, lips and feet are black and face is white. They are beautiful in appearance.

4. Leicester: Place of origin: England. This breed is a long wool breed of sheep with medium-size and a broad head. Produce very good mutton, hence dual purpose.

5. Corriedale: Place of origin: New Zealand. This breed is a Crossbred wool breed of sheep (Cross of Merino and Lincoln). This is a dual-purpose breed (wool and mutton) of exotic sheep. Animals have a good mutton conformation from Lincoln and good fleece quality from Merino. The face, ears and legs are covered with white hairs. This breed is prolific and hardy.

6. Southdown: Place of origin: England. This breed is stocky with a compact body and a grey face and short, rounded ears. This has a very good mutton conformation. Wool is of high quality with excellent crimp. Do not possess horns (polled).

7. Suffolk: Place of origin: England. This is a large sized breed of sheep with a black face, ears and legs and is very good for mutton production. Head and ears are devoid of wool. Wool is absent below the knee and hock. Rams and ewes are polled.

8. Dorset: Place of origin: England. This breed is a medium sized animal with face, ears and legs white in Color. Nostrils, lips and skin are pink and hooves are white. There are two types – horned and polled. Produce superior quality meat.

9. Karakul: This breed of sheep is a major pelt type breed of sheep. Mutton is of poor quality. Animals are very well adapted to extreme climatic conditions. Males are horned and ewes are polled. Drooping ears

5. Breeds of Pigs

1. Large White Yorkshire

Origin: England

This is considered as the best bacon type breed. Animals are long and white in Color (with occasionally black spots in the skin). Ears are erect. Animals are highly prolific and possess very good mothering ability.

2. Landrace

Origin: Denmark

This is an extremely long animal with white skin and white hairs. Small black spots are common. Ears are large and drooping and usually cover the face. Many animals have weak pasterns. Animals are highly prolific.

3. Duroc

Origin: America

Animals are large in size and red in Color (with shades varying from a golden yellow to very dark red). Black spots may appear over the skin. Animals are highly prolific with good mothering ability and produce large quantity of milk for the young ones.

4. Berkshire

Origin: England

This is a long animal with black Color. White markings are present on the feet, head and tail. Animals have a short snout and a wide dished face.

5. Hampshire

Origin: Kentucky

Animals are smaller than other breeds with erect ears. They are black in Color with a white belt encircling the body including the forelimbs. Hind limbs are usually black and no white should appear above the hock. Legs are

short. Head and tail are black. Animals are highly prolific with good mothering ability

6. Poland China

Origin: America

This is a large sized animal with good length and drooping ears. Color is black with six white points – feet, face and tip of the tail. The major disadvantage is that it is not highly prolific.

7. Tamworth

Origin: England

This is one of the oldest breeds of pigs. Body is long and narrow. Head is long and narrow with a long snout and erect ears. Shoulder is thin. Animals are red in Color with shades varying from light to dark

8. Chester White

Origin: Pennsylvania

Animals are intermediate / medium in size with white hairs and white skin. They are highly prolific and have good mothering ability. Sows generally produce and raise large litters. Piglets have rapid growth rate.

EXERCISE

Fill-up the blanks with appropriate answers:

1. Example of a Short-horned zebu cattle is ——————————
2. Example of a Lateral-horned zebu cattle is ——————————
3. Example of a Lyre-horned zebu cattle is ——————————
4. Example of a Long-horned zebu cattle is ——————————
5. Example of a Small, short horned zebu cattle is——————————
6. Indian cattle with long, pendulous ears having a curled leaf-like appearance and a notch at the tip is ——————————

7. Breed in which cows are considered to be the most economic milk producers among the Indian breeds of cattle is ——————

8. Breed of cattle resembling Gir cattle to a certain extent is ————

9. Breed of cattle with Cobra hood shaped horns is ——————

10. The largest / heaviest Indian breed of cattle is ——————

11. Exotic cattle that is small in size with a straight top line and a double-dished face is ——————

12. Black and white exotic breed of cattle with very low fat in milk is ——————

13. Exotic breed of cattle that is considered as the most beautiful dairy breed of cattle in the world is ——————

14. The breed of buffalo with tightly coiled horns is ——————

15. The breed of buffalo with sickle shaped horns is ——————

16. The breed of buffalo with long, sword-shaped horns is ————

17. The breed of buffalo that has been evolved as a cross betweenMurrah and Surti breeds is ——————

18. The largest breed of goat in India is ——————

UNIT-4

Housing

1. Housing principles

Proper house is compulsory not only to protect the animals from the extremes of environment but also to get maximum production by them. A housing facility for dairy animals (cattle and buffaloes) is called "**Barn**", for sheep is called "**Pen**" and for pigs it is called "**Sty**".

Housing requirements for animals vary with the type or category of animals like weaned (separated from mother) stock, growing stock, breeding stock, dry stock, pregnant females, etc. The type and design of the house will vary according to the species and type of the animal and also the region/location. For example, in the plains the height of the building should be more for effecting good ventilation and in high altitude areas, the height of the shed could be slightly less. The house used for cattle and buffaloes will be different from that used for housing pigs or goats. That is housing of animals is "species-specific and location specific".

1.1. Benefits of housing animals

1. House provides comfortable environment for optimum production. It provides warmth and comfort.
2. Should provide adequate light and ventilation.

3. Should provide safety (from injury, from escape).
4. It facilitates workers attending on the animals
5. Affords protection to the animal from cold, heat, wind, rain etc.
6. Feeding and watering can be easily monitored (and controlled).

1.2. Selection of a site for the construction of an animal house

The following factors / points should be considered in the selection of a particular site for the construction of an animal house:

1. **Area and location:** the site should preferably be away from crowded cities and towns and human habitations, but not too far from market.
2. **Size of land:** the site should be of adequate size to accommodate the requisite buildings and also should have sufficient space for further expansion. Sites lying on either side of the road, railway track, river side area etc should be preferably avoided.
3. **Topography of the land:** the land area should be level and without abrupt slopes. This would help to avoid unnecessary expenditure for filling the area and making it level.

1.3. Features of a good animal house

1. The floor of the barn should be hard and non-slippery, impervious to water and easy to clean. Generally, it is made of cement concrete or by paving bricks.
2. Wall is made of bricks and corners are rounded off. Sharp corners would harbor pests and parasites such as ticks, lice, insects etc., which, in turn, can cause discomfort and/or disease(s) to the animals.
3. Roof should be strong, durable, weather-proof, bad conductor of heat and should not allow condensation of water toward inner surface. Roof can be made of thatch, asbestos, tiles, PVC sheet or RCC. PVC sheet would be ideal for a barn to house a small herd as it would be cheap, light in weight and permits natural light inside. Since, only a small herd is taken into consideration in the present case, the roof could be of a

single slope (Shed – type house). For such a building, the supporting walls or posts should be higher on one side.

4. A trough or a box like structure used to offer feed and fodder to cows is called a "Manger". The manger should be made of a hard, impervious material (preferably concrete) and it should be easily cleaned. If the manger is not cleaned properly, fodder/or and other feed material adhering to the bottom of the manger can become moldy and cause infections. To facilitate cleaning, its corners have to be rounded off and a continuous manger is constructed so that it can be flushed with a jet of water from one end. The manger should be at a higher level than the floor (so that the animals could easily reach the floor of the manger)

5. An overhang is the projection of the roof outside eaves to prevent water/rain – water seepage into the building. Generally, an overhang (0.9 to 1.2 m; 3 to 4 ft) is provided. The horizontal distance between tip of the overhang and the side – wall should be at least 1 m (3.3 ft).

6. Pitch is the angle between "Run" and the roof at the eaves. Hence, pitch provides a gradient (25 to 33°) in the roof to facilitate flow of rain-water. If the roof is made of thatches, pitch should be at least 45º to ensure quick drainage of water especially during heavy rain and prevent seepage of water into the shed through the that chmaterial. With tiles, a pitch of 30º is generally advised. In case of aluminium sheets or asbestos, pitch as less as 5 to 10º also can serve the purpose.

   Caution: Pitch < 45º in thatched roof buildings is likely to leak and/or give – in due to weight of water during heavy to very heavy rain.

7. It is preferable to have gates made of iron bars. This would be strong and durable. Gates leading to individual sheds should be wide enough (at least 1.5 m) to allow a trolley to pass through.

8. Fencing helps contain the animals within a known area and protect from intruders. Should be strong and durable and at the same time should not cause injury to the animals. For instance, it can't be made of barbed wire.

2. Housing systems

To calculate the dimensions of any building, it is mandatory that

information regarding number, type and age of animals are available along with their respective floor space requirement. If there are any restrictions on length and/or width of the shed to be constructed, such information should be taken care of while the design is finalized. Similarly, if more than one building has to be constructed, location and separation distance between the buildings also have to be finalized on the basis of scientific norms.

For the housing of cattle and buffaloes, generally the following types of housing systems are used:

1. **Loose housing system:** In this system, animals are let out on an open paddock to roam about freely. A small area is sheltered for the animals to retire during the hot part of the day and at the time of rains. Feed manger and water troughs are provided in the sheltered area. The advantage of this system is that animals can freely move about thus getting enough exercise and also they can exhibit their normal behavioral patterns. It is difficult to get the area cleaned and the animals will be subjected to the vagaries of climate all through the day and night. In addition, more of land is required for this type of housing. At the time of milking, the animals in milk are taken to a separate milking shed, milked and then brought back.

2. **Conventional housing system or tie barn system:** In this system of housing cattle and buffaloes, the animals are tied in stalls and milking is done in this shed. This is the common type of housing adopted by farmers in India and most of the developing countries. There are two different types of sheds in this system viz.,

   a. Single row shed: is employed in those farms having small number of animals (say less than 20)

   b. Double row shed: is employed in large farms having more number of animals. Further, in these sheds, the arrangement of animals can be of two different types as follows:

   (i) Head-to-head type of arrangement (Face-to-face): In this case, the animals face each other. Hence, feeding is easy as the feed and fodder can be provided in the manger by walking through the common feeding passage. Cleaning of the shed and milking of animals is difficult as the worker has to go through each side passage separately for these jobs.

(ii) Tail-to-tail type of arrangement (Back-to-back): In this case, it is easy for the workers to clean the shed and milk the animals and it becomes difficult to feed the animals.

Fig. 4.1. Cows resting under thatched roof in loose housing system

Fig. 4.2. A typical manger 2.1. Floor space recommendations 2.1.1. Cattle and Buffaloes

Table 4.1 Floor space – Cattle and buffaloes

Type of animal	Floor space (sq. m)*	Maximum number**
Cow	3.5	50
Buffalo	4.0	50
Breeding bull	12.0	1
Calf	2.0	30
Pregnant cow/buffalo	12.0	1

* Covered area ** In one shed

2.1.2. Sheep and Goats

Table 4.2 Floor space – Sheep and Goats

Type of animal	Floor space (sq. m)*	Maximum number**
Ewe/Doe	1.0	60
Lamb/Kid	0.4	75
Ram/Buck	3.4	1
Lactating Doe /Ewe	2.0	1
Pregnant Ewe/Doe	2.0	1

* Covered area ** In one shed

Table 4.3 Floor space – Pigs

Category of animal	Covered area (sq.m)	Open area
Boar	6 – 7	8 –12
Farrowing sow	7 – 9	8 – 12
Weaner/grower	0.9 – 1.8	0.9 – 1.8
Dry sow/gilt	1.8 – 2.7	1.4 – 1.8

3. Special features of different houses

3.1. Calving shed/ kidding pen/ lambing pen

This is a shed / pen in which advanced pregnant cattle/buffalo/ doe/ewe are transferred and housed singly at least two weeks before the expected date of calving/kidding/lambing. The parturition takes place in this shed. It is mandatory to house animals individually in this shed. Separate feeding and watering arrangement should be present in this shed. The floor should be non-slippery so as to avoid slipping of the animals and the walls should be complete so that crows or other vermin do not enter the shed.

3.2. Farrowing sty

This is a sty in which advanced pregnant sows are transferred and housed singly at least two weeks before the expected date of farrowing. The sow with piglets is left in this sty during the nursing period (milk feeding period, i.e., 56 days) also. The main feature of the farrowing sty is that it should provide sufficient space for the nursing sow and the piglets.

Guard rails should be provided all along the wall of the farrowing sty (25 cm from the ground and 25 cm away from the wall). This would help the piglets to run under the rails when the sow lies down along the side wall, thus escape from being crushed.

4. Ventilation in animal houses

Ventilation in any animal house is usually by using the natural phenomena of wind, sunshine and draft controlled by suitable adjustments, most of the times manually, by opening of side – wall windows and / or adjustable curtains. Under extremes of weather, fans, exhaust fans, heaters and rarely air – conditioners are used. If the shed is open on one side (North or South), ventilation is generally not a problem. The main aim of ventilation is to remove stale air from within the house and replace it with clean and fresh air.

If ventilation is improper, there will be accumulation of heat (produced by animals mainly), humidity (due to water in expired air and evaporated water from the water troughs and spilled water and urine), ammonia (produced due to action of microorganisms in the feces and urine), increased carbon – dioxide (produced during respiration) and reduced oxygen availability. All these factors impose severe stress on the animals which is genetically developed and scientifically fed for fast growth. In addition, stale environment within the house is ideal for growth of disease causing bacteria. Obviously, not only diseases (especially respiratory) precipitate, they even spread very fast.

5. Light in animal houses

Light is a factor that influences all stages of production in the case of farm animals. Animal houses should be located in such a way that it is possible to get maximum amount of natural light which is beneficial to the maintenance of health.

Day light has also germicidal properties. This is partly due to the presence of UV rays and partly due to the dehydrating effect of sunlight on microorganisms.

EXERCISE

Fill-up the blanks with appropriate answers:

1. A housing facility for dairy animals (cattle and buffaloes) is called _____.
2. The floor of the barn should be hard and _____.
3. Roof should be strong, durable and _____.
4. A trough or a box like structure used to offer feed and fodder to cows is called as _____.
5. The projection of the roof outside eaves to prevent water/rain – water seepage into the building is called as _____.
6. Pitch _____ in thatched roof buildings is likely to leak.
7. The system in which animals are let out on an open paddock to roam about freely _____.
8. Single row shed is employed in farms having number of animals _____.
9. Floor space requirement of an adult cow is _____.
10. Floor space requirement of an adult bull is _____.
11. Floor space requirement of an adult buffalo is _____.
12. Floor space requirement of a breeding buck is _____.
13. Floor space requirement of a boar is _____.
14. Floor space requirement of an ewe is _____.

15. A sty in which advanced pregnant sows are transferred is _____.

UNIT-5

Feeding and Management

Feeding is the one of the most important and costliest component in the care/ management of animals. The main objective of a farmer (small scale/large scale/ organized) will be to attain the maximum benefit in terms of animal health and production at the least cost.

1. Terminology

1. Ration: The 24 hour feed allowance of an animal is called 'Ration'. The ration that provides all the essential nutrients in the correct proportion to the animal for proper nourishment is called, 'Balanced feed/ ration'. Daily ration for ruminants consist of a) Roughage and b) concentrate. A balanced ration should be:

a. Highly palatable.

b. Have all nutrients in correct proportion (correctly balanced).

c. Include many different ingredients / feedstuff.

d. Made of good quality raw materials.

e. Bulky and laxative (easy movement in the intestinal tract).

f. Prepared hygienically and properly.

g. Economically at feasible cost.h. Devoid of toxic principles.

i. Stable over a reasonable storage period. j. Have good flavor and appearance.

2. Roughages: Roughages are bulky feed stuffs containing more of less digestible substances with high fibre content. In general it could be said that roughages contain more than 18% of crude fibre. Roughages may be generally classified into two types as:

a. Succulent roughage – it contains more of moisture (60-90%) which includes green grass, green fodder, tree fodder, pasture grass etc. succulent roughages can in turn be sub-divided into leguminous type and Non-leguminous (grass) type. Leguminous type is nutritionally good as it contain more protein content when compared with Non-leguminous type. In addition to this, leguminous plants fix atmospheric nitrogen in the soil with the help of their root nodules. This fodder can be intercropped among grass, thus its saves space and improves the soil quality.

b. Dry roughages- contain less of moisture (10-15%). It includes paddy straw, hay, Stover etc.

3. Concentrate: is the mixture of different feed ingredients which includes grains, oil cakes, brans, molasses minerals and vitamins. It may be in mash or pellet form; it contains highly digestible nutrients and costly feed when compared with roughages.

4. Dry matter content of feed stuffs includes the matter that is not water. Dry matter is the major criterion used for the computation of ration. Feed intake of an animal is considered on dry matter basis. As such, the dry matter content of concentrate and dry roughages will be higher than that of succulent / green roughage.

5. Hay: dry form of preservation of fodder in which there is reduction in the moisture content and no loss of nutrients.

6. Gestation period: is the period between successful mating and parturition (delivery of the young one).

7. Dry period: is the period between the stoppage of lactation (milk production) and the commencement of the next (subsequent) lactation after parturition.

2. Feeding of cattle and buffalo in milk

The total dry matter intake in case of cattle is 2.5% of its body weight whereas in buffalo is 3.0% of its body weight. As rule of thumb 1/3rd of dry matter should come from concentrate and 2/3rd from roughages. The total dry matter from roughages should be at least 1% of the body weight of animal but not exceeding 2% of body weight.

2.1. Practical aspects of feeding cattle and buffaloes

1. As a thumb rule, good quality roughages alone can meet the nutrient requirement of a cow whose production is up to 4 - 5kg/ day.
2. As a general rule, for cows 1.0kg of concentrate per day is given for every 100 kg body weight as maintenance ration and for buffalo, it is 1.10 kg. For milk production, 1 kg of concentrate for every 2.5 kg of milk (400 g/kg of milk) in crossbred cows and 1 kg concentrate for every 2 kg milk produced (500 g per kg of milk) in case of buffalo.
3. The ration should be properly balanced. It should be noted that the quality of feed should be digestible with all nutrients.
4. Ration should have varieties which makes it palatable
5. Always provide good quality roughages in adequate quantity. Green roughage is bulky, easily digestible, laxative (to help smooth movement of food in the intestines) and contains enough vitamins; leguminous fodder contain more protein. The deficiency of poor quality fodder cannot be made good by providing a good quality concentrate or more of concentrate. Animals that are fed with good quality fodder yield more quantity of milk.
6. Avoid sudden changes in the diet. Sudden changes leads to many digestive problems like indigestion and bloat. Any change should be done slowly and gradually in very less amount. It will be a better practice to make such changes during the dry period.
7. It is better to offer feed / roughages at the same time because cows and buffaloes get accustomed to routine easily. Any change may be done gradually.
8. Feeding the ration at more frequent intervals (4times/day) results in better digestibility and utilization. Both, the roughages and concentrate

should be provided in divided doses which help in uniform fermentation in rumen.

9. Grains should be mixed with roughages before feeding. In general, concentrate mixture is fed at milking time and roughages are provide before and after milking.
10. In case of high yielding cow, it is better to feed concentrate either mixed with roughages or after the animal has consumed certain quantity of roughage.

2.2. Feeding and Management of calves

At the time of birth, proper care should be taken to avoid any infection. Immediately after birth, clean the nostrils and see whether the new born calf is breathing. If there is any difficulty in breathing, give artificial respiration. This can be done as follows:

1. Clear the mucous from the respiratory tract. Artificial respiration can be given by alternatively pressing and releasing the chest region.
2. If there is no result, then insert a twig of straw or dried grass in to the nostrils. This will initiate sneezing and will result in clearing the tract.
3. If this also fails, hold the new born animal by the hock and swing it to and fro (upside down) so that the mucous flows out.
4. If this does not work, then mouth – to – mouth respiration should be resorted to by closing the nostrils and blowing in expired air into the mouth of the new born.
5. Other management measures include the following:
    a. Tie a knot around the navel cord about 2 to 3 cm from the body by using a sterile thread. Cut the navel cord 1 cm below the knot (toward the calf). Apply antiseptic solution (like Betadine) to the cut ends still attached to the mother and the calf. Attending to the navel cord of the new born calf is very important as infection gaining entry through the navel can cause serious conditions (like navel ill).

    Note: The stalk hanging at the navel of the calf dries and falls off by

itself within two days.

b. Dry the new born by scrubbing with a dry cloth

c. Allow the dam to lick the new born

d. If there is any difficulty in standing, assist the new born to stand

e. Allow the new born to suck colostrum at the earliest (i.e. within half an hour). This is very important as the new born calf is able to completely absorb the gamma globulins as such only for a certain while after birth. As time passes on the intestinal lining of the new born gets transformed and no more direct passage of proteins is possible.

2.2.1. Colostrum

Colostrum is the secretion produced by the udder immediately after calving (up to 5 days). It contains a large amount nutrients (proteins, vitamins and minerals) and disease – resisting factors in an easily absorbable form. Hence, it protects the calf passive against many infections during early life; this is particularly important in buffaloes.

The quantity of colostrum to be fed to calves is $1/10^{th}$ (or 10%) of the body weight for five days. If weaning is not practiced immediately after calving, the calves should be allowed to suck for 5 minutes 4-5 times a day. In case of buffalo calves, it is a general practice to allow the calf to suck as much as it wants.

After feeding colostrum for the first 5 days, from 6 days to 90 days of age, milk is given to the young calves @ $1/10^{th}$ of the body weight (twice daily). Simultaneously, at 1 month of age, the calf should get good quality calf starter whatever the quantity it can consume (ad libitum). In general, a calf consumes around 125 g and 250 g of calf starter per day when it is 31 to 60 days and 61 to 90 days in age, respectively. When the calf starts consuming 250 g calf – starter per day, milk feeding can be completely stopped.

From 3 months of age calves can be fed on fresh, tender green fodder; this stimulates growth and functioning of stomach (rumen) by 6 months of age after which most of the nutritive requirements could be met from good quality fodder.

Note: Fresh clean water should be available always to the calves.

2.2.2. Weaning

Weaning is the practice of removing the calf from the dam (mother). Most dairy calves are weaned from their mother either immediately after calving or 3-5 days after calving.

After weaning, the calf should be housed in a clean, dry, well – ventilated calf pen and trained to drink milk immediately.

Many do feel that it is not proper to separate calf from its mother and some do attach religious sentiments too. But, scientific knowledge on this issue indicates the following advantages of weaning:

1. Ensures clean milk production
2. The milk produced by the cow can be accurately quantified
3. Calves can be fed milk – replacers, thus saving milk for human consumption
4. Adequate measured quantity of milk can be given to the calf, thus preventing under – feeding and over – feeding
5. Helps prevent injury to the teat
6. Helps control mastitis.

Note: There are drawbacks as well of weaning; for instance, in buffaloes and zebu breeds of cattle, weaning of calves poses certain problems because of the reduction in milk yield, early drying off and temperamental problems.

2.3. Feeding and Management of growing heifers

Heifers are important in any farm to:

1. replace the cows that are culled (removed out of the herd)
2. to sell out to other farmers.

Rearing of heifers for replacement helps to reduce the expenditure on purchase and transport of new animals in to the herd. In addition, being reared in the farm, the heifer will be very well adapted to the local conditions. This would also help to reduce the chances of bringing infection in to the herd. The

main disadvantage of rearing heifers for replacement is that it would lead to expenditure without any returns for about 2 – 3 years.

Heifers should ideally be provided with good quality freshly cut green fodder along with 1 to 1.5 kg of a balanced concentrate mixture. Poor feeding of heifers would result in poor growth and thus, late maturity. The feeding of heifers before pregnancy should be in such a way that the animal is lean in stature. During the last fortnight (two weeks) of gestation (pregnancy), heifers should be provided with increased quantities of concentrate mixture. This will help to build up body reserves and also help the animal to get adjusted to high concentrate ration after calving. This type of feeding extra concentrate ration to advanced pregnant heifers during the last two weeks of gestation/pregnancy is called “Challenge feeding”.

2.4. Feeding and Management of pregnant cows and buffaloes

The entire period of gestation in cattle and buffaloes can be divided into three stages as, early stage, mid stage and the final stage. During the early and mid stages of gestation, the cow or buffalo will be in lactation. Therefore, feed allowance should be provided for the growing calf as well as for milk production. During the final stage of gestation, cows and buffaloes will be in a dry state, hence, extra feed allowance for growth of calf alone should be provided.

2.5. Feeding and Management of dry cows and buffaloes

During the initial phase of the dry period, the udder stops secretion of milk, during the second phase, the udder will be in a state of rest (nonproductive state) and during the third phase, the udder will be in an active state regenerating for the next lactation.

Feeding during the dry period should be adjusted in such a way as to maintain the body condition of the animal.

2.6. Feeding and Management of breeding bulls

Breeding bulls should be maintained in a trim condition so as to have good vigor and stamina. The animal should be trained for handling and leading from the calf hood stage itself.

Thumb rule for feeding breeding bulls include 1 kg of good quality hay and ½ kg of good quality balanced concentrate mixture per 100 kg body weight. This would help the animal to maintain good body condition.

It should be borne in mind that bulls should be fed a different concentrate mixture (not the same mixture fed to cows). This is because the concentrate mixture fed to cows usually contains extra Calcium. Extra calcium in bull's ration will lead to serious problems like calcification and fusion of bones and vertebrae.

Bulls should be housed singly in one pen having a dimension of 12sq.m with good ventilation. Enough of exercise should be imparted to breeding bulls in the early morning and late evenings. Showering or splashing of water is to be carried out during summer months.

3. General management practices

Components of management practice for different classes and types of cattle and buffaloes include:

1. Feeding a balanced ration as per requirements.
2. Very high milk yielders should be housed separately.
3. Maintain high health standards.
4. Housing should be clean and comfortable.
5. Avoid slippery floors and sharp bends in sheds.
6. Avoid over – stocking; in other words provide sufficient floor space as per the requirement.
7. Provide optimum feeding and watering space.
8. Protect against thermal stress.
9. Group cows / buffaloes according to size / production.
10. Culling of highly temperamental and low producing cows.
11. Careful and gentle handling.

12. Avoid disturbance due to noise.
13. Provide sufficient exercise.
14. Schedule of management operations should be regular.
15. Any change in routine should be effected gradually, spread over a period of time. This is mainly because animal in general settle down to routines.

    Note: Changes in routine could be effected during the dry period during which time cows / buffaloes seem to accept changes in routine.
16. Gentle milking operations.
17. Maintenance of high reproductive efficiency.
18. Prompt disease control measures.

4. Ration formulation

All animals require feed for mainly two purposes:

1. Maintenance of normal physiological functions of the body.
2. Growth, production and reproduction.

Both the above requirements are considered on dry matter intake of the animal (See Section 2 above). It is assumed that the body weight of a crossbred cow and buffalo is 400 and 500 kg, respectively.

4.1. Maintenance requirement of a dairy animal

	Dry matter (DM) requirement		
	Body weight, kg	% of body weight	kg
Crossbred cow	400	2.5	10
Buffalo	500	3.0	15

4.1.1. Partitioning the DM requirement into roughages and concentrates

Rule of thumb: S! from concentrates and T! from roughages with a condition that the total roughage should be at least 1% of the body weight but not exceed 2% of the body weight (1% of body weight d" Total roughage d" 2% of body weight).

All in kg	Body weight	DM from roughage			DM concentr
		Recommended	Minimum	Maximum	
Crossbred cow	400	6.7	4.0	8.0	3.3
Buffalo	500	10.0	5.0	10.0	5.0

4.1.2. Quantity of dry and green roughage to be given

All in kg		Roughage partitioning	
	Total required	Dry roughage	Green roughage
Cross bred cow	6. 7	2. 2	4 .5
Buffalo	10.0	3.3	6.7

Note: Value in the parentheses indicates proportion of total roughage

4.1.3. Converting DM requirement to their corresponding actual weights

General formula: $\left(\frac{\text{DM Requirement}}{\text{DM Content}}\right)\times 100$. Utilizing this, the actual weight of concentrate, dry and green fodders can be calculated as follows:

Calculation of actual quantities of concentrate, dry and green fodder requirements

Species	Item	Dry matter		
		Requirement, kg	Content, %	Actual weight required, kg
Crossbred cow	Concentrate	3.3	90	3.67
	Dry fodder	2.2	90	2.44
	Green fodder	4.5	25	18.0
Buffalo	Concentrate	5.0	90	5.56
	Dry fodder	3.3	90	3.67
	Green fodder	6.7	25	26.80

Note:

1. As a general rule, 1.0 (crossbred cow) to 1.10 (buffaloes) kg of concentrate per day for every 100 kg body weight is given for maintenance.
2. For supporting milk production, 1 kg concentrate for every 2.5 lit milk (400 g per lit) in case of crossbred cows and 1 kg concentrate for every 2 lit milk (500 g per lit) in case of buffaloes has to be provided.
3. The quantity of green and dry fodder is to be provided as per the above calculation.

5. Identification of animals

Identification of animals is required for proper and effective management of animals, especially when they are reared in groups.

5.1. Purpose of identification

1. For specific (individual) identification of animals.

2. For spotting and identifying of sick animal.
3. For proper recoding of milk production.
4. For proper recording of breeding data.
5. For effective culling of animals.
6. For proper maintenance of health records.
7. For proper recording of the parentage of animals.

5.2. Features of a good identification system

The following are the important features of a good system of identification:

1. Should be legible, clearly visible and readable from a distance.
2. Should be permanent.
3. Should be easy to apply.
4. Should be painless to the animal.
5. Should be affordable at a reasonable price.

5.3. Commonly used systems of identification

The identification systems that are commonly used in cattle, buffaloes, sheep and goats are the following:

1. Tattooing: this consists of piercing the outlines of numbers or alphabets on the surface of the skin (especially in the inner ear) by means of tattoos made up of brass or stainless steel. Afterwards, the injured outline is smeared with indelible ink or dye. This method can be used very effectively in the case of calves, sheep, goats and also in adult cattle and buffaloes. The main disadvantage is that the animal should be handled every time to read the number in the inner surface of the ear.

2. Tagging: is the use of specific ear tags in which the number is present. There are two different types of tags – (a). Self-piercing tags and (b). Non-piercing tags. Self piercing tags can be applied directly on to the ears, whereas in the case of non-piercing tags, the ear has to be pierced (a hole has to be made) so as to apply the tag. Tags are made up of different materials, for

example, brass, poly urethane, plastic etc.

3. Branding: is putting the outline of numbers or alphabets on the skin of animals (especially on the thigh, shoulder region, rump region) by means of red-hot iron (Hot iron branding), by means of caustic chemicals (Chemical branding) or by means of liquid nitrogen (Freeze branding or Cold branding). Hot iron branding and chemical branding inflicts severe pain and causes destruction of the skin, thus making skin of that area unfit / less effective for leather making.

In addition to the above mentioned methods, there are several other temporary methods of identification like painting the horns of animals, use of neck tags, use of leg tags, use of tail tags etc.

There are some recent methods of identification like use of Dermatoglyphics (muzzle printometry), use of microchips (latest method) etc.

6. Restraint and handling of animals

It becomes necessary to approach, handle and restrain different species of animals for different reasons. For these activities, a thorough knowledge of the behavior of the species of animal is necessary.

6.1. General points to be considered while approaching and handling animals

1. Always call the animal and speak to it so that it does not get frightened.
2. It is always better to approach animals from their left side
3. Approaching animals directly from the front side will make the animal afraid.
4. Handle the head and neck regions of the animal first.
5. Always consider that animals can sense the fear in the person approaching, so be fearless and confident.
6. It will be better to have the owner or the handler of the animal nearby.
7. Be aware of the general danger potentials of the animal.
8. Do not try to catch large animals by their horns.

9. Do not inflict unnecessary pain on an animal while handling.10. Always be calm, confident and gentle with the animal.

6.2. Restraining animals

It becomes necessary to restrain a particular body part of an animal or the animal as a whole. Under such conditions, it should be borne in mind that animals do not like to be restrained and that they will try to struggle and escape from the handler.

To restrain means to limit or to restrict, the animal from moving or doing something. In other words, to restrain means to keep the animal under control.

The act of restraining an animal or a device used to restrain an animal is termed as a "restraint".

There are five types of restraints like:

1. Psychological restraint
2. Sensory diminishment
3. Use of confinement
4. Use of chemicals / drugs
5. Use of tools and physical force.

6.3. Common restraint tools used in animals

1. Rope: a very common and frequently used restraint tool for effectively controlling all species of animals (whether large or small).
2. Neck chain or neck rope: a rope leather or chain that is put around the neck of n animal so as to hold the animal or to tie the animal to some post. This is a very simple tool used for different species of animals.
3. Nose rope: a piece of rope that is passed through the nasal septum in the case of cattle and buffaloes. When this rope is pulled, the animal will have pain and this helps to restrain the animal.
4. Nose ring: ring made of copper or stainless steel that is fixed to the nasal septum in the case of animals (especially bulls) that are difficult to control.

5. Mouth gag: is a device to keep the mouth of an animal open for sometime for performing some operation. There are different types of mouth gags available depending up on the species and the utility. For example, (1)."Drinkwater's gag is used for cattle and buffaloes. (2). In the case of sheep and goats, Linton's gag is used.

6. Cradle: is the device used for immobilizing the neck region of an animal / for preventing the animal from flexing the neck.

In addition to the above methods of restraining the head and neck of animal, there are different mechanisms to restrain the limbs of animals. Restraining the limbs of animals is required for cleaning the hoof, trimming the hoof, shoeing of animals, dressing the limbs etc.

For restraining the whole body of a large animal (cattle or buffalo), a trevis or crush is used. This is a device made up of wood or metal tubing and is fixed on to the ground. A temporary trevis can be made under village condition by using two long pieces of wooden poles or bamboo.

Casting is the process by which the whole body of an animal is brought under control by making the animal lie down on its side. This is done for performing major operations and for special examination of animals. There are different methods of casting like the Reuff's method, Alternate method, country method etc.

7. Estimation of the body weight of cattle and buffaloes

It is necessary to weigh the animals in order to get an idea of their body weight. Under situations where platform balances are not available (such as in field/village conditions), estimation of the body weight of animals can be made by using certain body measurements. The important body measurements used here are the length of the body and the chest girth. The length of the body is measured as the distance between the point of shoulder and the pin bone region. The chest girth is measured as the circumference of the chest of the animal just behind the elbow joint (the body points mentioned here is explained in Unit 3).

The above body measurements are used in the following formulae to arrive at the approximate body weight of the animal.

1. Shaeffer's formula: this is the most commonly used formula for estimating the body weight of adult cattle and buffaloes. This formula cannot

be used for very heavy and very young animals as it gives erroneous results. Live weight in pounds $=\left(\frac{L\times G^2}{300}\right)$, where L is the length of the body of the animal and G girth at the chest region of the animal both in In. The formula can be modified to metric system as follows: Live weight (kg) = $92.5(L\times G^2)$ where L is the length of the body of the animal and G girth at the chest region of the animal both in m.

2. Aggarwala's modified Shaeffer's formula: this is another formula used in the case of adult cattle.

Live weight in seers (One seer = 0.93 kg) = $\left(\frac{L\times G}{Y}\right)$, where Y assumes a value of 9.0, 8.5 and 8.0 when G < 65 In, > 65 In but < 80 In and > 80 In, respectively. This formula can be modified to metric units as follows: Live weight (in kg) = where Y assumes a value of 0.00625, 0.00590 and 0.00555 when G < 1.65 m, > 65 1.65 m but < 2.0 m and > 2.0 m, respectively or Live weight (kg) = where Y assumes a value of 160.0, 169.5 and 180.2 when G < 1.65 m, > 1.65 m but < 2.0 m and > 2.0 m, respectively.

Note: the estimation of body weight of animals by using measurements is not accurate, but only approximate.

EXERCISE

Fill-up the blanks with appropriate answers:

1. The 24 hour feed allowance of an animal is called _____
2. The ration that provides all the essential nutrients in the correct proportion is called _____
3. Bulky feed stuffs containing more of less digestible substances with high fibre content is _____
4. The total dry matter intake in case of cattle is _____ of its body weight.

5. Green roughage is bulky, easily digestible and _____

6. Feeding the ration at more frequent intervals (4times/day) results in better _____

7. The secretion produced by the udder immediately after calving is _____

8. The quantity of colostrum to be fed to calves is _____ of the body weight for five days.

9. Milk is given to the young calves at the rate of _____ of the body weight (twice daily).

10. When the calf starts consuming _____ calf – starter per day, milk feeding can be completely stopped.

11. Feeding extra concentrate ration to advanced pregnant heifers during the last two weeks of gestation/pregnancy is called _____

12. Breeding bulls should be maintained in a _____ condition.

13. For supporting milk production, 1 kg concentrate should be given for every _____ in case of crossbred cows.

14. A recent method of identification in animals is the use of _____

15. A very common and frequently used restraint tool for effectively controlling all species of animals is _____

16. For restraining the whole body of a large animal (cattle or buffalo) _____ is used.

UNIT-6

Milk Production and Milking

1. Milk Secretion Process

Udder of cattle and buffaloes is made up of four quarters. Each quarter has a teat that provides an outlet for milk. A circular (sphincter) muscle at the end of the teat controls the flow of milk. In the case of sheep and goats, the udder consists of two quarters with two teats.

Udder consists of alveoli that manufacture milk. Alveolus contains milk cavities. A tubule leads from each alveolus to small ducts that lead to large milk ducts. The large milk ducts empty into a gland cistern. Milk passes from the gland cistern through the teat cistern and then through the streak canal to the outside. Milk is stored in the milk cavities, tubules and small ducts between milking.

Cow responds to (sensory) stimuli which can be calf sucking the udder, washing the udder with lukewarm water etc. by producing a hormone (oxytocin). The hormone causes milk let down.

The effect of the hormone lasts for only about 5 – 7 minutes. Therefore, milking must be completed by this time. About 80 percent of the milk is removed from the udder at each milking. Frightening or hitting a cow at the time of milking will result in the release of another hormone (adrenaline), which will eventually interfere with the milk letdown process.

Regular milking is important to maintain high production. High producing

cows will stop increasing the amount of milk in the udder after 8-10 hours. In low producing cows, this takes about 16-20 hours. Therefore, high producing animals are milked thrice a day.

2. Milking of animals

There are two different methods of milking animals. They include:

1. Hand milking
2. Machine milking

2.1. Hand milking

Hand milking is milking by hand and is the most common milking practice in India. Here the animal is prepared for milking by first washing the animal and then thoroughly washing and wiping the udder and teats with a mild antiseptic. There are different methods of hand milking practiced in different regions. They are:

2.1.1. Wet hand milking

This method involves lubricating the milk man's hand and the teats of the animal with oil, milk or water. This is not considered as a good method of milking as this practice makes the teats dry and chaffed. This may even lead to the formation of cracks and sores causing much pain to the animal.

2.1.2. Dry hand milking

In this method, milking is done without lubrication of the milk man's hand and teats of the animal. This method is considered to be the best method as it doesn't cause any harm to the animal.

2.1.3. Milking procedures

Stripping and full hand milking are two commonly used procedures of milking.

1. Full hand milking: consists of holding the whole teat in the ring formed by the palm and the fingers. The teat is then squeezed using middle, ring and

the little fingers and hollow of the palm, forcing the milk out. This process should be repeated in quick succession. Full hand milking removes the milk quickly from the udder. Cows with large / long teats and buffaloes are generally milked by full hand milking. This is considered to be a superior method of milking animals.

2. Stripping: consists of firmly holding the teat at its base between the thumb and the forefingers and drawing down the entire length of the teat pressing it simultaneously to force the milk out. Here also, the process is repeated in quick succession. Both the hands may be used, each holding a different teat stripping alternatively. Stripping is generally used in cows with very small sized teats. In addition, this method is used in animals at the close of milking to drive the milk completely from the udder. This last drawn milk from the udder by stripping method is generally called as "strippings" and is very high in fat. The major disadvantage of this method of milking is that it causes irritation and injuries on the teats due to friction caused by repeated sliding of the fingers.

3. Knuckling: is a wrong method of milking animals. Here, the thumb is folded and the teat is held in between the other fingers and the folded thumb and is drawn down. This process is repeated in succession. This method also causes injury to the teats as the folded thumb inflicts too much pressure on the teat muscles.

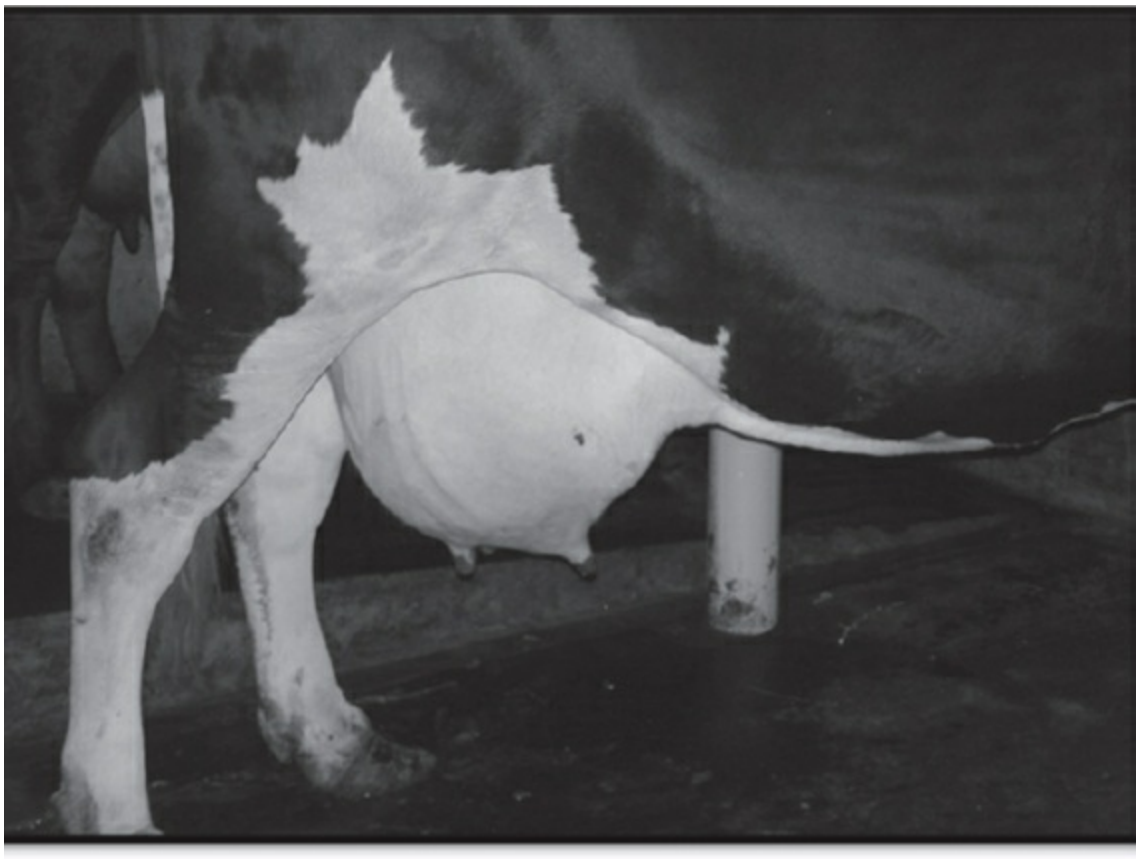

Fig. 6.1. A typical udder; note the prominent milk vein

2.2. Machine milking

Machine milking is milking by means of machine. This method is used commonly in large organized dairy farms. There are different milking machines available in the market manufactured by different companies.

A milking machine has four parts viz. milking unit, the pulsation unit, vacuum supply system and the milk flow system; of these, it is the milking unit that is attached to the udder. Attach the milking machine gently to the udder at the time of milking. At the end of milking, remove the machine gently. First shut off the vacuum and remove the teat cups together.

3. Handling fresh milk

3.1. Preventing off-flavors

Off – flavors in milk include Feed flavor, Rancidity flavor, Sanitizer

flavor, Medicine flavor and Salty flavor. The most common off-flavor is caused by feed. Silage should be fed only after milking. Avoid feeding dusty feed before or at the time of milking. Poor barn ventilation also gives rise to off-flavors in milk.

3.2. Preventing sediments in fresh milk

Adopting the following precautions will cause reduction in the sediments in fresh milk:

1. Keeping the cows clean
2. Ensuring thorough ventilation in the milking shed
3. Washing the udder thoroughly before each milking
4. Keeping the milking area free of dust
5. Keeping the milking machine units off the ground
6. Straining or filtering milk
7. Removing dung from the shed before milking
8. Not sweeping the barn just before or at the time of milking
9. Not feeding dry concentrate or silage just before or at the time of milking

4. Factors affecting milk yield

1. Breed of the cow or buffalo: Different breeds have their own capability of production that is genetically determined. Given the requisite environment and inputs, they will be able to produce to their maximum capacity.
2. Dry matter intake: This is a factor that directly influences the milk yield of cows and buffaloes. This is because all the nutrients needed for the production of milk is supplied by the feed they consume.
3. Quality of the feed / ration: A high fiber diet or a low quality diet has a slow digestion and hence, the dry matter intake will be low. In order to sustain high milk production, animals should be provided a well balanced ration in correct quantities.

4. Quality and type of the forage: The forage provided should be of good quality in the sense that it should contain the correct amount of nutrients and that it should not contain any toxic principles.

5. Climatic conditions (within the barn and outside): Increased atmospheric temperature and humidity can lead to reduction in the quantity of milk production by different species of animals. These parameters cause increased stress on the animals thereby, leading to a reduction in milk production.

6. Frequency of milking: High yielding cows / buffaloes should be milked at least three times a day so as to keep up their high production. Even the timing of milking should not only be equally spaced but also around the same time on each day.

7. Quantity and quality of drinking water: Lactating cows need 2.2 – 2.5 kg (lit) of water per kg of milk produced. Reduction in the intake of water will lead to considerable reduction in the milk production by different species of animals.

8. Space provided per cow in the barn: Over-crowding in the barn will lead to undue stress on the animals, resulting in low production. Therefore, it is highly essential to adhere to the specification of floor space for different classes and species of animals.

9. Stress due to physical handling of cows/buffaloes: Unnecessary handling and/or rough handling of the animals results in stress leading to low milk production.

10. Health status of the animal: Many diseases impair the production of cows and buffaloes. Some diseases (e.g. mastitis) have a direct impact on milk production, where as others (e.g. foot problems) have an indirect effect.

5. Composition of milk of cattle and buffaloes

		Composition of milk, %					
Species	**Specific**	**Water**	**Total**	**Fat**	**SNF**	**Total**	**Sug**

	gravity		solids			protein	
Cow	1.0313	87.27	12.73	3.68	9.05	3.39	4.94
Buffalo	1.035	82.25	17.75	7.51	10.24	5.05	4.44

Note:

1. pH of cow milk is 6.60 (Lactic acid 0.15%) whereas that of buffalo milk is 6.70 (Lactic acid 0.16%)
2. Freezing point of cow milk is (-) 0.53 to 0.57 ºC and that of buffalo milk is (-) 0.5443 to 0.545ºC

5.1. Factors affecting composition of milk

The factors influencing milk fat content (MFC) are:

1. Days in milk: Fat content will be higher at the start of lactation, decreases a few weeks after calving, low at peak lactation (5-7 weeks of lactation), increases after peak yield phase.
2. Breed of the cow: Holstein Friesian crosses will have less MFC when compared to the milk of Jersey cross cows.
3. Rapid changes in rations will affect the fat content, especially when the ration is deficient in fiber less fiber in the ration).
4. Change in the rumen pH (optimum pH should be > 6.2).
5. Particle size of forages – fine particle size reduces milk fat.
6. High grain – low forage diet, high amount of highly degradable starch and high amount of unsaturated oils reduce the MFC.

6. Clean milk production

The following must be borne in mind for producing clean milk:

1. As far as possible, maintain the exact time of milking in a day (av. 12 hr interval).
2. Weaned animals should not be milked with the calves nearby.
3. Do not feed dusty concentrate during the milking period.
4. Prepare and collect all materials required for milking before the start of

milking.

5. Prepare the cow for 'let down' of milk – usually by washing of the udder and wiping it dry.
6. Milk man's hands should be thoroughly washed before the start of milking.
7. Begin the milking as soon as the 'let down' starts (within 40 – 60 seconds)
8. Use a strip cup. This helps to remove the first milk, which is usually high in bacterial count. This also helps in detecting mastitis.
9. Animals suspected of udder infections should be milked at the end.
10. Complete the milking within seven minutes.
11. The milking process should be carried out continuously, gently, quickly, cleanly and completely. Avoid excitement of the cow prior to milking and during the milking period.
12. Use both hands for milking.
13. Use the correct procedure and method of milking.
14. Dip the teats in antiseptic dipping solution after milking.
15. Do not allow milk to come in contact with copper or iron.
16. Keep milk away from sunlight.

EXERCISE

Fill-up the blanks with appropriate answers:

1. The udder of cattle and buffaloes is made up of ———————— quarters.
2. The effect of the hormone, oxytocin lasts for only about ————————
3. High producing animals are to be milked ———————— times a day.
4. A wrong method of milking animals is ————————————

5. Poor barn ventilation also gives rise to ———————— in milk.

UNIT-7

Animals in Agricultural Operations

Cattle and buffaloes are useful in many ways especially for small – and medium – farmers; they include:

1. Ploughing, puddling, harrowing, threshing, leveling etc.
2. Carting to and from the farm; even for short distance rural transport
3. Source of high quality manure (Farm Yard Manure, FYM)
4. Renewable energy like biogas, household fuel
5. Sports

The role of Draught Animal Power (DAP) in developing countries still continues to be significant due to a variety of social and economic reasons. In short, it can be said that the use of animals for work purpose is a near universal feature of Indian agriculture. With over 80 m draught animals contributing to the cultivation of about 143 m hectares (ha) of land, DAP forms an inseparable component of the crop-livestock production system of our country. On the assumption that each bullock can generate on an average 0.5 hp (1hp = 0.746W) of power, our work animals can generate 40 m hp which, is roughly equivalent to 30,000 mw (mega watts) of electric power (Ramaswamy, 1985).

The highest DAP use in the world is in India and Bangladesh. Here, draught animals are utilized in pairs for field operations and sometimes singly

for carting. There are certain countries (Philippines, Africa) where draught animals are used singly for cultivation purposes. In Africa, the major source of energy for agricultural purpose is manual labour; now this is being gradually replaced by draught animals. Buffaloes are also used as draught animals in many South-East Asian countries and in India.

For paddy cultivation under certain ecological conditions (say in muddy / waterlogged situations) and in hilly terrains, tractors are not of much use. The low economic level of our farmers and lack of spare parts have adversely affected mechanization programs in many developing countries including India. In addition, depletion in the global reserves of fuel and its cost escalation has compounded the problem. Moreover, mechanization can not be sustained by small – or medium – farmers who form the bulk of agriculturists in India; hence, DAP is the only alternative.

Recently, the following environmental issues have given new dimension to the use of DAP:

1. Chemical fertilizers are likely to cause irreparable damage to the soil in contrast to FYM; in fact, organic farming bans use of chemical fertilizers in toto.
2. Chemical fertilizers are a source of contamination of surrounding water sources used by both animals and man.
3. Draught animals are useful even after their productive life in the form of beef (meat from cattle), skin, bones etc.; the latter two having industrial applications.

1. Selection of draught animals

Studies on draught animals are meager, to tell the least; obviously, very less documented evidence is available on the selection criteria of draught animals. However, some of the important external (qualitative) characteristics for selection of a good pair of draught animals include the following:

1. Good physical condition of the animal
2. Holding of the head erect
3. Bright eyes
4. Alertness

5. Response to the surroundings
6. Holding of the tail high

Some of the important quantitative (measurable) features include:

1. The length of the body
2. Height at withers
3. Speed of walking
4. Conformation of legs and feet/hoof
5. Heat tolerance.

In addition to the above, behavioral features such as temperament should also be given importance. Temperament refers to the nature and disposition of an animal. It is reflected in the animal's behavior, the way it moves and the way it reacts to the surroundings. It is generally a pair of bullocks that are used in agricultural operations.

The pairing process begins early in age (after castration of bull-calves) when the animals are fed, handled and allowed free together so that they 'understand' each other and the owner. They are also trained with relatively less strenuous work together and slowly made as a pair. Making such pairs itself is an art and can hardly be described completely. Suffice to mention that with proper training the animals get so accustomed that if any one other than the owner wants to handle a pair of bullocks, he is not likely to get cooperation from the pair.

Signs of good temperament in draught animals are as follows:

1. The animal should accept the handling of the owner
2. The animal should not kick at the other animal of the pair
3. The animal should not be over aggressive, as very much aggressive animals will not work as a pair.

Fig. 7.1. Crossbred bullocks used for ploughing

2. Training bullocks for agricultural work

The age at which bullocks are trained for work varies from 2 to 3 years depending up on the species (cattle or buffaloes), type of work and the temperament of the animals. After selecting a suitable pair of animals similar in size and height, training is imparted for 2 – 3 hours per day for a period varying from 20 – 30 days.

The process of training consists of different stages (Sreekumar and Obireddy, 1996). The first stage consists of teaching the bullocks to accept and carry the yoke. Once the bullocks get used to the yoke, they are walked with the yoke. During this time the bullocks are taught to respond to voice commands. The next stage of the training consists of attaching the plough to the yoke and making the bullocks walk through a dry field without actually applying the plough. By this time there will be injury on the top of the neck (crest of neck) of animals and they will be made to rest for 3 – 4 days for treatment. Finally, the plough will be applied to the ground and the bullocks walked behind a trained pair of bullocks.

Once the bullocks are trained for ploughing, they could be easily used for

threshing operation without any difficulty. Training for carting involves taking the bullocks with only the yoke through the road at least 3 – 4 times before they are actually tied to a cart.

3. Work performance

Performance of draught animals (cattle and buffaloes) is generally evaluated by the following criteria:

1. Speed of walking: This is influenced by many factors like body weight, length, height, age, health status, feeding status etc.
2. Area covered while ploughing: This, being dependent on speed of walking, is also influenced by the above factors.
3. Carrying capacity / load carriage
4. Physiological responses (like respiration rate, pulse rate and rectal temperature) before and after work. These parameters increase considerably as a result of work and slowly decline after work. The time taken for these return to pre-exercise levels is more important; lesser the better. That means, animals that return to pre-exercise levels early are better. They have to be rested at least till the physiological values return to pre-exercise levels so that their performance is optimized.

After adequate rest, animals have to be washed, watered or fed. Grooming (similar to massaging) of the limbs, neck, front (fore quarters) and back portions (hind quarters) of bullocks before and after heavy work is desirable.

Defective harness design, defective design of the cart, bad fitment of the yoke, over working, over loading, beating while working and other cruelty like twisting the tail result in the reduction not only of the work performance of animals and also in the working life of animals.

4. Feeding management of work bullocks

The strategy of feeding draught animals in a particular region depends up on the quality and quantity of feed resources available. In most farming systems where draught animals are used, farmers by their experience have evolved feeding systems that utilize cheap forage resources.

It is found that there is a decline in the feed intake of work animals during

the work period. This is more pronounced when the animals are put to work in hot conditions. In general, it is stated that supplementation of high quality feed prior to the peak working season should be practiced in order to ensure good body condition and better work performance. It is also found that animals need extra requirements of energy than protein. Types of feed resources used for work animals include the following:

1. **Roughage:** paddy straw, wheat straw, maize stover, limited grazing on fields
2. **Concentrate ingredients:** paddy, horse gram, cotton seed, ground nut cake, gingelly oil cake, tapioca
3. **Crop residues:** leaves, stems
4. **Agricultural by-products:** rice bran, wheat bran

EXERCISE

Fill-up the blanks with appropriate answers:

1. One important quantitative (measurable) feature of draught animal performance is ——————————————
2. Bullocks are usually trained for work at ——————— of age.
3. Farmers of different regions in India use bullocks for work up to the age of ————
4. There is a ——————— in the feed intake of work animals during the work period.
5. Agricultural by-products like ——————— are commonly used for feeding work animals.
6. The age at which bullocks are trained for work varies from ——————————.

UNIT-8

Breeding Management

1. Cattle and buffaloes

1.1. Selection for milk production

Special characteristics of a dairy (for milk) animal are:

1. A typical extreme angular form without any surplus flesh, at the same time should show evidence of good feeding. (Note: The body of a good dairy cow should appear angular when viewed from the front, sides and also from the top).
2. A good dairy animal, in milk, will never show a rounded appearance (much flesh). However, care has to be exercised to differentiate an animal thin in flesh on account of insufficient food.
3. Development of abdomen in proportion to the size of the animal
4. Very good development of the udder with squarely placed, long teats and tortuous milk veins. Milk vein can be observed with the naked eye located at the mid-ventral aspect.
5. The animal should show all other normal signs of health viz.,
    a. Normal behavior / habits, stance/posture and sound.

b. Eyes bright with pink mucous membrane in cattle and brick red in buffaloes, without any abnormal discharges.

c. Ears should be mobile without any discharges.

d. Muzzle should be smooth, shiny and moist in cattle and buffaloes.

e. Absence of abnormal nasal discharge.

f. Should take normal quantity of feed and water.

g. Should ruminate while at rest.

h. Urine should be of light straw color and without any abnormal odor and should be clear (not cloudy).

i. Dung should be of normal color and consistency and of normal quantity.

j. Milk should be of normal color and consistency and of normal quantity.

k. Skin / coat should be smooth and shiny without any injuries or parasites.

Note: Important signs of ill health / sickness in animals are:

a. Animal standing with the head down with dull appearance;sunken eyes, along with lacrimation / discharge from the eyes.

b. Tendency to get separated from the group.

c. Loss of appetite and consequently, absence of rumination.

d. Coarse skin, loss of hairs.

e. Dry muzzle.

f. Nasal discharge.

g. Dark or pale or yellowish mucous membrane.h. Excessive salivation.

i. Changes in the color and consistency of dung and urine.

j. Reduction in quantity and changes in the quality of milk, in general illness and affections of the mammary gland.

k. Abnormal discharge from the genitalia, in case of reproductive disorders.

1.2. Estrus in farm animals

Estrus or heat is the period of intense sexual urge experienced by an animal during which time the animals exhibit specific signs or symptoms. In general terms, it can be said to be the state of sexual receptivity that recurs at definite intervals in female animals. It is usually synonymous with the occurrence of ovulation and refers to a state of sexual receptivity accompanied with behavioral as well as physical changes/signs. The length of the estrus cycle, the duration of actual estrus/heat period (receptivity to mate) and the signs of estrus/heat are different in different species of animals. Cattle and buffaloes are poly-estrus animals (animals that come into heat or estrus many times in a year).

1.2.1. Duration

In the case of cattle, the heat/estrus cycle ranges from 16-24d with an average of 21d. That is, a cow will show signs of heat/estrus once in 21d under normal, healthy conditions. During each cycle, it is observed that the actual duration of heat/estrus varies from 12-24 hr (16 hr, on an average) when the cow shows specific signs of heat. However, some cows do not exhibit the specific signs of heat during that period. These are called silent breeders. It is normally very difficult to detect heat in these animals.

In the case of buffaloes, /estrus cycle averages 21 d (19 to 23 d) with a heat period averaging 14 hr. Detection of heat in case of buffaloes requires careful observation of the animals by the farmer.

1.2.2. Signs of estrus / heat in cattle and buffaloes

All species of animals exhibit specific physical and behavioral symptoms of estrus / heat. The major signs of estrus / heat exhibited by farm animals are enumerated below:

1.2.2.1. Physical signs:

1. Swollen, relaxed and reddened external genitalia.

2. Clear mucous discharge from the genitalia which is clear and watery during the early period of heat and viscous and ropy during mid – heat.
3. Rise in body temperature during early heat, further rise during mid – heat and returning to normal during late heat.
4. Swelling of the vulva will be slight during early heat, more during mid – heat and normal during late heat.
5. Frequent urination during early heat, more frequent during mid – heat and returning to normal during late heat.

1.2.2.2. Behavioral signs

1. During the early phase of heat, the animal shows too much excitement, this gets reduced as the estrus/heat advances.
2. The appetite becomes less during the heat period, the reduction being more pronounced during the mid – heat phase.
3. The animal in heat will bellow more during the mid-phase.
4. There will be more of twitching of the tail during the mid phase of estrus.
5. The time spent eating and resting becomes much reduced during the mid heat phase than at other times.
6. The animal in heat will lick other cows in the herd and also mount on other cows. Mounting behavior will be pronounced during the early heat and during the mid-heat the animal in heat stands still to be mounted by other animals. In such situations, the animal allowing to be mounted is said to be in "standing heat".

In the case of buffaloes, the signs of heat are similar to that of cattle (physical as well as behavioral) but less pronounced than in cattle. Many of the buffaloes exhibit silent heat especially during the summer season. Therefore, it is advised that breeding buffaloes be kept cool during summer months by adopting various summer management measures. High humidity in association with high temperature further complicates detection of estrus. Hence, winter season is conducive for the expression of estrus and is more favorable for breeding buffaloes.

(Note: Though the above are the important signs of estrus in cows and buffaloes, there is considerable difference in individual animals in exhibiting all or many of these symptoms).

1.2.3. Detection of estrus/heat in cows and buffaloes

Most of the cows and buffaloes start showing heat signs during the night hours or during the early morning hours. The experience of the farmer or the person in charge of the animals is very important in this matter. The physical and the behavioral signs are to be interpreted accurately. The skill of the person is likely to have a profound influence on the effectiveness of heat detection. Efficient heat detection by the farmer is an essential component of breeding by artificial insemination.

The estrus cycle of cattle and buffaloes is mainly governed by different hormones. In addition, there are a lot of external factors that affect the estrus cycle like the nutritive status of the animal, health status of the animal, body condition of the animal, the length of day light (not serious in cattle and buffaloes), atmospheric temperature, age of the animal, parity of the animal, the number of animals in heat in the herd (more the number, the more intense will be the signs), the type of housing (mounting behavior will be more in open paddocks than in tie-barns), the intensity and frequency of heat is found to be higher at night time than during day time, the behavioral signs tend to be weak at first heat and become pronounced during subsequent cycles.

1.3. Right time of insemination

Once the signs of heat are interpreted correctly and the animal is declared / found to be in 'proper heat', the next step is to inseminate the cow / buffalo at the right time. The right time of insemination should always relate to the time of ovulation. Therefore, it would be a better thumb of the rule to inseminate the animal in the evening, if the heat signs are noticed in the morning and to inseminate in the morning, if the heat signs are observed in the previous evening.

It is found that cows usually ovulate and show signs of heat at around 30d after calving (post-partum). In the case of buffaloes, it takes a longer time (e.g. 60 d or even more). High yielding cows also take a longer time to return to estrus after calving.

2. Sheep and Goats

2.1. Selection of breeding animals

Selection of good breeding stock of sheep / goats (both females and males) is very important as they form the basis / foundation of the whole farming enterprise.

2.1.1. Ewes/Does

1. The animal should have feminine characteristics.
2. Should have wide chest
3. Straight fore and hind limbs and strong feet.
4. Loose, pliable, soft skin and coat.
5. Alert and bright eyes with an inquisitive look.
6. Broad muzzle with large open nostrils.
7. Udder should be carried forwards.
8. Straight top line.
9. Should be preferably from twin birth.
10. Should confirm to breed standards.
11. Should be free from genetic defects.
12. Should be free from infectious diseases.

2.1.2. Rams/Bucks

1. The animal should have masculine characteristics.
2. Should have a wide chest with large chest girth.
3. Straight fore and hind limbs with strong feet.
4. Legs should be wide apart and squarely set.
5. Should not show any evidence of lameness.

6. Back should be strong and straight.
7. Bright and wide eyes.
8. Should possess two testes of appropriate size.
9. Should possess two rudimentary teats of uniform size.
10. Should be preferably from twin birth.
11. Should confirm to breed standards.
12. Should be free from genetic defects.
13. Should be free from infectious diseases.

2.2. Estrus cycle

2.2.1. Length of estrus cycle

The length of estrus cycle in sheep varies from 14-19 d and the average duration of estrus is 18 – 24 hr.

2.2.2. Signs of estrus

1. Swelling and reddening of the external genitalia.
2. Clear mucous discharge from the external genitalia (this is not as pronounced as that in the case of cattle).
3. Flagging of the tail.
4. Bleating (sound produced by sheep and goats) continuously.
5. Nervousness.
6. Frequent urination.
7. Irregular appetite (dislikes feed/reduction in feed intake).

   (*Note:* the behavioral signs of estrus are very much less pronounced in sheep than in goats. Therefore, it is very difficult to detect ewes in estrus in all female flock without the help of a teaser ram. Teaser ram is a ram that has been vasectomized or sterilized and used for detecting females in estrus).

3. Pigs

3.1. Selection

3.1.1. Selection of Sow (female)

Factors to be considered include:

1. Should be active in disposition. An inactive female will be unable to raise a good litter of young ones.
2. Should have 12 – 14 sound teats in the udder, along the ventral line.
3. Should have good length, uniform width and depth (according to the breed standards).
4. Should have a good temperament (this affects the number of piglets that are saved at farrowing (at the time of giving birth) and at weaning.
5. A nervous female is more likely to step on young ones and cause their death.
6. Good temperament can be judged by the fact that a good tempered female will always let/allow a person to enter the pen/house.
7. Should have straight and short pastern and good feet and legs.
8. Should be smooth in shoulders, have a well-muscled loin and good hair coat.
9. Should have a trim head and jowl region.
10. Should have good growth and confirm to the breed standards

3.1.2. Selection of boar (male)

Factors to be considered include:

1. Should show masculinity and breed characters.
2. Should have smooth shoulders and strong back.
3. Should have uniform width from front to back.
4. Should not show any tendency to narrow at the loin.

5. Tail should be set high and there should be no fat around the tail.
6. Ham should be wide, deep and full.
7. Should have a short pastern and should stand squarely on all four legs.
8. Should have 12-14 rudimentary teats on the ventral aspect.
9. An extremely nervous male pig is not desirable.
10. A good male should be active and friendly. Inactive boars are usually slow breeders.

    (Note: Teats present in male pigs are called rudimentary teats. Teat on a female that is not connected to the milk gland will not produce milk. Such teats are called blind teats)

3.2. Estrus cycle

3.2.1. Duration of estrus

In the case of pigs, the heat/estrus cycle ranges from 19 - 24 d with an average of 21 d with a heat period averaging 48 hrs. In contrast to other farm livestock, pigs produce large number of young ones (litter) at one farrowing.

3.2.2. Signs of estrus

1. Grunting (sound produced by pigs).
2. Restlessness.
3. Swelling of the external genitalia.
4. Reddening of the external genitalia.
5. Stands still when pressure is applied on the back (this is a test that can be applied to detect heat in female pigs and is called riding test. If the female is in heat, it will stand still, otherwise, it will run away)
6. Females will seek out males during this period.

3.3. Breeding of gilts and sows

Gilts should be bred for the first time when they are in their third heat. During this time, they should normally weigh around 80 – 90 kg. Body weight is the best criterion to assess whether a female pig is ready to be bred for the first time.

Sows can be bred during the first heat after weaning their young ones, if they are in good body condition. Post weaning heat is the best and fertile heat in sows. This normally occurs within the first week of weaning. It is during this period that maximum fertility is observed in sows.

Maximum litter size (number of young ones) can be obtained by allowing mating twice during the heat period. In such cases, the first mating should be given on the first day of heat and the second mating, 12-14 hr later.

4. Summary

The following are general guidelines for optimizing reproductive efficiency of farm animals:

1. Prompt detection of estrus in female animals.
2. Allow mating at the appropriate time, in case of natural mating.
3. Use of good quality semen, in case of artificial insemination.
4. Allow sufficient service period and dry period.
5. Regular checking of reproductive disorders.
6. Hygiene at the time of calving/ kidding/ lambing/farrowing.
7. Quality and quantity of ration during various stages of pregnancy and production.
8. Accurate record keeping.
9. Feeding time should be avoided for the detection of heat.
10. Balanced feeding.
11. Heat detection should be carried out twice daily.
12. Maintenance of heat expectancy chart.
13. Standing heat is the best indication of estrus. This behavior will be manifested only if enough open area is provided to female animals.

14. Use records to predict the probable date of heat.
15. Look for irregular estrus cycles, abnormal discharges etc.
16. Provide suitable shelter management to reduce heat stress.

EXERFCISE

Fill-up the blanks with appropriate answers:

1. The body of a good dairy cow should appear ———————— when viewed from the front, sides and top.
2. The muzzle should be smooth, shiny and moist in ————————
3. In the case of cattle, the heat/estrus cycle ranges from ————
4. In the case of buffaloes, /estrus cycle averages ————————
5. Mounting behavior will be pronounced during the ———————— heat period.
6. Most of the cows and buffaloes start showing heat signs during ————
7. It is found that cows usually ovulate and show signs of heat at around ———— after calving.
8. In the case of goats, the estrus cycle varies from ————————
9. In the case of sheep, the estrus cycle varies from ————————
10. The average duration of estrus in sheep is ————————
11. The average duration of estrus in goats is ————————
12. It is very difficult to detect ewes in estrus in all female flock without the help of a ————————
13. A good female pig should have ———————— sound teats in the udder.
14. Teats present in male pigs are called ———————— teats.
15. In the case of pigs, the heat/estrus cycle ranges from ————

UNIT-9

Control of Diseases

SANITATION AND DISINFECTION

Disease is the condition in which the animal will not be at ease; it shows physiological, anatomical or biochemical changes from the normal. Health, on the other hand, is the state or condition of the animal in harmony with the environment; in simple terms, animal at ease.

1. Factors affecting health of farm animals

There are different factors affecting the health status of all animals. Some of the important factors that affect health of farm animals are:

1. Extreme climatic conditions without suitable remedial measures.
2. Faulty housing facility: this includes overcrowding, slippery/ improper flooring, mixing of age groups and improper drainage.
3. Faulty health management: improper sanitation and disinfection, and improper vaccination schedule.
4. Faulty feeding: not providing suitable quantity of ration of recommended composition / quality leads to nutritional deficiency diseases. In addition, contaminants and/or toxicants in feed and rarely excess feeding also leads to the incidence of diseases. Intake of unclean

water also pre-disposes animal to diseases.

5. Lack of proper exercise and inhibition of normal behavioral patterns are other important factors leading to severe stress and the incidence of diseases in animals.

2. General requirements

The following list provides the important aspects to be borne in mind to maintain optimum health status in any herd/flock.

1. Nutritionally adequate (balanced), easily digestible and palatable feed in divided doses and at regular timings (intervals).
2. Adequate cleaning and disinfection of the farm premises, equipment, water and livestock
3. Hygienic habits of personnel attending on the animals
4. Strict adherence to routine vaccination
5. Avoid exposure to extreme climate. Provide adequate warmth during cold weather and vice versa. In either case, avoid exposure to too much bright light.
6. Culling of weak animals in the herd/flock. It is a better practice to cull all the weak animals in the farm. Weak animals have poor growth rate and limited resistance to diseases and hence, are more susceptible to infections than other animals.
7. Control of ticks and other vectors.
8. First-aid kit must be available always. In case of emergency, prompt first aid measures should be followed.
9. In case of hemorrhage, tourniquet to be applied and ice packs used to stop bleeding.
10. Assist in respiration in case of difficulty in breathing.

3. Care and management of sick animals

Sick animals need extra care and attention when compared to healthy ones. This will help in faster recovery from the illness. A veterinarian has to be requested to visit the animal facility to inspect, diagnose and suggest remedial

measure(s).

3.1. Sick animal management

The following general precautions can be undertaken whenever sick animal(s) are identified in the farm:

1. Isolation – separate the sick animals from the group to a separate shed (sick animal shed).
2. Movement of people to be restricted - Attendants looking after sick animals should never be allowed to handle healthy animals. The sick animals have to be attended as often as possible.
3. Provide adequate bedding material on the floor of the shed so as to improve the comfort of the sick animal.
4. Follow strict sanitary conditions.
5. Provide fresh, clean drinking water.
6. If the disease is a scheduled disease; it must be reported to the nearby Dept of Animal Husbandry; for instance Anthrax disease

3.2. Steps at the face of an outbreak

In spite of all care, if any infection actually occurs, the following steps are equally important:

1. Quarantine: keeping all the animals that are brought into the farm from outside away from the farm stock for at least a month. This will help identify whether the newly brought animals are having any infections and if so, they could be removed from the stock.
2. Isolation of infected animals: Once, it is found that a particular animal is showing disease symptoms, it is better to isolate it from the farm stock and house it in the sick animal shed. This would help to contain the infection i.e., not allowing the infection to spread to other healthy animals in the farm.
3. Correct diagnosis and prompt treatment of diseased animals: Investigation should be done to diagnose the condition of sick animals and prompt treatment should be adopted. A veterinarian's help is

essential in this aspect.

4. Proper disposal of dead animals: The best method of disposal in the case of large sized animals is burial and for small animals, incineration.

4. Sanitation

Sanitation is the process of promoting hygiene and prevention of diseases by maintenance of cleanliness or sanitary conditions. This refers to a state wherein disease causing organisms (pathogenic organisms), even when present, are not a threat to the animal's health.

Disinfection, on the other hand indicates destruction of all vegetative forms of microorganisms whereas spores are not destroyed. Sterilization means destruction of all infective and reproductive forms of all microorganisms (bacteria, fungi, virus, and the like).

Having an effective sanitation (cleaning) and disinfection program is a crucial step in any livestock– biosecurity program. The provision of suitable house alone is not just sufficient enough to meet the requirements of animals. It is necessary that they should be periodically and systematically cleaned.

4.1. Animal house sanitation

The main purpose of a cleaning and disinfection program is to reduce the number of pathogens (disease – causing agents) in the environment so as to reduce the potential for diseases to occur in subsequent batches. This is the most effective method of prevention of diseases.

The essential points to be considered include:

1. Removal of dung from the shed. The removed dung should be shifted as far away from the shed as possible and stored in a dung pit.
2. House should be swept thoroughly to clean all floors, lighting fixtures, fan blades, if any. Burnt – out light bulbs replaced and all other bulbs cleaned.
3. All permanently installed water troughs, feeders, and any other equipment should be scraped, scrubbed, and cleaned.
4. The sills of the house should be scraped and cleaned. All material from inside the house, trash, and debris at/on outside the house are to be

removed while cleaning.

5. The ceiling, walls, manger and other equipments should be thoroughly disinfected with a good disinfectant used at the rate recommended by the manufacturer.
6. Cleaning and disinfection should start at the back and proceed toward the front of the building - spraying the ceiling first, then the walls, and finally the floor.
7. Fresh lime can be sprinkled on the floor, walls and ground for disinfecting inside the buildings. For manger and water troughs, lime wash gives very good results. Advantages are that it is simple, cheap and very effective. Lime has effect on organic matter, algae and other plant growths that are likely on the floor.
8. In addition to the cleaning and disinfection practices mentioned above the feeding – system clean – up is also mandatory. This consists of removing all left over feed from the manger and scraping and removing any mold or dirt present in the manger.

4.2. Sanitation of drinking water

If water in the well is used for the animals, the well can be treated with sodium hypochlorite (household bleach) dumped directly into the well. Water is then run through all the lines until chlorine can be smelled at the end of each line. The water is allowed to stay in the lines for a minimum of 24 hours.

Sanitization of drinking water can also be effected by the addition of 3 to 5 g stabilized bleaching powder (35% chlorine) per 1000 lit so that chlorine concentration does not exceed 1 to 2 mg/lit (ppm). Water is ready for use after about an hour's time. This method is the cheapest of all methods.

Note: Bleaching powder does not dissolve easily and hence, it is first dissolved in a small quantity of water and the resultant concentrate is poured into the well/overhead tank, as the case may be.

4.3. Disposal of dung and other wastes

A very good and effective system for the removal and disposal of all wastes is essential in a farm. This is for the maintenance of proper health of the

animals and the prevention of disease outbreaks. This involves the following:

1. The collection of dung and other solid wastes like waste grass, straw, bedding etc.
2. The storage of solid manure / dung.
3. The removal of urine and wash water (liquid manure).

4.3.1. Removal of solid manure

The removal of solid manure should be done at frequent intervals and stored in a dung pit situated away from the shed. The size of the manure pit is decided on the basis of the number of animals, species of the animal, nature of feed consumed by the animals and the duration of time the manure is to be stored. In order to avoid contamination of feed and water of animals and the products like milk and also to avoid infections that can arise out of these, periodic or frequent removal of wastes is required.

Numerous parasitic worms pass their eggs (ova) or larvae through the dung. These could infect healthy animals through contamination of feed or water. The oocysts of certain protozoan parasites can remain alive / viable for long periods when sporulated in the dung. Pathogenic organisms present in the dung can spread to healthy animals by several methods like direct contamination of feed and water, spread by insects and flies, carried on the clothing or footwear of workers, disseminated by rodents or birds like crows. Flies commonly use fresh dung as a material for laying their eggs. The most important are the house fly (non-biting) and the stable fly (biting fly). These flies are very important in disseminating diseases to animals and humans. These are the carriers of some serious diseases like cholera, typhoid, anthrax, mastitis and dysentery.

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1. The collection of dung and other solid wastes like waste grass, straw, bedding etc.
2. The storage of solid manure / dung.
3. The removal of urine and wash water (liquid manure).

5. Disinfection

Disinfection involves the use of a disinfectant that will reduce or kill the pathogens. Disinfectants are more effective at warmer temperatures. There are several types of disinfectants, and the one chosen should be effective against the disease agent(s). Several commercial preparations are available in the market.

5.1. Qualities of a good disinfectant

A good disinfectant should be	A good disinfectant should not be
Free from strong and objectionable smell	Toxic to animals and humans
Effective at room temperature	Irritating when inhaled
Effective when diluted with water	Destructive to materials
Cheap	Remain strongly active for a long time after its application
Able to kill the complete range of microbes	Corrosive
Maintain a good level of activity even in the presence of organic matter	Deleterious effect on clothing. Rubber boots, plastic and metal.

EXERCISE

1. The state or condition of the animal in harmony with the environment is termed as ——————————
2. Intake of unclean water pre-disposes animals to ——————————
3. Separating the sick animals from a group to a separate shed istermed as ——————————
4. Keeping all the animals that are brought into the farm from outside away

from the farm stock for at least a month is termed ———— ————————————.

5. The process of promoting hygiene and prevention of diseases by maintenance of cleanliness is ————————————————————

6. Destruction of all infective and reproductive forms of all microorganisms is called ————————————

7. Sanitization of drinking water can also be effected by the addition of ————————————

UNIT-10

Record Keeping

1. Farm records

In any commercial farm operation, records of all transactions have to be meticulously maintained in order to arrive at the economic returns of the enterprise. Records help one understand the current status (herd strength, production, health status, economics) of the farm. In addition, records help formulate a future plan for the farm taking in to account the present state of growth. The records must be such that they are accountable, auditable, easy to maintain, easy to understand and convenient to arrive at the economic returns of the enterprise. Registers to be maintained

1.1. For accounting and audit

1. Journal 2. Ledger – feed 3. Ledger- Livestock 4. Ledger – medicines 5. Ledger – equipment 6. Ledger – electricity, water and miscellaneous 7. Ledger – sales (livestock) 8. Ledger – sales (manure) 9. Ledger – sales (G. bags) 10. Cash – book 11. Miscellaneous register – to maintain records of land, buildings etc.

1.2. For farm operations (auditable)

1. Livestock register 2. Feed procurement and issue register 3. Medicines

and vaccines register 4. Building – maintenance register 5. Equipment purchase and maintenance register 6. Miscellaneous expenditure register 7. Sales register (livestock) 8. Sales register (manure) 9. Sales register (G. bags) 10. Bank transactions

The registers mentioned above are neither exhaustive nor compulsory; additions/deletions can be made depending on the requirements of the farm.

1.3. Pro forma for various farm registers 1.3.1. Livestock register

Month and year:			**Breed:**			
Date	Receipt	Issue	Sold	Died / Culled	Total	Closing balance	Initials

1.3.2. Feed procurement and issue register

Month and year:				**Breed**	**Adult / Young**	
Manufacturer's name and address:				**Feed:**	**Batch No.**	
Date	Receipt	Quantity	Amount	Issue	Balance	Remarks/Initials

1.3.3. Medicines and vaccines register

(Separate registers/pages to be allotted to each medicine/biological)

Month and year:				**Ingredient**		
Supplier's name and address:						
Date	Receipt	Quantity	Amount	Issue/Discard	Batch No.	Date of manufacture	Ex da

1.3.4. Building maintenance register

Date	Building constructed	Cost of construction	Name of construction firm	Remarks

1.3.5. Equipment purchase/maintenance register (Separate sheets for each of the equipments)

Date	Receipt	Quantity	Amount	Supplier details	Issued/condemned /sold	Closing balance

1.3.6. Miscellaneous expenditure register

Date	Item	Quantity	Supplier details	Amount	Issued	Closing balance	Remarks

1.3.7. Livestock sales register

Month and year: **Breed:** **Male/Female**

Date	Opening balance	Receipt	Sold	Selling price	Purchaser's details	Initials

1.3.8. Manure sales register

Month and year:

Date	**Opening balance**	**Receipt**	**Sold**	**Selling price**	**Purchaser's details**	**Initials**

1.3.9. Gunny bag sales register

Month and year:

Date	Opening balance	Receipt	Sold	Selling price	Purchaser's details	Initials

1.3.10. Ledger

Separate ledger or separate sheets within a ledger have to be maintained for each of the items like livestock, feed, medicine, sales etc.

Debit				Credit			
Date	Particulars	Journal folio	Amount	Date	Particulars	Journal folio	Amc

1.3.11. Cash-book

Date	Receipt		Credit	
Opening balance				
	Particulars	Amount	Particulars	Amount

UNIT-11

Economics of Milk Production

Livestock farming is primarily for livelihood of the farmer and hence, it should be profitable enough for his sustenance. The returns also should encourage him to continue in the business. In this unit, the method of working out economic returns from a dairy farm with 12 milking crossbred cows is enumerated. The concept can be expanded to any size of the unit. In addition, same principles can be employed to develop cost of other livestock products viz., mutton, pork etc.

1. Technical assumptions

It is essential to have a clear cut foresight for finance, building, herd schedule, items of income and expenditure etc. of the dairy farm to be established. The following tables give the details concerning the proposed dairy unit:

1.1. Finance

The monetary requirements for construction of dairy shed and purchase of animals will be obtained from a lending institution (Bank). The banks give 75% of the requirement, the rest being the farmer's contribution. The loan needs to be repaid in five equal annual installments with an interest rate of 12% pa on the outstanding loan.

1.2. Non-recurring expenditure

Table 11.1 Non-recurring expenditure

	Description		Cost
Building	Calves (up to 6 m)	2.0 m²/animal	Rs 1000/ m²
	Animals > 6 m	3.5 m²/animal	Rs 750/ m²
Equipment			Rs 500/animal/pa

1.3. Recurring expenditure

This includes cost on purchase of animals, feed, vaccines, medicines, insurance etc. They are tabulated below:

Table 11.2 Recurring expenditure

		Description				
		Animal purchase				**Rs 20,000/animal**
		Allowance, kg/d				
	For cattle	**0-3 m**	**3-6 m**	**6-12 m**	**> 12 m**	
Feeding	Roughage	-	6	15	25	Re 2/kg
	Concentrate	1	1	2	4	Rs 12/kg
		Vaccines, medicines etc.				Rs 250/animal/pa
		Insurance, 6% of cost of the animals purchased				Rs 1200/animal

1.4. Income

The sources of income, their quantity and value are shown below:

Table 11.3 Income

Description	Rate			
Sale of milk	LL 305 d, LY 3000 l			Rs 20/lc
	1 year old ♂			Rs 5,000/animal
Sale of animals	2 year old heifer			Rs 15,000/animal
	After Lactation V			Rs 2,500/animal
	Age, m			
Manure Production, kg/animal/d	0-6	6-12	>12	FYM Rs 500/t
	Dung	5	8	15
	FYM	3	4	8

LL: Lactation length, LY: Lactation Yield, FYM: Farmyard Manure

1.5. Other assumptions

The following are assumptions needed for computing profits and cash-flow:

1. Single row sheds one each for Calves and Grower / Milking animals
2. Labor: Self
3. Equal number of ♂ and ♀ calves, at first purchase and at the farm

4. Calving interval: 1 year
5. Sale of animals: ♂ after completion of 1 year of age; heifers after 2 years of age.
6. Mortality: 10%, to be applied on overall profits; under exigency for replacement, pregnant animals born at the farm will be used
7. Depreciation: Building – 2½% pa, Equipment – 5% pa

2. Economics of a 12-cow dairy farm

2.1. Herd schedule

It is highly essential that the expected number of animals in milk, calves, heifers and bull-calves are known to estimate costs and returns. It requires a schedule as per the purchase of animals at the beginning to facilitate calculation of recurring expenditure and income accurately.

Table 11.4 Herd Schedule

		< 6 m		> 6m, < 12 m		For sale			
Year	**Part**	♂	♀*	♂*	♀*	♂*	♀*	**In Milk****	**Lactation No**
	0.6 m	C^{A}_{I}	C^{A}_{I}	-	-	-	-	A_I	
1				$G^{A}I$	$G^{A}I$	-	-	A_I	
	7-12 m	C^{B}_{I}	C^{B}_{I}			-	-	B_I	I
				$G^{B}I$	$G^{B}I$	-	-	B_I	
2	**0-6 m**	$C^{A}II$	$C^{A}II$			$G^{A}I$	-	A_{II}	
				$G^{A}II$	$G^{A}II$		-	A_{II}	

	7-12 m	$C^{B}II$	$C^{B}II$			$G^{B}I$	-	B_{II}	II
				$G^{B}II$	$G^{B}II$		-	B_{II}	
3	**0-6 m**	$C^{A}III$	$C^{A}III$			$G^{A}II$	$G^{A}I$	A_{III}	
				$G^{A}III$	$G^{A}III$			A_{III}	
	7-12 m	$C^{B}III$	$C^{B}III$			$G^{B}II$	$G^{B}I$	B_{II}	III
				$G^{B}III$	$G^{B}III$		-	B_{III}	
4	**0-6 m**	$C^{A}IV$	$C^{A}IV$			$G^{A}III$	$G^{A}II$	A_{IV}	
				$G^{A}IV$	$G^{A}IV$			A_{IV}	
	7-12 m	$C^{B}IV$	$C^{B}IV$			$G^{B}III$	$G^{B}II$	B_{III}	IV
				$G^{B}IV$	$G^{B}IV$		-	B_{IV}	
4	**0-6 m**	$C^{A}V$	$C^{A}V$			$G^{A}IV$	$G^{A}III$	A_{V}	
				$G^{A}V$	$G^{A}V$			A_{V}	
	7-12 m	$C^{B}V$	$C^{B}V$			$G^{B}IV$	$G^{B}III$	B_{IV}	V
	Total	30	30	27	27	24	18		

Notes:

1. At the beginning of I year (Batch A) and after 6 m (Batch B), 6 milking animals with calf purchased i.e., 12 in milk and 12 calves
2. m = month, C = Calves, G = Growers
3. Superscript indicates Batch
4. Subscript indicates lactation number of the Batch to which it pertains
5. * 3 animals and ** 6 animals for each cell

6. Movable assets at the end of 5 years:

a) 3 each of $G^{A}V$ and $G^{B}V$ ♂ for sale

b) 3 each of $G^{A}IV$, $G^{B}IV$, $G^{A}V$ and $G^{B}V$, ♀ to be sold after AI and Pregnancy

c) Batch B animals to be sold after completion of V Lactation (6 m).

In the current program, it is assumed that:

1. Cows in advanced pregnancy or in first lactation with a newly born calf will be purchased twice in batches of 6 animals each at 6-month's interval during the first year only.
2. The animals will be inseminated at the farm and the calves born will be sold; males after 1 year and heifers after 2 years. However, under exigency, heifers may be used to replace the original stock.
3. Management including housing, feeding, handling, disease control and sanitation etc. will be as per standards which have been outlined in earlier Units in this publication.

2.2. Non-recurring expenditure

Table 11.5 Non-recurring expenditure

Description		n	Allowance	Cost	Total, Rs
Building	Calves (up to 6 m)	12	2.0 m²/animal	Rs 1000/ m²	24,000
	Animals > 6 m	24	3.5 m²/animal	Rs 750/ m²	63,000
Equipment		36		Rs 500/animal/pa	18,000
					105,000

Building requirement of calves = n x allowance x cost = Rs 24, 000; the same way others are also calculated.

2.3. Recurring expenditure

Recurring expenditure differs between I year and the rest primarily because:

1. Animal purchase is done only during I year
2. Number of animals is not the same during first and second half of I year because Batch B animals are purchased after 6 m of Batch A.
3. There are no sales of 1 year old bulls and 2 year old heifers

The following table illustrates calculation of various recurring costs. Note that insurance is done only for the animals purchased for the project.

Table 11.6 Recurring expenditure (I year)

Description				**Rate**	**n**	**An (R**
Animal purchase				**Rs 20,000/animal**	**12**	**24**
Feeding cost	Age	Feed	kg/animal			
	0-3 m	Concentrate	90	Rs 12/kg	12	12
	3-6 m	Roughage	540	Re 2/kg	12	12
		Concentrate	90	Rs 12/kg	12	12
	6-12 m	Roughage	2,700	Re 2/kg	6	32
		Concentrate	180	Rs 12/kg	6	12
	> 12 m	Roughage	9,125	Re 2/kg	12	21

	for 1 year					
		Concentrate	1,460	Rs 12/kg	12	21
Vaccines, medicines etc.				Rs 250/animal	24*	4,5
Insurance				Rs 1,200/animal	12	14
					TOTAL	77

General rule is multiply n with rate; and in case of fodder and concentrates, multiply the product obtained with quantity. For instance, cost of animal purchase is 12 x Rs 20,000 = Rs 240,000 and cost of concentrates (0-3 m) = 90 x 12 x Rs 12 = Rs 12,960

Table 11.7 Recurring expenditure (II year and onwards)

Description				**Rate**	**n**	**Am (Rs**
Animal purchase						
Feeding	Age	Feed	kg/animal			
cost	0-3 m	Concentrate	90	Rs 12/kg	12	12,9
	3-6 m	Roughage	540	Re 2/kg	12	12,9
		Concentrate	90	Rs 12/kg	12	12,9
	6-12 m	Roughage	2,700	Re 2/kg	12	64,8

		Concentrate	180	Rs 12/kg	12	25,9
	> 12 m for 1 year	Roughage	9,125	Re 2/kg	12	219
		Concentrate	1,460	Rs 12/kg	12	210
Vaccines, medicines etc.				Rs 250/animal	24	6,0(
Insurance				Rs 1,200/animal	12	14,4
					TOTAL	579

2.4. Income

Table 11.8 Income (I year)

Items sold		**n**	**Production**	**Total production**	**Rate, Rs**	**Total, Rs**
Milk	0-6 m	6	1,500 l/animal	9,000 l	20/l	1,80,00
	7-12 m	12	1,500 l/animal	18,000 l		3,60,00
Animals	Males					
	Females					
	After Lactation V					
FYM	0-6 m	12	540	6,480	500/t	3,240

			kg/animal			
	6-12 m	6	720 kg/animal	4,320	500/t	2,160
	> 12 m for 1 year	6*	2,920 kg/animal	17,520	500/t	8,760
					TOTAL RECEIPTS	554,340

* 6 animals for 12 m and 6 for 6 m

Table 11.9: Income (II year)

Items sold		**n**	**Production**	**Total production**	**Rate, Rs**	**Total, Rs**
Milk	0-6 m	12	1,500 l/animal	18,000 l	20/l	360,0
	7-12 m	12	1,500 l/animal	18,000 l		360,0
Animals	Males	6			5,000/animal	30,00
	Females					
	After Lactation V					
FYM	0-6 m	12	540 kg/animal	6,480	500/t	3,240
	6-12 m	12	720 kg/animal	8,640	500/t	4,320
	> 12 m for 1 year	12	2,920 kg/animal	35,040	500/t	17,52

					TOTAL RECEIPTS	775,0

Table 11.10 Income (III and IV year)

Items sold		**n**	**Production**	**Total production**	**Rate, Rs**	**Tota Rs**
Milk	0-6 m	12	1,500 l/animal	18,000 l	20/l	360,
	7-12 m	12	1,500 l/animal	18,000 l		360,
Animals	Males	6			5,000/animal	30,0
	Females	6			15,000/animal	90,0
	After Lactation V	-				
FYM	0-6 m	12	540 kg/animal	6,480	500/t	3,24
	6-12 m	12	720 kg/animal	8,640	500/t	4,32
	> 12 m for 1 year	12	2,920 kg/animal	35,040	500/t	17,5
					TOTAL RECEIPTS	865,

Table 11.11 Income (V year)

Items sold		**n**	**Production**	**Total production**	**Rate, Rs**	**Tota Rs**

Milk	0-6 m	12	1,500 l/animal	18,000 l	20/l	360,
	7-12 m	12	1,500 l/animal	18,000 l		360,
Animals	Males	6			5,000/animal	30,0
	Females	6			15,000/animal	90,0
	After Lactation V	6			2,500/animal	15,0
FYM	0-6 m	12	540 kg/animal	6,480	500/t	3,24
	6-12 m	12	720 kg/animal	8,640	500/t	4,32
	> 12 m for 1 year	12	2,920 kg/animal	35,040	500/t	17,5
					TOTAL RECEIPTS	880,

Income differs in all the years except years III and IV for obvious reasons of number of animals in production and available for sale. A look at herd schedule will indicate the number of animals at every 6 month's intervals.

2.4.1. Movable assets on hand at the end of 5 years

The following are the movable assets at the end of 5-year period:

Table 11.12: Value of movable assets at the end of 5 years

Growing males	6	10,000/animal	60,000
Growing females	12	25,000/animal	150,000
After Lactation V	6	2,500/animal	15,000

TOTAL VALUE	225,000

3. Cash flow

As indicated earlier, Banks stipulate that credit should be returned in five equal annual installments along with interest for the loan outstanding. They also require a cash-flow showing year-wise expenditure-income statement along with gross and net profits. The same are tabulated below:

Table 11.13: Cash – flow

Description	I year	II year	III year	IV year	V year	Total
Non-recurring	105,000	24,000	24,000	24,000	24,000	201,0
Recurring	772,380	564,840	564,840	564,840	564,840	3,031
TOTAL EXPENDITURE	877,380	588,840	588,840	588,840	588,840	3,232
Income	554,340	775,080	865,080	865,080	880,080	3,939
Income from loan	260,000	-	-	-	-	260,0
TOTAL RECEIPTS	814,340	775,080	865,080	865,080	880,080	4,199
Gross profit	(-) 63,040	186,240	276,240	276,240	291,240	966,9
Loan installment	52,000	52,000	52,000	52,000	52,000	260,0
Interest	31,200	24,960	18,720	12,480	6,240	93,60
Depreciation, building	2,175	2,175	2,175	2,175	2,175	10,87
Depreciation, equipment	1,800	1,800	1,800	1,800	1,800	9,000

NET PROFIT	(-) 150,215	105,305	201,545	207,785	229,025	593,4
CUMULATIVE NET PROFIT		(-) 44,910	156,635	364,420	5,93,445	

Notes:

1. Overall profit over 5 years is Rs 593,445 or Rs 118,689 (say 120,000)/pa; in other words Rs 10,000/month or Rs 833/animal/month or Rs 2.78/l of milk
2. Assets available will be of Rs 225,000 or Rs 313/animal/month
3. Total profit + assets is Rs 1,150/animal/month or Rs 3.83/l of milk

4. Cost of milk production

Table 11.14 Cost of milk production

Description	I year	II year	III year	IV year	V year	Total
Recurring	772,380	564,840	564,840	564,840	564,840	3,031,74
Interest	31,200	24,960	18,720	12,480	6,240	93,600
Depreciation, building	2,175	2,175	2,175	2,175	2,175	10,875
Depreciation, equipment	1,800	1,800	1,800	1,800	1,800	9,000
Total cost involved	807,555	593,775	587,535	581,295	575,055	3145215
Milk production, l	27,000	36,000	36,000	36,000	36,000	171000
Cost of milk production, Rs/l	29.90	16.49	16.32	16.14	15.97	18.39

UNIT-12

Poultry Farming

Role of Poultry production in India is enumerated in Unit – 1. Poultry production is gaining momentum, probably better than even industrial development in India; it is estimated that poultry industry is growing at a rate over 10% annually. In view of these facts, salient features of poultry production and management are presented in this unit.

1. Domestication

Information on domestication of chicken is scanty; only three fossils of *Gallus* species have been recorded. During periods of glaciation, single population of bird species across Eurasian continent fragmented into isolated population in warm southern refuges. When glaciers retreated, Western and Eastern subpopulations expanded Northward and evolved into separate species and subspecies which ultimately met depending on the length of isolation; however, these might have gone into extinction during later glaciation or ex-terminated by man.

Totally four species are known to modern Ornithology. One of these, Red Jungle Fowl (*Gallus gallus*) is undoubtedly a major contributor to domestic fowl although the role of the other three species is doubtful.

1.1. Wild Gallus species

There are four recognized species under the genus *Gallus* : G. *gallus* (Red Jungle Fowl, RJF), G. sonneratti(Grey or sonnerats), G. *lafayetti* (old name G. *stanleyi*, in Ceylon), and G. *varius* (Green, old name G. *furcatus*).

In case of *Gallus gallus*, because of geographical location, five subspecies, especially in males, have been reported. They are *G.g.gallus* (Cochin-Chinese RJF), *G.g.spadiceus* (Burmese RJF), *G.g.jabouillei* (Tonkinese RJF), *G.g.murghi* (Indian RJF) and *G.g.bankiva* (Javan RJF). These five subspecies differ in a) color of earlobes (white to red), b) shape and length of neck hackle feathers in males and c) shade of red plumage in males (golden yellow to mahogany).

1.2. Origin of modern poultry

Origin of modern poultry is not fully resolved although most agree for RJF as the only species as exclusive ancestor (Monophyletic origin). In addition, original site of domestication is also not clear; however, it is suspected that domestication might have begun in Burma (Myanmar). There are records to show that people of Harappan culture (2500-2100 BC) of the Indus valley reared chicken and later on diffused Westward to other parts of the World at a rate of 1.5 to 3.0 km/year. Except for Egypt, diffusion of chickens into Africa is unknown. However, India is likely to be the source of chickens keeping in view well developed trade between India and Africa. Similarly, diffusion of birds eastwards has not been completely understood. However, Japanese chicken might have come from China via Korea during Yagoi period (300 BC to 300 AD); chicken in Pacific islands might have originated in China and India.

Recent discoveries indicate that it could even be China from where domestication began. Therefore, it is reasonable to agree that domestication was completed by about 2000 BC although some authors have reported it to be around 3200 BC. Darwin proposed 1400 BC as the time for probable introduction of chickens from China to India. Further, sites from Iran, Turkey, Syria, Greece, Romania and Ukraine also suggest the possibility of domestication prior to Indus valley civilization supporting ancient China to be the origin.

1.3. Classification

Order: *Galliformes* Sub-order: *Galli* Family: *Phasianidae* Sub-family: *Phasianinae* Tribe: *Phasianini* Genus: *Gallus* Species: *domesticus*

Domestic chicken: *Gallus domesticus*

2. Nomenclature

The term poultry refers all birds domesticated for meat, eggs and fancy including chicken, ducks, turkeys, quail guinea fowl, geese, pigeon, emu and ostrich. However, chicken are the most popular among all and account for more than 90 percent of the total poultry. The common terminologies for various species of poultry are tabulated below:

Table 12.1 Nomenclature to denote various species of poultry

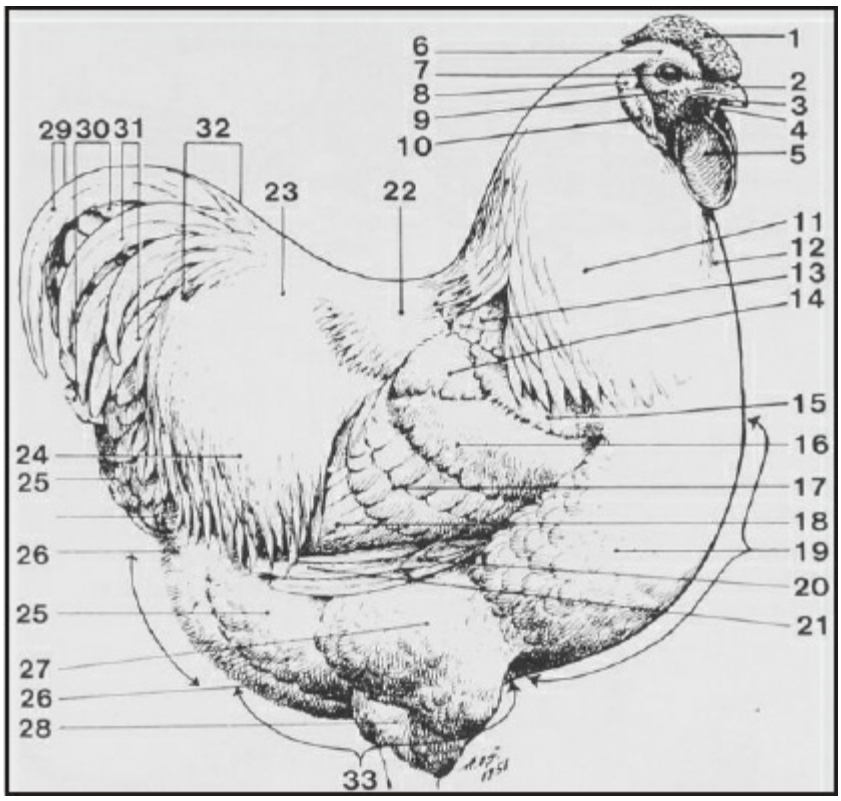
Description	Chicken	Ducks	Turkeys	Geese	Jap.Quails
Adult male	Cock	Drake	Tom	Gander	Male quail
Adult female	Hen	Duck	Hen	Goose	Female quail
Young male	Cockerel	Duckling	Poult	Gosling	Chick
Young female	Pullet	Duckling	Poult	Gosling	Chick
Newborn	Chick	Duckling	Poult	Gosling	Chick
Collection/Group	Flock	Band	Flock	Gaggle	Covey
Incubation period	21 d	28 d	28 d	28 d	16-18 d
Genus	*Gallus*	*Anas*	*Meleagris*	*Anser*	*Coturnix*
Call/Sound					
Males	Crow	Belch	Gobble	Honk	Call/Song
Females	Cackle	Whimper	Gobble	Honk	Call/Song
Act of breeding			Mating		
Emergence of			Hatching		

newborn

Term used for castrated cock is Capon. Young ones of Guinea fowl, Pigeon and Swan are referred to as Keats, Squabs and Cygnets, respectively. Incubation period of Muscovy duck eggs is 35 d.

Source: Sreenivasaiah, 2006

3. External parts



1. Comb 2. Upper mandible or beak 3. Lower mandible or beak 4. Throat 5. Wattle 6. Skull 7. Eye 8. Ear 9. Face 10. Ear-lobe 11. Hackle 12. Front of neck plumage 13. Cape 14. Shoulder 15. Wing front 16 . Wing bow 17. Wing coverts or wing bar 18. Secondaries of wing bay 19. Breast 20. Primary coverts 21. Primaries 22. Back 23. Upper saddle 24. Lower saddle 25. Rear body feathers 26. Fluff or stern 27. Lower thigh feathers 28. Hock plumage 29. main sickles 30. Main tail 31. Lesser sickles 32. Tail coverts 33. Abdomen

Fig. 12.1 Nomenclature of Chicken (The American Standard of Perfection, 1998)

4. Breeds

4.1. Official or Standard classification

This classification is internationally accepted and is based on Class, Breed, Variety and Strain. Totally about 53 breeds and 176 strains have been officially classified into various Classes.

4.1.1. Class

Relates to official or standard classification with which various groups of birds can be distinguished largely on the basis of geographical regions from where they originated. Most important of various Classes are American, Asiatic, English and Mediterranean; other minor ones are Game Class, Continental Class (North European), Continental Class (Polish), Continental Class (French), Oriental Class and Miscellaneous Class.

4.1.2. Breed

Breed is a sub-division under Class, referring to a group of fowls, all members of which are descended from common ancestry, are similar in shape and conformation and breed true to type. Each breed will have its distinctive characteristics and are developed for some special purpose. Ex: Plymouth Rock, Brahma, Leghorn etc.

4.1.3. Variety

This is a sub-division of a breed; mostly differentiated by plumage color and/or special formation of comb. Ex: White Cornish, Red Cornish, Single Comb White Leghorn, Rose Comb White Leghorn etc.

4.1.4. Strain

A group of birds within a variety usually named after the breeder responsible for its development and bred for certain special characteristics (like size, maturity, egg production etc.) in view. Ex: Babcock strain of Single Comb White Leghorn.

Important characteristics of principal classes of poultry are tabulated below:

Most popular breeds among the above Classes are: White Plymouth Rock, New Hampshire and Rhode Island Red (American Class), Cochin and Brahma (Asiatic Class), Cornish and Australorp (English Class) and Leghorn and Minorca (Mediterranean Class). Red Cornish, White Cornish, Black Australorp, Single Comb White Leghorn and Black Minorca are the popular varieties among the above breeds.

Note: White Cornish and/or Red Cornish are generally used as male line and White Plymouth Rock and/or New Hampshire are used as female line to produce commercial broilers. Therefore, all broilers are crossbreds and none of them is a breed.

Table 12.2 Salient features of principal Classes of Poultry

Class	Ear-lobes	Color of Eggs	Skin	Comb shape	Shank feathering
American	Red	Brown	Yellow	Single*	Not seen
Asiatic	Red	Brown	Yellow [1]	Single [2]	**Seen**
English	Red	Brown **	**White** [3]	Single [4]	Not seen
Mediterranean	**White**	**White** ***	Yellow [5]	Single and Rose*	Not seen

All breeds, regardless of Class, have Yellow shanks except Jersey Black Giant (American Class, Black shanks), Langshan Black (Asiatic Class, Bluish-black shanks), Australorp (English Class, dark-slate/black shanks), Minorca with dark-slate/black shanks and Andalusian with slaty-blue shanks (Both Mediterranean Class)

* Some less important breeds do vary in comb patterns

** Except Dorking and Red Cap which lay white eggs

*** Eggs of Andalusian blue are blue-tinged

[1] Except Langshan (White skin) [2] Except Brahma (Pea comb) [3] Except Cornish (Yellow skin) [4] Except Cornish (Pea comb) and Red Cap (Rose comb)
[5] Except Minorca, Spanish, Catalana and Andalusian (White skin)

Source: Sreenivasaiah, 2006

Most of the table eggs in the world today are laid by Single Comb White Leghorn layers.

The following diagrams of important breeds are reproduced from The American Standard of Perfection, 1998:

Fig. 12.2 New Hampshire pair

Fig. 12.3 White Plymouth pair

Fig. 12.4 Rhode Island Red pair

Fig. 12.5 Buff Cochin pair

Fig. 12.6 White Cornish pair

Fig. 12.7 Black Australorp pair

Fig. 12.8 White Leghorn pair

Fig. 12.9 Black Minorca pair

5. Management

5.1. Housing

Poultry houses, conventional/open-sided/windowed or environment-controlled/window-less, are constructed with their length facing East-West.

This is to obviate direct sunlight, draft and rainfall into the building. In case of open-sided houses, direct sunlight complicates the control of temperature within the house, direct draft causes problems of dustiness due to agitation of litter and direct rainfall results in damp litter and the consequent disease problems. The roof of the poultry house also projects 0.60 to 0.90 m outside the side-wall in order to drive away the rainwater; this projection is referred to as overhang. Buildings for younger birds should be constructed upwind from those for adult birds.

5.1.1. Separation distance

Distance between a poultry building and any other building (including another poultry shed) called "Separation distance" can be calculated as follows:

$D_{min} = 0.73h\sqrt{L}$, where D_{min} = the minimum distance needed (m), h = building height at the ridge (m) and L = length of the obstructing building (m). For example, a poultry shed is located downwind from another animal (poultry) shed 27 m long 9 m wide and 3.3 m high. Then, minimum distance to maintain adequate natural ventilation will be: $D_{min} = 0.73 \times 3.3 \times \sqrt{27} = 12.52$ m (about 42 ft)

5.1.2. Plinth

Poultry houses are constructed in an elevated area with a plinth of the least 0.60 to 0.90 m in order to keep the floor well above the ground to obviate seepage of moisture from the surroundings.

5.1.3. Width

Poultry excreta has a digested food material, uric acid etc. which when acted upon by enzymes elaborated by the bacteria present in it liberate ammonia; hence, there will be accumulation of ammonia in the poultry house which is accentuated by the reduced draft due to orientation of the building itself. Therefore, to keep the ammonia concentration within the acceptable limits of 15 ppm, Width of a conventional poultry house (which are windowed) should not exceed 12.20 m; preferably, 9.0 m.

5.1.4. Length

The length of the house is fixed depending on the type and age of birds as well at system of rearing.

5.1.5. Side walls and roof

Stud or height of the side wall of a poultry house will be 2.10 to 2.40 m and the height at the centre will be 3.00 to 3.30 m. In areas where temperatures are likely to be high, the stud height can be 3.00 m. Hence, there will be a gradient with a pitch of 25 to 33° in the roof on both the sides. The roofing material is preferably asbestos; otherwise, tiles, thatches etc. can also be used as roofing material. An overhang should be provided to protect from seepage of rain-water into the poultry house.

A brooder house (where young chicks will be grown up to eight weeks of age) will have one half to two-thirds the side wall from the floor level made of brick and the remaining covered by the expanded metal. This is to conserve heat during the brooding period. If the climatic conditions are expected to be warm throughout the year, the entire side wall, excepting the brickwork sufficient to fix expanded metal, can be covered with expanded metal.

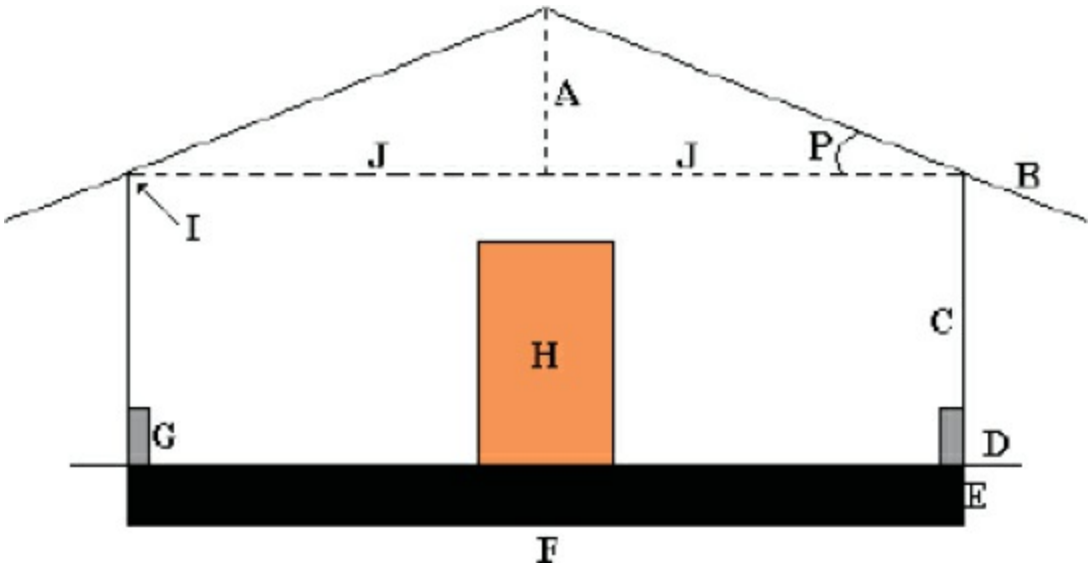
In case of grower house (8 to 18 weeks) and layer houses (after 18 weeks) under deep-litter system, the side walls will be of one thirds brick with the remaining portion covered by expanded metal. In case of caged layer house, the entire side wall is open and covered only by expanded metal. This is because, housing density is higher in cage system (nearly twice as much as in deep-litter system) which results in a) excess heat b) excess carbon dioxide and c) excess excreta being produced; the latter, also results in production of excess ammonia due to microbial action and excess moisture due to evaporation; consequent on these, higher ventilation becomes mandatory to drive out excess ammonia, carbon dioxide, heat and moisture from the building so as to keep the layers comfortable.

5.1.6. Floor

The flooring, in case of deep-litter system, must be preferably of reinforced cement concrete to contain the rats making a way through the flooring and also to minimize seepage of moisture. In case of conventional

caged layer house, dropping pits are constructed, amidst the concrete flooring, just below the cages to suit the fall of droppings from the birds so that part of the moisture in the excreta will be absorbed into the soil. In case of high-rise houses, no flooring is required.

A Rise, 0.60 to 1.20 m B Overhang C Stud height, 2.10 to 2.40 m D Side-walk, 0.45 to 0.60 m E Plinth, 0.30 m F Width, 9 m (Max) G Side-wall, 0.30 to 1.20 m depending on climate H Door, 1.80 x 1.20 m I Eaves J Run, 4.5 m (Max) P Pitch, angle depending on A and J or F (**Note:** Pitch normally does not exceed 30°)



A Rise, 0.60 to 1.20 m B Overhang C Stud height, 2.10 to 2.40 m
D Side-walk, 0.45 to 0.60 m E Plinth, 0.30 m F Width, 9 m (Max)
G Side-wall, 0.30 to 1.20 m depending on climate H Door, 1.80 x 1.20 m
I Eaves J Run, 4.5 m (Max) P Pitch, angle depending on A and J or F
(Note: Pitch normally does not exceed 30°)

Fig. 12.10 Cross-section of a poultry house – Deep-litter system]

5.1.7. Side walk

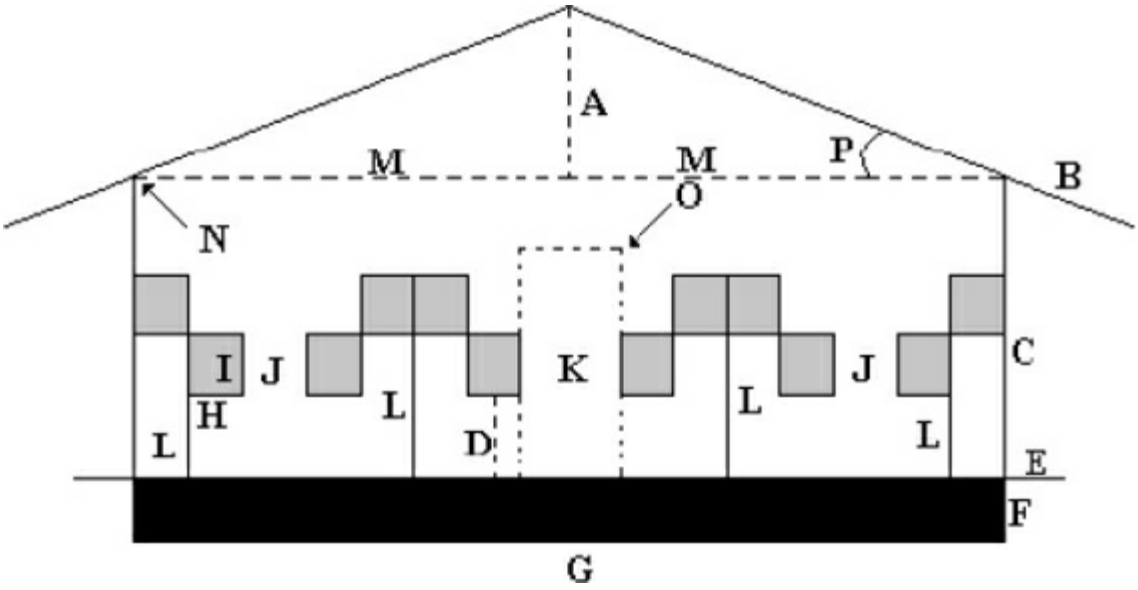
It is a good practice to allow a 0.45 to 0.60 m projection of the floor outside the side walls with all the surfaces being smoothened; this helps control rats and snakes. Similarly, a gap of 0.90 to 1.20 m between the steps and the poultry house itself also helps control rats.

A cross-section of deep-litter and conventional cage-system is shown in

fig. 12.10 and 12.11, respectively; a floor-diagram of conventional cage-system indicating dropping-pits is given in Fig. 12.12. Cross-section of high-rise house is given in Fig 12.13.

In case of conventional caged layer houses, the problem of elimination of excess moisture, carbon dioxide, ammonia and heat is accentuated by the fact that a) the height of the house is only 3.30 m and b) only 0.60 to 0.75 m space is available between lower most cage and the floor.

Hence, the new innovation in housing players in cages is by raising the passages to 2.1 m above the floor over concrete pillars and the cages being fixed above the catwalk so formed. Consequent on this, a clear 2.10 m space is available below the cages for optimum ventilation and quick drying of the excreta and the stud or height of the side wall increases to 4.10 m; thereby facilitating ventilation and manure-handling. Such houses are referred to as high rise or improved caged layers houses. Inside such houses, the cages can be arranged as per the needs of the farmer. Cross-section of two popular high-rise house designs is shown in Fig. 12.13 and Fig. 12.14.



A Rise, 0.60 to 1.20 m B Overhang C Stud height, 2.10 to 2.40 m D Height up to cages, 0.60 to 0.90 m E Side-walk, 0.45 to 0.60 m F Plinth, 0.30 m G Width, 7.8 m H Depth of the cage, 0.375 ml Height of the cage, 0.45 m J Side passages, 0.90 m K Central passage, 1.20 m L Cage support, 0.08 to 0.10 m M Run, 3.90 m N Eaves O Door, 0.75 m x 1.80 m P Pitch, angle depending on A and G or M (usually does not exceed 30°)

Fig. 12.11 Cross-section of a poultry house – Conventional cage

system

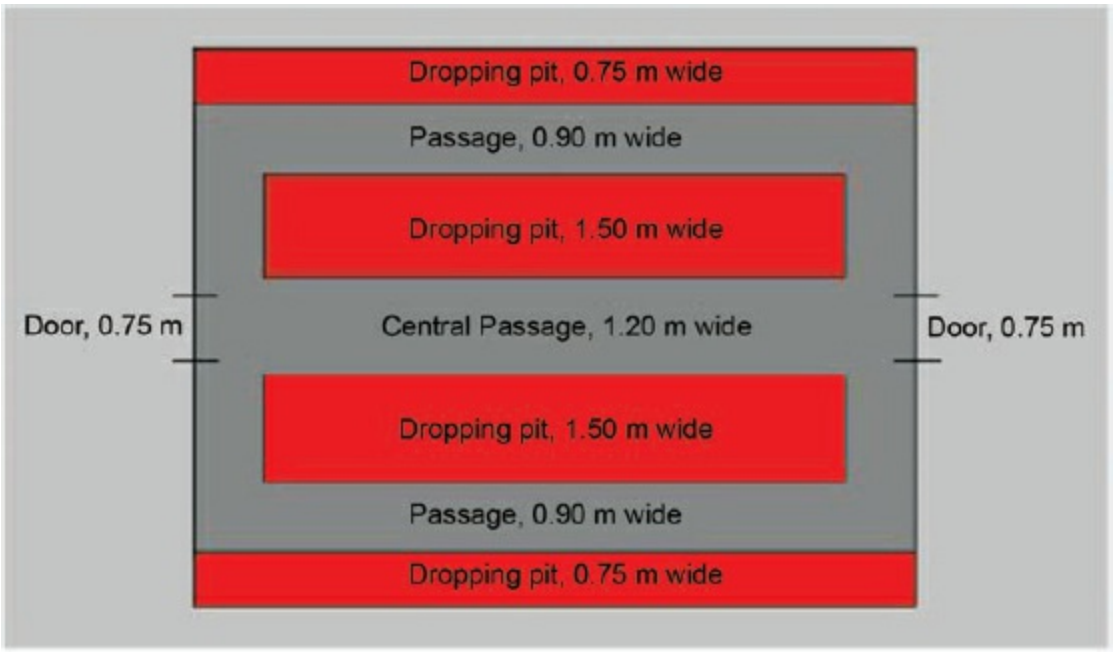
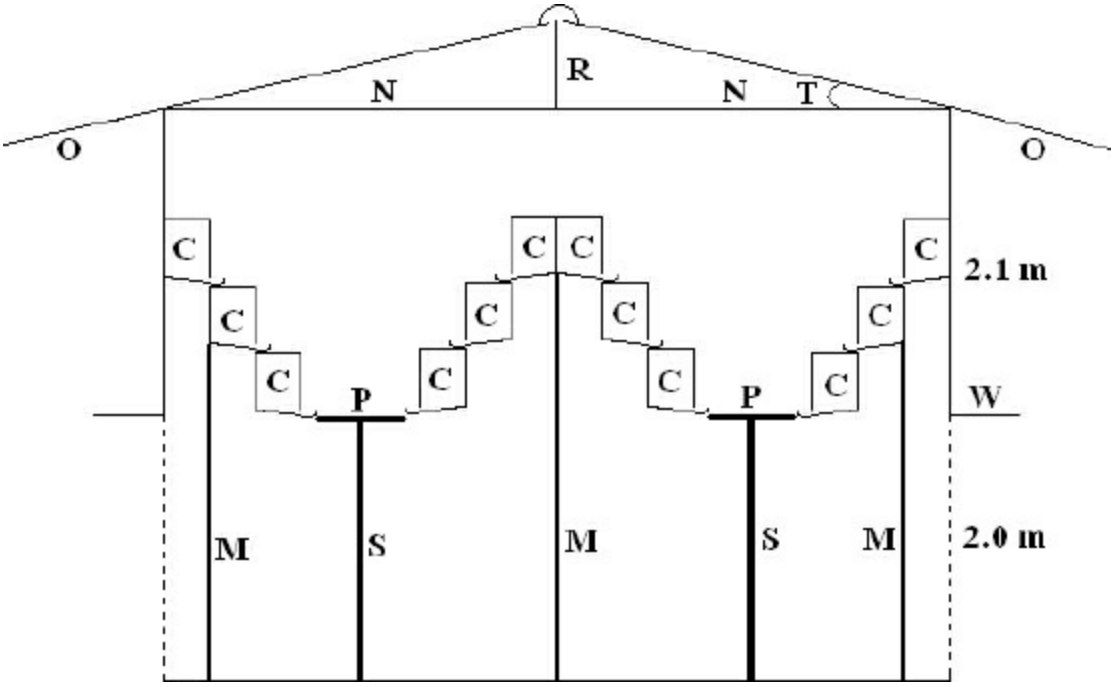


Fig. 12.12 Floor diagram - Conventional cage-system



P Concrete passage (0.5 m) O Overhang (0.90 to 1.20 m) S Support for cages R Rise (0.60 to 0.90 m) M Metal supports to fix cages C Cage N Run (3.09 m) T Pitch (11 to 16º) W Side – walk

Note:

1. Steps have to be constructed for men to carry birds, feed, eggs etc. from and to the Cage Layer House (CLH).
2. Door will be provided to the store – room directly on the side wall but at the level of passages. From the store room, entry is provided into the CLH; door is also provided in the partition wall between CLHs.
3. Wall is constructed only from the level of passages and upwards; below the level of passage, it is left completely open.
4. Side – walls above the level of passage can also be completely open; but to prevent predators and theft, they may be covered by expanded metal.
5. Pitch normally does not exceed 30°

Fig 12.13 High-rise house

Fig 12.14 Interior view of a high-rise house

5.2. Rearing systems

The intensive system of rearing is under continuous refinements starting from all-litter, cages, all-slats, slats-and-litter to the recent "enriched or furnished cages" and "alternate systems". Each of the systems has its own

advantages and disadvantages; therefore, the farmer has to select depending on his needs. However, in India, all-litter and cage systems are more popular than others and hence, they are enumerated below:

5.2.1. Deep – litter system

In this system, the birds are reared on floor covered with six to eight cm of litter material which is made of paddy husk (rice hulls), wood shavings, peanut shells (peanut hulls) or any other suitable material. The birds are free to move and the feeders and drinkers are arranged at convenient height so as to be accessible by the birds at all times on the litter floor.

5.2.1.1. Advantages

1. Deep-litter keeps cool during summer and warm during winter. Hence, the birds will be comfortable during all seasons; that they can move freely also adds to their comfort.
2. Birds derive certain un-identified growth factors (presumably, vitamin B_{12}, animal protein factor etc.) from the litter. This has been found to be of specific advantage for breeding flock in terms of fertility.
3. There will be no incidence of breast blisters in case of broilers.
4. Usually, there'll be no problem of ammonia accumulation and house-flies in a well-managed deep-litter flock.
5. Incidence of broken eggs is very minimal.
6. There will be no problem of caged layer fatigue.
7. There will be uniform distribution of light in the layer house.
8. Initial investment is less when the land cost is low.
9. Provides for all the welfare requirements of the birds

5.2.1.2. Disadvantages

1. Housing density is lower than in cage system.
2. There will be more feed wastage due to spilling etc.

3. Birds consume more feed since they move about more freely wasting some energy; hence, feed efficiency is inferior to that of birds in cages.
4. Litter-borne diseases can occur, especially coccidiosis, costing severe economic losses particularly in broiler industry.
5. Diseases spread faster due mainly to free movements.
6. Cannibalism, if starts, will be severe when compared to cage system. Similarly, feather-pulling, picking and other vices are possible.
7. Incidence of unclean or soiled eggs is higher.
8. Birds consume more feed per dozen eggs.
9. Maintenance of individual records will not be as accurate as in case of cage system and hence, culling of birds requires careful observation and even handing of birds individually.
10. Birds are likely to produce slightly fewer and lighter eggs than in cage system; but this is still debatable.
11. Broodiness can be a problem.
12. Nests have to be provided and the eggs have to be collected regularly.
13. There is a chance of egg-eating vice, especially when the eggs are left in nest boxes or on floor for a long time.
14. Fighting among breeding cockerels/cocks is noticed especially in pens with many cocks.
15. Birds of different color patterns cannot be mixed and reared. However, if chicks of different plumage are reared together from the brooding stage itself, no problems will be encountered; otherwise, serious fighting among the birds, sometimes leading to considerable mortality among cockerels, can result.

5.2.2. Cage system

In this system, the birds are reared in enclosures made of, usually, wire mesh or expanded metal. Therefore, the birds do not have access to their own fecal matter. The enclosures, referred to as “cages” can be in the form of “tiers” depending on the convenience and the type of birds. Hence, more

number of birds can be reared per unit floor space than in deep-litter system or any other system for that matter.

5.2.2.1. Conventional cage-system

5.2.2.1.1. Special features of cage-layer houses

5.2.2.1.1.1. Side-walls

One of the main advantages of cage-system is possibility of higher density; approximately, twice the number of birds as on all-litter can be reared in the given space. However, consequences of high density are:

a) More heat produced – leads to heat build-up within the house.

b) More production of CO_2 per unit space

c) More fecal matter per unit space and therefore more ammonia (NH_3) production as well as more evaporated water – leads to moisture build-up and accumulation of NH_3.

d) Increased oxygen (O_2) requirement per unit space of the building.

e) Increased ventilation requirements to meet oxygen demand into the house on one side and eliminate excess heat, moisture, CO_2 and NH_3 out of the house on the other.

f) Fecal matter, particularly with delayed drying, is an excellent breeding ground for flies; warm humid conditions due to heat and moisture build-up within the house further supports fly population. Hence, fly nuisance is a common problem in most of the cage-layer houses.

In order to minimize the above problems, side-walls of a cage-layer house will be covered entirely with expanded metal to facilitate easy air moment and ventilation.

5.2.2.1.1.2. Feeding and watering channels

Regardless of the type of cage, feeding channel is fixed at the level of the back of the birds and the watering channel about 10 cm above it. This

arrangement serves to purposes;

a) It is convenient for the birds to drink because, they cannot suck water from lower levels due to absence of lips and

b) If watering channel leaks, water falls into the feeding channel but not onto the droppings.

Due to high density of the birds, there are already multiple problems in the form of removal of heat and moisture produced by the birds and ammonia produced in the droppings. Further, fly problem is common in most of the cage-rearing facilities due to excess moisture content in droppings which acts as an excellent breeding ground for flies. Therefore, it is beneficial if, in case of water leaks, additional water is not added into the droppings. Recently, nipple drinkers have replaced watering channels.

5.2.2.1.2. Advantages

1. Higher housing density possible.
2. Movement of birds is restricted and hence they consume less feed than on other systems.
3. There will be less wastage of feed because movement is restricted.
4. No problem of litter-borne diseases, especially coccidiosis.
5. Spread of disease is slower than in other systems.
6. Incidence of cannibalism is minimal.
7. Birds lay more and heavier eggs; this is still controversial.
8. Consume left feed per dozen eggs.
9. Eggs will be cleaner than in other systems.
10. Maintenance of individual records is easy and accurate; hence, culling is also easy and accurate.
11. Broodiness is avoided.
12. Labor requirement minimum

5.2.2.1.3. Disadvantages

1. Birds are uncomfortable because they are not able to move freely.
2. Birds suffer from boredom. It is common to fix a colored plastic wheel in all cages so that the birds can peck at them and play.
3. Under tropical climate, birds are most uncomfortable due to high temperature accentuating the effects of high density and humidity.
4. Feed must be accurately balanced.
5. Under humid conditions, there will be problems of house flies and ammonia concentration within the house.
6. More number of cracked eggs is expectable.
7. Caged layer fatigue is unique to birds reared in cages; the actual cause of the disease is still incompletely understood.
8. Distribution of light will not be uniform.
9. Broilers show higher incidence of breast blisters leading to loss of carcass quality and grade.
10. Layers show higher incidence of bumble foot, breast blisters and other injuries due to cages.
11. Initial investment is high on equipment.
12. Natural mating is not possible Hence, if fertile eggs are required, artificial insemination has to be resorted to.
13. Handling the birds is generally difficult and stressful to the birds.
14. Manure handling is difficult because of limited space available below the cages.

Note: With nipple drinkers in cage system, many problems arising out of watering channel are avoided; however, nipple drinkers also need to be watched regularly for leakage as well as blockage.

5.2.2.2. Raised platform/High-rise houses

Most of the shortcomings under conventional cage-houses were due to a) high temperature and moisture build-up b) fly problems c) difficulty in handing manure and d) ventilation problems due to limited air volume. In order to

minimize many of the above problems, the passages (platforms) in the conventional cage-houses were raised by 2 m above the ground and hence, such houses are referred to as “raised platform” houses.

It is obvious that in a raised platform houses, manure pit is 2 m deep and hence it is easy for drying process as well as for handling. Mechanization of manure removal is also possible. In addition, side-walls will be of more than 4 m height which increases the total volume of the building, thereby facilitating ventilation to a considerable extent. Other advantages and disadvantages are similar to conventional cage house. It is for the above reasons that raised platform houses are becoming more popular for housing layers.

5.3. Incubation and hatching

The freshly laid chicken egg contains everything that the embryo needs for its growth and development – excepting for oxygen and heat. The oxygen diffuse is into the egg from the surrounding air through microscopic pores in the egg shell. The pores allow the carbon dioxide produced by the embryo to diffuse out of the egg but they also permit loss of water vapor from the egg. Thus, the regulation of gas exchange between the egg and its environment is closely related to its water balance; both are covered by the diffusive conductance of the egg shell until the embryo penetrates (pips) out of the egg shell with the aid of its egg tooth.

The adult bird has a key role in incubation providing not only the heat necessary for embryonic development but also the microclimate of the egg. In the poultry industry and for research purposes, brooding adult bird is conveniently replaced by an incubator.

5.3.1. Natural brooding and hatching

Most birds develop “brood patch”, a seasonal bare patch of skin, on the ventral side (abdomen mainly) through which it directly transfers heat to the eggs. The hen can adjust the rate of heat transfer by standing or leaving the egg, but also by closeness with which the bird applies its patch to the egg. The hen herself incubates the eggs by keeping the brood-patch on the top of the eggs. Most of the times, eggs will the horizontal on floor of the nest.

The temperature at the top of the eggs will always be higher (37.2 to 37.8°C) because it is in contact with the brood- patch; the lower side of the

egg will be cooler (32.6°C) and the centre of the egg will be intermediate (35°C). At the beginning, top of the yolk containing embryo is towards the brood-patch and it rotates within the albumen-sac when egg is rotated to keep embryo near the brood-patch. Therefore, embryo will be few mm away from the body of the hen.

As the embryo grows, the extra embryonic membranes (EEM) develop and blood flowing through them warms the embryo. Hence, centre of the egg becomes warmer than before. Simultaneously, metabolic activity contributes heat and hence, in the later stage incubation, centre and bottom of eggs also become as warm as the portion in contact with the brood-patch. Hence, the hens leave the eggs for cooling during later stages.

With commercialization of poultry industry, natural brooding has been replaced by artificial methods of incubating and hatching eggs. However, under village and backyard rearing, even now, natural brooding is being practiced.

5.3.2. Artificial incubation and hatching

5.3.2.1. Hatching egg storage

When large number of eggs have to be incubated at a time, it becomes necessary that large number of breeding birds is available to produce the desired number of eggs. Maintenance of this large breeding flock becomes very expensive which will be reflected on the cost of the day-old chick. In addition, eggs produced after the desired number of eggs for incubation is obtained have to be sold as table eggs although they are fertile.

Alternatively, a huge incubation facility may have to be created to accommodate all the eggs produced by the breeding flock; which again is very expensive.

Therefore, it is necessary that eggs produced over a period of time be stored / pooled so that the size of the breeding flock as well as incubation facility required is minimized. However, eggs produced during the earlier days will have their embryos grown partially and hence they will not hatch on the same day. This makes it mandatory that the embryo should be stored so that they neither grow nor die. It has been found that at the temperature of 12.8 to 18.3°C (15.6°C, preferably), the embryos remained quiescent and hence, this temperature is referred to as “physiological zero”. To avoid excessive loss of

moisture, it is ideal that the relative humidity be maintained above 70%.

The above two conditions are provided in a cold storage and fertile eggs can be stored ideally for 7 to 10 d (for a maximum of 15 d) without adversely affecting hatchability. All the eggs stored under the above conditions hatch on the same day; in other words, the hatching will be synchronized.

The eggs should warm slowly before being placed in the incubator. The shock of warming the eggs too rapidly will cause moisture to condense on the shell. This may lead to disease problems.

5.3.2.2. Physical conditions required

The conditions described below are for chicken eggs and are applicable for other species with some minor changes.

Table 12.3 Physical conditions for chicken eggs

	Incubator (setter)	**Hatcher**
Number of days	First 18 d	19th, 20th and 21st d
Position	Broad-end up, in contact with each other	Horizontal
Temperature, °C		
Dry bulb	37.6 to 37.9	36.1 to 36.7
Wet bulb	29.2 to 29 5	30.6 to 31.1
Relative humidity, %	55	65
Turning	At least 6 times a day	Not required
Oxygen, %	21	21
Carbon dioxide, %	0.04	0.04

Note: The hatching eggs from the cold storage should never be directly loaded into a setter; they must be allowed to come to room temperature after which they are loaded into the setter in trays specially meant for the purpose. The eggs are transferred quickly to hatcher trays on 18^{th} d

Fig 12.15 Eggs in a setter

Fig 12.16 Hatcher tray with eggs

Fig 12.17 Hatcher tray with chicks

5.3.2.3. Fertility testing

Eggs in setter can be tested whether they are fertile or not between 6th and 8th d of incubation or on 18th d along with transfer of eggs to hatcher. In both cases, the eggs are viewed through equipment called candler which emits light through eggs; when performed in less light conditions (dark), the interior of the egg is clearly visible. The way fertile and infertile eggs look is diagrammatically shown in Fig 12.18 below (All infertile eggs are removed and discarded):

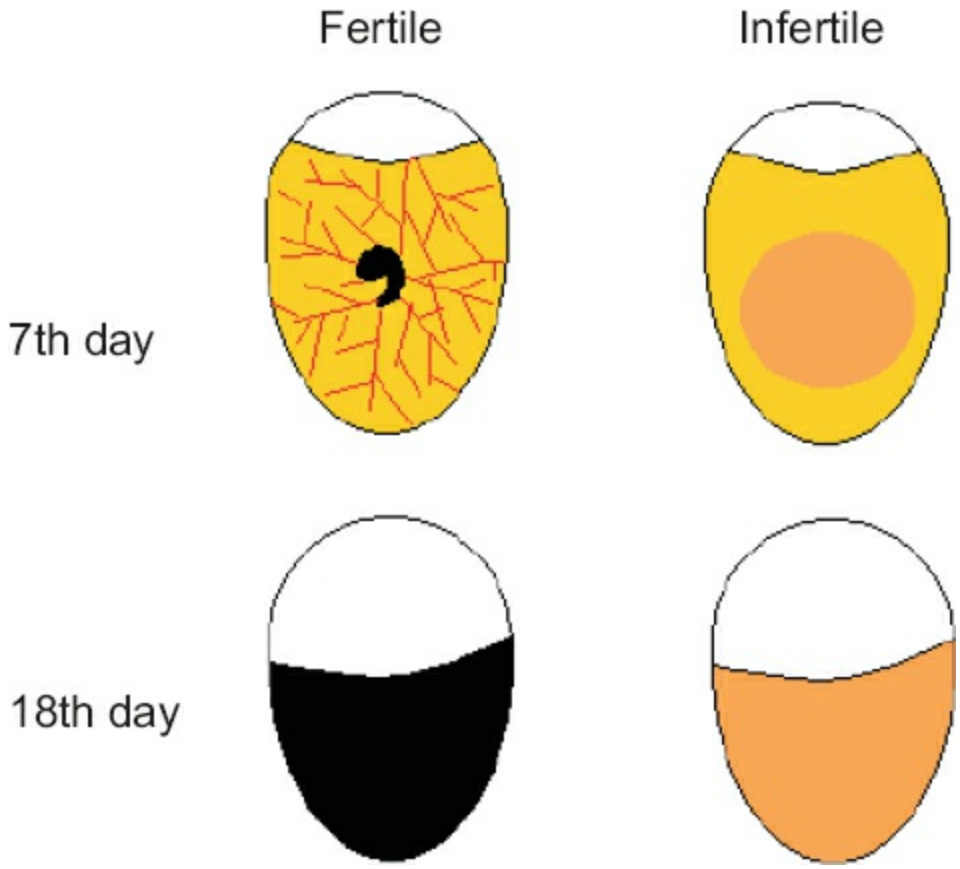


Fig 12.18 Fertility testing during incubation

5.3.2.4. Evaluation of incubation performance

Even under natural conditions, neither all the eggs set will be fertile nor all eggs hatch. Hence, with artificial incubation also, there will be eggs which will be either infertile or fail to hatch for various reasons already discussed.

Therefore, it is necessary that performance of the breeding farms as well as the artificial incubation facility be evaluated to take up suitable measures to obtain maximum profit out of hatchery business.

In view of the above, the following parameters are estimated to assess the efficiency of both breeding farm as well as incubation facility:

$$\text{Fertility, \%} = \frac{\text{Number of eggs fertile}}{\text{Total number of eggs set}} \times 100$$

$$\text{Hatchability, \% (on TES)} = \frac{\text{Number of chicks hatched}}{\text{Total number of eggs set}} \times 100$$

$$\text{Hatchability, \% (on FES)} = \frac{\text{Number of chicks hatched}}{\text{Number of fertile eggs}} \times 100$$

Among the above estimates, fertility is the prerequisite for incubating any egg and hence it can not account for efficiency of artificial incubation and hatching process; however, it definitely indicates health and management of the breeding stock. In a good breeding farm, both fertility and hatchability (FES) will be > 95%.

5.4. Brooding

Unlike newborns of other domestic animals, except possibly piglets, newly hatched chicks require additional heat (brooding) soon after they hatch because they cannot regulate their body temperature efficiently due to following reasons:

1. Their body temperature is higher (41.7°C) than that of adults and hence, tends to lose heat.
2. They have a higher metabolic body size (surface area per unit body weight) than that of adults; therefore, they lose heat quickly.
3. They lack feathers which are excellent insulating material which further facilitates heat loss
4. They have changed over from poikelothermy to homoieothermy just three days prior to hatching and hence their thermoregulatory centre, will not be completely functional. Poults (turkey chicks) are known to be least equipped at hatch as far as thermoregulation is concerned.

Therefore, it is mandatory that newly-hatched chicks have to be provided with artificial heat during the initial stages – duration of which depends on the environmental temperature.

5.4.1. Brooding temperature

The temperature required, for chicken, at the beginning is 35°C which has to be reduced at a rate of 2.8°C per week until the brooding temperature equals environmental temperature; this duration varies between two weeks to six weeks, and usually four weeks; cooler the environment temperature longer the brooding period and vice versa.

Brooding temperature has to be reduced every week to:

1. Facilitate development of homoieothermy and
2. To stimulate normal feather growth.

To conserve heat within the brooder house, windows may be closed by curtains during the night and/or daytime depending on the season and environment temperature. As the birds age, the curtains are lowered to open the upper portion of the windows to facilitate easy exit of hot air which, being lighter, rises up.

5.4.2. Methods of brooding

Of several methods of brooding, floor brooding by use of canopy or infra-red bulbs is most common in India.

5.4.2.1. Canopy brooding

In this method, an umbrella-like canopy with two to three incandescent bulbs (40 to 100 W each, depending on the season) fixed at the centre, is inverted and hung in such a way that the birds can move freely in and out of it. The bulbs, when put on, heat the air and the hot air is trapped by the canopy preventing the escape of hot air thereby providing warmth to the chicks.

5.4.2.1.1. Brooder guard

The brooder area is delineated by the brooder guard arranged in a circular fashion so as to avoid corners and dark areas. The brooder guard contains chicks nearer to the brooder area and prevents the chicks straying away from the heat source. A canopy measuring 90 cm in diameter can accommodate about 250 chicks. As the chicks grow, brooder guard is moved away from the canopy to avoid requisite floor space.

5.4.2.1.2. Paper on litter

For the first seven to ten days, paper is spread on the litter material and feed or maize grit is sprinkled on it. This is primarily to:

1. Avoid the chicks eating the litter material which might result in choke and possible death.
2. Birds when comfortable move freely throughout the brooder area; and hence, if the droppings are uniformly distributed on the paper, it indicates the correctness of the brooder temperature. On the contrary, if the droppings are distributed only within the canopy area, it suggests that the temperature was insufficient and the chicks were mostly inside the canopy. If the droppings are noticed all-round but only near the brooder guard, it is indicative of a high temperature inside the canopy forcing the chicks to move to the periphery. If the droppings are noticed as a triangle with the apex towards the centre of the canopy, it is suggestive of draft blowing from the direction corresponding to the base of the triangle (Fig 12.19).

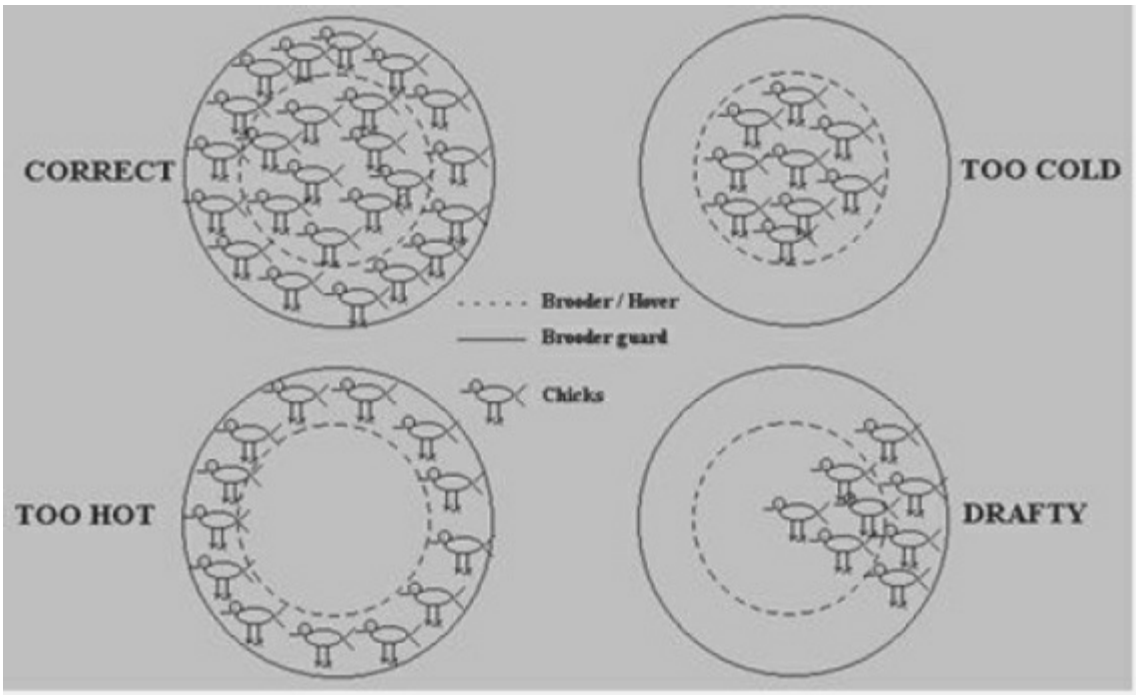


Fig 12.19 Brooding temperature *Vs* comfort of chicks

5.4.2.1.3. Feeders and drinkers

The feeders are arranged like spokes in a wheel in the brooder area with half the length of the feeders inside the canopy area (Fig 12.20). The drinkers are arranged at the edge of the canopy interspersed between the feeders. This is done to ensure both feed and water within 30 cm of distance from any part of the brooding area, especially at the beginning of brooding. Later on, both feeders and drinkers should be uniformly distributed so that no bird need move more than 3 m to have access of either feed or water.

Person looking after the brooder house should have the "chicken sense" and must be able to judge the comfort of the birds without the aid of a thermometer. The brooder temperatures required for chicks is warm for human beings and hence there will be slight sweating in properly managed brooder house at least during first two weeks. Should the temperature be recorded, it is done at a height of 10 cm above the litter level at the edge of the canopy, since it is the height at which the most portion of the body of the chick is exposed to the brooding temperature. On the same lines, as the birds grow, the height at which the temperature has to be recorded also increases.

The height at which the canopy is fixed depends on the height of chicks; in other words, age of birds. In the beginning, edge of the canopy should be about 8 to 10 cm above the litter level; as the birds grow, the canopy is raised till it is about 0.9 m above the litter and when brooding is no more required the canopy can be removed, cleaned and disinfected for further use.

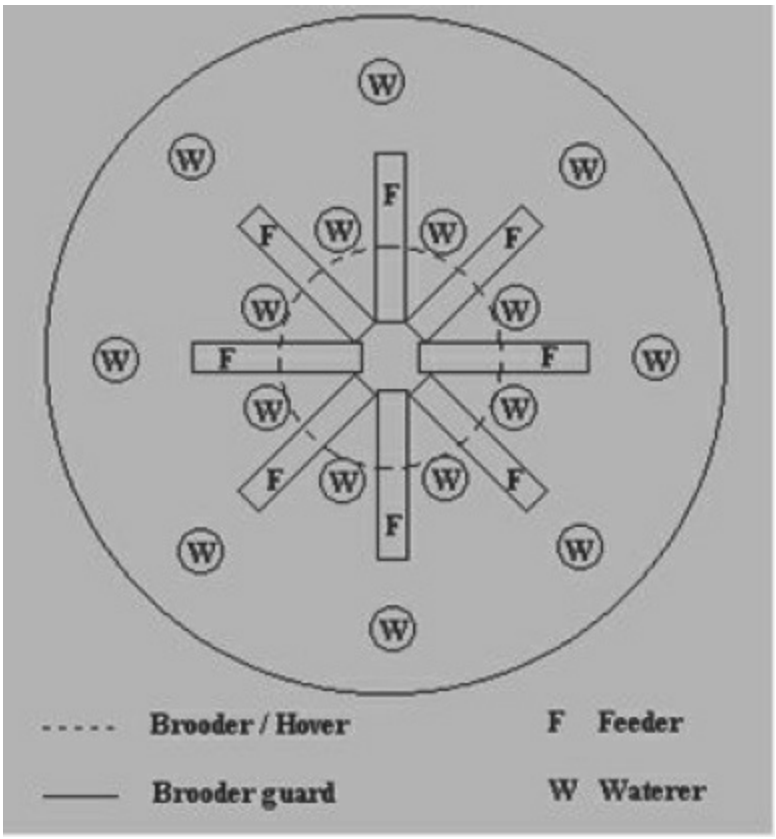


Fig 12.20 Placement of equipment during brooding

Drinkers are not placed inside the canopy area because the water gets heated and the chicks do not drink hot water; in addition, there is a risk of drowning especially during the initial period because, the chicks will be learning to drink and eat.

After the chicks have learnt feeding (which may take about 2-3 d), it is advisable to have either a wire grill or a reel over the feeders to prevent the birds from getting into the feeder; this greatly minimizes feed wastage.

5.4.2.2. Infra- red brooding

In this method, there is no need of canopy because the infra-red light heats any object that comes in contact with it, by radiation, but not the air. Infra-red red and infra-red white bulbs of 150 and 250W are available which can be suffice for 75 to 90 and 125 to 150 chicks, respectively. The bulbs must be hung at least 25 to 30 cm above the litter floor; otherwise, the litter material itself may catch fire (due to radiation heat), especially during summer.

Spread of paper on litter, placement of feeders and drinkers and rest of the management procedures are similar to that under canopy brooding.

5.4.2.2.1. Advantages

1. Since there is no canopy, observation of the chicks is easier.
2. Accidental mortality due to improper handling of canopy is avoided.
3. Infra-red light has been found to have some germicidal effect and hence survivability of the chicks will be higher in this method.
4. Infra-red light has been found to reduce cannibalism; infra-red red bulbs are popularly used for brooding broiler chicks.
5. Brooding cost, on a long run, has been found to be lower.
6. Although debatable, some authors feel that infra-red enhances Vitamin D synthesis.

5.4.3. Battery brooding

5.4.3.1. Advantages

1. Housing density is high.
2. There will be no litter-borne diseases.
3. Since movement is restricted, birds spend less energy and hence feed efficiency will be improved.
4. Survivability of the chicks will be higher.
5. Labor requirement is minimal.
6. Control of temperature is more accurate.

5.4.3.2. Disadvantages

1. Initial investment is high.
2. Birds are uncomfortable.
3. Broken legs, breast blisters and other carcass defects may appear,

especially in case of broilers.

4. Handling of fecal matter is cumbersome.

6. Rearing broilers

Broilers chicks are brooded as described above and are marketed at or after 35d of age; generally when they weigh ≈ 1.5 kg. Proper sanitation, disinfection and vaccination procedures should be undertaken while raising broilers because they are very fast growing; a broiler chick weighs about 40g at hatch and attains a body weight of 2kg by 40d of age. In other words about 50g per d or 2g per hr. This in itself enough to emphasize the care and supervision required while rearing broilers. Space requirements are given in Table 12.5. Vaccinations indicated under Section "Vaccination" below have to be administered.

7. Rearing layers

Layers are maintained till they complete one year (52 weeks) of laying; they start laying by 20 weeks of age. Hence, they are maintained for 72 weeks or 18 months. They are three stages which are as follows:

7.1. Chicks (up to 8 weeks)

During this period they are looked as described under brooding providing recommended space allowances. Vaccinations indicated under Section "Vaccination" below have to be administered. It is a general practice that layer chicks are grown on floor (deep-litter) till they are ready to lay (18/20 weeks).

7.2. Growers (9 to 18/20 weeks)

During this period, the birds are generally subjected to restricted feeding, beak-trimming and worming. However, worming (deworming) is required only if layers are grown on litter; otherwise, they can be wormed and shifted to cages.

7.2.1. Restricted feeding

7.2.1.1. Advantages

1. A considerable saving on feed cost because, only 80% of the calculated feed requirement will be offered.
2. They are likely to consume less feed per dozen eggs even during laying period when they are offered ad libitum feed.
3. The pullets accumulate less fat and therefore produce more eggs.
4. It is easier to identify weaker birds at an early age during feed restriction. Culling of such birds helps not only saving feed but also promoting layer house survivability because, healthier birds will be moving to layer house
5. Layers feed restricted during growing period have been found to produce heavier eggs in longer clutches than those fed ad libitum.

7.2.1.2. Disadvantages

1. Feed restricted birds mature late; but this is more than compensated by sustained production of heavier eggs.
2. There will be reduction in grower house survivability because, weaker birds will be culled; but this is reflected in the form of higher layer house survivability. In fact, it is possible to save feed which would have been offered to weaker birds had they entered layer house.
3. Feed-restriction requires technical supervision.
4. Does not conform to welfare requirements – is discussed separately.

7.2.1.3. Methods

Feed restriction can be effected by several ways but, under commercial conditions, quantitative feed restriction is commonly practiced on Leghorn-

type laying pullets mainly because it is easier for execution and the chick-supplier will be providing a readymade chart of the quantity of feed to be offered during the growing period. Quantitative feed restriction is offering 92-93% (commercial egg-type pullets) 75-85% or less (meat-type/ egg-type breeder pullets) of the calculated feed requirement / skip-a-day program in

which the birds are fed on alternate days from 9 weeks to sexual maturity.

7.2.2. Beak trimming

Beak trimming (debeaking) is generally done after 6 to 8 weeks of age using an electrical debeaker. The cutting blade will be red hot (> 900ºC in temperature) and the beak is cut followed by cauterization (blocking of bleeding from blood vessels). In breeding males both beaks are cut equally to help them catch the females while mating; ½ the portion from tip of the beak to nostrils. In case of females, lower beak is left longer to help them eat the feed easily; upper beak is cut ½ to $^{2}/_{3}$ and lower beak 1_{3} from the tip to the nostrils.

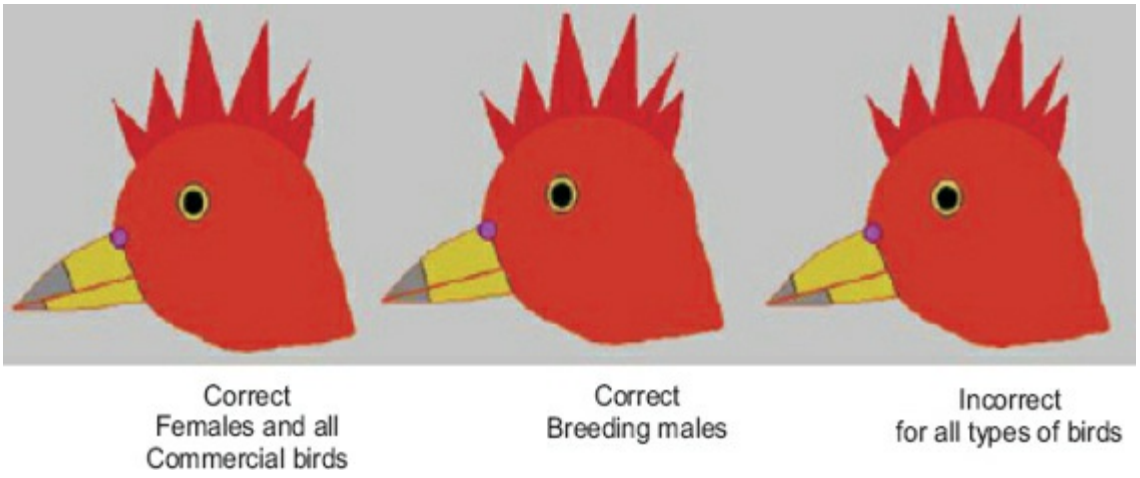


Fig. 12.21 Beak-trimming procedure

7.2.2.1. Advantages

1. Prevents cannibalism – a vice of eating one's own species; especially following injury
2. Minimizes feed wastage due to peck order (specific dominance pattern within a flock) and spillage
3. Minimizes egg-eating vice
4. Facilitates handling of breeding males

7.2.2.2. Disadvantages

1. Severe stress on the birds

2. Birds need to learn feeding and drinking once again
3. If some birds are left bleeding, it may trigger cannibalism
4. Requires labor and technical supervision

7.2.2.3. Precautions

7.2.2.3.1. Before trimming

1. Administering vitamin K through drinking water 2-3 days prior to trimming.
2. Birds should not be subjected to stress from housing, vaccination or worming during the week prior to or the week after trimming.
3. Give no medicines which will give a bad taste to the feed or water.
4. Sick birds should not be beak-trimmed
5. Never beak-trim in combination with vaccinations except for fowl pox, when moving birds or birds on medication

7.2.2.3.2. During trimming

1. The operator should hold the bird in such a way that it neither shakes it head nor suffocates.
2. The beaks are opened with the help of index finger and the tongue is held back.
3. The upper beak is cut first to the recommended level. The beak is held against the blade and circular motion is given for at least 2 sec while holding to effect proper cauterization.
4. Lower beak is then cut as per the recommendation.
5. Proper cauterization is once again ensured before the bird is left into the pen.
6. In case of breeding males, both upper and lower beaks to be cut equally so as to facilitate them to catch the females while mating.

7.2.2.3.3. After trimming

1. Feeders must be kept full with feed to help birds eat easily; probably this is the only occasion when feeders are full with feed.
2. Vitamins (B-complex and C) and vitamin K can be given through water to help alleviate stress.
3. All the birds must be observed carefully for any bleeding, especially in the upper beak. If any bird shows bleeding it must be separated at once, suitably treated/cauterized; otherwise, there is a likelihood of cannibalism.

7.2.3. Worming

Routine worming (deworming) programs are relevant in the control of round worms in most management systems. However, birds in cages are not much exposed to parasite eggs and hence, under practical conditions, they are not dewormed. Hence, before transfer of birds to cages from floor rearing, they are advisable to undergo worm treatment; any general deworming agent (fenbendazole, mebendazole, piperazine, Ayurvedic compounds etc) can be used as per manufacturer's recommendations.

Note: Most such drugs are not palatable; hence, birds may be deprived of water for 3 to 6 hrs (depending on weather at that time) before treatment.

7.3. Layers (after 18/20 weeks)

During this period birds will be producing eggs. Other than routing sanitation, disinfection and vaccination, the following are important management aspects during laying period:

7.3.1. Light management

Usually incandescent bulbs are preferred to fluorescent bulbs, Bulbs must be fixed at a convenient height to facilitate easy cleaning and replacement as required.

7.3.1.1. Reflectors

It is preferable to use flat-type reflectors rather than cone-type, since the latter confines light to a small area and corners are left without illumination. Size of the reflector is a square of side 25 to 31 cm. Cleanliness of the bulb and reflector is also important to produce calculated quantity of light. Clean reflectors, on most occasions, improve the light efficiency by about 50% since they reflect the light that would have been absorbed by the ceiling.

7.3.1.2. Arrangement of bulbs

When the birds are reared on floor, the rule of thumb is to fix the bulbs in such a way that the distance between two bulbs is 1½ times the distance from the bulb to the bird level or the floor. The reflector, a square of side 25 to 31 cm, with the reflecting surface facing the bulb, is fixed in such a way that it will not sway due to wind/draft etc. If the bulbs move, they cast moving shadows, especially in cage system, which frighten the birds and may lead to reduced egg production.

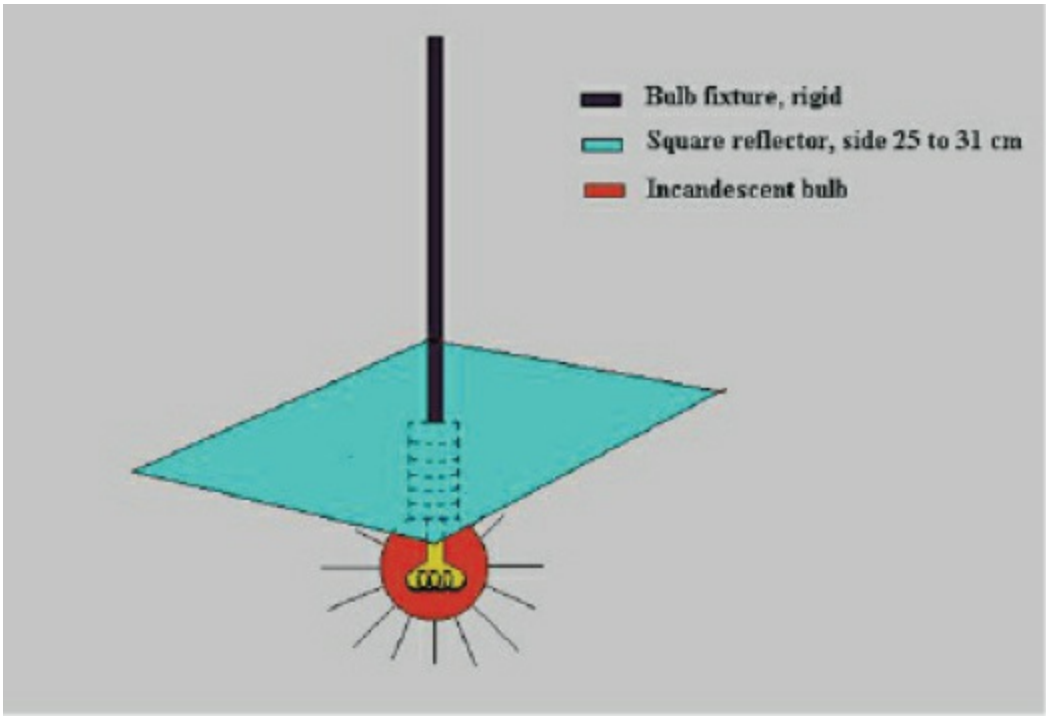


Fig. 12.22 Bulb-reflector assembly

In case of cage system, the bulbs are arranged over the passages (Fig.

12.23) whereas in all-litter system, bulbs are fixes at the center of the pen (Fig 12.24) so that light always falls on feed and water.

As a rule of thumb, 4 bulb-Watt for each m² of floor space is the wattage requirement. The bulbs are fixed at a height of 2.1 to 2.4 m above the floor and 3.15 to 3.6 m apart. It is preferable to use many smaller bulbs than fewer larger bulbs to effect proper distribution of light.

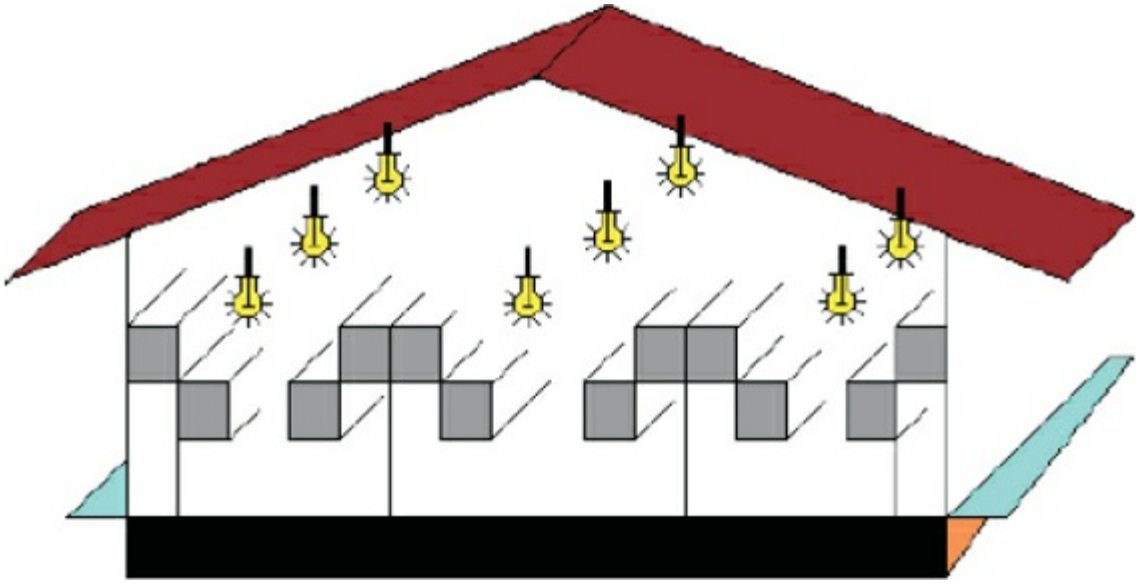


Fig. 12.23 Arrangement of bulbs – Cage system

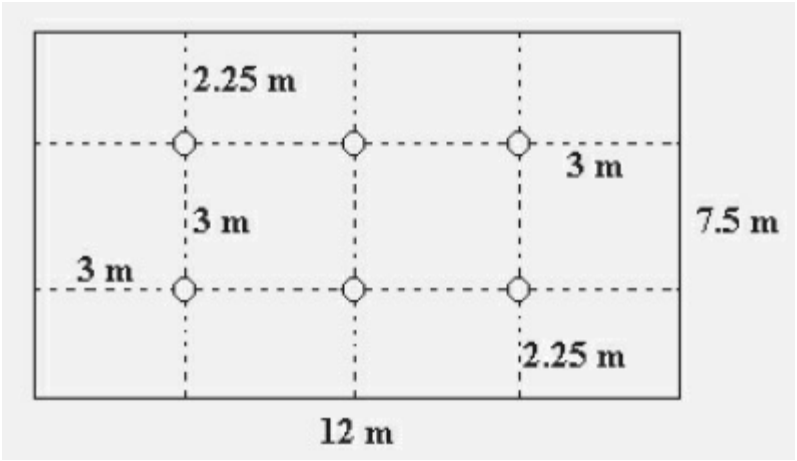


Fig. 12.24 Distribution of 60W bulbs – Deep-litter house

7.3.1.3. Photoperiod

The total duration of light, including sunlight is referred to as

“Photoperiod”. Under natural sunlight, in Northern hemisphere, light-day increases gradually and reaches maximum by June 21st and thereafter starts reducing gradually and reaches the lowest by December 21st. Hence, spring-hatched birds complete half of their growing period under increasing light-day and the remaining half during decreasing light-day; therefore, they mature late. On the contrary, winter-hatched birds are subjected to natural increases in light-day during growing period and therefore, mature early. The reverse is true in Southern hemisphere. In open-sided poultry houses, which are common in our country, the growing pullets must not be subjected to increasing light-day.

7.3.1.4. Lighting program during brooding

After hatching, birds require 24 hr light to learn to find feed and water After 4 weeks of brooding, they do not require any artificial light; but, in case of broilers, a dim light of about 4 to 6 lumens is often provided to help them consume feed and water all through the night but for one hour of darkness. One hour of darkness provided will train the birds not to panic in the event of power failure.

7.3.1.5. Lighting program during growing period

7.3.1.5.1. Growing during a period of decreasing light-day

To this category included are the birds hatched from March 1st to August 31st, since during their latter part of the growing period they will be under decreasing natural light-day. These are called “in-season” flocks. These require no supplementary light during the growing period.

7.3.1.5.2. Growing during increasing light-day

Birds hatched during September 1st to February 28th fall into this category. They will have increasing light-day during latter part of their growing period. These are called “out-of-season” flocks. These flocks are usually the problem flocks and lighting program in case of these birds can be one of the following:

7.3.1.5.2.1. Constant light-day program

From a local meteorological table, number of hours of day-light during the longest day until the flock reaches 20 weeks (egg-lines) or 22 weeks (meat-lines) is found out and this amount of light (natural + artificial) is given when the chicks are three days of age till the pullets begin to lay.

7.3.1.5.2.2. Decreasing light-day program

From a local meteorological table, number of hours of day-light during the longest day until the flock reaches 20 weeks is found out and 7 hr are added to this figure. That much amount of light is given to the chicks from first week (starting from three days) and reduced at a rate of 20 min per week till the pullets reach sexual maturity. However, decreasing light-day program is not very effective because the birds will be receiving light well above the threshold value to stimulate a production in conventional open-sided poultry houses.

7.3.1.6. Lighting program during laying period

A sudden change in duration of light and/or feed should not be done and only a gradual change must be made in length of the light-day (photoperiod). When the first eggs are laid, is advisable to consider the change of lighting program. Layers require a light-day of 16 hr and the additional light other than the natural day-light may be given either before the sunrise or after sunset or a combination of both; the latter is more convenient as it coincides with normal working schedule.

Layers must never be given continuous (24 hr) light; excess light results in excess feed consumption, fat accumulation, hyperexcitability, cannibalism, prolapse, reduced egg production and others.

Light intensity threshold of layers appears to be about 10 lux at the bird level; excess light doesn't produce additional benefits. Under natural sunlight, maximum egg production is stimulated when light is provided 11 to 13 hr after dawn.

Length of the light day should never reduce for laying pullets.

7.3.2. Judging for laying capacity

Judging/culling, in the broad sense, as practiced by poultry-men, refers to the sorting of the desirable and undesirable hatching eggs, chicks, pullets, cockerels, hens, or breeding males. The greatest emphasis, however, has been placed on the sorting of hens, not only to eliminate the non-layers but also to determine when and how long the remainder have been laying.

Present production may be determined by examining the vent, pubic bones, comb, wattles, and earlobes (Table 12.4). Non-layers are the birds old enough to have produced eggs but have not yet started laying and poor layers are the pullets which have started laying but are producing fewer than expected number of eggs.

Table 12.4, Fig 12.25a to 12.25h Judging present production

	Good layer	Poor layer	Non-layer
Comb	Large, red, warm 	Small, less warm, shrunken 	Underdeveloped
Eyes	Big, bright and active	Comparatively looks smaller and less active	Appears dull and inactive
Vent	Oblong, moist and pink 	Less oblong, maybe moist and pink 	Round, dry and has a yellow rim
Distance between two pubic bones	At least three fingers 	Less than three fingers 	Maximum one finger
Distance between tip of the breastbone and pubic bones	At least four fingers, the region being soft and pliable 	Less than four fingers, not very soft 	Hardly two fingers, very hard and rubbery
One finger is approximately 1¼ to 1½ cm			

7.3.3. Nests and collection of eggs

Layers on all-litter or any other system where they are grown on floor, nests are to be provided at a rate of 25 to 30% of the number of layers. The

nests should have dry, soft and resilient nesting material and are located in darker areas. Roof of the nest may be sloping to avoid perching. Birds make peculiar sound while they start egg production; such birds must be manually kept into the nests in order to train them enter the nest. Otherwise, eggs appear on the floor; leading to dirtying of eggs and possibility of egg-eating vice developing in the flock.

In cage system, the eggs automatically roll out of the cages and nests are not required.

In any system, eggs have to be collected at least once every hour and shifted to storage room as soon as possible. Chicken mostly lay eggs between 10 am to 3 pm.

8. Feeding

Standard commercial rations are available which are manufactured as per BIS or NRC recommendations. The different feeds to be offered for chicken are as follows:

1. Broilers
    a. Up to 3 weeks: Broiler Starter Ration
    b. After 3 weeks: Broiler Finisher Ration
2. Laying type
    a. Up to 8 weeks: Chick Ration
    b. 9 to 18/20 weeks: Grower Ration
    c. After 20 weeks: Layer Ration

Notes:

1. Linear feeders (Long feeders) should never be more than ½ to ⅓ full
2. With both linear and hanging (circular) feeders, feed should be available at the level of back of the birds
3. Feed should be offered at specific time(s) every day

9. Breeding

9.1. Breeding for broiler production

All broilers are crossbreds and usually strains of Cornish breed are used as the male line and New Hampshire and/or Plymouth Rock (White variety usually) as the female line in a 2-way, 3-way or a multi-way cross. Cornish selected as the male line because of superior growth rate, feed efficiency and livability. However, due to the higher body weight, they consume more feed and require more space. In addition to these, they are poor egg producers (since body weight and egg production are inversely related), and hence the cost of production of hatching eggs (in turn, the day-old chicks) will be high. To reduce the cost of production of hatching eggs, the female line must be good in all the characters listed for the male line and also must be a moderately good egg producer. Therefore, the females are actually from New Hampshire and/or Plymouth Rock breeds.

The component traits of broiler production are:

1. Body weight (Rate of growth)
2. Feed efficiency
3. Viability
4. Dressing percentage
5. Body conformation

All the above traits are moderate to highly heritable (except viability) and hence, the males are selected by individual selection. The females have to be selected for reproductive traits also (egg number, fertility, hatchability etc.) and therefore, they are selected on an index or by other methods to improve egg production.

9.2. Breeding for egg production

Usually breeds belonging to Mediterranean Class, especially Leghorns are involved.

The component traits of egg production are:

1. Rate of lay
2. Age at sexual maturity

3. Clutch size
4. Pause duration and
5. Broodiness.

Other factors like egg number, feed efficiency and laying house survivability also decide the productive efficiency of layers.

Majority of the above traits are low to moderately heritable and therefore, egg production can be improved by combined selection (Osborne index) and sire-family selection. Inbreeding and hybridization also produces more response for this trait.

Inbred lines are produced by mating closely related individuals. Those birds with survive at an inbreeding coefficient (F) of at least 0.5 in the population are said to be inbred lines. Inbreeding brings about homozygosity of both favorable and unfavorable genes, and those with unfavorable genes cannot survive when F approaches or exceeds 0.5. Therefore, cross-breeding of two such inbred lines with favorable genes may bring about significant improvement in egg production.

The inter-population selection methods (Recurrent Reciprocal Selection or Recurrent Selection) are also efficient in developing both broilers as well as laying-type birds.

10. Recommended space allowances

Table 12.5 Recommended space allowances for commercial broilers and layers

Type of chicken	Age (weeks)	Floor space (cm^2/bird)		Feeder space (cm/bird)	Drinker space (cm/bird)
		All-litter	Cages*		
Broilers	0 to 4	450	225	5.0	2.5
	5 to 8	900	450	8.0	2.5

	0 to 8	700	155	5.0	1.5
Laying–type	9 to 18/20	1200	290	7.6	1.9
	> 18/20	1600	387	8.75	2.5

* Does not include passages; total space required will be ≈ 50% of all-litter for laying type and ≈ 70% of all-litter for broilers

11. Control of diseases: Sanitation, Disinfection and Vaccination

Diseases and infections are major concern to the poultry industry. However, microbial contamination can be prevented and controlled using proper management practices and health products.

Sanitation refers to a state wherein pathogenic organisms are present but are not a threat to the birds' health; disinfection indicates destruction of all vegetative forms of microorganisms whereas spores are not destroyed and sterilization means destruction of all infective and reproductive forms of all microorganisms (bacteria, fungi, virus, and the like).

Having an effective sanitation (cleaning) and disinfection program is prerequisite for biosecurity programs. Cleaning and disinfection following depopulated and prior to restocking are compulsory. The main purpose of a cleaning and disinfection program is to reduce the number of pathogens thereby reduce occurrence of diseases in subsequent flocks.

11.1. Sanitation

11.1.1. Cleaning Poultry houses

After depopulation (removal of all birds), all equipment have to be removed, cleaned and disinfected. In floor houses, litter has to be removed; if chunks of litter are adhering, they have to be meticulously scraped, if necessary after soaking. Finally, the house has to be washed and disinfected. Manure has to be transported as far away as possible (at least 100 m).

Cleaning of the house should include all corners and crevices; first dry

and later on wet cleaning should be done. All immovable fixtures (cages, fans, light mount etc) must also be cleaned thoroughly. Drinkers, feeders and other equipment should be scrubbed and cleaned with a detergent and sun-dried wherever feasible. They also need to be disinfected by a suitable procedure.

11.1.2. Hatchery

Any multi-purpose biocide suitable for use in the hatchery or egg handling environment should be selected with the following general properties:

1. Broad spectrum biocidal activity.
2. Superior activity in the presence of organic challenge and at low temperatures
3. Independently proven bactericidal and fungicidal activity on Salmonella and Aspergillus.
4. Independently proven biocidal activity when sprayed on eggs
5. Can be used as a foam, spray or egg dip.
6. Non-staining and non-tainting.
7. Biodegradable.
8. No residue after application

11.2. Disinfection

Disinfection involves the use of a disinfectant that will reduce or kill the pathogens. Disinfectants are more effective at warmer temperatures. There are several types of disinfectants, and the one chosen should be effective against the disease agent(s).

Disinfectants are effective against bacteria, viruses, and fungi but not effective against parasites. In general, the descending order of resistance of disease agents to disinfectants is Spores and acid – fast bacteria > Gram negative bacteria > Fungi > Non-enveloped viruses > Gram positive bacteria > lipid enveloped viruses. Avian parasites (i.e., lice, mites, and endoparasites) are best treated using insecticides or by means of parasiticides.

Disinfectants can be of the classified as follows:

1. Aldehydes (i.e., formalin, formaldehyde, and glutaraldehyde)
2. Chlorine-releasing agents (i.e., sodium hypochlorite, chlorine dioxide, Sodium dichloroisocyanurate, and chloramine-T)
3. Iodophors (i.e., povidone-iodine and poloxamer-iodine)
4. Phenols and bis-phenols (i.e., triclosan and hexachlorophene)
5. Quaternary ammonium compounds
6. Peroxygens (i.e., hydrogen peroxide and peracetic acid). These, even at the recommended dilution for their use, are caustic and dangerous; therefore, not generally used in poultry facilities.

Table 12.6 Properties and uses of some disinfectants

Properties	Chlorine	Iodine	Phenol	Quarternary Ammonium	Formaldehy
Bactericidal	+	+	+	+	+
Bacteriostatic	-	-	+	+	+
Bacterial Spores	±	-	±	-	-
Fungicidal	±	+	+	±	+
Viricidal	±	+	+	±	+
Insects	-	-	-	-	+
Worm eggs	-	-	±	-	-
Toxicity	+	±	+	-	+
Activity with organic matter*	++++	++	+	+++	++
Personnel	+	+	-	+	-
Egg “Washing”	+	-	-	+	+

Foot Baths	-	+	+	+	-
Rooms	±	+	±	+	+
Residual Effects	±	±	++	+	±
Water sanitation	+	+	-	+	-
Hatchery	+	+	+	+	+
Poultry House	±	+	+	+	+

* Number of + indicates degree of affinity for organic material and corresponding loss of disinfecting action (negative property).

+ Positive property - Negative property ± Limited activity for specific property

11.2.1. Water disinfection

If water in the well is used only for the flock and all birds have been removed from the farm, the well can be treated with sodium hypochlorite (household bleach) dumped directly into the well. Water is then run through all the lines until chlorine can be smelled at the end of each line. The water is allowed to stay in the lines a minimum of 24 hours.

11.2.2. Hatchery disinfection

Disinfection is of primary importance at every stage. The vehicles entering into the farm/hatchery will have to cross through a disinfectant pool so that their tires are completely washed in the disinfectant. Personnel will have a disinfectant spray, especially on the underside of their shoes, and wherever practicable, change their dress and take bath.

11.2.2.1. Formaldehyde fumigation

Fumigation is by far the most common method of disinfection in a hatchery facility. Hatching eggs on receipt, in the setter, chicks in hatcher and all hatchery equipment (after thorough cleaning) are fumigated. Fumigation is also

employed for poultry houses, equipment and many other related materials on a regular basis.

11.2.2.1.1. Method

The most popular method of formaldehyde fumigation is to mix the 40% formalin onto potassium permanganate ($KMnO_4$) to liberate the gas. The $KMnO_4$ crystals are kept in an earthen pot deep enough to hold the volume several times that of the combined chemicals to avoid the spillage of contents during bubbling and splattering that takes place in the process. The door of the cabin must be closed immediately since the formaldehyde gas instantaneously released is harmful to the eyes of the operator.

11.2.2.1.2. Proportion of chemicals

Two parts by volume of formalin to one part by weight of $KMnO_4$ are taken. Usually, 40 cc of 40% formalin and 20 g of $KMnO_4$ for every 2.83 m^3 is 1X concentration. For the same area, if the quantities of the chemicals are doubled, it is called 2X and so on. If, after the reaction, the residue is purple, the quantity of formalin added is more; when proper quantities are used, a dry, brown powder will be left.

11.2.2.1.3. Neutralization

In the event that the fumigation must be stopped after a period of time, it can be done, most of the times, by opening the air intakes and exhausts. However, it can be expedited by sprinkling the fumigated floor area with ammonium hydroxide (NH_4OH) prepared to contain 26-29% ammonia. The quantity of NH_4OH required is equal to one-half of the quantity of formalin used for fumigation.

11.2.2.1.4. Concentrations required

Table 12.7 Concentration and duration of fumigation

	Concentration	Time

		(min)
Hatching eggs, soon after lay	3X	20
Eggs in incubator, 1st day only	2X	20
Chicks in hatcher	1X	3
Incubator room	1X, 2X	30
Hatcher room, Chick room between hatches	3X	30
Wash room	3X	30
Chick boxes, pads, farm equipments	3X	30
Trucks	5X	20

Source : North, 1984

11.3. Vaccination – Principles and Practices

Vaccines are an important part of disease prevention and control. However, vaccines have to be purchased and administered which not only adds to cost of poultry operations but also involves labor. Notwithstanding these, vaccines create immune response which needs metabolic adjustments many times leading to potential performance loss.

Therefore, if the risk of a particular disease is low, vaccination may simply add to the cost of production. But, it is not possible to assess risk/ s of disease/s accurately. Hence, vaccination is part and parcel of Poultry production. It should also be borne in mind that vaccination is not a panacea to rid all the diseases; on the contrary, vaccines are only a part of good management.

In summary, vaccines should stimulate the immune system similar to a natural infection and afford, as far as possible, immunity for the entire period for which the bird is reared. In addition, they should have minimal side effects, if any and their cost should be less than the economic loss expected by the disease itself.

11.3.1. Vaccination schedule

Table 12.8 Vaccination schedule - General

Disease	Vaccine	Age	Route	Broilers	Layers	Breeders
MD	HVT	Hatch	s/c or i/m	±	+	+
ND	F/LaSota	7-10 d	Ocular / Water	+	+	+
CocciVac	Irradiated	10 d	Water	±	±	±
IBD	Intermediate	14 d	Ocular / Water	+	+	+
IB	Attenuated	21 d	Ocular / Water	±	±	+
IBD	Intermediate	28 d	Ocular / Water	+	+	+
ND	F/Lasota	42 d	Ocular / Water	NA	+	+
Pox	Attenuated	49 d	Wing-web	NA	+	+
ND	R_2B	70 d	s/c	NA	+	+
ILT	Attenuated	70 d	Ocular / Water	NA	±	+
Cholera	Killed	12-13	s/c	NA	±	+

		Weeks				
AE	Attenuated	14-16 Weeks	Wing-web or Water	NA	±	+
ND, IB, IBD, EDS	combined	16-18 Weeks	s/c	NA	+	+
ILT	Attenuated	18 Weeks	Ocular / Water	NA	±	+

± Given only in endemic areas s/c Subcutaneous i/m Intramuscular

Table 12.9 Vaccination schedule – Commercial broilers

Disease	Vaccine	Age (d)	Route
MD	HVT	At hatch (if endemic)	s/c or i/m
ND	F/B_1/LaSota	5 – 7	Ocular/Water
IBD	Intermediate plus	14 – 15	Ocular/Water
ND	LaSota	21 – 22	Water

Table 12.10 Vaccination schedule – Commercial layers

Disease	Vaccine	Age	Route
MD	HVT	At hatch	s/c or i/m
ND	F/B_1/LaSota	6 – 7 d	Ocular/Water
IBD	Intermediate plus	15 d	Ocular/Water
IBD	LaSota	22 d	Ocular/Water
ND & IB	LaSota and H_{120}/M_{41}	28 d	Ocular/Water

Coryza	A, B, C Killed	7th Week	s/c
Pox	Attenuated	8th Week	Wing-web
ND	K/R_2B	10th Week	s/c Wing-web
Coryza	A, B, C Killed	12th Week	s/c
IB	Ma5	13th Week	Water
ND	K/Killed LaSota	16th Week	s/c or i/m

s/c Subcutaneous i/m Intramuscular

Based on the level of antibody titer against ND, flock vaccination program should be planned during the laying period.

Vaccination with LaSota (32nd week), killed vaccine (40th week), R_2B/K (48th week) and

LaSota (56th week) can also be practiced.

For IB, vaccination with Ma5 at 8 weeks with repeat vaccination every 8 weeks is advisable in endemic areas.

Based on the level of antibody titer against ND, flock vaccination program should be planned during the laying period. Vaccination with LaSota (32nd week), killed vaccine (40th week), R_2B/K (48th week) and LaSota (56th week) can also be practiced. For IB, vaccination with Ma5 at 8 weeks with repeat vaccination every 8 weeks is advisable in endemic areas.

11.3.2. Precautions for vaccination

Although specific precautions during vaccination through different routes are listed separately, certain general precautions are given below which suit most of the commercial facilities:

1. Should be purchased from a reliable source. Batch number, date of manufacture and Supplier's details have to be recorded.
2. Expired vaccines should neither be purchased nor used.
3. If premixed vaccine has to be transported, it must be done in a flask filled with ice and used as quickly as possible; preferably, within two to three hours.

4. Vaccines are normally stored at the temperature of 2-8°C; they should neither be frozen not kept above 8°C. While transportation also, the same temperature range is ideal.
5. Vaccine should not be mixed in or exposed to sunshine.
6. Vaccination be carried out during cooler part of the day; temperature above 30°C may affect vaccine potency.
7. Sick birds not to be vaccinated.
8. Vaccines administered via drinking water should be opened underwater into which it is mixed; because, vaccines are normally vacuum-sealed and when opened in air, there may draw contaminated air into the container.
9. Tap-water with chlorine or other disinfectants must not be used because they lower the potency of the vaccine.
10. Metal containers must be avoided because reactions of the surface of the metal, if any, can produce chemicals that affect potency of the vaccine.
11. Antibiotics must be removed from water before and after administering bacterial vaccines, in particular.
12. Careless spillage of vaccine must be avoided especially with live vaccines which can cause the disease.
13. While administering water-based vaccines, water should be withdrawn for 2-3 h before administering the vaccine. During hot-whether, the withdrawal period can be reduced.
14. Adequate drinker space has to be provided.
15. Vaccine should be administered so as to enable the vaccine to break through the maternal antibodies. Hence suitable information regarding vaccination of the breeding flock has to be obtained from the chick supplier.
16. Quantity of water to be used for reconstitution should be properly determined depending on type and age of birds, temperature etc.
17. Vaccine should be administered depending on manufacturer's

recommendations.

18. When a vial is opened, complete contents must be used. The vaccine should be opened and mixed just before administering the vaccine.
19. The vaccinating equipment must be sterile and chemical disinfectants must not be used for sterilization.
20. Reconstituted vaccine must be kept in an ice-bath during the period of vaccination. It is advisable to use the reconstituted vaccine within 2h of its preparation.
21. Empty vials, left-over vaccines and other material containing the vaccine must be burnt and destroyed.
22. The birds must be provided with adequate heat, feed, water and ventilation depending on the requirements
23. The vaccine and/or the diluent must be properly stored as per the manufacturer's recommendations and administered through the route specified at an appropriate age.
24. All birds must be vaccinated.

12. Preservation of table eggs

It is obvious that shell-eggs have to be properly and adequately preserved so that their quality does not deteriorate in the marketing channels. Different methods of preservation of eggs (both with shell and without shell) are:

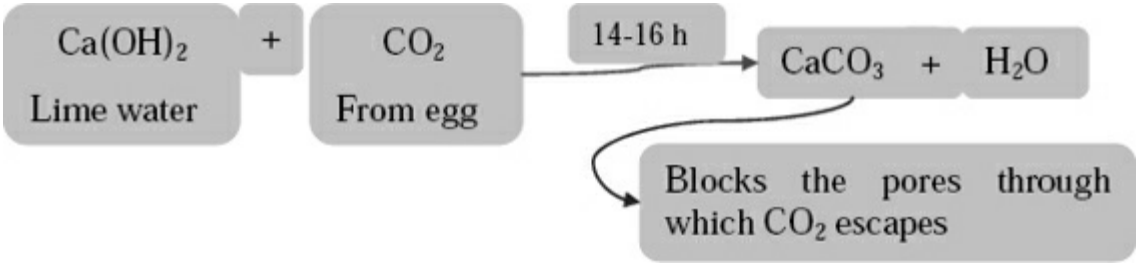
1. Wet methods
    a. Lime-water method
    b. Water-glass method
2. Dry methods
    a. Oil
    b. Gas
    c. Cold storage
3. Miscellaneous methods - Thermostabilization

12.1. Wet methods

Under these methods, eggs come in contact with a solution usually prepared with water as solvent. Most of the shell-pores will be blocked during the process and hence a small pin hole has to be made before boiling the eggs stored by wet methods to avoid breakage of shell due to expansion of eggs contents as well as air-cell.

12.1.1. Lime-water method

Principle



12.1.1.1. Procedure

1. One kg of quicklime (CaO) is mixed with 1L of water and allowed to react.
2. After the reaction is over, 120 g of salt is added to increase the specific gravity so that none of the eggs touch the bottom of the container when immersed and get broken due to the weight of eggs on top of them.
3. Further, 5-6 L of water is added and stirred thoroughly.
4. Solution filtered through muslin cloth and to the filtrate, a small quantity of slaked-lime (available on the muslin cloth) is added in order to maintain the concentration, since there will be production of water molecule replacing every molecule of lime water during the reaction resulting in dilution of solution.
5. The eggs are held in the solution for 14-16 h and later on, removed and stored at room temperature.

12.1.1.2. Efficacy

1. Eggs may be stored up to 3-4 weeks.
2. Albumen and yolk quality maintained even under room temperatures.

12.1.1.3. Advantages

1. Easily available, cheap and easy to prepare
2. Solution is alkaline and hence, surface bacteria killed
3. No residual flavor encountered
4. The chemical reaction occurs at all effective shell-pores and therefore, the method is very efficient is
5. The chemical reaction produces $CaCO_3$, which is the shell material itself but not produced by the hen.

12.1.1.4. Disadvantages

1. Hatching eggs cannot be preserved, since embryos die due to increased carbon dioxide tension within the egg.
2. Due to blockage of shell-pores, embryo cannot respire.
3. Thin-shelled eggs when removed from the solution will be subjected to a cooling effect. This is likely to produce anomalous expansion of water present in albumen which is closer to the shell. Since all the shell-pores are blocked through the chemical reaction, the egg shell being thin, is likely to crack.

12.1.2. Water-glass method

A 10% solution of sodium silicate ($NaSiO_3$) is popularly called as “water-glass”. Water glass, a bacteria-resistant solution, discouraged the entrance of spoilage organisms and evaporation of water from eggs.

12.1.2.1. Principle

Water glass is a colloid solution and hence, sodium silicate molecules

adsorb of the shell surface and physically block the effective shell-pores, without any chemical reaction unlike lime-water method.

12.1.2.2. Procedure

1. Water is boiled thoroughly to remove the dissolved CO_2, which otherwise form a complex with sodium silicate.
2. Calculated amount of sodium silicate is added.
3. Eggs are dipped in the cooled water-glass solution and kept overnight.

12.1.2.3. Efficacy

The solution is most effective at 25°C.

12.1.2.4. Disadvantages

1. Efficacy is less at higher temperatures.
2. The chemical is costly and not easily available.
3. The procedure is time-consuming and requires accurate weighing.
4. At -1°C, the solution becomes a mass and hence cannot be used.

12.2. Dry methods

Eggs will not come in contact with water in any of these methods and therefore, they are referred to as “dry methods”.

12.2.1. Oil

Of the vegetable oils, excepting coconut oil, all the colored and impart the same onto the eggs. Besides, they are unsaturated and hence are prone to rancidity, costly and are human foods. Therefore, mineral oils (by-products of petroleum industry) are generally used. The standards of egg-coating mineral oil are: specific gravity: 0.830 to 0.840, viscosity: 50 poises, colorless, pour point: (-) 1.11°C, flash point: 140°C and neutral in reaction.

12.2.1.1. Methods

Eggs can be dipped (400 cc/200 eggs) or sprayed (over the broad end, 400 cc/1000 eggs). Usually, eggs are kept broad end up in filler flats and sprayed cover ½ to ¾ of the shell surface. Bactericides and/or fungicides can be added to the oil to enhance efficacy

12.2.1.2. Principle

Most of the effective pores are present towards the broad end of the egg; the use of oil blocks these pores and prevents CO_2 loss. Spraying with heated oil is more beneficial.

12.2.1.3. Precaution

Oil should be done 5-6 hr (winter) or 8-10hr (summer) after lay to avoid syneresis (weeping of eggs; collection of water).

12.2.2. Gas

12.2.2.1. Principle

Inert gases are used. Eggs are kept in plastic bags or special plastic retail cartons which are filled with the gas and sealed. Usually N_2:CO_2 = 94:6 is used. Higher CO_2 pressure outside the eggs precludes its loss from inside the eggs the affording protection to egg quality.

12.2.2.2. Disadvantages

1. Transportation is difficult
2. Costly and cumbersome
3. Causes turbidity or cloudiness of the albumen.

12.2.3. Cold-storage

Cold-storage of eggs is done at the temperature of 10.0-15.6°C and a

relative humidity of 75-90%. And ante-room is a must to avoid the entry

of hot air causing air pockets and corners of cold-storage room which can subsequently trigger mold growth under hot humid conditions. Air circulation is also important to effect a proper loss of heat from eggs. Cold-storage temperature should not be less than (-) 2.22°C. Eggs keep for a long time (up to 8-10 months) in cold-storage.

12.2.3.1. Disadvantages

1. After 7-8 months in cold-storage, eggs develop a metallic taste referred to as "storage taste".
2. Mold growth, if not controlled, cause whitish marks on the shell (mucous growth), referred to as "old man's beard".
3. Sweating: when the eggs are taken out of the cold-store, due to lower temperature of the egg, the atmospheric moisture condenses on the shell surface which is referred to as "sweating". Thus, eggs are to be brought through graded temperature cabins viz., 10, 15.6, 21.1°C and then to room temperature.
4. Costly, since proper maintenance of cold-storage is compulsory.

12.3. Miscellaneous methods

Several methods are attempted and/or advocated; but the most popular is Thermo stabilization : 54.4°C for 30 min: This is stabilization of albumen quality by application of heat. Several combinations of temperature and duration are tried to ensure a 100% kill of embryos and also to have uniform coagulation of albumen close to the shell.

12.3.1. Principle

To effect peripheral coagulation of albumen and hence inhibit CO_2 loss. Thermostabilization influences only albumen quality and yolk quality unaffected.

12.3.2. Effects of Thermostabilization

1. Only stabilization of the existing egg quality is possible.
2. pH of albumen increases.
3. Stabilizes albumen quality.
4. Many of the bacteria on shell surface are killed.
5. Loss of CO_2 reduced.
6. Even hottest summer, eggs keep for 10-12 d at room temperature.

12.3.3. Disadvantages

1. Cake-volume is reduced
2. Requires specific temperature for efficacy
3. Requires a additional fuel for heating and maintaining temperature

Keeping the above methods for preservation of shell-eggs in view, lime-water method appears to be the most practicable one under village conditions followed by oiling and thermostabilization, in that order. The large number of eggs is to be preserved at a centralized facility, cold-storage is the method of choice.

13. Economics of poultry farming

Like any other animal enterprise, the ultimate aim of the poultry farmer is to maximize or optimize the returns. Several factors contribute to efficiency; they include among other things, the quality of the stock purchased, their maintenance, feeding and management, and the marketing efficiency. However, there are certain technical considerations which vary only a limited extent and other variables which have to be considered before venturing into commercial poultry farming.

13.1. Inputs

Investment in poultry business is mainly classified into:

1. Non-recurring – comprises of such expenditure which is incurred in the beginning and includes land, buildings and equipment. This expenditure does not repeat unless there is an expansion in the volume of output from

the poultry farm.

2. Recurring – this constitutes the expenditure which repeats every time a new batch of chicks arrives. This includes cost of chicks, feed, medication, vaccination, labor etc.

Non-recurring and the recurring expenditures depend on type of house, birds and management, and number of birds and frequency of batches. Obviously, innumerable combinations are possible and hence it is not possible to give details for all possibilities.

13.1.1. Non-recurring expenditure

This comprises of such expenditure which is incurred in the beginning and includes land, buildings and equipment constituting 60-70% of the total expenditure depending on the type of house, birds and management, and number of birds and frequency of batches.

13.1.1.1. Housing

Major consideration in the construction of poultry house is floor space required. Usually, broilers are reared on deep litter. However, if there are grown in cages, floor space required is 60-70% that on deep litter. In case of layers, usually the birds are grown up to 16 weeks of age on deep litter and later on shifted to cages. The floor space required will be a 50% of that on deep litter. The floor space suggested in cages includes the space left for passage. On deep litter system, land required and building area are higher than for cage system.

Additional expenditure has to be made on equipment like feeders and drinkers in case of deep litter system, whereas, in cage system, in addition to the cost of construction of building, investment has to be made on cages for birds. Regardless of the land cost, considering the cost of construction of the building as same for both systems, cage system is cheaper than deep litter system; however, if the shed is already available, then deep litter system requires a lower initial investment than cage system.

Table 12.11 Non-recurring expenditure

Building	**Cost of construction - Rs 2000 per m²**

	Deep litter	Cage system
Floor space (cm² per bird)		
Broilers	900	540-630 (600)
Laying type		
Up to 8 weeks	700	350
9-16 weeks	1350	675
after 16 weeks	1800	900
Cost of building (Rs per bird)		
Broilers	180	120
Laying type	630	315
Equipment (Rs per bird)		
Broilers	15-20 (18)	40-50 (45)
Laying type	30-40 (35)	120-130 (125)
Miscellaneous (Rs per bird)*		
Broilers	5	5
Laying type	15	15
TOTAL (Rs per bird)		
Broilers	263	215
Layers	842.5	538.75

Value in parentheses indicates the one which is considered for computation
*Crates, egg filler-flats etc.

Cost of construction of poultry sheds is variable depending on locality, material used and type of construction. Reasonable estimate, at present rates is Rs 2000 per m² of construction.

13.1.1.2. Equipment

Equipment cost for broilers on deep litter is also highly variable depending on the material costs. However, the current costs ranges between Rs 15-20 per bird. The equipment are regularly cleaned and disinfected and used for many subsequent batches so as to minimize investment on this account. In the case of cage system, cost of battery or single tier cages ranges between Rs 30-40 per bird. For layers, on deep litter system, in addition to feeders and drinkers, nests have to be provided. In cage system, additional investment on cages ranges between 120 and 130 per bird. Total equipment cost in case of deep litter system will be Rs 40-50 per bird whereas in cage system since the feeders and drinkers are built-in, only the egg-filler flats have to be purchased which might cost Rs 6 per bird.

13.1.1.3. Water and electricity

Power supply must be ensured to the poultry sheds, especially the brooder and layer houses. Expenditure on power supply depends on number of power points and total Wattage permitted. Wherever the size of the farm is high (10,000 birds or more), it is justifiable to install a generator of suitable output, especially to the brooder house. Cost of the generator depends on its make and output. To ensure continuous water supply, pump can be fixed to a well/bore-well.

13.1.2. Recurring expenditure

13.1.2.1. Day-old chicks

Cost of day-old broiler as well as layer chicks is highly variable; the present cost averages Rs 22 and Rs 30, respectively. The hatchery supplies 2% extra chicks without additional cost. Packing and transportation costs are the farmer's responsibility.

13.1.2.2. Feed

Feed cost constitutes 60-70% of the recurring expenditure in both broiler and layer enterprise.

13.1.2.2.1. Broilers

Under commercial conditions, FCR ranges between 1.8 and 2.2; hence, it is reasonable to assume an FCR of 2.0 at 8 weeks of age. Many factors affect the feed efficiency at the farm level; for instance, a farmer who can sell all his broilers before 6 weeks of age itself can definitely expect a better feed efficiency; on the contrary, if the broilers cannot be sold even after 8 weeks of age, FCR will increase and drastically reduces returns. Similarly, average body weight that can be expected when the birds are sold is highly variable depending mainly on age, genetic potential, feed and other management conditions. The broilers at 6 weeks are likely to weigh between 1.8 and 2.0 kg whereas, at 8 weeks, the range expected is 2.4 to 2.8 kg. Under farmers' conditions, an average body weight of 1.80 kg at 6 weeks of age appears reasonable. Therefore, total feed consumed per broiler will be 3.60 kg (1.80 kg x 2.0). Cost of the broiler feed is also highly variable and present rate is Rs 16,000 per ton.

13.1.2.2.2. Layers

Feed consumption up to 8 weeks of age (Chick starter) is around 1.5-1.75 kg per bird, whereas during 9-18 weeks and during the year they consume 5.0-6.0 kg and 38-40 kg of grower and layer ration, respectively. Cost of chick starter, grower and layer ration is also highly variable and the present rate is Rs 14,000, Rs 12000 and Rs 10000 per ton, respectively. Present-day layers are likely to produce 300 eggs in a laying year.

13.1.2.3. Medication and administration

Cost of medication for broilers and layers is estimated at Rs 10 and Rs 20 per bird, respectively.

Table 12.12 Recurring expenditure

	Broilers		Layers	
	Quantity	**Cost**	**Quantity**	**Cost**
Cost per chick		Rs 22 (per		Rs 30 (per

		tonne)			ton)
Feed, per bird	3.60 kg	Rs 16,000	2.0 starter	kg	Rs 14,000
			5.0 grower	kg	Rs 10,000
			38.0 layer	kg	Rs 12,000
Medication, per bird	Rs 10		Rs 20		
TOTAL, per bird		Rs 89.6 ? 90			Rs 584

In general, mortality never exceeds 5% and in most occasions, only extra chicks (2%) supplied by the hatchery will account for mortality. However, for calculation purposes, a total mortality of 3% can be considered. The average body weight at 6 weeks of age can be taken as 1.80 kg at a current rate of Rs 60 per kg live weight.

13.2.1.2. Manure

About 300 broilers produce a ton of manure which fetches Rs 300 i.e., about Re 1.00 per bird.

13.2.1.3. Gunny bags

One gunny bag is expectable from 16 broilers and each gunny bag costs Rs 8 i.e., about Re 0.50 per bird.

13.2.2. Layers

Up to the beginning of egg production, mortality does not usually exceed 5% and during the laying period, a mortality rate of 0.1% per week is expected. Hence for purposes of calculation of eggs produced, mortality of 5% is considered whereas, for calculation of number of spent hens, mortality accounted for the 10% (excluding 2% extra chicks).

13.2.2.1. Sale of eggs

It is reasonable to expect an overall rate of 300 eggs during the laying year; that means around 285 eggs per hen per annum after giving weightage to mortality (5%). The current price of eggs averages Rs 250 per 100 eggs. That means, Rs 712.50 per bird.

13.2.2.2. Sale of spent-hens

Average body weight will be 1.5 kg and selling price currently is Rs 30 per kg. Giving weightage to mortality (10%), Rs 40.50 per bird

13.2.2.3. Manure

150 birds up to 18 weeks of age as well as 40 hens in a laying year produce a ton of manure (in other words, about 30 birds from day-old to the end of laying year produce one ton of manure) which fetches Rs 300 per ton. Therefore, about Rs 10 per bird can be the realized from sale of manure.

13.2.2.4. Gunny bags

3 laying-type birds consume about 2 gunny bags feed and hence Rs 8 per bag, Rs 5.33 per bird will be the income from this source.

Table 12.13 Income estimation (Rs per bird)

	Broilers	Layers
Sale of eggs	NA	712.50
Sale of birds/spent-hens	108.00	40.50
Manure	1.00	10.00
Gunny bags	0.50	5.33
TOTAL	109.50 (≈ 110)	768.33 (≈ 768)

13.3. Interest on capital and depreciation

Certain annual maintenance costs of buildings and equipments are expected; this includes white-washing of buildings, or replacement of feeders, drinkers and egg flats etc. During the first 5 years, depreciation on new building and equipments does not usually exceed 2.5% of the cost the building and 5% of the cost of equipment. Subsequently, the same may be 5% and 10%, respectively. Many commercial banks advance loans for poultry farming. Usually, the bank's share will be 75% of the non-recurring expenditure + recurring expenditure till the first batch of broilers is sold or first batch of layers have produced for 6 months, as the case may be. The annual simple interest charged, at present, is 12% and the actual loan amount has to be returned within a maximum of five years.

13.4. Profit estimation

Gross profit = Total income - Recurring expenditure and

Net profit = Gross profit - (Loan premiums + Interest on loan + Depreciation on building and equip)

Table 12.14 Profit estimation in broiler and layer farming (Rs / bird)

	Broilers		**Layers**	
	Deep-litter	**Cages**	**Deep-litter**	**Cages**
		Non-recurring		
Building	180	120	630	315
Equipment	18	45	35	135
Miscellaneous	5	5	15	15
Total	203	170	680	465
Chicks	22	22	30	30
Feed	58	58	534	534
Medication etc.	10	10	20	20

Total recurring	90			584
Capital required	293	260	1264	1049
Bank's share (75%)	220	195	950	790
Eggs	NA		712.50	
Birds (Meat)	108.00		40.50	
Manure	1.00		10.00	
Gunny bags	0.50		5.33	
Total income		109.50 (≈ 110)		768.33 (≈ 768)
Gross profit	20			184
Loan premium*	5.50	4.88	190.00	158.00
Interest on capital**	3.30	2.93	171.00	142.20
Depreciation***				
Building, 2.5% pa	0.70	0.47	29.53	14.77
Equipment, 5% pa	0.11	0.28	2.63	10.13
Total deductions	9.61	8.56	393.16	325.10
NET PROFIT	10.39	11.44	(-) 209.16	(-) 141.10

* Loan to be returned in 5 equal annual installments; Calculated for 1½ months (broilers) and 18 months (layers)
** Reduces every year (see Tables 12.15 and 12.16)
*** Calculated for 1½ months (broilers) and 18 months (layers), 12% pa

It can be seen (Table 12.6) that in case of layers the net profit is negative. This is the reflection of the fact that the building and equipment are not used to the fullest capacity and hence the birds start laying eggs, the brood-grow house

and equipment therein are kept idle for another 12 months. A similar under use of brood-grow facility is true for layers in cage system also.

Therefore, it is a common practice to grow laying-type birds on deep-litter in brood-grow houses and then shifting to cage layer houses so that cost on buildings and loan required are reduced.

Alternatively, to utilize the non-recurring expenditure efficiently, the chicks have to be procured in batches once every 4-5 months.

Even in case of broilers, the profit shown is for all in all-out system and hence, the net profit is likely to increase when the chicks are procured in weekly, bi-weekly, fortnightly or monthly batches. Accordingly, suitable modifications have to be made while working out the gross and net profits, total capital required and cash-flow as per the requirement of the lending agency. Since the flock schedule is highly variable, a general model is given based on which any type of project can be developed by extending the underlying principles. Part feed consumption becomes necessary if the flock schedule is not all-in all-out. Weekly feed consumption of broilers and layers are provided in Chapter "Management requirements and specifications".

In addition, repayment of loan and interest on credit can be deferred for 1 to 3 years. The banks usually extend repayment time to 8 years provided the assumptions are as per norms (see Table 12.8).

Table 12.15 Repayment schedule, broilers on deep-litter, Rs/bird

	Year				
	I	II	III	IV	V
Gross profit	20.00	20.00	20.00	20.00	20.00
Loan premium	5.50	5.50	5.50	5.50	5.50
Interest	3.30	2.64	1.98	1.32	0.66
Depreciation: Buildings, 2½ % pa	0.70	0.70	0.70	0.70	0.70
Depreciation: equipments, 5 % pa	0.11	0.11	0.11	0.11	0.11
Net profit	10.39	11.05	11.71	12.37	13.03
Cumulative Net profit		21.44	33.15	45.52	58.55

VI year onwards, Net profit will be Rs (20.00 – 0.81) = 19.11 per bird; it works out to be Rs 12.75 / bird / month of rearing

In case of laying-type birds, a flock schedule of 2 batches pa is considered. Accordingly, non-recurring expenditure increases to Rs 1090 (because one more layer house is essential whereas the brood-grow house is washed, disinfected and reused) and recurring expenditure of Rs 584 for the first batch together makes the capital required to Rs 1674 and Bank's share to Rs 1250. From II year onwards, income doubles because 2 batches will be in production continuously. Accordingly, repayment schedule is drawn (Table 12.8):

Table 12.16 Repayment schedule, layers on deep-litter, Rs pa

	Year					
	I	II	III	IV	V	VI
Gross profit *	250.00	500.00	500.00	500.00	500.00	500.00
Loan premium	Deferred	250.00	250.00	250.00	250.00	250.00
Interest	150.00	150.00	120.00	90.00	60.00	30.00
Depreciation:	24.75	24.75	24.75	24.75	24.75	24.75
Buildings, 2½ % pa						
Depreciation:	3.50	3.50	3.50	3.50	3.50	3.50
equipments, 5 % pa						
Net profit	71.75	71.75	101.75	131.75	161.75	191.75
Cumulative Net profit		143.50	245.25	377.00	538.75	730.50

* Referring to one layer in 1st year and 2 layers from 2nd year onwards
From VII year and onwards, net profit will be Rs (500.00 – 29.25) = 470.75 for 2 layers or about Rs 235 per bird or Rs 13.06 / bird / month of rearing

13. 5 Cost of production

Table 12.17 Estimation of cost of production of meat and eggs, in Rs

	Item	Broilers	Layers
	Chicks	22	30
Recurring expenditure	Feed	58	534
	Medication etc.	10	20
	Total	90.00	584.00
Depreciation	Building	0.70	14.77
	Equipment	0.11	10.13
Total cost of production		90.81	608.90
Salvage		Nil	40.50
Weighted total cost of production		90.81	568.40
Product produced		1.80 kg	300 eggs
Mortality		2%	5%
Product after mortality weightage		1.764 kg	285 eggs
Number of birds after mortality weightage		0.98	0.95
Cost of production		51.48/kg; 92.66/broiler; 73.54/kg dressed weight	1.99/egg

Assumed that broilers are reared on deep-litter and layers on litter up to start of lay

and then in cages.

Exercise

I. Fill-up the blanks with appropriate answers:

1. Major contributor for origin of Domestic fowl is ——————.
2. Zoological name of domestic chicken is ——————————.
3. Most of the breeds belonging to Mediterranean Class lay ——————— colored eggs.
4. Most popular breed/variety of chicken producing most of the table eggs in the world is ——————————.
5. Feathered shanks are characteristic of ——————— Class birds.
6. Chicken eggs hatch in ——— days of which they are held in the setter for ———— days.
7. Brooding temperature at the beginning is ———— and is reduced at a rate of ——————— per week.
8. After beak trimming, ————— beak will be left longer.
9. In laying-type of chicken, feed restriction is generally practiced during ————— period.
10. Layers require ——————— hrs of light per day.
11. Floor space required for broilers aged 5 weeks is ————— and for layers it is ——————————.
12. Hatching eggs are stored at ————— temperature and ———— —— relative humidity.

II. Write short notes on the following:

1. Separation distance
2. Width of a poultry house
3. Side-walls of a cage layer house
4. High-rise house

5. Advantages of all-litter system
6. Disadvantages of all-litter system
7. Advantages of cage system
8. Disadvantages of cage system
9. Paper spread on litter during first 10d of brooding
10. Beak trimming
11. Judging layers
12. Arrangement of bulbs in a layer house
13. Fumigation
14. Lime-water method of preservation of table eggs
15. Cold storage of table eggs

III. Define the following:

1. Breed
2. Hatchability on fertile eggs set
3. Brooding
4. Photoperiod
5. Sanitation
6. Disinfection
7. Non-recurring expenditure
8. Recurring expenditure
9. Depreciation
10. Gross profit

Answers

Unit – 1

1. In India, ……. % of the rural families own livestock. **(above 70)**
2. Livestock sector contributes about …… % to the Gross Domestic Product of our country. **(6)**
3. Livestock sector contributes about …… % to the Agricultural Gross Domestic Product of our country. **(25)**
4. During the last two decades, livestock sector has grown at an annual rate of …….. **(5 to 6%)**.
5. The livestock population of our country as per the latest census is …….. **(185.2 m)**.
6. The per capita milk availability in our country is……**(258 g/ day/person)**.
7. Meat production in India has grown by …… % during the last two decades. **(9.3 %)**.
8. Over the last two decades, egg production in our country has grown at an annual rate of ……..% . **(5.8%)**.
9. Central Cattle Breeding Farms were established during the ……. Five year plan period. **(IV plan)**.
10. The National Dairy Development board was established in the year, …… **(1965)**.
11. The Indo-Danish Project for the development of cattle was established in the year …… **(1964)**.
12. The breed of cattle evolved as a result of Indo-Swiss project in Kerala is ……. **(Sunandini)**.

Unit – 2

1. Performing all functions necessary for the efficient and economic results from livestock is called …… **(Production)**.
2. an animal that has been bred in captivity for the purpose of economic profit for man is called a …….. **(domestic animal)**.
3. The farming system in which 50 % or more of the receipts (output) are obtained from a single source is ……**(Specialized farming system)**.
4. A general purpose farming system is otherwise called as ……. **(Diversified farming system)**.
5. A farming system in which crop production is combined with livestock production is termed ……. **(Mixed farming system)**.
6. The farming system in which the farmer generally rears only a single livestock species and all the products are sold for cash is …….. **(Commercial farming system)**.
7. The farming system in which the animals are let out for grazing in large areas of land that are not suitable for agriculture is termed …….. **(Extensive faming system)**
8. The farming system in which there is limited grazing and stall feeding of cut grass or tree leaves is called as……. **(Semiintensive farming system)**.
9. Sustainable farming systems are generally …… type systems. **(mixed or diversified)**
10. Different breeds of animals were developed by…….**(Selective breeding)**
11. The first farm animals to be domesticated by man were …….. **(sheep and goats)**.
12. The Swedish Botanist, who is considered as the Father of Taxonomy is …….. **(Caroleus Linnaeus)**.
13. The branch of biology concerned with the naming and classification of living organisms (plants and animals) is ……

(Taxonomy).

14. Cattle/buffalo/sheep/goats belong to the family, ……. **(Bovidae)**.
15. The zoological name of Indian cattle is. ……**(*Bos indicus*)**.
16. The zoological name of European/exotic cattle is ……**(*Bos taurus*)**.
17. The zoological name of domestic goat is. …… **(*Capra hircus*)**.
18. The zoological name of domestic sheep is. ……**(*Ovis aries*)**.
19. The zoological name of domestic buffalo is ……(*Bos bubalis*).
20. Adult male cattle that is castrated and used for work purpose is called …… **(bullock)**.

Unit – 3

1. Example of a Short-horned zebu cattle is Hariana or Ongole or Rathi or Nagore
2. Example of a Lateral-horned zebu cattle is …….. **(Gir, Deoni, Sindhi, Sahiwal)**.
3. Example of a Lyre-horned zebu cattle is ……... **(Kankrej, Tharparkar, Malvi)**
4. Example of a Long-horned zebu cattle is …….. **(Kangayam, Khilari, Hallikar, Amrithmahal)**
5. Example of a Small, short horned zebu cattle is ……... **(Ponwar, Punganur)**
6. Indian cattle with long, pendulous ears having a curled leaf-like appearance and a notch at the tip is …… **(Gir)**.
7. Breed in which cows are considered to be the most economic milk producers among the Indian breeds of cattle is …… **(Red Sindhi)**.
8. Breed of cattle resembling Gir cattle to a certain extent is ……

(Deoni).

9. Breed of cattle with Cobra hood shaped horns is …….. **(Kangayam)**.
10. The largest / heaviest Indian breed of cattle is …….**(Kankrej)**.
11. Exotic cattle that is small in size with a straight top line and a double-dished face is …….**(Jersey)**.
12. Black and white exotic breed of cattle with very low fat in milk is ……. **(Holstein Friesian)**.
13. Exotic breed of cattle that is considered as the most beautiful dairy breed of cattle in the world is …….**(Ayrshire)**.
14. The breed of buffalo with tightly coiled horns is ……. **(Murrah)**.
15. The breed of buffalo with sickle shaped horns is ……. **(Surti)**.
16. The breed of buffalo with long, sword-shaped horns is ……. **(Nagpuri)**.
17. The breed of buffalo that has been evolved as a cross between Murrah and Surti breeds is …… **(Mehsana)**.

Unit – 4

1. A housing facility for dairy animals (cattle and buffaloes) is called **Barn**.
2. The floor of the barn should be hard and **non-pervious**.
3. Roof should be strong, durable and **weather proof.**
4. A trough or a box like structure used to offer feed and fodder to cows is called as **manger.**
5. The projection of the roof outside eaves to prevent water/rain – water seepage into the building is called as **Overhang**
6. Pitch **< 45º** in thatched roof buildings is likely to leak.
7. The system in which animals are let out on an open paddock to roam

about freely **loose housing.**

8. Single row shed is employed in farms having number of animals **< 20.**
9. Floor space requirement of an adult cow is **3.5 sq.m**
10. Floor space requirement of an adult bull is **12 sq.m**
11. Floor space requirement of an adult buffalo is **4 sq.m**
12. Floor space requirement of a breeding buck is **3.4 sq.m**
13. Floor space requirement of a boar is **6 – 7 sq.m**
14. Floor space requirement of an ewe is **1 sq.m**
15. A sty in which advanced pregnant sows are transferred is **Farrowing sty.**

Unit – 5

1. The 24 hour feed allowance of an animal is called **Ration.**
2. The ration that provides all the essential nutrients in the correct proportion is called **Balanced ration.**
3. Bulky feed stuffs containing more of less digestible substances with high fibre content is **Roughage.**
4. The total dry matter intake in case of cattle is **2.5%** of its body weight.
5. Green roughage is bulky, easily digestible and **laxative.**
6. Feeding the ration at more frequent intervals **(4times/day)** results in better **digestibility.**
7. The secretion produced by the udder immediately after calving **is Colostrum.**
8. The quantity of colostrum to be fed to calves is **1/10th (or 10%)** of the body weight for five days.
9. Milk is given to the young calves at the rate of **1/10th** of the body weight (twice daily).
10. When the calf starts consuming **250 g** calf – starter per day, milk feeding

can be completely stopped.

11. Feeding extra concentrate ration to advanced pregnant heifers during the last two weeks of gestation/pregnancy is called **Challenge feeding.**
12. Breeding bulls should be maintained in a **trim** condition.
13. For supporting milk production, 1 kg concentrate should be given for every **2.5 lit milk** in case of crossbred cows.
14. A recent method of identification in animals is the use of **microchips.**
15. A very common and frequently used restraint tool for effectively controlling all species of animals is **Rope.**
16. For restraining the whole body of a large animal (cattle or buffalo) **a trevis or crush** is used.

Unit 6

1. The udder of cattle and buffaloes is made up of **four** quarters.
2. The effect of the hormone, oxytocin lasts for only about **5 – 7 minutes.**
3. High producing animals are to be milked **three** times a day.
4. A wrong method of milking animals is **knuclking.**
5. Poor barn ventilation also gives rise to **off-flavors** in milk.

Unit 7

1. One important quantitative (measurable) feature of draught animal performance is **Speed of walking or area ploughed or load carriage.**
2. Bullocks are usually trained for work at **2 – 3 years** of age.
3. Farmers of different regions in India use bullocks for work up to the age of **9 – 10 years.**
4. There is a **decline** in the feed intake of work animals during the work period.
5. Agricultural by-products like **rice bran or wheat bran** are commonly used for feeding work animals.

6. The age at which bullocks are trained for work varies from **2 to 3 years.**

Unit 8

1. The body of a good dairy cow should appear **angular** when viewed from the front, sides and top.
2. The muzzle should be smooth, shiny and moist in **cattle and buffaloes.**
3. In the case of cattle, the heat/estrus cycle ranges from **16-24d.**
4. In the case of buffaloes, /estrus cycle averages **21 d.**
5. Mounting behavior will be pronounced during the **early** heat period.
6. Most of the cows and buffaloes start showing heat signs during **night hours.**
7. It is found that cows usually ovulate and show signs of heat at around **30d** after calving.
8. In the case of goats, the estrus cycle varies from **18 – 21 d.**
9. In the case of sheep, the estrus cycle varies from **14 – 19 d.**
10. The average duration of estrus in sheep is **18 – 24 hr.**
11. The average duration of estrus in goats is **24 – 48 hr.**
12. It is very difficult to detect ewes in estrus in all female flock without the help of a **teaser ram.**
13. A good female pig should have 12 – 14 sound teats in the udder.
14. Teats present in male pigs are called **rudimentary** teats.
15. In the case of pigs, the heat/estrus cycle ranges from **19 - 24 d.**

Unit 9

1. The state or condition of the animal in harmony with the environment is termed as **health.**
2. Intake of unclean water pre-disposes animals to **diseases.**

3. Separating the sick animals from a group to a separate shed is termed as **Isolation.**
4. Keeping all the animals that are brought into the farm from outside away from the farm stock for at least a month is termed **Quarantine.**
5. The process of promoting hygiene and prevention of diseases by maintenance of cleanliness is **Sanitation.**
6. Destruction of all infective and reproductive forms of all microorganisms is called **Disinfection.**
7. Sanitization of drinking water can also be effected by the addition of **bleaching powder.**

Unit - 12

1. Major contributor for origin of Domestic fowl is **Red Jungle Fowl or *Gallus gallus***
2. Zoological name of domestic chicken is ***Gallus domesticus***
3. Most of the breeds belonging to Mediterranean Class lay **white** colored eggs.
4. Most popular breed/variety of chicken producing most of the table eggs in the world is **Single Comb White Leghorn**
5. Feathered shanks are characteristic of **Asiatic** Class birds.
6. Chicken eggs hatch in **21** days of which they are held in the setter for **18** days.
7. Brooding temperature at the beginning is **35ºC** and is reduced at a rate of **2.8ºC** per week.
8. After beak trimming, **lower** beak will be left longer.
9. In laying-type of chicken, feed restriction is generally practiced during **growing** period.
10. Layers require 16 hrs of light per day.
11. Floor space required for broilers aged 5 weeks is **900 cm²** and for

layers it is **1600 cm².**

12. Hatching eggs are stored at **12.8 to 18.3°C or 15.6°C** temperature and > 70% relative humidity.

Abbreviations

A_I	Artificial insemination
BS	Brown Swiss
cm	centimeter
CCBF	Central Cattle Breeding Farm
d	day/days
ºC	Degrees Celsius
FAO	Food and Agricultural Organization
G	Girth
g	gram/grams
GDP	Gross Domestic Product
GoI	Government of India
HF	Holstein Friesian
ha	hectare
hp	Horse power
hr	hour/hours
In	Inches
ICAR	Indian Council of Agricultural Research
ICDP	Intensive Cattle Development Project
JS	Jersey

KVS	Key Village Scheme
kg	kilogram/kilograms
L	Length
lb	pounds
lit	liter
mw	Mega watts
m	million/millions, meter/meters
mg	milligram
ml	milliliter
mm	millimeter
min	minutes
NDDB	National Dairy Development Board
ppm	parts per million, mg/kg
%	percent
RD	Red Dane
seer	An old unit of measurement; equivalent of 0.93 kg
t	tonne
UG	Under-graduate
w/v	Weight by volume

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Z

TextBook of

Animal Science

As per ICAR UG Syllabus

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Indian Council of Agricultural Research (ICAR) which regulates UG Education (Agriculture, Horticulture, Fisheries etc) has mandated a course on Livestock Production and Management which is essential to understand the livestock which are part and parcel of Agriculture. With organic farming gaining momentum, knowledge of basic Animal Production is more relevant than ever before. Students and teachers depend on many publications, Indian and Foreign, during the course of study / teaching. Therefore, a book with contents conforming to the ICAR Syllabus has been long awaited.

This publication has been prepared keeping the ICAR Syllabus as the framework. The Chapters included are Domestication of livestock, Breeds, Hosing, Feeding and management, Milk production and Milking, Breeding, Control of diseases, Record keeping and Economics of milk production. A separate chapter on Poultry Farming is also included because rearing poultry is conspicuously different from that of other animals.

Each of the Chapters has "Study questions" with both objective and subjective questions which is a unique feature of this publication. Answers are provided only for objective questions. However, the questions listed are not exhaustive and the teacher can develop many more contained only by imagination.

It is hoped that this publication will be received well by all those related to the subject "Livestock Production and Management", in general and students of State Agricultural Universities, in particular.

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