Avian Production and Management
LPM-211

COURSE OUTLINE

LPM 211: AVIAN PRODUCTION MANAGEMENT (1+1)

This Course entitled **"Avian Production Management"** emphasizes about

- Various factors responsible for growth and development of Poultry Industry,
- Common breeds of poultry including duck, quail, turkey & guinea fowl and indigenous fowls.
- Male and female reproductive systems, formation of eggs
- Important economic traits of poultry
- Backyard poultry rearing

This course is intended for providing information in detail about

- Optimum conditions for Incubation of eggs
- New colored feathered birds developed for meat and egg production for rural poultry,
- Scavenging system of management - raising the chicks
- Management practices - Brooding and rearing practices for chicken, duck, quail, turkey and guinea fowl,
- Organic and hill farming. Mixed farming
- Marketing of poultry and poultry products
- Project preparation on poultry

MODULE-1: INDIAN POULTRY INDUSTRY

Learning objectives

This module deals with

- Growth and development of Poultry Industry in India
- Strength/Achievements of Poultry Industry
- Statistics on Poultry population and Per-capita availability in India
- Various factors responsible for commercialisation of Poultry

GROWTH OF POULTRY INDUSTRY

- Scientific Poultry keeping in India - first advocated by Christian Missionaries towards the beginning of the 20th Century A.D
- Organized effort to develop poultry in India was first started in 1957 when second five year plan (1956-61) was launched
- Hybrid layer strains - introduced into India in 1955 and broiler strains in 1961
- An All India Poultry development Project - initiated by setting up of regional poultry farms at Bangalore, Mumbai, Bhubaneswar, Delhi and Simla to acclimatize imported good quality stock under their respective agro-climatic conditions
- Period between II and IV Five-Year plan - turning point in the history of poultry industry in India
- Central Poultry Breeding Farms at Mumbai, Bhubaneswar and Hasserghatta - produced high egg producing strains and Chandigarh farm has evolved fast growing broiler strains
- Random Sample units at Hasserghatta, Mumbai and Bhubaneswar were conducting egg laying and broiler quality test and thereby provided useful information to poultry farmers and breeders regarding the performance of various stocks available in the country
- Central Training Institute for poultry production and management at Hasserghatta - Imparted training to the State Agricultural and Veterinary University officers engaged in various aspects of poultry farming
- Indian Council of Agricultural Research (ICAR) has sponsored All India coordinated research projects on poultry breeding and poultry nutrition in number of research institutes including Agricultural and Veterinary Universities of the country
- National Agricultural Co-operative Marketing Federation of India (NAFED) - marketing of egg and poultry meat at national and regional levels

POULTRY DOMESTICATION

- Historical and Archaeological evidences - chickens were domesticated during 5400 B.C.,
- The term "Poultry" indicates all domesticated species of birds like chicken, ducks, turkeys, Japanese quail, guinea fowls, geese, pigeons, ostrich, emu etc.,
- Chicken - most numerous and popular among the domesticated poultry species and account for 92 per cent of the total poultry
- Ducks account for 9 per cent of poultry population (FAO, 2008) and are mostly found in coastal states of the country and in states with more lakes and rivers like West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Assam, Jammu & Kashmir and Tripura
- Duck raising - still in a primitive stage and indigenous ducks outnumber exotic ducks in spite of their inferior performance
- Important Indigenous ducks are Chara and Chemballi (Kuttanad ducks) of Kerala, Sythetmete and Nageswari of Eastern region, Aarani ducks of Tamilnadu, Pati, Deo, Cinahanh and Raj Hanh varieties of Assam.
- The duck population in Asia is 101 million (FAO,2008)

- India has a population of 36 million ducks (FAO,2008)
- Quail eggs and meat have also become popular
- Growth of quail farming - is progressing but the progress is slow due to insistence on wild life licensing, high cost of production and non-availability of superior quail germplasm
- Turkey, Guinea fowl farming, Emu and Ostrich farming - are in infant stage and has good potential for commercial exploitation

STRENGTH / ACHIEVEMENTS OF POULTRY INDUSTRY

- High consumer acceptance of eggs and Broiler meat
- Improved Feed Conversion Ratio (FCR), quality control, upgraded management.
- Advances in new feed milling technologies
- Purchase of feed raw materials and supply of better quality materials
- Better breeding stocks with assured price
- Rationalized pricing of breeder and commercial stocks
- Pelleted feeds with increasing market share
- Availability of feed additives viz. enzyme, probiotics, prebiotics, acidifiers etc.
- Positive role of Integrators and corporates in industry
- Distribution of feed units in all regions
- Increase in percentage of processed foods
- Effective and fast transport system of raw and finished products
- Marketing of branded eggs
- Tapping of export potentials
- Advancement in disease diagnosis and screening procedures

Development of poultry industry in India has been brought about by the following ways

- Developing new more productive layer and broiler strains
- Development of vaccines
- Giving freedom to the poultry farmers for fixing prices for egg through organizations like National Egg Co-ordination Committee (NECC)
- Financing of poultry schemes

POULTRY PRODUCTION

- Improvement in genetic potentiality and productivity of hybrid layers and broilers - 60 per cent of the increase in production of egg and meat
- Hybrid layers of today - lay on an average of 310 eggs per year compared to 240-250 eggs 30 years back
- Genetic improvement - Broilers which achieved mean body weight of 1500 g at 8 weeks of age during early eighties of 20thcentury attain 1.8-2.0 kg mean body weight at present in about 38 days of age
- India - **Third** largest producer of eggs in the world next only to China and USA
- Andhra Pradesh, Maharashtra , Haryana and Tamil Nadu - major egg producing states that account for more than 60 per cent of the eggs produced in the country
- India ranks **fifth** in the world in respect of poultry meat production with the highest production recorded for USA
- Andhra Pradesh - leading state in broiler production; other major broiler producing states are Tamil Nadu, Maharashtra, Punjab, West Bengal and Karnataka. More than 65 per cent of the broilers produced in India are raised in these states.

INDICATORS - POULTRY STATISTICS (Source:FAO)

- Historical and Archaeological evidences - chickens were domesticated during 5400 B.C.,

Egg Production

- During the past four decades, annual egg production in India has gone up to register about 55,640 million eggs in 2010 (estimated)
- Per capita availability of eggs - increased from a mere seven eggs per annum to 48 in spite of population explosion witnessed in India

Broiler Production

- Although hybrid broiler strains - brought into India in the year 1961, the highly tender and juicy broiler meat was not readily accepted by the Indian public
- Sustained propagation by the Government, State Agricultural Universities and the industry has resulted in growing awareness on the nutritive aspects and cost advantage of broiler meat over other red meats like mutton, chevon etc
- An initial, slow and steady growth - witnessed in broiler population during 70's and the broiler industry during 1985 had made an impressive growth
- The low fat, low calorie, high protein, cost effective broiler meat -now finds ready acceptance not only among urban consumers, but also in rural households

Indicators of Poultry Development in India

Year	Production			Per capita availability	
	Eggs (Million)	Broiler (Million)	Poultry Meat ('000 MT)	Eggs (No.)	Poultry Meat (g)
1961	2881	<1	81	7	188
1971	5340	4	121	10	220
1980	12500	30	179	18	266
1985	16128	75	274	22	365
1990	23300	190	412	28	498
1991	23660	215	440	28	521
1992	22740	210	427	26	493
1993	24800	235	454	28	517
1994	26290	275	507	29	566
1995	28130	330	578	31	633
1996	30000	400	659	32	707
2000	33500	700	980	34	820
2003	37000	1100	1440	37	1200
2005 2007 2010	44000 51000 55640	1700 2000 2370	1900 2240 2650	41 45 48	1400 1980 2300

FACTORS RESPONSIBLE FOR COMMERCIALISATION OF POULTRY

- High prolificacy -one layer breeder produces at least 240 chicks in an year
- Shorter generation interval
- It is adaptable to various agro-climatic conditions, i.e. chicken can be reared at temperatures as low as 00C and as high as 400C. Chicken can be economically reared in arid, semi-arid conditions aswell as in high humid zones.
- Chicken can be reared under high stocking density (number of birds/unit area). In one acre of land, about 10,000 layers under deep litter system of rearing and 25,000 layers in cage system can be reared; in case of broilers, about 20000 birds can be reared whereas only limited heads of cattle or sheep can be reared in the same holding. Poultry farming requires a modest initial capital outlay and its returns are achieved much earlier.
- Land required for poultry need not be fertile, further the water requirement is also less when compared to other species of livestock. Cattle production and small ruminant production are dependent mostly on the availability of land, which is a limiting factor for improving such activities.

- Poultry can be managed under varied systems and also it easily adapts to automation, enabling large numbers to be reared in one farm. Poultry farming and production techniques are simple and need less skill which means that even the uneducated or poorly educated rural population can run a poultry farming business quite successfully if the necessary facilities are made available at a reasonable cost.
- Among the various species of livestock, the dressing yield and edible yield of poultry is the highest.
- Poultry: 72-75%; Beef: 50-55%; Pig: 68-72%; and Sheep & Goat: 40-48%.
- Poultry meat and egg are food materials universally acceptable without being forbidden by any religious taboos.
- The poultry industry has helped in uplifting the allied industries like manufacturing of equipment, feed, pharmaceuticals, vaccines etc. Credit facilities are available from various nationalised banks, scheduled banks, rural co-operative banks etc., with refinancing facility from National Bank for Agriculture and Rural Development (NABARD). In other words, poultry farming provides the employment for rural and urban population with scope for diversification, increases revenue, and enhances the value of certain agro and industrial products and by-products by transforming them into quality products like poultry meat and eggs.
- Poultry meat and eggs are considered to be the cheapest food sources of animal protein. There is a higher consumer preference for poultry products because of low value units of eggs and young broiler meat available at low cost.
- Unlike other animal fats, egg and chicken lipids are not fats; but oils good for health; they contain more omega-9 fatty acid-MUFA which increases the good HDL-cholesterol in the serum. Moreover, they contain considerable amounts of omega-3 fatty acids (N-3 PUFA) which reduce the serum bad LDL-cholesterol. Hence, egg and chicken lipids are good for health.
- Chicken are the most efficient converters of feed into meat and egg. It hardly requires 1.6 kg of feed to produce 1 kg of body weight and in case of eggs it requires 1.4 kg of feed to produce 12 eggs or 2.0 kg of feed to produce 1 kg of eggs

FUTURE GROWTH AND DEVELOPMENT OF POULTRY INDUSTRY

The factors which will promote and accelerate the growth of Indian poultry sector during the next two decades include:

- Increase in human population of the country as well as that of the world.
- Change in the life style of people with more people becoming non-vegetarian.
- Strict enforcement of Animal Welfare Laws in industrially developed countries resulting in shifting of production centres to developing countries like China, India, Brazil and Mexico.
- Increase in demand for poultry and poultry products in world market.
- Competitiveness of poultry egg and meat compared to the other foods of animal origin.
- Poultry's contribution to food production and food security and its special role in alleviation of poverty and employment and empowerment of rural women.
- Organic egg and meat is gaining popularity in western countries even though they cost more. Small holder backyard systems of poultry production existing in our country provide ample opportunity for production of organic poultry egg and meat. This will help in expansion of small holder system and also in obtaining foreign exchange.

Future appears to be very bright for poultry egg and meat processing industry. Rapid growth of this sector will help to provide wholesome poultry products to the consumers.

The demand for ready-to-cook chicken and value added poultry products although very small at present, is likely to grow several folds very soon as has happened in western countries through appropriate consumer education and if necessary through suitable legislation. The ability of the Indian poultry sector to fulfill its targeted growth in productivity and output will depend upon the quality, availability and accessibility of services. Development of human resources and upgrading the skill and capability of existing human resources will be necessary.

MODULE-2: CLASSIFICATION OF POULTRY

Learning objectives

- This module deals with various classes, breeds and varieties of poultry.

DOMESTICATED SPECIES OF POULTRY

- Chicken
- Ducks
- Turkeys
- Geese
- Quails, Guinea fowl and Pigeons

DEFINITION OF CLASS, BREED, VARIETY, STRAIN AND LINES

- *Class* - Used to designate a group of birds - developed in certain regions or geographical areas. They are American, Asiatic, Mediterranean and English.
- *Breed* - refers to an established group of birds within a species related by breeding, possessing a distinctive shape, conformation, plumage colour, comb type, general body weight and breeds true. Ex. Aseel, Rhode Island Red, Leghorn, Cornish, etc.
- *Variety* - used to sub-classify breeds. There may be many varieties within a breed differentiated by plumage colour, pattern and comb type Ex. White Leghorn, Black Leghorn, Brown Leghorn, Barred Plymouth Rock etc.
- *Strain* - Sub classifications of a breed. Normally a strain is named after the person who has evolved them or it can also be named after the institution where it is developed. They are developed duly giving importance to certain specific traits like egg production, early maturity, better feed efficiency, egg weight etc. Ex. Meyer strain of White Leghorn, Forsgate strain of White Leghorn, Sterling strain of Rhode Island Red.
- *Lines* - Sub classes of a strain developed such that the gene(s) responsible for a particular trait is fixed so as to be utilized for production of commercial hybrids.

HYBRIDS OF CHICKEN

- These are incrossbreds of poultry, produced by 2-way, 3-way or 4-way crossing of inbred pure lines.
- They are the actual commercial-type of poultry used for egg or meat production; since they are high laying/fast growing. However, they will not breed-true and are unfit for further breeding.
- These birds possess high degree of heterosis and hybrid vigour.

1. Common egg-type hybrid chicken

- BV-300, ISA, Babcock, Bovans, Euribrid, Hyline, HH-260, Dekalb, Keystone, Lohmann and H & N Nick chick.

2. Common Meat-type hybrid chicken

- Cobb, Ross, Steggles, Arbor acres, Hub chicks, Hybro, Hubbard, Lohmann, Pilch, Starbro, Tegel, Anak-2000, Marshall, Peterson, Samrat-2000 and Avian-34.

NOMENCLATURE OF DIFFERENT POULTRY SPECIES (Age and Sex wise)

Sl. No.	Species	Adult		Young	
		Male	Female	0-8 weeks	9-18 weeks
1.	Chicken	Cock	Hen	Chick	M:Cockerel
					F:Pullet
2.	Duck	Drake	Duck	M:Drakeling	M:Drakelet
				F:Duckling	F:Ducklet
3.	Goose	Gander	Goose	Goosling	
4.	Turkey	Tom Turkey	Turkey hen	Poult	
5.	Quail	Quail cock	Quail hen	Quail Chick	
6.	Guinea Fowl	Guinea Fowl	Guinea Fowl	Keet	
7.	Pigeon	Pigeon	Pigeon	Squab	

POULTRY BREEDS-HISTORY OF EVOLUTION

- In the process of evolution, *cold blooded (poikilotherms) reptiles* are the ancestors of birds
- The birds are *warm blooded, (homeotherms)* feathered and flying reptiles, adapted for hot and dry climate of their terrestrial habitat
- Now birds are classified into the class Aves, Subclass *Neornithes*, super order *Ratitae* (flat breast bone- Ostrich, Emu and Kiwi) and *Carinatae* (Keel breast bone- all flying birds)
- *Red jungle fowl* - closely resembles chicken so that there is no doubt that it was the main ancestor.
- Historical and scientific documentations suggest that domestication of chicken originated from the Asian continent only. China, India, Bangladesh, Myanmar (Burma), Thailand, Sri Lanka, Malaysia and other South East Asian countries were the home of the ancient jungle fowls from which the modern day breeds and commercial strains of chicken were evolved.

Zoological names of domesticated fowls with Chromosome number

Sl. No.	Common Name	Zoological Name and Chromosome number (2n)
1.	Chicken	*Gallus gallus domesticus* -78
2.	Duck	*Anas platyrynchos* - 80
3.	Turkey	*Meleagris gallopavo* - 80
4.	Goose	*Anser anser- 80*
5.	Japanese quail	*Coturnix coturnix japonica - 78*
6.	Bobwhite quail	*Colinus virginianus -78*
7.	Guinea fowl	*Numida meleagris - 78*

8.	Partridge	*Perdix perdix- 80*
9.	Pheasant	*Phasianus colchicus - 82*
10.	Pea fowl	*Pavo cristatus – 80*
11.	Ostrich	*Struthio camelus – 80*
12.	Pigeon	*Columba livia – 80*
13.	Dove	*Columba oenas -80*
14.	Muscovy Duck	*Cairina moschata – 80*
15.	Emu	*Dromaius novaehollandiae-80*

CLASSIFICATION OF CHICKEN

- Based on the place of origin (Standard or official classification)
- Based on utility, economics or commercial value

BASED ON THE PLACE OF ORIGIN

- *Asiatic* - Eg. Brahma, Langshan, Cochin
- *American* - Eg. Plymouth Rock, Rhode Island Red, Wyandotte
- *Mediterranean* - Eg. Leghorn, Minorca, Ancona
- *English* - Eg. Orpington , Sussex, Cornish
- *Continental* - Eg. Houdans, Hamburg, Polish, Campines, Lackvelders
- *Oriental* - Eg. Malaya, Yokohama, Sumatra, Cubalayas
- *French, South American (or) Latin American* - Eg. Araucana
- *African* - Eg. Negro, Jago
-

BASED ON UTILITY, ECONOMICS OR COMMERCIAL VALUE

- *Egg-type:* Eg. Leghorn
- *Meat-type:* Eg. Cornish, Plymouth Rock
- *Dual purpose:* Eg. Rhode Island Red, New Hampshire
- *Game type:* Eg. Aseel
- *Fancy variety or Exhibition - type:* Eg. Silky, Frizzled, Bantams
- *Desi type:* Eg. Kadaknath, Naked neck, Chittagong
-

GENERAL CHARACTERISTICS OF VARIOUS STANDARD CLASSES OF CHICKEN

American Class

- Body size - Medium to heavy
- Egg shell colour -Brown
- Shanks - Clean and yellow
  Skin - yellow (except Jersey Black giant, where the shanks are black) Ear lobes-Red
- Comb Shape- Rose or Single
- Eg. Plymouth rock, Wyandotte, Rhode Island Red, Jersey Black giant, New Hampshire

Asiatic Class

- Body size -Heavy
- Egg shell colour-Brown,
- Broody with motherly instinct
- Ear lobes -Red, mostly
- Shank - feathered and yellow
- Skin - Yellow (except Langshan)
- Eg: Brahma, Cochin, Langshan

English Class

- Body size - Medium to large
- Egg shell colour - Brown
- Ear lobes - Red
- Shank - Clean and White
- Skin -White
- Comb shape -Single (except Cornish with pea comb)
- Eg: Australorp, Cornish, Dorking, Orpington and Sussex

Mediterranean Class

- Body size -Small
- Egg-type, non-broody
- Egg shell color - White
- Ear lobes -White
- Shanks - Clean and yellow/slate coloured
- Skin -Yellow or White
- Eg: Leghorn, Minorca, Ancona, Andalusian

INDIGENOUS FOWLS - ASEEL

Indian Chicken Breeds

Aseel

- The literal meaning of *Aseel* is real or pure.
- Aseel is well known for its pugnacity, high stamina, majestic gait and dogged fighting qualities.
- The name *Aseel* appears to have been given to this indigenous breed because of its inherent qualities of fighting. The remarkable endurance of an Aseel even during the most critical stages of fight is proverbial as it prefers death to dishonour. The Aseel is, therefore, known to every game lovers all over the world for these specific characteristics.
- Andhra Pradesh is said to be the home of this important breed. The best specimen of this breed, although rare, are encountered with the fanciers and the people engaged in cock-fighting show through out the country.
- Aseel is larger inbuilt with noble looking and dignified appearance. A good specimen of an Aseel cock usually measure 28 inches from back to toe.
- The standard weight varies from 3 to 4 kg for cocks and 2 to 3 kg for hens. The wattles are rudimentary and almost imperceptible. The beak is short and well curved. The face is long and not covered with feathers. The eyes are compact, well set and present bold looks. The neck is long, uniformly thick but not fleshy.
- The general feathering is close, scanty and almost absent on the breast. The plumage has practically no fluff and the feathers are tough. The tail is small and the legs are strong, straight, clean and set well apart. The birds as a rule present upright material gait suggestive of strength and alertness. Aseel is larger in built with noble looking and dignified appearance.

Performance Profile

- Body weight at 20 weeks 1220 g
- Age at sexual maturity 196 days
- Annual egg production 92
- Egg weight at 40 week 50 g
- Fertility 66 %
- Hatchability FES 63 %

Chittagong

- It is also known as Malay and is found in Eastern India

INDIGENOUS FOWLS - KADAKNATH

- This breed is otherwise known as “Kalamasi” which means “fowl with black flesh” and is native of Madhya Pradesh
- The colour of the day old chicks is bluish to black with irregular dark stripes over the back.

- The adult plumage varies from silver to gold spangled to blue black without any spangling.
- The skin, beak, shank, toes and soles of feet of males and females are dark gray colour. Even the comb, wattles and tongue also show a purplish hue. The shining blue tinge of the earlobes add to its unique features.
- The peculiarity of this breed is that most of the internal organs show the characteristic black pigmentation which is more pronounced in trachea, thoracic and abdominal air sacs, gonads, elastic arteries, at the base of the heart and mesentery. Varying degree of blackish colouration is also found in the skeletal muscles, tendons, nerves, meninges, brain and bone marrow. The black colour of muscles and tissues is due to the deposition of melanin pigment, a genetic condition called "Fibromelanosis".

Performance Profile

- Body weight at 20 weeks (g) 920
- Age at sexual maturity (days) 180
- Annual egg production (number) 105
- Egg weight at 40 week (g) 49
- Fertility (%) 55
- Hatchability FES (%) 52

Busra

- Small to medium sized bird found in Gujarat

INDIGENOUS FOWLS - NAKED NECK

- Naked neck is relatively larger inbuilt with long cylindrical neck.
- As the name indicates, neck of the birds is fully naked or only a tuft of feathers is seen on the front of the neck above crop. The resulting bare skin becomes reddish particularly in males as they approach sexual maturity. General body feathering is also reduced.
- Various types of combs *viz.* pea, rose, walnut and single combs are seen.
- The beak is short and well curved. The face is long and not covered with feathers. The eyes are compact and well set. The skin is thin and pinkish in colour.
- The beak and shanks have no correlation with plumage colour. Main plumage colours are brown, black, white and mixture of brown and black.

- Due to the reduced feathering, the birds are capable to tolerate the tropical stress. It lays the biggest size eggs among all the Indian native breeds of chicken.
- Trivandrum region of Kerala is considered to be the homeland of Naked neck but it is available throughout hot and humid coastal area including Andman and Nicobar island and North-Eastern states of the country in small numbers.
- People of these regions have great affinity for Naked neck birds due to their better adaptability to the hot and humid climatic conditions as well as for better taste and flavour of meat.

INDIGENOUS FOWLS - FRIZZLE

- Frizzle fowls have oval body with well-developed comb and wattles. The skin is thin and pinkish pale in colour.
- The beak and shanks generally have no correlations with the plumage colour and are creamish pale in colour.
- The birds have single comb and earlobes are well developed with white spots on them. The eyes are bright and well-developed. Plumage colours vary considerably among the birds but white, brown, black and mixed colour are most common.
- Frizzle fowls are found all over the hot and humid coastal areas including Andaman Nicobar Islands.
- Good numbers of these birds are also available on high altitudes hilly tracts of North-Eastern states.
- It is said that birds have better adaptability to the hot and humid climatic conditions.

DUCKS

The domesticated breeds of ducks can be classified as follows

- Egg type breeds
- Meat type breeds
- Ornamental type and
- Indigenous breeds

EGG TYPE BREEDS

Campbell

- Campbell ducks - developed by Mrs. Campbell during the beginning of the 19th century by crossing Rouen (male line) with Indian Runner (female line)
- Khaki Campbell is a variety resulted from colour selection of the Campbell breed
- The drake is having lustrous green bronze colour in head, neck up to sternum and the remainder body is of shades of Khaki and the duck is having uniform shades of khaki throughout the body which makes it useful for sex differentiation

Indian Runner - derives its name from its place of introduction- East India

- It is having perpendicular carriage which is the out standing feature of this breed
- It does not have pronounced shoulders
- The body shape and carriage (posture) resemble the penguins
- Three standard varieties - Fawn, White and White penciled
- They are excellent layers and thus formed the female line in developing the Campbell ducks

Nageswari

- It is an indigenous egg type breed of duck commonly seen in North-eastern part of the country.
- These birds are highly resistant to disease and capable of laying 180-200 eggs even under the range system of rearing.
- The females weigh around 1.5 kg and males weighing 1.7 kg.
-

MEAT TYPE BREEDS

Pekin - These ducks originated in China

- White Pekin is the most popular duck.The plumage is creamy white, the flesh is yellow and the bill and legs are deep orange
- The adult body weight of drake and duck will be 4 kg and 3 kg
- Early maturity, fleshing and good laying capacity are the special features of this breed

Aylesbury -Native of England

- The plumage colour is spotless white in both the sexes. The legs and feet are orange. It is larger than pekin and the adult drake and duck weigh around 4.5 kg and 4 kg, respectively

Rouen ducks - Originated in France. This formed the basis (male line) for developing Campbell ducks

Muscovy - Originated in South America. The males have no characteristic drake feathers. However, have a knob on the head like a crest. If Muscovy is crossed with other ducks, the progeny will be "**sterile"** called **Mule ducks** having high growth rate and lean meat. The incubation period is 35 days .

The plumage colour is spotless white in both the sexes. The legs and feet are orange. It is larger than pekin and the adult drake and duck weigh around 4.5 kg and 4 kg, respectively

ORNAMENTAL TYPE

- Buff Orpington, Mandarin, Crested white etc.

INDIGENOUS BREEDS

Indigenous duck breeds

- Sythetmet, Nageswari ducks of North Eastern states
- Kuttanad ducks of Kerala (Variety -Chara and Chemballi)
- Arani ducks of Tamilnadu

In India, 90-95 percent of ducks are indigenous or nondescript types, which are hardy, with mediocre egg production and highly suitable for extensive system of rearing.

Hybrid Ducks

- Cherry valley (Both Meat and Egg type)
- Hytop (Mule duck)
- Legarth (Meat-type)

TURKEYS

- Turkeys - originated from Northern and Central America and were domesticated about 300 years ago by the Europeans colonized in North America

Common varieties of turkeys

- Broad Breasted Bronze
- Broad Breasted White
- BeltsVille White
- White Holland
- Narragansett

BROAD BREASTED BRONZE

- Most popular and heaviest variety of turkey
- As the name indicates, it is having a broad and prominent chest region and bronze coloured feathers
- The males and females at maturity weigh 15-18 kg and 12-13 kg, respectively
- Most of the present day hybrid turkeys are crosses of different strains of Broad Breasted Bronze or Beltsville White
- One of the common hybrid turkeys popular in North America is *Nicholas Turkey*. It is the cross of the Broad Breasted Bronze and Beltsville white
-

BELTSVILLE SMALL WHITE TURKEY

- It is a medium sized turkey having white feathers
- They produce more eggs compared to Broad Breasted Bronze
- The toms weigh 10-12 kg at maturity and hens 7-8 kg

WHITE HOLLAND

- It is a popular variety of turkey most commonly found in European countries
- It is bred and developed in Holland after importing several varieties from North America
- They are also used in producing crosses with the local turkeys to improve their growth rate and reproductive ability
- The toms weigh 10-12 kg and the hens 6-8 kg at maturity

NARRAGANSETT

- This is a popular variety next to White Holland
- It is commonly reared in Germany and Italy
- Most of the hybrid turkeys available in Europe are crosses of White Holland or Narragansett

GEESE

Toulouse

- Originated in France. Some strains are non-broody and the goose is a fair layer among the heavy breeds
- Gooslings tend to grow slowly and have to be kept to an older age before being ready for market
- The flesh is coarser than the Emden and the proportion of bone and offal is high
- The progeny of a Toulouse goose crossed with an Emden gander grows rapidly and has good fleshing qualities
  Gander-14 kg; Goose-9 kg

Emden

- Originated from Hanover in Germany
- It is a heavy breed, a prolific breeder with a quiet disposition and currently the most popular in New South Wales
- Emdens are good egg producers (upto 40 eggs per season), good sitters, early maturing and good foragers
- Because feathers from Emdens are white, they are of greater value than feathers from other geese
- Gooslings can be sexed at day old with a reasonable degree of accuracy as female chicks have a darker down than male chicks
- Bill, legs and feet are bright orange and the hard tight plumage is pure glossy white
- Other goose breeds are African, Chinese, Egyptian, Canada etc.

JAPANESE QUAILS

- In India, the Japanese quail, scientifically known as *Coturnix coturnix japonica* is very popular
- These birds are well suited for research studies and economical
- Males weigh less than the females
- Colour of the feathers in the breast region in the male is a plain rust colour while in the female it is speckled
- Eggs are mosaic patterned
- The known breeds of Japanese quails - Manchurian Golden, British Range, English White and Tuxedo

Japanese quail meat

- Japanese quail can be sold to the market at five weeks of age as live birds. The practice of hot water dipping and defeathering is not followed, and the skin is removed along with feathers, after the birds have been bled, by slitting the necks.
- Cleaned meat will be 70-74 percent of the live body weight. Quail meat contains more protein (22-24 percent) and less fat (about 2 percent) than most other kinds of meat, like mutton, chicken, etc. Therefore, it is good for growing children and youths and also for convalescing and health-conscious adults.
- Quails carry more meat in the breast region (41 percent) and also contain a high amount of calcium.

Japanese Quail egg

- Quail eggs are tasty, they contain more yolk than chicken eggs. They can be served as boiled eggs for table purposes, and children are very fond of them. Quail eggs contain higher proportions of high-quality protein and fat. They can also be used to prepare pickles.

GUINEA FOWL

Guinea fowl - derive their name from Guinea, a part of the West Coast of Africa

The domestic guinea fowls descended from one of the wild species of Africa and the ancient Greeks and Romans were known for raising them as table birds.

Origin	Africa
Adult body weight	1.5 kg
Sex differentiation	By voice
Age at sexual maturity	6-7 months
Varieties	Pearl , White and Lavender
Annual egg production	170-180 eggs
Egg weight	40-45 grams
Egg shell colour	Dark brown
Purpose of rearing	Meat purpose, Have red lean meat with strong game flavour
Marketing Age	12-13 weeks
Incubation period	28 days

COMB

Comb types

- A comb is defined as a fleshy protuberance on top of the head of a fowl, larger on the male fowl than the female.
- Comb patterns help in identifying the various breeds and varieties of chicken. The common comb pattern noticed in chicken is the *'single comb'*. This comb is very prominent in the White Leghorn breed.

- A typical comb has a base, blade, serrations, points and spikes.
- The comb is an indicator of the reproductive ability of the bird as the growth of the comb is controlled by oestrogen and androgen hormones. An experienced farmer will distinguish a healthy bird from a sick bird by observing the comb alone.
- The comb should be brick red in colour and erect (except in White Leghorn females where it falls on anyone side) it should be prominent, rigid, velvetty, soft, warm and waxy to touch.
- Sick birds or a poor layer will have a dry, shrunken, pale, cold comb, with chalky deposits over the surface. Some of the diseases can be identified by the colour and condition of the comb.

COMB VARIETIES

The varieties of comb are

- Single comb
- Rose comb
- Pea comb
- Strawberry comb or Walnut comb
- Cushion comb
- Cap comb
- Cup comb

SINGLE AND ROSE COMB

Single comb

- This is a comb when viewed from the front is narrow and has spikes on the top, one behind other.
- It consists of a blade which is the lower solid portion.
- The space between the spikes are known as serrations. The serrations and spikes are definite in size and shape in different breeds.
- White Leghorn has five or six spikes. Rhode Island Red has six spikes. The number of spikes on the comb depends on the action of the modifying genotype. (e.g.) White Leghorn, White Rock.

Rose Comb

- This comb is nearly flat on the top and is covered with small irregular points finished with spikes. It varies in length and the length of carriage varies according to the breed. The modifying genes determine the size and number of rounded points on the comb as well as the length and direction of the spikes. (e.g.) Rose combed Leghorn, Wyandotte.

PEA, WALNUT AND CUSHION COMB

Pea comb

- This is a comb resembling three very small single combs joined together at the base and rear. (e.g.) White Cornish, Dark Cornish

Walnut or Strawberry comb

- This comb resembles one half of a strawberry fruit or a walnut with the round part uppermost. It is small in size and has irregular grooves on the surface. (e.g.) Malay, vaienkoppe

Cushion comb

- This comb is basically noticed in the Silkie breed. (e.g.) Silkie

CAP AND CUP COMB

Cap comb or V-shaped comb

- This comb will be in the form of a stylish cap and this is seen in red cap breeds. (e.g.) Polish.

Cup comb

- This comb is cupped between two single combs stretched further apart and fused at the base. This is seen in butter cup breeds.(e.g.) Butter cup, Poland.

FEATHER

Parts of feather

- The root is called *'calamus'*. The base is known as the *'quill'*, which gives rise to a structure known as a shaft which in turn terminates in a structure called *'rachis'*.
- The structure called barbs arise from the shaft which gives rise to the barbule. This further gives rise to barbicels. These join together to form the vane.
- Feather serves as a protection to the bird from extremes of weather by insulating the body. They are essential for flight. The feather pattern and colour will assist in identifying the breed and variety and also help in identifying the sex of the bird, because sexual dimorphism exists in the feather pattern of poultry.

Sex differentiation

- In the male fowl the tail feathers are sickle shaped.

- In case of ducks the male has a curved tail feather (sex curl) known as the *'Drake Feather'*, which is useful in identifying the sex of the bird.
- In the Tom turkey the tail feather is long when compared to that of the female.
- In the *Japanese quail* the feathers on the neck and breast region of the male is golden or rust brown, while in the female it is speckled. Condition of feathers help in identifying a good layer from a non-layer, an old layer from a young layer and also to identify the stage of moult in a bird.

Male Japanese quail

Female Japanese quail

FEATHER TYPES

The various types of feathers are as follows:

- Contour feather: This forms the general covering of the body and wings including the large flight feather of the wings.
- Covert feather: These are noticed on the base of the wings and do not have barbicels; also called fluff.
- Down feather: This is present in newly hatched chicks. Sometimes it is seen below the contour feathers especially in the abdominal and head regions.
- Filo plume: Hair like structures under the contour feathers of the body, which can be seen when the feathers are plucked. It consists of an axis and very few terminal barbs.
- Pin feather: Are very small feathers.

FEATHER TRACTS

- Even though the body of the bird looks fully covered with feathers, it has originated only from certain definite feather tracts called **"Pterylae".** There are 10 pairs of feather tracts.
    - Cephalic
    - Alar
    - Humoral
    - Spinal
    - Crural
    - Ventral
    - Femoral
    - Cervical
    - Auxiliary
    - Caudal
- During the moulting process, the feathers are shed in a particular pattern starting from the cephalic tract and finally ending with the crural tract.

MODULE-3: EGG FORMATION AND STRUCTURE

Learning objectives

This module deals with

- Steps involved in the process of Egg formation
  - *Graafian follicle development, Albumen secreting region, Shell and Shell membrane secreting region, formation of Cuticle and Pigment secreting region-Oviduct*
- *Hormonal control of Ovulation and Oviposition*
- Structure of egg and Different parts of Egg *viz.Albumen, Egg yolk, Air cell, Shell and Shell membrane*

PROCESS OF EGG FORMATION

Formation of egg

- The yolk is not the true reproductive cell, but a source of food material from which the live cell (blastoderm) and its resultant embryo partially receives its nutrients for growth
- When the female attains sexual maturity- mature ovum inside the graffian follicle grows rapidly and reaches its full size in about 9 to 10 days due to the action of Follicle Stimulating Hormone (FSH) produced by the anterior pituitary
- The yolk weight also increases 7 days prior to ovulation due to the deposition of yolk material over the ovum in concentric and alternate layers of white and yellow of which, white layer of yolk is deposited during the night and the yellow layer during the day
- As the ovum increases in size, due to the deposition of yolk, the nucleus migrates from the centre of the ovum to the periphery and lies underneath the *vitelline* membrane
- The nucleus of the infertile egg is called '*germ spot*' and that of fertile egg *'germ disc'*
- The anterior pituitary releases Follicle-Stimulating Hormone (FSH) that regulates the growth and maturity of graffian follicle and Luteinising hormone (LH) that helps to release the ovum by rupture of graffian follicle
- The liberation of ovum from graffian follicle is called *Ovulation*
- Ovulation occurs normally 14 to 75 minutes after *oviposition* (act of laying)
- Most of the albumen is formed in the magnum, so it is known as the albumen-secreting region of the oviduct. Peristaltic movement of the magnum pushes the ovum to the isthmus
- *Chalazae,* the egg protein formed in the magnum, becomes visible only in the uterus and not before, probably because of change in colloidal structure of albumen adjacent to the yolk and rotation of this albumen around the yolk in the uterus.
- The inner and outer shell membranes of the egg are formed in the isthmus. Probably some amount of water is also added to albumen in the isthmus.
- The uterus is responsible for the formation of egg shell and hence is also known as *shell gland*. Calcium required for the formation of the egg shell is mobilized from the feed assimilated and long medullary bones.
- The tubular and unicellular glands present in uterus secrete a watery fluid which is added to the albumen through the shell membranes.
- The shell pigments are formed in the uterus during the last 5 hours before the oviposition and brown colour of egg shell is due to the pigment *Porphyrin*.
- The cuticle is laid on the outside of shell in the uterus and it represents the last of the concentric layers of egg formation.
- The oviposition or laying of egg, is through the contraction of uterus. The hormones responsible for uterine contraction and oviposition are oxytocin and vasotocin released from the posterior lobe of pituitary.

EGG STRUCTURE

Four Major structures of the egg from outside to inside are

- Shell
- Shell membranes
- Albumen
- Yolk

EGG SHELL

The egg shell consists of

- Cuticle
- Spongy or calcarious layer
- Mammillary layer or matrix and pores
- Pores are funnel shaped, distributed at right angles to the shell surface and form connecting passages between the shell membrane and cuticle.
- Average number of pores varies from 8,000-10000 per egg, distributed unevenly over the shell surface with more number of pores at the broad end than at the narrow end.

SHELL MEMBRANE

The shell membrane consists of

- Air cell
- Outer shell membrane
- Inner shell membrane
- Air cell is situated in between the two membranes at the broad end
- Air cell - formed as a result of contraction of the egg contents, soon after oviposition, due to differences in the temperatures exposed to by the egg prior to and after oviposition
- The outer shell membrane is attached firmly to the shell by numerous cones on the shell surface extending into the membrane
- The inner shell membrane closely surrounds the albumen

ALBUMEN

- The albumen consists of 4 layers, namely
    - Chalaziferous or inner thick white, which forms (3%)
    - Inner thin albumen (17%)
    - Outer thick firm or dense albumen (57%)
    - Outer thin albumen (23%) of total albumen
- The chalaziferous layer -very close to the yolk immediately surrounding the vitelline membrane of the yolk - twists into two chords on either sides of the yolk called chalazae, which are formed due to rotational movement of the egg in the oviduct

Functions of chalazae

- Chalazae - hold the yolk firmly in its central position and thus serves as an anchor for yolk
- Chalazae - contain a protein called lysozyme, which is possessing antimicrobial properties and helps to prevent the microbial spoilage of the egg
- Ageing, improper storage and microbial spoilage makes thick albumen watery

YOLK

The yolk consists of

- Concentric layers of dark and light yolk material, due to differences in their chemical composition
- *Latebra* is the centre of the yolk, which is a small, nearly circular core of light coloured fluid, which does not completely harden on boiling
- Nucleus of Pander is a cup-shaped structure, which is an extension of the neck of latebra, connecting the base of the germinal disc
- In an *infertile egg* it is unicellular (ovum) and contains haploid number of chromosomes, called "Blastodisc". It is circular in shape, with a diameter of about 3.5 mm and with vacuoles in it. Where as in a *fertile egg,* it is a multicellular structure having diploid number of chromosomes, called "Blastoderm". It is oval in shape, with an average diameter of about 4.5 mm and with no vacuoles in it.
- "Vitelline membrane" is a semi-permeable elastic membrane, surrounding the yolk, separating the yolk material from the albumen

LEARNING OUTCOME

This chapter deals with

- Parts of Male Reproductive structures
- Physiology of Spermatogenesis
- Parts of Female Reproductive system - Ovary and Oviduct
- Parts of Oviduct *viz. Infundibulum, Magnum, Isthmus, Uterus and Vagina*
- *Process of Egg formation*

MALE REPRODUCTIVE STRUCTURES

- Male reproductive structures include testes, vas deferens, cloaca and the rudimentary copulatory organ

FUNCTIONS

- Testes are paired, small ovoid structures lying on the dorsal body wall, on either side of the vertebral column and anterior to the kidneys. The testes are reddish-yellow in colour. The left kidney is slightly larger than the right one
- The testis is formed of numerous slender seminiferous tubules, inside which spermatogenesis takes place. From each tubule arises the vas deferens, which join together to form the long coiled epididymis. The epididymis of each side continues down as the vas deferens and terminates in the cloaca
- Puberty in a cockerel (immature male) is defined as the age when spermatozoa first appear in ejaculated semen

- Sperms undergo maturation in the epididymis and attain the power of motility here. The sperms are carried down with the seminal secretion into the cloaca from where they are discharged during copulation
- The number of fully formed sperms released from the seminiferous epithelium into the lumen is known as “Spermiation”.
- The pH of the semen varies between 7.45 to 7.63.
- Daily sperm output in cocks is about 2000×10^{6} while in toms it is about less than 1120×10^{6}.
- On the median ventral portion of the cloaca is a small button-like structure called copulatory papilla, which is the rudimentary copulatory organ
- During copulation the papilla of male and female are everted and pressed together so that sperms are ejected directly into the female urodeum, from where they are squeezed into the oviduct by the contraction of the urodeum. A temperature, lower than that of the body at the nodule, probably hastens maturity of the sperms

FEMALE REPRODUCTIVE SYSTEM

- Birds are unique among animals as they reproduce through an egg which contains all the necessary components for the commencement and maintenance of life process during embryonic development
- The hen actually does bulk of the reproductive work prior to the laying since the egg laid provides all the nutrients necessary to create and maintain early life of the embryo
- The female reproductive system consist of Ovary and Oviduct
- At the time of early embryonic development, two ovaries and two oviducts exist. But the right set atrophies, leaving only the left ovary and oviduct at hatching

OVARY AND OVIDUCT

Ovary

- At the time of embryonic development, two ovaries and two oviducts exist, but only the left ovary and oviduct are functional at hatching, the right atrophies
- The left ovary is situated at dorsal part of abdominal cavity and the fore end of kidneys
- The ovary is responsible for the formation of yolk only

Oviduct

- The oviduct is a long zig zag tube consisting of glandular and muscular parts . Oviduct extends from the ovary to the cloaca. *It has 5 distinct parts, viz. infundibulum (9cm), magnum (33cm), isthmus (10cm), uterus (10-12cm) and vagina (12cm)*
- Infundibulum is the funnel-shaped, anterior portion of the oviduct, and measures about 9 cm in the laying hens. The mature ovum immediately after release from the graffian follicle, is engulfed by the infundibulum, and remains there for about 18 minutes before moving to the magnum
- Magnum, about 33 cm in the laying hens is the largest portion and albumen-secreting region of the oviduct. The ovum remains in the magnum for about 2 hrs and 54 min
- The ovum stays in isthmus for about 1 hour and 14 minutes. Shell membranes are secreted and egg gets its shape in this region
- Uterus, also known as *shell gland*, is a pouch-like structure and the ovum stays here for about 20 hours and 40 minutes in the uterus
- Vagina is the terminal portion of the oviduct having a muscular sphincter at the utero-vaginal junction which helps in expelling the egg during oviposition

MODULE-4: IMPORTANT ECONOMIC TRAITS OF POULTRY

Learning objectives

- To study the Economic traits of Layers
  - Age at sexual maturity
  - Body weight at maturity
  - Egg number
  - Egg weight
  - Egg quality traits
  - Feed efficiency
  - Livability/Survivability
  - Egg Production Indices
- To study the Economic traits in Broilers
  - Growth traits - Body weight and Growth rate
  - Feed efficiency
  - Livability/Survivability at market age
  - Carcass traits -Dressing percentage in Commercial broilers

ECONOMIC TRAITS OF LAYERS

- Age at sexual maturity (days)/Age at start of lay
- Body weight at maturity
- Egg production/Egg number
- Egg weight
- Feed efficiency
- Livability

AGE AT SEXUAL MATURITY

Age at sexual maturity (days)/Age at start of lay

- For a flock of layer pullets, age in days at which 5 % egg production level is reached is considered as the age at maturity. It usually falls within 21st week of age. Sometimes the level may be reached even at 19th or 20th week which is not desirable. It happens when additional night lighting is given to growers indiscriminately even after six weeks of age
- If laying starts early, the eggs laid are smaller in size which continue to be so for long time, thus affecting the egg price and in turn, the profitability
- Adopt lighting schedule for growers as advised
- Strain of the bird and quality of feed are two other factors influencing age at start of lay of eggs

BODY WEIGHT AT MATURITY

- This character decides feed efficiency, egg number and egg weight
- The body weight of layers at start of lay has to be optimal; it should neither be low nor high
- Low body weight indicates poor growth of egg forming female reproductive tract, which in turn will result in poor egg production and egg weight
- Higher body weight at maturity will lead to higher feed consumption and reduced persistency
- If higher body weight is due to high abdominal fat, the same will obstruct infundibulum and affect egg production
- Strain and feed quality also influence this character

EGG NUMBER

- Commercial hybrid layers produce around 300-310 eggs in one year from 21-72 weeks of age.

Factors such as

- Strain of the bird
- Age and body weight at start of lay
- Lighting schedule during growing and laying
- Feed quality (protein, energy, vitamins, mineral and trace mineral content and toxin free feed)
- Culling procedure
- Climate
- Managemental factors like space allowances
- System of feeding
- Water quality
- Vaccination and other disease control measures influence egg number

EGG WEIGHT

- It varies from 52-56 g on an average
- Egg weight is mainly dependent on body weight of the birds
- Birds at later stage of production are comparatively older, heavier and lay larger sized eggs
- First egg in a clutch (series of eggs laid daily without a break) is always heavier than other eggs in the series
- If total number of eggs laid in a laying cycle of one year is comparatively less, individual egg size by such strain of birds is normally larger and if the egg number is more egg size will be comparatively less. To overcome this and to decide as to which strain is preferable, another character known as “egg mass” is considered
- It is the total weight of eggs laid by a bird in a laying cycle
- It depends both on egg number and average weight of an egg
- All other factors such as quality of feed, managemental factor, age, strain etc., which influence body weight also have an influence on egg weight

FEED EFFICIENCY

- It denotes the efficiency of conversion of feed into egg.
- *Feed efficiency of layers is calculated in terms of conversion into number of eggs (per dozen eggs) or weight of eggs (per kg egg mass)*

$$\text{Feed Efficiency (per dozen eggs)} = \frac{\text{Average quantity of feed consumed (kg) by a bird in a laying cycle}}{\text{Average numer of eggs in dozens, produced by a bird}}$$

$$\text{Feed Efficiency (per kg egg mass)} = \frac{\text{Quantity of feed consumed (kg)}}{\text{Total weight of eggs (kg) produced}}$$

- Feed efficiency of a layer depends on the
- strain of the bird
- average egg number
- egg weight (in the latter case)
- Quality of feed (energy, protein and contents of other vital nutrients, presence of toxins, if any, inclusion of performance promoters etc.), managemental care (space allowances, system of feeding, feed wastage, proper debeaking, deworming, insect and rodent control), climate, disease control measures etc.

LIVABILITY

- Per cent livability is worked out separately for each of the three stages of layer management viz. in Brooder (0-8 weeks), Grower (9-20 weeks) and Layer (21-72 weeks) stages
- Permissible levels of mortality during these stages are 4%, 2-3% and 6-8% respectively
- Accordingly, livability levels of 96%, 96-97% and 92-94% are prescribed as optimal for these stages independently of each other
- Strain, feed quality, litter management, vaccination schedule and other disease control measures, disease outbreaks, lay out and design of poultry houses, climate, biosecurity measures adopted, dead bird and manure disposal, parent breeder management and hatchery sanitation etc. all influence livability levels in layers

EGG PRODUCTION INDICES - LAYERS

Egg production or egg number percentage (No.)

- *Hen-housed egg production*

$$\frac{\text{No. of eggs laid on that day}}{\text{No. of birds at start}} \text{X } 100$$

$$\text{Number for a period} = \frac{\text{Average total no. of eggs laid during that period}}{\text{No. of birds at start}}$$

- *Hen-day egg production*

$$\frac{\text{No. of eggs laid on a given day}}{\text{No. of live birds available on that day}} \text{X } 100$$

$$\text{Number for a period} = \frac{\text{Total no. of eggs during that period}}{\text{Average hen days during the period}}$$

$$\text{Average Hen Days} = \frac{\text{Sum of living birds on each day during the period}}{\text{Total no. of days during that period}}$$

ECONOMIC TRATIS OF BROILERS ENTERPRISE

- Growth traits - Body weight and Growth rate
- Feed efficiency
- Livability/Survivability at market age
- Carcass traits - Dressing percentage

BODY WEIGHT AT MARKET AGE

- It is the average live weight of a broiler when sold to market. It is obtained by dividing the total weight of birds sold by the number of broilers. Since the broilers fetch price based on their body weight, it is advantageous to get heavy birds at an early market age (fast growing).
- The body weight at market age depends on so many factors, the knowledge of which will help the farmer to make their birds grow faster viz. Strain, disinfection, downtime, system of rearing, water sanitation, feeding, night lighting, watering, floor space, growth promoters, housing design etc.

FEED EFFICIENCY

- The term indicates the quantity of feed required to put up a unit live body weight. Since feed involves 70 % of the cost of production, feed efficiency or efficiency of feed conversion by the broilers determines profit margin also. It is calculated as:

$$\text{Feed Efficiency} = \frac{\text{Quantity of Feed consumed by a batch (kg)}}{\text{Total live weight of broilers marketed(kg)}}$$

- For broilers, a feed efficiency of 1.8-2.0 kg feed to put one kg live body weight is considered as optimal. Lower the feed efficiency value, the better for the farmer.
- The factors influencing feed efficiency are strain, quality and energy level of feed, feeding, growth promoters, climate, floor space, role of microbes, mortality etc.

LIVABILITY/SURVIVABILITY AT MARKET AGE

$$\text{Livability} = \frac{\text{Number of birds alive at market age}}{\text{Number of chicks purchased}} \text{ X } 100$$

- Under standard rearing conditions, 94 to 96 % livability is anticipated at market age since the death rate (mortality) should not exceed 4 to 6 %.
- The factors influencing livability are strain, housing design, disinfection and other disease control measures, medication, vaccination, standard of management like brooding, extremes of climate, downtime between batches, system of rearing, Quality of feed, litter material etc.

CARCASS TRAITS

- It is the proportion of edible meat to total live weight which varies from 72 to 76 %.
- Strain of the bird, energy content of the diet, feeding and watering before slaughter, length and time of transport etc. are some of the factors that influence dressing yield.

FERTILITY AND HATCHABILITY

Fertility

- Refers to capacity to reproduce. It is the factor, which determines the successful offspring that may be obtained from a given number of eggs.

Factors influencing fertility

- Sex Ratio
- Age of breeders
- Length of duration between mating
- Diseases and management practices.
- Fertility is expressed as % of fertile eggs in a set of total eggs incubated.
- Fecundity-Producing many offspring.
- Fecundate – To fertilize

Hatchability

- Is defined in two ways
  - Based on the fertile eggs set (FES)
  - Based on the total eggs set (TES)
- Refers to the % of chicks hatched to the eggs set.
- Size, shape and condition of egg shell are important for hatching. Very large and very small eggs do not hatch well.
- Eggs having abnormal shape show low heritability.
- Condition and duration of storage of eggs prior to incubation as well as setter and hatcher environment affect hatchability (or) The quality of fertilized egg to produce normal embryonic development with normal emergence of the young when incubated.

FACTORS AFFECTING FERTILITY

- Age of the parent stock: There is an increase in fertility in a breeder flock between the ages of 25 to 40 weeks after which fertility gradually diminishes
- Breed: Lighter breeds like White Leghorn is more fertile than heavier breeds like the broiler breeders.
- Genetic factors: Many genes influence fertility eg: in Wyandotte the gene responsible for rose comb (RR) lowers fertility in males.
- Environmental factors: Excessive high and low temperature reduces fertility due to poor mating frequency because of the inactiveness of the birds.
- Disease conditions: Many diseases like Ranikhet disease, Mycoplasmosis, Salmonella etc., affect fertility.
- Sex ratio: Both higher and lower males to female ratio will reduce fertility. The recommended ratio in lighter breeder is 1:10-12,. In broiler breeder 1:8-10 and in J.quails 1:1-2
- The semen volume, sperm concentration and number of successful mating also alter fertility. Inseminating the birds during the after noon can lower fertility.
- Nutritional factors: Some deficiencies like vitamin A, E , Biotin, Pantothenic acid and B2 and minerals like calcium, phosphorous, sodium, Magnesium, Manganese, Zinc and Iodine lower fertility.
- Photo period: A photo period of 16 hrs per day will give optimum fertility. By either lowering the length of period to 12 hrs or increasing it to 18 hours lowers the fertility.
- Male nutrition: Male breeders should be fed with lower protein levels of 12-14% for optimum fertility.

FACTORS AFFECTING HATCHABILITY

Hatchability is defined as the number of chicks produced from eggs. It is measured by two means

- Hatchability on the total number of eggs set
- Hatchability on the fertile eggs set

The factors affecting hatchability are:

- Breed, strain and individual variation.
- Presence of lethal and semi lethal genes like creeper, crooked toe, crooked beak, polydactyl conditions
- Intense Inbreeding leads to reduced fertility while out-breeding improves it.
- Management and nutritional status of breeding stock with special reference to minerals and vitamins alter hatchability considerably. B2 deficiency causes 0% hatchability. Vitamins A, B2 and E are critical vitamins which affect hatchability.
- Too high and very low temperature in breeder houses also lower hatchability.
- Hatchability is higher in egg from younger flocks and vice versa. Eggs from birds between the age of 21 to 40 weeks hatch well.
- Eggs having abnormal shape, too small or extra large eggs, thin shelled eggs with poor internal quality do not hatch well.
- Faulty pre-incubation storage conditions for eggs reduce the hatchability considerably
- Optimum temperature and humidity in incubator is most essential for desired hatchability. Abrupt and frequent variation in these factors alters hatchability seriously.
- The desire levels of oxygen and carbon dioxide in incubator play major role in obtaining optimum hatchability seriously.
- The reverse setting of eggs with narrow end up lower the hatchability seriously
- Inadequate and faulty turning of eggs during incubation lower the hatchability.
- Use of separate hatcher with slight decrease in temperature and increase in humidity as compared to that setter improves hatchability.
- Diseases which are vertically transmitted lowers hatchability.

EGG QUALITY

External Characteristics and Grading of Shell Eggs

- A normal chicken egg is ovate in shape.
- Wide variation in shape may lead to breakages during handling and transport. For easy transportation and merchandising of egg, the egg should possess normal external characteristic.
- If shape and size are abnormal, the eggs are liable to break. Similarly, thin shell and weak shell egg or shell less eggs are liable to break and are unfit for transportation.
- Moreover, eggs with thin shells loose their quality quickly.
- Shell colour and other external characteristics will determine the market acceptability.
- Clean eggs will be sold at premium price, than dirty eggs.

EXTERNAL CHARACTERISTICS OF EGG

The external characteristics of the egg will be assessed by the following methods:

- Egg size/ weight
- Shape
- Shell colour & Texture
- Cleanliness
- Volume
- Specific gravity
- Surface area

EGG QUALITY - EGG SIZE OR WEIGHT

- Each species of bird has its own standard egg weight. Similarly the egg weight vary between breed and age of the bird. Heavier birds produce heavier egg.
- A normal chicken egg weighs 55-60gm depending upon the breed and age. *The chicken egg will be about 1/30th of the hen's body weight.*
- In case of ducks, the egg weight ranges from 65-70gm, depending upon the breed. When compared to chicken, ducks lay heavier eggs which will weigh 1/25th of its body weight.
- Goose lay eggs weighing 130-200gm, depending upon the breed.
- Japanese quail eggs will weigh around 10gm, which will be about 1/15th of its adult body weight. When compared to body size, Japanese quail lay heavier egg than other species.
- Turkey egg will weigh 65-70g, ad it is only about 1/60th of its body weight. In all species of birds, older birds lay heavier eggs than younger birds. Record the weight of egg provided to 0.1gm accuracy using triple beam balance.
- Some times the egg size will be extremely small or large as in the case of yolk less/ double yolked eggs which are difficult to transport because they will break during transit. They are sold in the farm itself.

EGG QUALITY - SHAPE

- The usual egg shape is "ovate". The shape of the egg plays a major role in packing and transport.
- The normal shape of an egg can be marred due to diseases like Ranikhet and Infectious Bronchitis. Too small or too large eggs are discarded in the farm itself.
- Egg shape is expressed as "Shape index'. Here the process is to measure the maximum length of the egg using a vernier caliper and also the average width of the egg measured in two places. It is measured to an accuracy of 1mm and the shape index is arrived at by using the formula.

$$\text{Shape Index} = \frac{\text{Average width}}{\text{Average length}} \text{X } 100$$

- A normal egg will have a shape index of 72 (Range 70-74).
- Egg which is spherical in shape will have a shape index of 75 and above; such of those eggs which are elongated/ elliptical will have lesser shape index of 70. These eggs which do not fall into the normal range of the shape index cannot be used for hatching.

EGG QUALITY-SHELL COLOUR AND TEXTURE

- It indicates smoothness and roughness of shell surface and also indicates shell quality.
- Shell colour is due to the presence of pigments.
- Ooporphyrin gives brownish colour to the egg shell, which is normally seen in eggs laid by the Asian, the English and the American Class of birds.
- The pigments Oocyan causes other blue colour in eggs seen in eggs laid by the breed Aracauna.

EGG QUALITY - CLEANLINESS AND VOLUME

Egg quality - Cleanliness

- This is essential for consumer satisfaction and also to improve and maintain the keeping quality.
- A dirty egg may harbour harmful microbes which will spoil the egg and render it unfit for consumption.
- Eggs collected from deep litter will be more dirty than caged eggs, obviously due to dirty wet litter and delayed collection of eggs.

Egg quality - Volume

- Volume is also one of the indicators of egg size.
- Egg volume is directly proportional to the egg size. Since the specific gravity of egg is more than one, the volume of a fresh egg will always be less than the egg weight. However a small egg will have greater volume by weight ratio.
- The egg volume of different species will be around 90-95% of their fresh egg weight. To measure the volume of the egg, fill a measuring cylinder of 500 ml/ 1 litre capacity with a known quantity of water.
- After noting the lower meniscus of the water, gently slant the measuring cylinder and slide the egg carefully into the measuring cylinder and note the final reading of the water, the difference in value will give the volume of egg in cm^3.

EGG QUALITY - SPECIFIC GRAVITY

- This gives an indication of the egg shell quality, as well as its freshness. Fresh eggs will have higher specific gravity than old and long stored eggs, because there will be a loss of moisture in the old eggs which inturn replaced by air. So the air cell will become bigger as the egg is stored for a longer time.
- Similarly, eggs having stronger shell will have higher specific gravity than thin shelled eggs.
- The measure of specific gravity can be made by several methods.
    - By measuring the egg weight and then weighing the egg in water, to find the weight loss in water.
    - By dipping the eggs in a salt solution having several concentration of salt dissolved in it; having a specific gravity ranging from 1.0-1.1 with an interval of 0.02.

A normal egg will have a specific gravity of 1.06.

- Any value less than this may indicate that the egg is old or the eggs are thin shelled; irrespective of other criteria, smaller eggs will have high specific gravity due to more uniform shell.
- By knowing the egg weight and volume.

$$\text{Specific gravity} = \frac{\text{Weight of the egg in gram}}{\text{Volume in cc}}$$

EGG QUALITY - SURFACE AREA

- It is calculated by using the formula

$$\text{Surface area} = 12.6 \times \frac{\text{length} + \text{width}}{4} \times 2$$

Where, 12.6 is a constant.

- Surface area of an egg is directly proportional to egg size. The surface area will be more for elongated eggs than for spherical eggs.

ECONOMIC PRODUCTION-COMMERCIAL BROILERS AND LAYERS

Economic traits of commercial broilers and their mean performance

- Body weight at day old (g) : 42
- <pBody weight at 6th week (g) : 2075</p
- Feed consumption – 6th week (g) : 3611
- Feed conversion ratio (FCR) – 6th week : 1.74
- Ready-to-cook yield (%) : 70-72

Economic traits of commercial layer and their mean performance

I. Rearing period (0 -17 weeks)

1	Livability (%)	96 %
2	Body weight at 5 and 8 weeks of female (g)	370/590
3	Feed consumption per bird	5.2 kg

II. Laying period

1	Age at 50 % production	140 days
2	Feed consumption per hen day (21-80 weeks)	108 g
3	Livability % (17-80 weeks)	94 %
4	Hen housed egg production (72 weeks)	319
5	Egg weight (g) at 32, 60, 72 weeks	56.5, 58.7, 59.6
6	Egg mass (kg) upto 60, 72 weeks	14.9, 18.0
7	Feed conversion per kg egg mass -60, 72 weeks	1.98, 2.01
8	Livability (%) at 60, 72 weeks	96, 94.8 %
9	Body weight (g) at 20, 40, 72 weeks (female)	1295/1450/1540
10	Egg number per hen housed at 40, 72 weeks	108/275
11	Feed intake cumulative per hen housed at 40, 72 weeks	16.8/40.0

ECONOMIC PRODUCTION- BROILER BREEDER AND LAYER BREEDER

Economic traits of broiler breeders and their mean performnce

1	Body weight (g) at 20, 24 and 64 weeks of female	1980-2140, 2400-2700 and 3350-3650 g
2	Age at 50 % lay	26-27 weeks
3	Age at peak production	29-31 weeks
4	Hen housed egg production (upto 64 weeks)	175-185
5	Percent hatchability	84.5-87.0
6	Number of broiler chicks per hen housed (24-64 weeks)	139-150
7	Average number of unsettable eggs per hen housed	3-5 %
8	Livability (%) at 1-24 and 25-64 weeks	95-97 and 90.5-93.5 %
9	Feed consumption – per egg laid (g)	3288 (0-64 weeks)
10	Feed consumption – per 100 broiler chicks (kg)	41.0 (0-64 weeks)

Economic traits of layer breeders and their mean performance

1	Livability (%) 1-18, 19-70 week Males	93/93
	Females	97/97
2	Age at 50 % peak production	143 days
3	Hen housed egg number - 19-70 weeks	293
4	Hen day egg number -19-70 weeks	297
5	Number of settable eggs per hen housed at 25-70 weeks	280
6	Number of female chicks produced at 25-70 weeks	112
7	Per cent hatchability (%) at 25-70 weeks	85 %
8	Body weight (kg) of male and female at 18, 60 weeks Male	1.45/2.12
	Female	1.23/1.89
9	Feed consumption per hen housed 1-18 weeks	5.84
10	per dozen eggs 19-70 weeks	1.39
11.	Egg quality traits	Albumen index – 0.10 Yolk index – 0.40 Specific gravity – >1.06 Shell thickness – >0.33mm

ECONOMIC PRODUCTION - COMMERCIAL MEAT TYPE TURKEYS AND JAPANESE QUAIL

Economic traits of commercial meat type turkeys and their mean performance

1	Body weight at day old, 6, 12, 16, 20 and 24 weeks of males	1.8/3.8/5.5/6.8/8.4 kgs
2	Body weight at day old, 6, 12, 16, 20 and 24 weeks of females	1.2/2.4/3.7/4.5/5.6 kgs
3	Livability (%) at 6, 16, 24 weeks	96, 94, 93
4	Feed efficiency at 6,12,16,20 and 24 weeks	1.8/2.2/2.8/3.6/4.2
5	Ready-to-cook yield (%) Males	78-80
	Females	74-76

Economic Traits Of Meat Type Japanese Quail And Their Mean Performance

Commercial

1	Body weight (g) at 0,7,14,21,28 days	8, 32, 80, 132, 190 g
2	Feed efficiency at 7,14,21,28 days	1.2, 1.6, 2.0, 2.6
3	Livability (%) at 7,14,21,28 days	97, 95.5, 94.5, 94

Parent

1	Egg weight (g) – 16 weeks	13 g
2	Age (days) at 5%,50%, 75% egg production	51d, 65d,72d
3	Livability (%) at 6, 24, 40 weeks	93%, 85%, 77%
4	Egg number hen housed to 24, 40 weeks	88, 160
5	Body weight (g) at 6 weeks and at 40 weeks Males	215 g and 240 g
6	Females	265 g and 280 g
7	Hatchability (%) – summer, other seasons	65, 72 %

MODULE-5: SCAVENGING SYSTEM OF MANAGEMENT

Learning objectives

This module deals with

- Scavenging system of management
- Introduction -Backyard /rural poultry keeping
- Extensive system of housing
- Semi-intensive system of housing
- Feeding through scavenging
- Feed resources under free-range rearing
- Scavenging Feed Resource Base (SFRB)

INTRODUCTION - BACKYARD / RURAL POULTRY KEEPING

- Desi birds in villages constitute as source of ready money and so called “Walking Banks”. Backyard poultry farming will generate petty cash for house hold requirement in addition to providing a balanced food with minimum inputs available in the rural areas
- The backyard poultry farming is more beneficial to small, marginal farmers, land less labourers, tribal and backward class people
- Backyard poultry keeping can play a great role in alleviating the protein hunger in rural sections of our country.
- It is a land saving, with low financial investment and minimum management requirements but can bring about a sizable income to the rural families
- Feeding of backyard poultry is made easy by using household wastes, farm products and green vegetation, besides free scavenging for waste grains and insects

EXTENSIVE SYSTEM OF HOUSING

Free-Range Extensive systems

- Rearing of poultry by letting them loose on ground (field) is known as “Free-range system"
- Under free-range conditions, the birds are not confined and can scavenge for food over a wide area. Rudimentary shelters may be provided by way of temporary roofing supported by ordinary poles. The birds may also roost outside, usually in trees and nest in the bush
- The flock contains birds of different species and varying ages.
- Poultry are housed at night under backyard systems but allowed free-range during the day. They are usually fed a handful of grain in the morning and evening to supplement scavenging

SEMI - INTENSIVE SYSTEM OF HOUSING

- These are a combination of extensive and intensive systems where birds are confined to a certain area with access to shelter. Birds are half-way reared in houses and half-way on ground or range (Pen and Run system)
- In the “run” system, the birds are confined in an enclosed area outside during the day and housed at night.
- The success of rearing depends on maintenance of condition of runs to reduce the contamination. The danger of infection is from the ground immediately surrounding houses called "foul-patch" due to congregation of birds there for most of the time in a day
- Feed and water are available in the house to avoid wastage by rain, wind and predators

FEEDING THROUGH SCAVENGING

- Birds under scavenging conditions pickup farm produced grain like maize, jowar and millets to meet their energy requirement and depend upon, at least partially, on grains offered by flock holders in early part of the day
- In addition birds scavenge to prey on insects, worms, larvae, snails, termites, maggots, marine wastes etc. to satisfy the protein, mineral and vitamin needs. However, a considerable diversity in climate, terrain, ethnic groups, socioeconomic status etc, significantly influences the feeding pattern in different geographical locations
- Therefore, the sustainability of poultry depends upon the interplay between environment, local resources, agricultural practices and skills in poultry management
- Any gap between the scavenge able feed and the feed required has to be compensated with supplemental feed
- Under household conditions available feed ingredients are at times given in combination, which, invariably will be imbalanced and may in fact be deleterious, if the birds are restricted from scavenging. However, the importance of supplemental feed cannot be underestimated due to its direct and indirect effects on many aspects of production
- A bird cannot certainly find all the nutrients needed for optimum production round the year. During peak production and dry season, hens can be exposed to vitamin and mineral deficiencies due to scarcity of natural resources of feed. Hence, offering supplemental feed becomes essential.

FEED RESOURCES UNDER FREE - RANGE REARING

- Availability of feed resources on extensive system of rearing exhibits considerable variability due to geographical, climatic and agricultural factors.
- However, the feed resources available to the weakest family in the community are;
    - household wastes
    - naturally occurring organic material like worms, insects, maggots termites etc,
    - crop surpluses and their by products
    - fodder material and
    - non commercial feed like grasses, herbs, algae etc.

SCAVENGING FEED RESOURCE BASE (SFRB)

- It is important to monitor the quantity of scavengeable feed available seasonwise in a village to assess the gap between resources accessible to the birds and their actual requirement to provide feed through supplementation
- SFRB is defined as the total amount of food items available to all scavenging birds in a given area. It depends on the number of households, the type of food crops grown, and their crop cultivating and crop processing methods as well as on the climatic conditions that determine the rate of deposition of the food items
- If the biomass of the flock exceeds carrying capacity of SFRB, some birds in the population, particularly the weaker ones will die. On the other hand survival will be more when SFRB is more than the requirement of flock
- Seasonal fluctuations in the SFRB occur due to periods of fallow or flooding, cultivation, harvesting and processing. The land area available for scavenging and the distance a flock can travel to scavenge will depend on flock size, feed availability, population density, agricultural activities, predators etc. If the capacity of SFRB and seasonal variations are known, efficient strategies for better scavenging, feed resource availability can be evolved
- The SFRB includes termites, snails, worms, insects, grain from sowing, harvesting by-products, seeds, grass, fodder tree leaves, water-plants and unconventional feed materials. The crop contents can be utilized to determine the metabolizable energy and protein components of scavenging feed resources. The anticipated reduction in SFRB can be determined and accordingly appropriate nutrients can be supplemented

MODULE-6: NEWLY DEVELOPED COLOUR PLUMAGED BIRDS FOR RURAL POULTRY

Learning objectives

- This module deals with the newly developed birds suitable for rural environment.

COLOURED CHICKEN VARIETIES - RURAL POULTRY

Coloured Chicken varieties-Backyard farming

- Nandanam Chicken-1 & Nandanam-Broiler II (TANUVAS, Chennai)
- Giriraja (UAS,Bangalore), Indian Broiler developed at Bangalore under AICRP on Poultry (IBB-83)
- Swarnadhara (KVAFSU), Coloured broilers-Rajali under AICRP on Poultry, Bangalore
- Vanaraja, Gramapriya and Krishi-bro (PDP, Hyderabad)
- Krishna-J (Jabalpur farm varsity)
- Grama Laxmi (Kerala Agricultural University) and Kalinga Brown (Bhuvaneshwar-based poultry organisation -- CPDO)
- Development of scavenging chicken at CARI, Izatnagar with native fowl base
- CARI NlRBHEEK
- CARI SHYAMA
- UPCARI
- HITCARI

GIRIRAJA

- First initiative by poultry breeders to develop varieties suitable for backyard rearing. It is a polycross, resemble local fowls in plumage color and pattern and was released in1989.
- Easily acclimatize to varied agro climatic regions
- Sturdy and more tolerant to many diseases
- Adapted well to scavenging conditions
- Very popular all over the country and also abroad

SWARNADHARA AND RAJA II

Swarnadhara

- Swarnadhara birds are similar to Giriraja in their plumage colour and pattern
- Released in 2005
- Birds are more compact than Giriraja and produces 180-200 eggs
- Better suited to scavenging because of thin and longer shanks

Raja II: Coloured broilers

- Second in the series of coloured broilers developed at Bangalore
- Similar to Giriraja and Krishibro in Plumage colour and Pattern
- Suitable for small farmers to rear in few 100s to 1000s
- Quite hardy and more tolerant to diseases and leg abnormalities than commercial broilers

NANDANAM CHICKEN - I AND NANDANAM BROILER - II

Coloured Chicken Varieties developed at TANUVAS

- *Nandanam Chicken - I*
  - This strain was developed from the Sterling strain of Rhode Island Red breed. Nandanam chicken – I is a purebred having dark red plumage with medium sized body and is a dual-purpose breed
- *Nandanam Broiler - II*
  - This is a coloured broiler chicken developed through sustained selection and breeding for 10 years in the synthetic broiler scheme.
  - Multi coloured feather pattern with good survivability under the backyard system are the advantages of this breed

VANARAJA AND GRAMAPRIYA

Vanaraja

- Vanaraja is a multi-coloured dual-purpose chicken variety developed at Project Directorate on Poultry, Hyderabad, for free range and rural backyard rearing.
- The plumage colour and disease resistance of Vanaraja is similar to native chicken. Vanaraja grows fast and produces more eggs than native chicken

Gramapriya

- Gramapriya is a multi-coloured egg purpose chicken variety developed for free range and rural backyard rearing. This bird lays more number of eggs than native chickens and eggs are tinted brown in colour and heavier than native chicken eggs.
- This bird has better adaptability to adverse conditions and better immunocompetence.

CHICKEN VARIETIES - CARI

Cari Nirbheek

- It is cross of Indian native breed Aseel with Cari Red. Birds are active, larger in built, pugnacious in nature with high stamina and majestic gait. They are able to save themselves from their predators due to its fighting characters and activeness and are adapted to all climatic zones of the country.

Cari Shyama

- It is cross of Kadakanath breed of Indian native chicken with Cari Red. Birds have plumage of various colours dominated by black. The skin, beak, shank, toes and soles are dark gray colour. Most of the internal organs show the characteristics black pigmentation. Varying degree of blackish colouration is also found in skeletal muscles, tendons, nerves, meninges, brain and bone marrow.

Upcari

- Indian native chicken with Frizzle plumage has been crossed with Cari Red for development of UPCARI birds These multicoloured birds have single comb and medium body size. Presence of Frizzle plumage helps in fast heat dissipation due to which birds are better adapted to tropical climate especially for arid zones.

Hitcari

- Indian native chicken with Naked neck plumage has been crossed with Cari Red for development of HITCARI birds which are adapted to tropical climate specially for hot and humid coastal region of the country.

ECONOMIC TRAITS OF VARIOUS STRAINS DEVELOPED FOR RURAL POULTRY FARMING

Name	Type	Body weight (KGs)	Feather colour	Purpose	Institutions
Giriraja	Synthetic Breed cross	1.50	Multicolour	Dual	Dept. of Poultry U.A.S., Bangalore
Swarnadhara	Breed cross	0.90	Mixed	Egg	Dept. of Poultry, Bangalore KVAFSU ((B)
Vanaraja	Breed cross	1.40	Mixed	Dual	P.D.P. Hyderabad
A.V.M	Breed cross	1.05	Mixed	Meat	A.V.M.Coimbatore
Krishna.J	Synthetic	0.60	Mixed	Egg	Jabalpur
Krishnapriya	Breed cross	0.90	Mixed	Dual	Kerala
CARI-Gold	Breed cross	1.00	Mixed	Dual	CARI, Izat Nagar
Croiler	Synthetic	1.20	Mixed	Meat	KECG Delhi
B2	Synthetic	1.10	Multicolour	Meat	IPPM,TANUVAS
Nandanam IBB 83 RAJA II	Synthetic Synthetic Synthetic	0.90 1.2 1.5	Red Multicolour Multicolour	Dual Dual Dual	IPPM,TANUVAS AICRP,Bangalore AICRP,Bangalore
SATPUDA-DESI	Synthetic	1.00	Multi coloured		Yaswant Agritech Pvt Ltd.
SATPUDA-SPK	Synthetic	0.10			

MODULE-7: BROODING MANAGEMENT - EGG TYPE CHICKS

Learning objectives

This module deals with

- Purpose of Brooding
- Types of Brooding Equipment
- Brooder Operation
- Feeding and Watering - Recommendations
- Brooding temperature and duration
- Chick comfort zone
- Space requirements - Chicks
- Water and Feed intake-Layer chicks
- Debeaking
- Vaccination Schedule-Layer chicks
- Cage rearing-Layer chicks

PURPOSE OF BROODING

- Egg type female chicks are received as Day old Chicks (DoC) at the farm and they require additional warmth during early age for atleast two to three weeks
- The thermoregulatory mechanism of a newly hatched chick is not well developed and takes about two weeks for this mechanism to develop fully and maintain homeostasis
- Therefore chicks cannot maintain the body temperature properly for the first few weeks of life; and may be subjected to chilling, if not properly taken care off
- Under these circumstances, artificial brooding is mainly aimed at, providing extra heat or warmth during the first two to three weeks of the chicks life
- This is done to prevent cold shock since the environmental temperature may be lower than the hatcher temperature
- A brooder simulates the care and attention of a mother hen

CLASSIFICATION OF BROODING

Natural brooding

- It is done with the help of broody hens after hatching, up to 3 to 4 weeks of age.

Artificial brooding

- In artificial brooding large number of baby chicks are reared in the absence of broody hen.
- Equipments used for brooding are called brooders. Brooder comprises of three elements:
    - Heating source
    - Reflectors
    - Brooder guard
- Heating source may be electrical, gases like natural gas, LPG and methane, liquid fuel like kerosene and solid fuel like coal, wood can be used as a heating material.

Charcoal stove / kerosene stove

- Where electricity is not available, ordinary charcoal / kerosene stoves are used to provide supplementary heat to chicks.

These stoves are covered with plate / pans to dissipate the heat.

Electrical brooder

- It is also thermostatically controlled heating system that spread required amount of heat uniformly above large area, this avoid crowding of chicks under brooder directly.
- One electrical brooder can be used for 300 to 400 chicks.

Infra red bulbs

- It is a self reflecting bulb. One 250 watts IR bulb can provide brooding for about 150 to 250 chicks.

- **Gas brooder** Natural gas, LPG or methane is connected to heating element which is hanged 3 to 5 feet above the chick to provide heat. Now practised particularly in semi-environmentally controlled and environmentally controlled houses. *These are costly but can take care of 1500 to 2000 chicks*

Reflectors

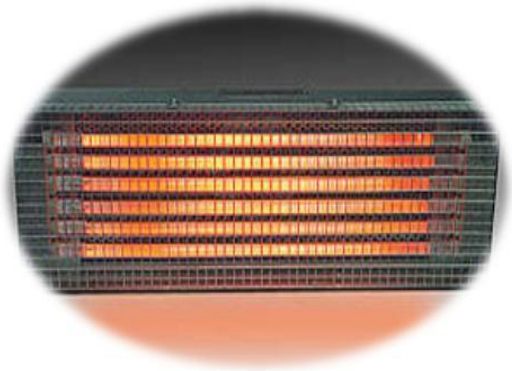
- These reflectors are called Hovers . Flat type hover – These hovers are provided with heating element, heating mechanism and pilot lamp and in some cases thermometer is also there in order to record the temperature.
- Canopy type hover – These reflectors are in concave shape consisting of ordinary electrical bulb, thermostat mechanism and in some cases thermometer.

Brooder guard / chick guard

- They are used to prevent chicks from straying too far away from heat supply until they learn the source of heat.
- We have to provide brooder guard with a diameter of 5 feet, height of the brooder should not exceed 1.5 feet.
- For this purpose, we can use materials like cardboard sheet, GI sheet, wire mesh, and mat etc. depending upon the season of brooding.
- During summer season, brooding is done for 5-6 days. In winter season it is 2-3 weeks.

Heater coils

- Hater coils may also be provided for warmth instead of bulbs.
- Heater coils of various watts capacities with thermostats, reflector hoods and hanging chains are available for providing heat to chicks. These coils are more suitable for cold climates, because they give more heat. Separate tube lights have to be provided for lighting the house. They have to be hanged above the reach of the chicks



- **Centralised heating system of brooding** is followed in environmentally controlled poultry houses; where the room temperature is maintained at an average of 32˚C during first week of age
- **Battery brooders** – Multi-tier cage brooding is also practised. Bulbs or heaters with thermostats are used to provide warmth to chicks in the battery cages
- **Bio-gas brooders** – Certain farms use the cage droppings and cow dung to generate bio-gas; which will be used to provide light and heat to the birds

BROODER OPERATION

Brooder Operation - Prior to the arrival of Chicks

- About 24 hours before the anticipated time of arrival of the chicks, the brooder arrangements are made and kept ready
- The house is cleaned, white washed and blow lamped
- *Litter materials* - Dry litter material such as saw dust, wood shavings, paddy husk etc. is spread to a height of 5 cm and newspaper has to be placed over this to prevent the chicks from consuming litter material
- Brooder guards - can be made of metal sheets or even card board. The brooder guards have to be arranged in a circular fashion on litter material with necessary heating arrangements
- *Downtime* - The house may be prepared before hand for the purpose and kept vacant for considerable length of time (minimum two weeks downperiod); 225 chicks may be let into brooder arrangement of 150 cm diameter and 300 chicks in 180 cm size brooder guard circle
- Required number of feeders and waterers are arranged alternate to each other on the newspaper area.
- The chick linear feeders and chick waterers should be placed alternatively in a radiating way, to give a *"cart wheel"* appearance
- Care should be taken to avoid placing them crowded at the centre under the source of heat
- Keep feeders open for five hours and also spread some feed on the newspaper
- Two linear feeders of 60 cm size and two chick waterers may be used for every 100 chicks
- Automatic feeders and waterers may also be used as per manufacturer's specifications
- Allow free moving space on the sides of waterers and feeders.
- Switch on the bulbs 1-2 hours before the arrival of the chicks to keep the environment warm. When chicks are delivered, do not allow the delivery van into the farm premises. Take delivery at the entrance itself.

FEEDING AND WATERING

Feeding

- Brooder mash with 22% crude protein and 2700 Kcal/kg of metabolisable energy has to be prepared and provided (As per the recommendation of BIS)

Watering

- Antibiotics and vitamins may be continued for 3-5 days. Keep medicated water in the waterers before leaving the chicks into the brooder arrangement
- Good quality, potable medicated water has to be provided in the waterers. Look for the health of the chicks at the time of delivery
- Keep boiled and cooled drinking water ready
- Add 8 g of glucose, 0.5-1g of mild antibiotic or antibacterial drug per litre, electrolytes and vitamin mixture at recommended dosage in water for the first day

BROODING TEMPERATURE AND DURATION

Before receiving the chick, the heat source should be switched on

- Temperature required during the first week is 90-95^{o}F, later reduced by 5^{o}F every week, to reach a temperature of 75^{o}F
- Brooding period is a very sensitive period particularly during the cold months or rainy seasons
- Lighting for heating (brooding) has to be provided for 23 1/2 hours in a day for first 3 days, switching it off for only 30 minutes during day time
- Later on, lighting for heat may be given during night only up to the end of 2nd or 3rd week, depending on the season
- It may be restricted to one week only during peak summer and extended to three weeks during winter/ rainy seasons. In such seasons, it is advisable to close the sides of the house with thick curtains during first week

BEHAVIOUR OF CHICKS

- As the chicks arrive, check whether the chicks are healthy, of uniform weight
- Count the chicks, and moist the beak of the chick by dipping it in the water containing vitamins, electrolytes and/or antibiotic and place it gently into the brooder arrangement
- Check that the chicks move actively scratching and taking feed and water. Return weak, inactive, unhealthy chicks with matted feathers at the back and the dead chicks and ask for replacement

Chick comfort

- It is necessary to verify whether the warmth given is sufficient to the chicks.A thermometer kept at the bird level will indicate the temperature
- More practical way of assessing the adequacy of warmth provided is by watching the distribution of the chicks within the brooder guard management
- If they crowd under or near the source of heat, then the warmth given is not sufficient. Then, a bulb may be added to the hover or the height of the hover may be brought down. If chicks have moved to the periphery and are reluctant to come to the centre under heat source, then temperature in the environment is higher than required. The hover may be pushed up or a bulb removed. If the chicks feel comfortable at the given temperature, they walk actively throughout the area unmindful of the heat provided and some take rest setting their head down on the side, the posture being given the name as *"Chick comfort"*.
- Heat source should be placed at the right height at the centre and the temperature has to be checked by observing the *chick comfort zone*

Newspaper - removed after 3 or 4 days and must be burnt.

Chick or brooder guards - removed after a week or 10 days. The corners of the rooms have to be rounded off and the litter material spread out. As age advances the initial chick feeders and waterers may be replaced with bigger ones to match the growth of the chicks

SUGGESTED PRACTICAL RATIONS AND NUTRIENT REQUIREMENTS FOR EGG-TYPE CHICKS
Source:IPPM,Chennai

Ingredients	Chick mash
Age in weeks	0 - 8
Maize	26
Cumbu	24
Dorb	15
SB Meal	20
SFOC EXT	4
Dry Fish	10
MM	1
Shell Grit	
DCP	
Total	**100**
Nutrients	**Chick mash**
C.P	21.60
ME K cal / Kg	2708
Calcium	1.18
Phosphorus	0.41
Lysine	1.24
Methionine	0.42

SPACE REQUIREMENTS - CHICKS

- Floor space allowance during brooder stage is 0.75 sq.ft. (675 cm^2) per layer chick
- Feeder space allowance required is 1.0 cm per bird up to four weeks and 2.5 cm up to eight weeks and 0.5 and 1.0 cm are the space allowances to be given per bird in waterers respectively for those periods
- Accordingly, the brooder house should be constructed with required space for the number of chicks to be ordered at specified intervals
- Initially, smaller size feeders and waterers with lesser depth will have to be provided which should be changed to larger size with greater depth after three weeks of age
- Adjust the height of the feeders and waterers to match the height of the growing birds to avoid wastage
- Feed and water the birds twice daily at regular intervals
- Watch the growth of the birds and water and feed consumption regularly

WATER AND FEED INTAKE - LAYER CHICKS

Feed and water intake by 1000 layer chicks

Age in weeks	Feed intake/ week (kg)	Water intake/ day (litre)	Body weight at end of the week (g)
1	40	10	60
2	80	25	105
3	140	45	160
4	200	65	230
5	250	80	300
6	300	95	370
7	350	105	440
8	390	120	510

DEBEAKING

Debeaking/Beak trimming

- To avoid feed wastage, the chicks are to be debeaked. Their beaks have to be cut short by *electrical cauterization*
- Debeaking if carried out properly may be done only once during fourth week. It may also be performed at the end of second week and repeated at 12-14th week. The upper beak has to be cut 2/3rd and the lower beak 1/3rd portion. The cut portion has to be cauterized by touching on the hot plate. The tongue should be carefully held back
- Undertake debeaking during cooler parts of the day
- Provide anti-stress B-complex vitamins and vitamin K in drinking water before, during and after the day of debeaking; adjust the feeder and waterer height to be lower than before to suit the shortened beak
- Engage experienced persons to perform debeaking, to do it properly with lesser stress and to avoid the necessity for repetition. Since layer chicks are comparatively more active, they tend to peck at each other's back (cannibalism), cause injury and death also. Debeaking helps to prevent such instances

VACCINATION SCHEDULE - LAYER CHICKS

Suggested Vaccination Schedule during Layer chick stage

SI. No.	Age in days	Type of vaccine	Remarks
1.	0 day	Mareks' vaccine (Hatchery)	Ensure that the same has been given at the hatchery itself
2.	5-7th day	RDVF/ LaSota	Drops at the nostril/ eyes
3.	14-16th day	IBD vaccine (Intermediate/ killed)	Eye drops/S/C injection
4.	20th day	IB vaccine	Optional consult local veterinarian
5.	26th day	IBD (intermediate)	Eye drops/ drinking water
6.	30th day	LaSota vaccine	Drinking water/ eye drops
7.	56th day	RDVK/ R2B	S/C injection

- Take care to buy quality vaccines, kept under proper storage conditions
- Ensure proper dosage as per specifications
- Vaccinate the birds with minimum stress to them

CAGE REARING - LAYER CHICKS

- Chicks can be reared in cages also from 0-8 weeks
- Fix the cages at 75 cm above the floor level
- Cages may be of 180 x 90 cm size (6' x 3') and 30 cm (1') height
- About 100 chicks may be reared in it with 160 cm^2 space per chick. The floor has to be made of 1.25 x 1.25 cm size welded mesh of 16 gauge thickness
- One 100 watt bulb is sufficient on the top of the cage for providing heat for first three weeks
- For first two weeks, small feeders and waterers have to be kept inside the cage and afterwards they may be fixed outside on the sides of the cage. For first few days, it may be required to keep card boards on the sides of the cages to prevent small young chicks falling down through the sides

MODULE-8: CARE OF GROWER MANAGEMENT - EGG TYPE CHICKEN

Learning objectives

This module deals with

- System of Housing and Feeding ,Growth pattern in grower stage of Layers
- Lighting & Vaccination - Growers
- Deworming
- Dipping/Spraying
- Culling
- Cage rearing - Growers

HOUSING AND FEEDING - GROWERS

- Majority of the farmers tend to neglect layer birds at this age. However, it has to be kept in mind that the reproductive organs of the bird which produce eggs later on undergo proper growth only during this age and it is all the more necessary to provide appropriate care during *grower phase*

Housing & Feeding

- Growers may be reared in separate grower houses or continued to be reared in brooder-cum-grower house
- Floor space allowance has to be increased to 1.4 sq.ft. (1260 cm^2) per bird
- Feeder space to be given is 6-8 cm per bird. One linear feeder of 120 cm length and 8 cm depth may be provided for 40 grower birds. Raise the height of the feeders as age advances
- Waterer space allowance during growing phase is 2 cm per bird. A circular waterer of 36 cm height and 8 cm depth of 6 litre capacity may be provided for 50 growers. At this age, 100 birds will take about 15-20 litres of water per day. Provide fresh, cool, potable water twice a day.
- Take care to avoid spillage of water on the litter. Rake the litter often to bring down the moisture level

Grower mash - Recommendations

- Feed them with grower mash containing 16% crude protein and 2600 Kcal/kg of M.E. up to 20 weeks of age. They may take approximately 60 to 80 g of feed per bird per day

Restricted Feeding Programme

- It is not advisable to provide *ad libitum* feeding at this age as the birds may then tend to put on more fat and their persistency of egg production will be reduced later on. If birds are found to be over weight, then follow alternate day feeding or quantum restriction of feed (only 75% of normal quality to be provided per day) to bring down the body weight

RESTRICTED FEEDING PROGRAMME

There are two types of restricted feeding.

- *Quantitative feed restriction*
  - In which the amount of feed is reduced below the normal requirement of birds.
  - This can be done on day-to-day basis or skip-a-day programme or skip-two days in a week programme.
  - But this restriction depends on the matching of the flock average body weight with standard body weight provided by the breeder.
  - Quantitative feed restriction is usually followed in commercial breeders.
- *Qualitative feed restriction*
  - In which the quality of the feed is reduced below the standard requirement of the bird.
  - This can be done by including unconventional feeds or lesser nutrient feed ingredients in place of high protein or high energy diet.
  - Here the quantity of allotment to the bird is not restricted.

- During restricted feeding programme, provide more number of feeders and see that all the birds are taking feed simultaneously or otherwise dominant birds will take more amount of feed and the weaker will be subjected to feed deprivation and hence the uniformity will be affected.

Advantages of feed restriction during growing period

- A considerable saving on feed cost because, only 80 % of the calculated feed requirement will be offered.
- They are likely to consume less feed per dozen eggs even during laying period when they are offered *ad libitum* feed.
- The pullets accumulate less fat and therefore produce more eggs.
- 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 laying house.
- Layers feed-restricted during growing period have been found to produce heavier eggs in longer clutches than those fed *ad libitum*.

FLOCK UNIFORMITY

- At a given age, growing pullets should have average body weight very close to breeder recommendations and at least 70% of the birds' weight within 10% of flock average.
- Points to be considered for getting uniformity among growing pullets are:
  - Receive chicks of uniform weight.
  - Provide proper feeding, watering and floor space.
  - Change the feeder and waterer according to the age.
  - The height of the feeder and waterer should be at the back height of the bird.
  - Provide proper energy in the diet.
  - Sample weights of the pullets are taken at regular intervals and change the feed accordingly.
  - Provide proper feeding space, so as to all birds consume feed simultaneously.

GROWTH PATTERN IN GROWER STAGE

Age in weeks	Body weight at end of the week (g)	Age in weeks	Body weight at end of the week (g)
9	565	15	985
10	635	16	1045
11	705	17	1100
12	785	18	1160
13	855	19	1210
14	920	20	1260

LIGHTING AND VACCINATION - GROWERS

Lighting - Growers

- If natural day length remains constant around 10-12 hours per day or decreasing during growing period, no artificial lighting at roof level is necessary. If the day length is increasing, then start giving additional lighting so as to maintain constant day length during growing phase. If necessary, repeat debeaking at 12-14 weeks of age following the precautions already given.

Vaccination - Growers

- Fowl pox vaccine has to be given on 10th week by web-puncture method. Vaccine against infectious bronchitis is recommended between 12-13th week depending on the need.
- RDVK/R_2B vaccine against Ranikhet disease should be given at 16/17th week of age by S/C route as injection.

DEWORMING AND DIPPING

- In general, growers reared on deep litter suffer from round worm infestation of the intestines and sometimes with tape worms also, especially if the farm is located around wet fields
- As a routine, the birds may be dewormed between 16-18 weeks of age and a few days before they are to be transferred to laying cages. Otherwise, the worms eat upon the feed consumed by the birds, bring down their health status which may hamper onset of laying of eggs
- *Piperazine, robendol, levamisole, thiobendazole, zodex* etc, are the drugs used to remove round worms while *panacur, taenil, helmonil, dicestal* etc., are used against tape worms at recommended dosage levels. Stop watering for two hours and then allow limited levels of medicated water to ensure that the required dosage of medicines is consumed by the birds without any wastage through left-over water
- *Dipping in 0.25% sumithion, malathion or sevin solutions or Spraying* may be carried out whenever the infestation of ectoparasites is noticed and preferably on hot/sunny days. Take care to avoid dipping head into the medicated solution
- Leave the birds outside after dipping to facilitate drying under sunlight
- External parasite infestation may be prevented by having solid floor without cracks, painting the wooden supports with petrol oil mixture or 40% Nicotin sulphate

CULLING

- Cull the poorly grown, injured and lame birds regularly
- Ensure that mortality level during brooding is below 4% and during growing phase below 3%
- Keep proper records on number of chicks received, feed intake, mortality, day to day culling, medication and vaccinations

CAGE REARING - GROWERS

Cage system of rearing - Growers

- Growers can also be reared in cages
- The floor may be made up of welded mesh of 1.25 x 5.0 cm size
- In a cage of 180 x 90 cm size, 50 birds can be reared with a space allowance of 325 cm^2 per bird
- Feeders and waterers may be fitted lengthwise on the sides one below the other

MODULE-9: CARE AND MANAGEMENT OF LAYERS

Learning objectives

This module enables the learner to learn in detail about the

- Care and Management of Layers
- Deep litter system of rearing - Layers
- Cage rearing - Layers
- Advantages of Cage rearing - Layers
- Lighting management - Layers
- Egg Production - Layers
- Collection of eggs
- Vaccination Schedule

DEEP LITTER SYSTEM OF REARING - LAYERS

- Grower birds are transferred to layer houses at the end of 18th week itself after deworming and dipping and protective vaccination against Ranikhet disease.
- Layers can be reared both on deep litter and in cages. When reared on litter, litter material has to be provided to 12-15 cm height

Space allowance

- A floor space allowance of 2 sq.ft. (1800 cm^2) per bird has to be given
- Circular or linear feeders may be provided; feeder space allowance of 10-12 cm per bird bas to be given
- Furnish waterer space allowance of 2.5 cm per bird
- A linear feeder of 180 cm length and 10 cm depth will suffice for 35 layer birds
- Circular plastic or aluminium water basins may be used
- Use waterer guards on the waterers at all stages of rearing to avoid birds standing on the edge and tilting the waterers
- Provide fresh, cool water twice a day
- During laying stage 1000 birds will consume 250 litres of water per day approximately
- A circular waterer, of 45 cm diameter and 7cm depth will be sufficient for 50 birds
- Arrange the feeders and waterers alternatively at equal distance; take care to adjust their heights so as to avoid feed wastage
- Fill them only to 2/3rd of their capacity at any time

Layer mash

- Layer mash with 18% crude protein, 2700 KCal/kg of M.E. 2.75% calcium and 0.80% available phosphorous has to be fed. *Ad libitum* feeding at all times has to be ensured

Nest boxes

- Nest boxes made of G.I or aluminium sheets may be provided at 45 cm height-one for every three to five birds
- The layers have to be trained to get into the nest box for laying eggs
- Otherwise, eggs laid on the floor have higher chances of breakage

- The mouth of the box should be of 30 cm width with a depth of 20 cm. Some litter material may be spread inside the nest boxes. Some farmers even tend to use pots as nest boxes as they provide cooler atmosphere to the birds experiencing stress while laying

CAGE REARING - LAYERS

Based on the number of birds in a cage , it is classified as

- Single or individual bird cage (Only one bird in a cage)
- Multiple bird cage (From 2 to 10 birds, usually 3 or 4 birds per cage)
- Colony cages (Holding birds more than 11 per cage)

Based on the number of rows

- Single-deck
- Double-deck
- Triple-deck
- Four-deck
- Flat-deck

Based on arrangement of cages

- Stair-step cages
  - M-type cages
  - L-type cages
- Battery cages (Vertical cages)
- Layer birds are reared mostly in cages. Cages of various sizes are to house 3-5 birds in a cage. Currently, reverse cages are used with their longer side being fitted to remain in the front. The cages of following sizes may be made and fitted in rows

45 x 30 cm - for 3 birds

45 x 40 cm - for 4 birds

50 x 35 cm - for 4 birds

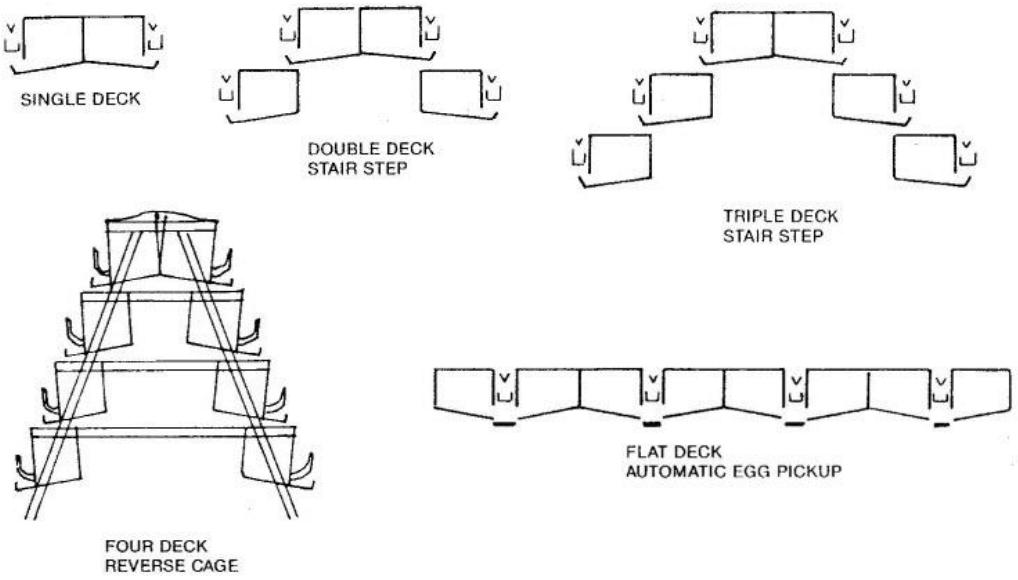
55 x 45 cm - for 5 birds

60 x 37.5 cm - for 5 birds

- These cages are arranged in two or three such rows one above the other on either side. They are termed as *Californian cages*.
- Depending on the number of rows, and number of tiers in each row, the breadth of caged layer house ranges from 24-26 feet (7 to 8 metres)
- There is no stipulation for length of such houses, which can be adjusted as per the number of birds to be housed
- No side walls are required for cage houses with the mesh being stretched down to the floor level to facilitate better ventilation for drying up the moisture in the droppings
- A floor space allowance of 420 – 450 cm^2 is allowed within cages
- Conventionally, the bottom of the lower most cage was fitted at 75cm height from the floor
- Now a days, they are fitted at 120-240 cm height above the floor level with walking platforms constructed on the sides

- The layer cage will be of 40 cm height. The floor is fitted with 2.5 x 5.0 cm size weld mesh of 14 gauge thickness. On sides, 7.5 x 7.5 cm size mesh of 16 gauge thickness is fitted
- The bottom floor is provided with 1/6 slope downwards to the front to facilitate rolling of the eggs to the cage front. The mesh rails on cage floor should run from back to front and not sideways; otherwise they will block free run of the eggs downwards to the front
- Waterers are fitted above the feeders in the front
- Automatic waterer nipples/ buttons and feeders may be provided to the cages

Elevated cage houses



- Of late, 'elevated cage houses' are preferred in which cages are fitted at above 5-6' height platform
- This arrangement widens the gap between birds and their droppings, facilitates quicker drying and easy removal of droppings

ADVANTAGES OF CAGE REARING - LAYERS

Cage rearing facilitates

- Easy management
- Lesser space requirement
- Easy collection of eggs
- Better egg weight
- Clean egg production
- Easy culling and reduced mortality levels

LIGHTING MANAGEMENT - LAYERS

- Artificial lighting has to be provided during laying stage by a minimum of one 60 watt bulb for every 200 sq.ft. area
- Start giving 20 minutes additional lighting per week and go on increasing it until a total day length (natural day length + duration of artificial lighting) of 16 hours per day is reached. It may be maintained at the level till 72 weeks of age
- Day length should never be decreased during laying period

PRODUCTION INDICES - LAYERS

Egg Production

- Egg laying starts at 21st week and the rate of laying (percentage production) increases every week to reach a level of 90% and above by 28 weeks of age which is maintained up to 40-42 weeks
- Afterwards, it slumps down slowly to reach 70% or below by 72 weeks of age. When the egg production goes below 65%, it is uneconomical to retain them unless the egg price is exceptionally high
- Egg production may be calculated as percentage on total number of birds available at 21st week (hen-housed egg production) or on number of birds available on each day (hen day egg production)

Egg Production indices

Hen-day egg production percentage

$$\frac{\text{No. of eggs laid on a given day}}{\text{No. of live birds available on that day}} \text{ X100}$$

$$\text{Number for a period} = \frac{\text{Total no. of eggs laid during that period}}{\text{Average hen days during the period}}$$

$$\text{Average hen days} = \frac{\text{Sum of living birds on each day during the period}}{\text{Total no. of days during that period}}$$

- HDEP is mostly used for the scientific studies and truly reflects the production capacity of the available birds in the house.
- A farm average of 85% or more per year is desirable.

Hen-housed egg production percentage

$$\frac{\text{No. of eggs laid on that day}}{\text{No. of birds at start}} \text{X } 100$$

$$\text{Number for a period} = \frac{\text{Average total no. of eggs laid during that period}}{\text{No. of birds at start}}$$

- It is usually expressed in numbers. HHEP values of 80% or 295 or higher are desirable.
- Although HDEP is an excellent indicator of how well the live birds are laying, it does not consider egg size and egg quality.
- Since these factors help in determining the income from eggs, HDEP is often misleading from a profit standpoint.
- It also fails to account for past mortality. However, it is the best egg production index available and is universally used by the industry.
- From a cost of egg production standpoint, HHEP is good as it measures the effects of both egg production and mortality.
- If there is no mortality during a period, the HDEP and HHEP are equal.

Egg mass

- The use of egg mass rather than egg numbers will lead to better comparisons of flocks or strains of birds.
- To calculate egg mass it is first necessary to determine the average weight of eggs by weighing representative samples of the eggs produced.

Average egg mass = Per cent HDEP X Average egg weight in

grams (Per hen per day in grams)

Feed efficiency (Feed conversion ratio – FCR)

- Feed efficiency per kg egg mass
  - This takes into consideration of the feed intake, egg weight and egg production. It is the ratio between the feed consumed and the egg mass.

FCR = Kg of feed consumed / Kg of egg produced

(per kg egg mass)

  - A value of 2.2 or less is advantageous to the farm.
- Feed efficiency per dozen eggs
  - This takes into consideration of the feed intake and egg production. It is the ratio between the feed consumed and the number of eggs produced.

FCR = (Kg of feed consumed x 12) / Total eggs produced

(per dozen eggs)

- A value of 1.5 or less is advantageous to the farm.

Egg feed price ration (EFPR)

- It is used to find out the ratio between the receipts from egg and expenditure on feed.

  EFPR = Total value of egg produced / Total value of feed consumed

- An EFPR ratio of 1.4 and above is desirable.

COLLECTION OF EGGS

- Layer type chicken lay their eggs mostly during forenoon
- Eggs may be collected twice in the morning and once in the afternoon
- Frequency of egg collection has to be increased to four to five times during peak summer
- In large layer farms, it is preferable to have air-cooled room for storage of eggs
- Specially designed plastic/ cardboard trays have to be used to collect eggs
- Usually 30 egg capacity collecting trays are used. It is not advisable to collect eggs in baskets

VACCINATION SCHEDULE

- **Vaccination Schedule For layers (0-72 weeks of age)**

Age	Type of Vaccine	Route of administration
0 day	Mareks Disease Vaccination	S/C 0.2 ml Turkey Herpes vaccine
5-7 days	Ranikhet Disease Vaccine	RDVF O/N
10th day	Leechi Disease Vaccine	Water
12-14 days	Infectious Bursal Disease Vaccine	Pruning Intermediate Georgia O/N or water
18-22 days	Infectious Bronchitis	O/N or water
24-27 days	IB Vaccine Booster	Water
28-30 days	RD vaccine Booster	La Sota - Water
6th Week	Fowl Pox Vaccine or Infectious Coryza Vaccine (if prevalent in the area)	S/C

8th Week	RD vaccine	RDVK or R_2B S/C or I/m
9th Week	Fowl Pox Vaccine	Wing web
10th-11thWeek	Infectious Coryza	S/C
12th-13thWeek	IB Booster	Water
18th week	RD Booster	RDVK or R_2B - S/C or I/m
45th-50thWeek	RD La Sota Repeated Every once in 2 Months	Water

SUGGESTED PRACTICAL RATIONS AND NUTRIENT REQUIREMENTS FOR LAYERS

Ingredients	Layer mash
Age in weeks	21 - 72
MAIZE	54
DORB	9
SB MEAL	14
SFOC EXT	8
DRY FISH	8
MM	2
S.GRIT	4
DCP	1
Total	100
Nutrients	Layer mash
C.P	18.04
ME K cal / Kg	2706
Calcium	3.02
Phosphorus	0.55
Lysine	0.97
Methionine	0.3

MOULTING

Natural Moulting

- Moulting is a normal physiological process of shedding and renewing feathers in feathered species and it occurs in both sexes
- In the wild state, birds usually shed and renew old, worn plumage before the beginning of the cold weather and their migratory flights
- Birds normally shed their old feathers and grow new feathers once a year, which is controlled by the gonads and the thyroid gland and is associated with a drop in estrogen levels and a decreasing rate of egg production

Commencement - Natural Moulting

- Natural moults in commercial layer normally occur after 8 to 12 months of egg production
- The loss of feathers is an orderly process with the head feather being shed first, followed by the feathers on the neck, body, wing and finally the tail

FACTORS AFFECTING MOULTING

- Several factors affect the onset and length of moulting. The important factors are
    - Weight and physical condition of the bird
    - Length of light exposure
    - Nutrition of the bird and
    - Environmental temperature and humidity
- It is possible to speed the moulting process through a *program of force moulting,* thereby recycling the hens for another period of egg production and improved egg quality.

PURPOSE OF FORCE MOULTNG (FLOCK RECYCLING)

- To minimize the cost to bring the flock into production
- To increase the length of egg production
- When the current egg prices are low with anticipation of higher egg prices after the flock returns to production
- Lack of available cash to maintain the flock
- Availability of empty laying houses

FORCE MOULTING REQUIREMENTS

Force (Induced) Moulting requirements

- Under forced moulting, a layer flock is induced to shed and replace its feathers at a time selected by the flock manager
- An induced moult causes all of the hens in a flock to go out of production for a period of time
- During this period, regressing and rejuvenation of the reproductive tract occur, accompanied by the loss and replacement of feathers

The three main factors involved in Force Moulting are:

Initiating the Moult

- All moulting programs require that egg production be reduced to zero, which is usually accomplished by fasting (no feed) the flock or by limiting critical nutrients such as protein, calcium or sodium until or beyond the time of production ceases
- Artificial lights should be turned off in open-sided houses and reduced to not more than 8 hours in environmentally controlled houses

Resting the Flock

- Once the flock is out of production, it may be held out of production for as little as 1 week to as much as 4 to 5 weeks depending on the requirement and the feeding program implemented during this period
- The level of nutrition can regulate the length of the resting period
- Low-protein or low-calcium diets will generally keep a flock out of production

Returning the flock to production

- When the flock is to be returned to production, a layer diet should be fed and lights should be returned to the normal lighting program for layers
- A 50% rate of lay should be reached in 2 to 3 weeks and the peak should follow in an additional 2 to 4 weeks

TYPES OF FORCE MOULTING PROGRAMME

Types of Force Moulting (Flock recycling) programs

- *Two cycle moulting program*
  - This program involves one moult and two egg production cycles
  - The hens are moulted after about 10 months of egg production, brought back into egg production and then sold at about 24 months of age
- *Multiple-cycle moulting program*
  - This program involves two or more moults and three or more cycles of egg production
  - The hens are first moulted after about 9 months of production, then held through successfully shorter cycles and sold at 30 or more months of age

FORCE MOULTING - METHODS

- Conventional force moulting program
- Low Nutrient Diet program
- Moulting by feeding zinc
- Use of drugs and other compounds

LOW NUTRIENT DIET PROGRAM

- Many countries do not allow egg producers to use the fasting methods because of concern for the welfare of the flocks. In such instances, the producer must use feeding programs which will achieve zero egg production without resorting to the complete removal of feed
- These methods include
  - Full or limited feeding of low protein or low nutrient diets
  - Pullet diet - calcium and phosphorus levels
  - No water restriction
  - Reduction of day length

CONVENTIONAL FORCE MOULTING PROGRAM

- This is otherwise known as on again/ off-again program

Days	Feed	Water	Light
1	None	None	8 Hours
2	None	None	8 Hours
3	45g/ hen	Water	8 Hours
4	None	None	8 Hours
5	45g/ hen	Water	8 Hours
6	None	None	8 Hours
7	45g/ hen	Water	8 Hours
8	None	None	8 Hours
9	45g/ hen	Water	8 Hours
10 through 55-60	Restricted feeding-about 75% of full feed intake	Water	8 Hours
61	Full-feed layer ration	Water	14 – 16 Hours

Note: Inducing moulting of Chicken through starvation is banned in India.

MOULTING BY FEEDING ZINC

- About 20g of zinc per kg in the layer diet (25kg of zinc oxide per ton feed) is used for a period of 5 days along with reduced photoperiod
- Then the birds are subjected to a regular laying ration containing 50 mg of zinc per kg diet (Normal level) and increased light period (14 to 16 hours)
- While on the high zinc program, hens will eat less than 10% of the normal amount of feed and will lose from 450 to 340g of their original weight within the first 7 to 10 days
- Egg production should stop by the fifth day after zinc feeding is started
- Birds will come back into production about 7 days after the high zinc diet is removed and peak egg production (75 to 80%) occurs depending upon the age at moult

Use of drugs and other compounds

- Compounds such as methalibure, enheptin, progesterone, chlormadinone, aluminium, iodine and others have been shown experimentally to effectively produce a moult

MODULE-10: REARING PRACTICES - BROILERS

Learning objectives

This module is intended for the learner to learn in detail about

- Brooding and Space requirements
- Feeding and Watering - Broilers
- Monitoring Growth rate
- Growth performance and Feed efficiency Chart - Commercial Broilers

BROODING AND SPACE REQUIREMENTS

Brooding of Broilers

- Brooding arrangement for straight run (unsexed) day old broiler chicks received at the broiler farms has to be made similar to layer type chicks described earlier
- The diameter for the brooder guard may vary from 150-240 cm for 175-300 chicks per unit respectively
- Newspaper spread on the litter may be removed after three days and the chicks guard arrangement also dismantled after eight days

Space requirements - Broilers

- Floor space allowance for broilers is 450 cm2 (0.5 sq.ft.) per bird upto 18 days and 1000 cm^2 (1.1 sq.ft) per bird after wards upto market age
- Feeder space allowance is 3 cm and 6-7 cm per bird
- Waterer space allowance is 1.5 and 3 cm per bird for the above periods respectively
- The waterers and feeders may have to be changed after second week and at fifth week and larger sized equipment have to be provided for adequate feeder and waterer space allowances

FEEDING AND WATERING - BROILERS

Feeding of broilers

- Feeding of broilers may be done in two phases
    - During first four weeks - Broiler starter mash with 22-23 % crude protein and 2950 Kcal/kg of M.E. has to be fed
    - After four weeks, till they are marketed, Broiler finisher mash with 19.5% crude protein and 3100 KCal/kg of M.E. has to be given
    - The broilers may also be fed in three phases from 0-2 weeks, three to five weeks and from sixth week to market age. Accordingly, different feed formulations have to be made for the three phases

Watering of broilers

- Clean, potable water should be provided. Early morning, as a first duty in daily routine, empty the waterers, clean them and provide water afresh
- Watering may be done twice daily and feeding four times in a day
- Fill waterers and feeders to only their 2/3rd capacity. Take care to avoid spillage of water on the litter
- If conventional chick waterers and plastic basins are used, have one spare set of waterers and clean and sun dry the used set every day

- During feeding and watering, take care that the birds are disturbed to the minimum. If possible, same person may be allowed to attend to one batch. Feeding and watering may also be done at the same time everyday to minimize the stress
- Take all steps to avoid feed wastage. Provide adequate number of feeders; make provisions to adjust the height of feeders, so that the brim of the feeder/ waterer is hiked to the level of the back of the growing broiler

MONITORING GROWTH RATE

Monitoring Growth rate in broilers

- Monitor the growth of the broilers up to the market age by weighing atleast 10 birds of average size at the end of every week of age so as to make sure that they put on weight normally and there is no sudden drop in growth rate
- If the growth rate is lower than the standard, the farmer has to check the quality of feed for the presence of toxins, adequacy of protein and amino acid levels (lysine, methionine etc.) and also the possibility of presence of any sub-clinical infection
- Also watch out for daily consumption of feed and water as any drastic change has to be investigated

GROWTH PERFORMANCE AD FEED EFFICIENCY CHART

Growth performance and feed efficiency of broilers

Age(weeks)	Mean body weight (g)	Feed intake/ 1000 birds/ day (kg)	Cumulative feed intake per bird (g)	Feed efficiency	Water intake 1000 birds/ day (litre)
0	42	--	--	--	--
1	170	19	146	0.86	46
2	380	37	426	1.12	89
3	720	68	945	1.31	165
4	1170	102	1730	1.48	245
5	1680	134	2720	1.62	320
6	2220	168	3996	1.80	405

- The table gives average weight of each bird, anticipated at the end of the week, and daily feed and water consumption by 1000 birds at the respective age even though water and feed consumption will vary depending on season
- Feed consumption will go down and water consumption will increase during summer and during winter/rainy season, water consumption will decrease and feed consumption will go up

VACCINATION SCHEDULE - BROILERS

0 day	Mareks Disease Vaccine (HVT)	0.2ml S/C
5-7 days	Ranikhet Disease Vaccine- RDVF	O/N
10th day	Infectious Bronchitis vaccine	O/N
12-14 days	Infectious Bursal Disease Vaccine- Intermediate Georgia	O/N
28th day	Booster RD La Sota	Water

MODULE-11: BROODING AND REARING PRACTICES FOR DUCKS

Learning objectives

This module deals with

- Brooding and rearing practices for Ducks
- Duck farming
- Housing
- Brooding of ducklings
- Grower rearing practices
- Layer duck rearing practices
- Feeding of Ducks
- Watering of Ducks

DUCK FARMING

- Duck farming in India is characterized by nomadic, extensive, seasonal, and is still held in the hands of small and marginal farmers. Traditionally West Bengal and Kerala are the major consumer states for duck egg and meat and one of the reason is that duck egg and meat highly suits and impart taste for their fish based culinary preparations.
- Binomial nomenclature for duck is *Anas platyrhynchos*

Advantages of Duck farming

- Ducks are more prolific and produce 15-20 eggs more than backyard chicken.
- Size of the duck egg is 10-15 gram larger than chicken egg.
- Ducks have long productive and profitable life *i.e.,* they will lay in second and third year also.
- Ducks supplement their feed by foraging; hence it will reduce the feed cost.
- Marshy, swampy river side, wet lands, barren lands not suitable for chicken can be used for duck rearing.
- Ducks lay their eggs during early in the morning (3am to 8am) and saves time and enables easy egg collection.
- Duck farming is having symbiotic relationship with paddy cultivation, so ducks and paddy cultivation can be integrated in the entire paddy farming areas.
- Ducks are quite intelligent birds and they can be easily trained for their daily routine (going to ponds, feeding etc) and it reduces the labour for management.
- Ducks are quite hardy, ducklings are easy to brood and are resistant to common avian diseases.

HOUSING

- In general, ducks do not require elaborate houses. The house should be well ventilated, dry, and rat proof.
- In semi intensive system of rearing, the house should have easy access to outside run as the ducks prefer to come out during the day time, winter and rainy time.
- The run should have slope away from the house to provide drainage.
- In the house of semi intensive system, a continuous water channel of size 50 cm wide and 15-20 cms depth should be constructed at the far end, on the both sides, parallel to the pen in the grower and layer house.

BROODING OF DUCKLINGS

Brooding of ducklings (0-4 weeks)

- Ducklings may be brooded on wire floor, litter or batteries. The brooding period of layer ducklings is 3-4 weeks while for meat type ducklings 2-3 weeks is sufficient.
- In general, in chilly season, brooding period needs to be extended by 1-2 weeks longer than the regular period. Provide hover space of 90-100 sq.cm per duckling under the brooder. A 250 watt bulb can brood 30-40 ducklings. The temperature of 32°C is maintained during the first week. It is reduced by about 3°C per week till it reaches 24°C during the fourth week.
- Under wire floor system of brooding, the space recommended is 0.5 sq.ft per duckling while under deep litter system, it is 1.0 sq.ft per bird up to three weeks of age.
- Water in the drinkers should be 5.0-7.5 cm deep, just sufficient to drink and not to dip themselves.
- The thickness of the litter recommended is 3 cm or more in order to absorb the excess moisture of droppings of the ducklings.
- Under extensive system, no artificial warmth is provided. However, the heat in the brooder shed is conserved by making "Closed tents" (Tent brooding) to provide the required warmth. The ducklings are allowed to swim in water only after attaining a week atleast.

GROWER REARING PRACTICES

Grower (5-16 weeks)

- Ducks can be reared both in intensive and semi intensive system.
- Under intensive system, floor space of 3 sq.ft per bird up to 16 weeks of age is sufficient.
- Under semi intensive system of rearing, a floor space of 2-2.5 sq.ft per bird for night shelter and 10-12 sq.ft per bird for outside run is necessary for free flow of birds up to 16 weeks.
- Water in the drinkers should be 10 -12 cm deep to allow the immersion of their heads.
- Partitions up to the height of 60-90 cm separating the pen and run are adequate for control of ducks.
- In rural duck farming, straight run ducklings (male and female) will be reared up to 20 weeks of age, then female ducks will be kept for laying purpose and male ducks will be sold for meat purpose after selecting good males for breeding.

LAYER DUCK REARING PRACTICES

Layer (above 17 weeks of age)

- Under intensive system, a floor space of 4 sq.ft per bird is essential. In semi intensive system a floor space of 3 sq.ft per bird for night shelter and 10-12 sq.ft per bird of outside run space is required.
- For wet mash feeding 10 cm of feeding space and for dry mash or pellet feeding 7.5 cm of feeding space per bird is required. For the collection of clean and hatching eggs, a nest box with 30x30x45 cm dimension shall be provided at the rate of one per three ducks.
- Lighting duartion of 14-16 hours is necessary for optimum egg production.
- The age at first egg and 50 percent egg production are 120, 140 days and the annual egg number is 300 eggs for Khaki Campbell ducks in intensive farming.
- The daily feed intake during laying, body weight and egg weight at 40 weeks of age is 120-140 gram, 1800 gram and 68 gram respectively.

FEEDING OF DUCKS

- Ducks are good foragers. In extensive system of rearing, ducks are allowed to graze on pre and post harvested paddy fields, ponds, lakes, canals.
- In this system, fallen paddy grains, insects, snails, earthworms, small fishes, fingerlings, tadpoles, water plants like algae etc. are the main source of feeding for ducks.
- Here, it is worth mentioning that paddy cultivation and duck farming is having symbiotic relationship, paddy fields are the excellent foraging centers for grazing ducks and duck droppings are good sources of manure for paddy field and they also condition the soil by its shoveling like action in grazing and feeding.
- So active duck farming is seasonal, coincide with monsoon based paddy cultivation season. As a thumb rule 100 ducks require 0.5 acre paddy field per day for effective grazing.
- During non laying periods, they are fed with low cost feed sources like paddy husk and low graded grains like broken rice, sorghum etc.
- Normally the rural duck farmers are practicing exclusively extensive system of rearing with grazing.
- However under the intensive and semi intensive system of rearing, ducks may be fed with dry mash, wet mash or pellets.
- Ducks prefer wet mash due to difficulties in swallowing dry mash.
- The most important point in feeding is *Ducks should have an access to feed with water*. During the first eight weeks, ducks should always have an access to feed but later on they may be fed twice a day *ie* first in the morning and then later afternoon.

WATERING

- Though ducks are water fowls and fond of water, in contrast to the prevailing myth among farmers, water for swimming is not essential at any stage of rearing .
- However, water in drinkers or water channels provided in the house should be sufficiently deep enough to allow the immersion of their heads and not themselves. If they cannot do this, their eyes will get scaly and crusty and in some cases, blindness may follow. In addition, they also clean their bills periodically and wash them to keep it clean.

COMMON DISEASES OF DUCKS

- In general, ducks are subjected to relatively few diseases when compared to chicken, but they are serious in nature.
- Light sandy soil is ideal for duck farming, because it tends to keep less disease germs and drain well. Since certain infections of chickens may be transmitted to ducks such as salmonellosis, colibacillosis, it is desirable to keep duck farm away from commercial chicken farms.

Viral diseases

Duck virus enteritis (Duck Plague)

- It is an important contagious disease affecting adult birds, characterized by vascular damage with tissue haemorrhage and free blood in body cavities. The intestine and gizzard will be filled with blood.
- It usually occur in per acute form and the mortality varies from 5-100 percent. The major symptoms are droopiness, ruffled feathers, discharge from eyes and nostrils, swollen and sticky eyelids, greenish watery diarrhea. In males prolapse of penis and in females severe drop in egg production will be noticed.

- The lesions are vascular damage, severe haemorrhages in gastro intestinal tract, petichae in liver, pancreas, lungs, kidney, ovary.
- In layers massive haemorrhages in ovary some times fill the abdominal cavity.
- Parent stock and commercial stock shall be immunized with live attenuated vaccines to transfer maternal antibody to the chicks. Commercial layers also immunized with vaccines at 8 weeks of age.

Duck virus hepatitis

- It is a highly infectious disease of ducks primarily affecting ducklings of 2-3 weeks of age, characterized by severe hepatitis.
- The major symptoms are closed eyes, falling on their sides, severe convulsions and death. The primary lesions are enlarged liver with haemorrhages.
- The reddish discolouration and mottling appearance of the liver with enlarged spleen and kidney is observed. Breeding stock can be immunized at 6-7 months of age to protect the ducklings.

Bacterial diseases

Salmonellosis

- The main causative organism is *Salmonella typhimurium*, usually occurs during first few days of life, clinical manifestation will be exhibited during the start of lay or peak production. The major symptoms are swollen and edematous eyelids.
- The primary lesions are enlargement and mottling of liver, pericarditis and arthritis makes the bird difficult in standing. The sulpha and furazolidone are the drug of choice for salmonellosis and control is by removal of carrier birds.

Pasteurellosis (Duck cholera)

- It is an infectious disease caused by *Pasteurella multocida* around four weeks of age. The symptoms are raised body temperature, green colour diarrhea, complete paralysis of legs and sudden death. Prevention is by vaccination and treatment with suitable antibiotics.
- The prominent lesions are pericarditis and arthritis, petichae in myocardium. The distended pericardial sac will be filled with yellow flakes and caseous masses. Treatment with sulpha drugs will be beneficial and control with elimination of affected birds.

Fungal diseases

Aflatoxicosis

- It is caused by aflatoxin produced by the fungus *Aspergillus flavus* and they are most potent carcinogen for ducks. Maize, Groundnut oil cake, soya bean oil cake, rice polish are the major feed ingredients for aflatoxin production on storage in wet conditions.
- Improper drying and humid weather favours the fungus growth. Ducks are very susceptible to aflatoxin content of the feed especially exotic ducks are more susceptible than indigenous ducks. The common aflatoxins are B_1, B_2, G_1, G_2 and B_1 is the most potent toxin. The minimum toxic dose is 0.03 ppm in the feed.

- The major symptoms are poor growth, lameness, purple discolouration of feet and legs. Ducklings will develop ataxia, c onvulsion and death. There is no specific treatment for aflatoxin and the preventive measures are, avoid the wet and mouldy feed and feed stuffs and use of completely dried feed and addition of fungistats and toxic binders.

Aspergillosis

- It is caused by *Aspergillus fumigatus*. Inhalation and ingestion are main modes of infection.
- The symptoms are dyspnea, gasping and accelerated breathing and ocular discharge.
- The major lesions are yellowish grey material or whitish fluffy spots in lungs, trachea, and abdominal cavity.
- The prevention is by good management of litter and avoiding over crowding.

Parasitic diseases

- Ducks are resistant to internal parasites, however, ducks grazing stagnant and over crowded ponds may get infestation of fluke, tape and round worms.
- Regular deworming with broad spectrum anthelmintics at 3 months interval during growing and laying stage will control the problem.

MODULE-12: BROODING AND REARING PRACTICES FOR JAPANESE QUAIL

Learning objectives

This module deals with

- Brooding and rearing practices for Japanese quail
- Advantages of Japanese quail farming
- Brooding of quail chicks
- Quail farming under Cage system

JAPANESE QUAIL FARMING - ADVANTAGES

Japanese quail farming

- The term "quail " refers to a group of small--sized birds, which generally crouch or run rather than fly to escape from danger, the term itself meaning "to sink, shivering from fear ".
- Zoological name for Japanese quail is *Coturnix coturnix japonica*
- Japanese quail (*Cotumix coturnix japonica)* is the domesticated species widely reared throughout the world for meat and eggs.

Advantages

The reasons for the popularity of Japanese quail farming are as follows:

- Japanese quail rearing does not require specially designed houses.
- The initial capital requirement is less due to lesser floor space requirement
- The quail will be ready for market/table purpose at the age of five weeks itself. They start laying from the sixth week itself. Hence the return on investment is faster.
- The Japanese quail management is much easier since they are comparatively more resistant to diseases than chickens, do not normally require any vaccinations, deworming, etc.
- The maintenance and recurring costs are also less because they consume less feed due to smaller body size.

Thus, Japanese quail farming can be undertaken with less capital investment, little skill to obtain faster returns.

JAPANESE QUAIL REARING

- Japanese quail can be reared either on the floor or in specifically designed cages.
- Under floor rearing, the roofing can be made of thatch or tiles, while the floor has to be made of cement or concrete flooring to facilitate easy cleaning and disinfection.
- When Japanese quail are reared for table (meat) purposes, about 5 quail per square foot area (floor space per bird: 180 cm^2) can be raised. In a 10' x 10' (0.9 m^2) room, about 500 Japanese quail can be reared up to market age (5 weeks).
- Alternatively, two weeks rearing on the floor, followed by cage rearing up to market age, can also be practiced.

BROODING ARRANGEMENTS FOR JAPANESE QUAIL CHICKS

- The brooder house should be thoroughly cleaned and disinfected atleast a day in advance to receive the chicks.
- Litter materials like paddy husk or groundnut hulls is spread to about 2.5 cm depth, and newspaper is spread over it.
- A brooder guard in the form of a cardboard sheet or metallic sheet about 20 cm height is arranged in a circle over the newspaper on the litter material. It is fastened properly.
- Japanese quail chicks are very tiny and cannot adjust themselves to a chill or cold environment. Hence, adequate warmth must be ensured by providing incandescent/infra-red bulbs at the centre of the brooder guard arrangement, or by coal-stove heating or gas brooding. The brooder house must remain covered up to the roof on all four sides, with full walls and windows.
- Open-sided houses with mesh arrangements must be closed with thick screens to conserve the heat.

BROODING SPACE - JAPANESE QUAIL

- In a brooder guard circle of 3 feet diameter (90 cm), about 150 chicks can be accommodated. It is not advisable to allow more than 300 chicks inside one circle.
- An electric bulb with a hood cover can be provided at 15 cm height at the centre of the circle, providing approximately 1 watt per chick. The heating arrangement has to be continued day and night during the first week, but only during the night in the second week. The brooder house temperature at the level of the birds has to be about 98^{o}F, which may be reduced by about 3^{o}F every 3 days.
- During winter and rainy seasons, heating has to be continued for atleast three weeks , while during summer, the practice may be restricted to only 10 days. From third week onwards, Japanese quail chicks do not require night lighting.

Drinkers and feeders -Space requirements

- Drinkers and feeders should not be kept under the source of heat inside the brooder circle. A drinker space of about 0.3 cm, and a feeder space of 0.6 cm per bird, must be provided during 0-2 weeks, and this has to be increased to 0.6 and 1.2 cm respectively from 3-5 weeks of age.
- The drinker size should be adjusted so that the gap between the brim of the plate and the cup should not be more than 1 cm, otherwise the chicks will get into the drinker and get drowned.
- Upto two weeks, two chick drinkers of 10 cm diameter and 1.5 cm high on the sides, each of 500 ml capacity, and two feeder plates of 22 cm diameter and 2 cm high will be sufficient for 150 chicks in each brooder circle.
- From the third week, a linear feeder 45 cm long, 2.5 cm height and 10 cm wide, and a drinker of 15 cm diameter and 2.5 cm high at the brim and 1200 ml capacity will be sufficient for 75 quail chicks.

CAGE REARING - JAPANESE QUAIL

- Two differently designed types of cages are required to rear Japanese quail chicks up to market age.

Brooder quail cage rearing

- A brooder cage is required to rear them from day-old to 17-18 days of age and a grower cage from 18-19 days to market age.
- The cages are designed as multi-tier cages (four or five tiers arranged one over the other) with about a 10 cm gap between each tier, and a droppings tray fitted into the gap. Each tier can be further divided into smaller compartments.
- A brooder cage can be constructed as four or five tiers of 180 x 120 x 25 cm, and each tier can be divided into four compartments of 90 x 60 cm size each. About 100 chicks can be reared in each compartment, and 400 chicks in each tier. Provision must be made for heating bulbs in the centre of each compartment.
- Appropriate side feeders and drinkers are provided inside the compartment itself.

Grower quail cage rearing

- The grower cage can be 240 x 120 x 25 cm size, with each tier divided into four compartments of 120 x 60 cm size each. About 60 quail can be reared in each compartment up to market size.
- Feeders and drinkers are fixed outside the cage units. Feeding is done three times a day and watering twice daily without limiting the intake.
- Japanese quail chicks should not be left without feed or water at any time of the day. This will affect their growth rate and increase the mortality rate.

MODULE-13: BROODING AND REARING PRACTICES FOR TURKEYS & GUINEA FOWL

Learning objectives

This module deals with

- Intensive system of rearing Turkeys
- Feeding of Turkeys
- Nutrient requirements of Turkeys
- Semi-intensive and Range system
- Guinea fowl -Origin
- Rearing practices for Guinea fowl
- Confined rearing of Guinea fowls

TURKEY FARMING

Introduction

- Domestic turkey production started in Europe in the 16th century. The consumption of turkeys at Christmas is a tradition which was spread to other countries by the British and Spanish.
- In India, turkey production is still in its infancy. Because of the structural changes that are taking place in the broiler production in South India, the small farmers who were eased out of the market are now looking to turkey production as an alternative means of employment, particularly as people are searching for diversified food items. The tendency to accept processed frozen food is now also growing in this region.
- At present, Indian institutions, like Central Avian Research Institute, IzatNagar, UttarPradesh, Department of Animal Husbandry, Kerala, Central Poultry Breeding Farm, Hessarghatta, Karnataka, Poultry Research Station, Nandanam of Tamil Nadu Veterinary and Animal Sciences University, Chennai and Haryana Agricultural University, Hisar, are promoting turkey production among Indian farmers.

INTENSIVE SYSTEM OF REARING TURKEYS

- Management of turkeys is similar to that of chicken. The building should be located at an elevated place, and cement floors are preferred.

Management of Turkey poults

- Binomial nomenclature for Turkey is *Meleagris gallopavo*
- Turkey poults grow very slow during early part of brooding and also they do not eat voluntarily. Hence, they should not be overcrowded and should be guided towards eating. About 900 cm^2 of floor space per poult is required during the first 3-4 weeks and thereafter up to eight weeks the floor space is increased to 0.135 m^2 per poult.
- A compartment of 3 x 3 m will be suitable for housing 100 poults up to 4 weeks of age. They are transferred to a compartment of 3 x 4.5 m for further floor brooding until 8 weeks.
- From 9-12 weeks of age, the floor space must be increased to 0.18 m^2 per growing poult, and thereafter until sixteen weeks of age, the minimum floor space allowance is 0.23 m^2 per poult.

- After sixteen weeks, they require 0.36m² space per bird. For small turkey breeds, the floor space requirements may be reduced slightly.
- The floor space is reduced to almost one-third under the range system, since only a small shelter is required to protect them from rain and sun.
- Turkey poults are also to be brooded at a temperature of 95°F during the first week of brooding. The brooder temperature may be reduced by 5°F weekly until it reaches 70°F.
- Artificial heat may be stopped at fourth week during summer and sixth week during winter. Debeak the poults at about 10 days of age. Trim the upper beak halfway between the tip and the nostrils with an electric debeaker.

FEEDING OF TURKEYS

- The turkey meat has very low fat content compared with other commercial avian species. For this reason, turkey diets have a smaller energy to protein ratio than those of other species.
- Balanced feed for turkeys may not be available commercially as easily as that of chickens; however, experienced farmers can easily prepare their own feed in consultation with poultry nutritionist.
- As turkeys require more protein, minerals and vitamins than chickens to support their growth, turkey rations are more costlier than chicken rations. Since the energy and protein requirement of the two sexes vary, they may be reared separately to obtain better results.
- Poults give more trouble than chickens with respect to feeding. The sooner they are fed after hatching, the better. If they don't find feed and water easily, starvation or dehydration can occur. Turkeys must always be fed on troughs or hoppers, and never on the ground.

NUTRIENT REQUIREMENT - TURKEYS

- **Feed for turkeys**

Age (weeks)	Type of feed	CrudeProtein (%)	ME (KCal/kg)
0 - 5	Starter diet	28	2800
6 - 8	Grower-first diet	26	2800
9 - 12	Grower-second diet	22	3000
13 - 16	Market age Finisher diet	16	3300
13 - 24	Holding/pre-layer diet	12	2750

SEMI INTENSIVE AND RANGE SYSTEM - TURKEY

- Turkeys are also reared under range systems in the backyards of rural households.
- Popular commercial production is through a semi-intensive system. Under this system, turkey poults are reared up to four to six weeks of age in closed, confined houses, after which they are allowed to forage for a few hours in an open yard during the day and then housed in the shelter for the rest of the day and night. Growers and breeders are reared under this type of semi-intensive system.
- Strutting behaviour is normally observed in Toms than female Turkeys

FLOOR SPACE ALLOWANCES FOR TURKEYS UNDER SEMI-INTENSIVE SYSTEM

Age (weeks)	Space per bird	
	Shelter	Open yard
7 - 12 weeks	0.09 m^2	0.18 m^2
13 - 16 weeks	0.16 m^2	0.32 m^2
17 weeks-market age	0.22 m^2	0.45 m^2
Breeders	0.27 m^2	0.54 m^2

- When the turkeys forage, they consume the sparse cultivated grass and greens available in the open yard and the feed cost is reduced. The farmers claim that they are able to get better fertility and hatchability under the semi-intensive system than under the intensive system.
- The feeders and drinkers are provided inside the shelter in a shaded environment.
- Turkeys are better foragers and digest fibre better than chicken. Therefore they are fed with cut legumes like lucerne (alfalfa), desmanthus, stylo, etc., in the yard, which reduces the feed cost.

TURKEY DISEASES

- Turkeys are completely resistant to Marek's disease and Infectious Bronchitis. Newcastle disease, Fowl pox and coccidiosis occur in a mild form
- Some of the commonly encountered diseases in turkeys are mycoplasmosis, fowl cholera, erysipelas and possibly haemorrhagic enteritis and avian influenza
- Turkeys are protected against fowl cholera and erysipelas by vaccination.
- It is difficult to control mycoplasmosis (caused by *Mycoplasma meleagridis*), since the disease is transmitted through eggs and semen
- This disease can be eliminated or reduced by using Mycoplasma-free turkey breeding populations, and by dipping the hatching eggs in antibiotic solutions (Gentamicin or Tylosin)
- In case of a disease outbreak, the sick birds must be isolated
- If the outbreak occurs during the brooding period, the brooder house must be thoroughly cleaned; and if the outbreak occurs in birds in the yard, the flock must be moved to clean ground and the veterinarian should be consulted for treatment
- Normal mortality under standard management up to maturity is 6-10 percent, and the farmer should not be unduly alarmed by the sporadic death of one or two birds in a flock
- If fowl pox is prevalent in the area, vaccinate the growers between 6-8 weeks of age. Breeders must be given booster vaccinations by about 7-8 months of age

GUINEA FOWL - ORIGIN

Guinea Fowl

- Guinea fowls originated in Africa from where they spread to almost all the parts of the world. In their natural habitat, they are found in great numbers in Savannahs of Sudan where they live in groups, the birds sleeping on trees and seeking all their feed from the fields.
- It is timid and gregarious in nature than that of chicken and habit of crowding together in panic is liable to cause heavy losses. Being noisy it cannot be reared in close vicinity of human dwellings. In wild state they cause havoc to the crops. Their peculiar feeding behaviour results in abnormally high feed wastage from the feeders. Guinea fowls are more resistant to heat than chicken. It is however possible to raise guinea fowls in wet climate also. During transportation it resists suffocation better than chicks.

Advantages of rearing guinea fowl as compared to chicken are

- Low cost of production.
- Premium quality of meat.
- Greater capacity to utilise green feeds.
- Better capacity to scavenge insects and grains.
- Better ability to protect itself from predators.
- Better resistance to common poultry diseases like Ranikhet and Fowl pox.

REARING METHODS - GUINEA FOWL

Free Range

- Free range guinea fowl farming constitutes a noteworthy resource for pheasants in some countries.
- A system ranges from providing night shelter to a complete outside rearing where birds spend their nights on the trees around the farmer's dwelling.

Semi-free range

- For meat type guinea fowl, aviary rearing in enclosures surrounded by wire mesh and roofed over by netting is very common.
- For 1000 guinea fowl chicks, a starter house of 24 m^2 is required for housing during first three weeks. This communicates with the rearing house to which chicks are then transferred. This comprises of 40 m^2 shelter equipped with perches and further leads into an aviary of 200 m^2. This accommodation should be located on a permeable soil showing slight slope for water drainage.
- For egg type guinea fowls, hens are made flightless by amputating extremity of wing at the most distal joint. The hens lay eggs wherever she chooses and nests need not be provided.

CONFINED REARING - GUINEA FOWLS

- Rearing of guinea fowls in confinement without any access to out doors has given better performance. For meat purpose, the batches of not more than 500 can be reared in lighted houses with density of 8-10 m^2 should be allowed. In dark houses, however, large batches at the density of 12 birds per m^2 can be allowed.
- Layer type birds can be reared on soil or batteries. For rearing on soil the density of 3-5 birds per m^2 in a house well equipped with perches is recommended.
- In battery rearing the breeding females are maintained in cages and fertility is ensured through artificial insemination.

MODULE-14: SETTING OF FARMS FOR POULTRY

Learning objectives

- This module deals with the general principles of housing different species of poultry.

SELECTION / LOCATION OF FARM SITE

- The location of the farm should facilitate easy operational convenience for various activities of the farmer.
- The farm should be located away from the city.However, not too far away to make strenuous to bring in and take out materials.
- Breeding farms should be located in an isolated place, away from commercial farms to ensure biosecurity.
- A commercial farm should be located nearer to the marketing centres.However, it should not be located in a congested area or in close proximity to existing farms. There should be a minimum distance of 1 km. from existing farms.
- It should be away from the Highway to avoid noise and dust pollution but it should have an access to connecting roads.
- It should be within 20-30 kms. from the main marketing centres and this is particularly true with broiler farms as these birds will cause a considerable loss during transportation by way of shrinkage and stress leading to mortality.

TOPOGRAPHY

- The farm should be located at an elevated area, preferably on even land with proper facilities for drainage.
- The area should be well protected against strong winds as it could easily damage the poultry house.

SOIL AND WATER

Soil

- The most reliable soil is loamy or sandy loam. The right kind of soil reduces construction expenditure, avoids seepage, dampness, erosion etc.

Water

- This plays a major role in the physiology of the bird. Abundant water is required for various activities. A minimum amount of 1 litre/bird/day is required.
- The water should be potable and must be subjected to various tests for impurities like total solids, microbial contaminations, high percentage of salts of sodium, potassium and chlorine. Water should be tested for nitrites and nitrates whose presence will indicate organic pollution.
- The desirable quality guidelines for drinking water to poultry are as follows:

Water quality Permissible Desirable level

- Total hardness 60-180
- pH 6.8-7.5
- Nitrate 10 mg/litre
- Nitrite 0.4 mg/litre
- Total bacterial count 0/ml
- Coliform count 0/ml
- Calcium chloride 60 mg/litre
- Sodium 50 mg/litre
- Sulphate 125 mg/litre

TRANSPORTATION AND LABOUR

Transportation

- The farm must be well connected to a highway to facilitate easy transportation and availability of inputs like chicks, feed, etc.

Labour

- The farm should be within the reach for labours to travel easily and fast.

SYSTEMS OF HOUSING

- The broilers may be raised on deep litter, in cages or in batteries with slatted or wire floor system. However, deep litter system of housing is the most widely used system for broilers.
- Layers are reared on deep litter floors, in cages or on different kinds of floors at different ages. Deep litter floor rearing involves rearing chicks or birds on any one of the preferred litter materials (paddy husks, groundnut hulls, wood shavings, etc.) spread on the floor.
- Cages of different sizes with different sized meshes need to be fabricated for rearing layer chicken of different ages.

BROILER HOUSING

The major capital expenditure is on buildings and therefore it needs thorough planning. The various types of buildings required on a broiler farm are:

- Brooder houses and Grower houses
- Broilers need houses to protect them from extremes of climate, theft, predatory animals like wild cats, dogs or bandicoots, etc. to ensure easy and better management, to facilitate automation and to provide ideal and comfortable rearing conditions.

OPTIMAL ENVIRONMENTAL CONDITIONS FOR REARING BROILERS

- Temperature: 22-30°C (70-85°F)
- Relative humidity: 30-60 per cent;
- Ammonia: Less than 25 ppm;
- Litter moisture: 15-25 per cent;
- Airflow: Airflow should be 10-30 metres per minute

ORIENTATION

- The broiler houses should be oriented with their long axis facing East-West direction to avoid direct sunlight falling into the building.
- The rule of the thumb is that the long axis of the houses should be parallel to the shadow of a vertically erected pole during the hottest summer.

ELEVATION

- The floor-level of broiler houses should be raised 30 cm (one foot) above the outer ground level to prevent seepage of water into the house.
- The floor should be made of cement concrete to prevent damage by rodents and to permit easy and efficient cleaning and disinfection.
- Mud floors and sand floors should never be permitted, as they will render cleaning between batches very difficult and will harbour micro-organisms, cysts of parasites, etc., which may cause outbreaks of disease in subsequent batches.

WIDTH AND LENGTH

- The width of open-sided broiler houses should not be wider than 24 ft (7.20 m) or less than 16ft (4.80 m) to permit optimal cross-ventilation.
- The length of the house may vary depending on the required capacity and the length of the available land. In tunnel-ventilated broiler houses fitted with automatic feeders and drinkers, the width may extend up to 12.00 m.

WALLS

- The long walls on the sides should not be more than 35 cm high above the floor level, with the rest of the area covered with a mesh.
- Open-sided broiler houses are preferred in tropical conditions for their hot climate.
- The top of the sidewall should be tapered sloping downwards to avoid young birds perching on the walls. The wall should be thoroughly cement-plastered and well watered to avoid cracks formation.
- In places of extreme climatic conditions, the walls may be constructed with hollow bricks for an insulating effect.
- The space between the top of the sidewall and the roof must be covered with wire mesh (1.25 X 1.25 cm, 20-22 gauge thick), welded mesh (2.5 X 5.0 cm, 12-14 gauge thick) or chain link (2.5 cm, 12 gauge thick). It should be durable and strong and close enough to prevent the entry of rodents and predators.
- The doors may be fitted with strong G.I. rod supporting-frames of welded mesh at 8-10 m intervals, each one metre in width.

ROOF

- The roof may be thatched (straw, coconut leaves or palmyrah leaves), tiled or covered with light roof (asphalt or bitumen), asbestos or aluminium sheets.
- Thatched roofs are cheaper, but less durable and may leak. They provide a cooler environment during the hot summer.
- To prevent leakage, the slope of thatched roofs must be steeper. Asbestos or aluminium roofs are durable, but more costly.
- As houses with these roofs remain hot during summer, the height at the ridge should preferably be about 4.0-4.5 m.
- Tiled roofing is good for low-capacity farms, and asbestos roofing for larger farms.
- The broiler houses can also be two-storeyed, with the lower floor having a concrete roof which will serve as the floor for broilers raised on the first floor.
- The height of the roof should preferably be 2.40-3.00 m at the eaves, and 3.60-4.50 m at the ridge. Thatched roofs may have a lower height of 1.95 m at the eaves.
- The projection of the roof at the eaves (overhang) should be atleast 0.90-1.35 m on either side to prevent direct sunlight and the splashing of rain water into the buildings. It is better to adjust the overhang to be half the length between the eaves and the top of the sidewall (the height of the area covered by mesh).
- In regions of extreme climatic conditions, it is very useful to have the roof insulated. Insulation may be provided by a bed of straw on the top of the roof, or by having false roofing at the level of the eaves in the form of mats spread to cover the entire roof area.
- Plywood, coir or hardboard as a covering can also be useful. The roof may also be painted with white aluminium paint to reflect the sun's rays and thereby reduce the heat build-up within the house.
- In areas where the summer is severe, it is better to have high roofed broiler houses, or to provide ridge ventilation at the roof. Chimneys can also be provided on the roof at intervals.
- In areas where winter is severe, it is advisable to have square-shaped broiler houses which expose a smaller area and help to conserve the heat produced by birds within the building.

NUMBER OF BROILERS HOUSES

- An approximate floor space of 1 sq.ft per bird (one square meter/ 10 birds) should be provided, and thus enough floor space should be constructed according to the required capacity.
- Under the all-in-all-out system, depending on the capacity required and length and slope of the available land, minimum number of houses with a width not more than 24 feet and of required length to provide the suggested space allowance may be constructed.
- It is advisable to maintain at least a 9.0 m distance between two broiler houses to ensure proper ventilation.
- Under the multiple batch system, if chicks are received bi-weekly, the houses or pens should be in multiples of 4 + 1. If chicks are received every week, the houses or pens should be in multiples of 8 + 2 to provide sufficient extra space to facilitate a minimum of two-week intervals between the rearing of two successive batches in any house.

FLOOR SPACE ALLOWANCE - BROILERS

- The floor space requirement per broiler depends on their body weight, housing system and climatic conditions.
- Approximately 540 cm^2 (0.6 square feet) per kg live body weight is the required floor space for broilers on floor under tropical conditions. Accordingly, at the end of two, four, six and seven weeks of age, floor space allowances of 120, 367, 730 and 945 cm^2 space per bird is required for average body weights of 220, 680, 1350 and 1750 g respectively. For a body weight of 1650 g, 900 cm ^{2} (one square foot) of floor space is sufficient. In summer, the space allowance may be increased by 20 per cent and in winter reduced by 15 per cent.

- When they are reared in cages, half the spaces suggested are sufficient.
- The cages must be fitted at a height of 75 cm above floor level with feeders and drinkers fitted on the sides, running along the length and width of the cages.
- Cage houses meant for broilers need not have sidewalls, and weld-mesh cover may be provided up to the bottom floor level.
- The cage mesh size should be 1.25 x 1.25 cm for the floor and 2.5 x 5.0 cm on the sides to allow birds to take feed and water.
- Many practical difficulties, like injuries to the flesh of the birds or to the attending workers, breast blisters due to the heavy weight of the birds, leg weakness, difficulty in gathering for the market, maintenance costs, etc., have forced farmers to abandon this system of housing for broilers.
- The emergence of full automation of feeding and watering and environmentally controlled houses may encourage farmers to opt for cage housing for broilers in future, as it ensures a faster growth rate, better feed efficiency and lower mortality levels.
- Environmentally controlled broiler houses may be established in future in this region when higher investments are made in broiler rearing for large-sized broiler farms. Such houses will have no windows. Hot air will be removed by exhaust systems and fresh air introduced through inlets by negative pressure. Air temperature, relative humidity, lighting, ammonia level, ventilation rate, etc., will be monitored and controlled automatically. Birds with the best micro-environment will grow faster with better feed efficiency.

LAYER HOUSING

- The number of buildings required for layers varies according to the length of intervals between receipt of each batch of chicks. Based on this, the layer farm may be established as follows.
    - 1 + 2 pattern - One brooder cum grower house + two layer houses (chicks to be received at 28-week intervals)
    - 1 + 3 pattern - One brooder cum grower house + three layer houses (chicks to be received at 20-week intervals)
    - 1 + 1 + 5 pattern - One brooder house + one grower house + five layer houses and the chicks are to be received at 12-weeks intervals
    - The layer farm may also be established according to the 2 + 6 pattern by receiving chicks at 10-week intervals.

BROODER SPACE REQUIREMENT

- The floor space allowance during the brooder stage is 675 cm^2 per bird. Feeder space allowance required is 1.0 cm per bird up to four weeks, 2.5 cm up to eight weeks. Drinker space allowance per bird for the same period is 0.5 and 1.0 cm per bird respectively.
- Chicks can also be reared in cages from 0-8 weeks. Fix the cages at 75 cm above the floor level.
- Cages should be 180 X 90 cm in size and 30 cm in height.
- About 100 chicks may be reared in such cages with 160 cm^2 space per chick. The floor must be made of 1.25 X 1.25 cm size welded mesh of 16 gauge thickness.
- One 100 watt bulb on the top of the cage is sufficient for providing heat for brooding. For the first two weeks, small feeders and drinkers must be kept inside the cage and afterwards they may be fixed outside on the sides of the cage.
- For the first few days, it may be necessary to keep cardboard on the sides of the cages to prevent small young chicks from falling down through the sides.

GROWER SPACE REQUIREMENTS

- Growers may be reared in separate grower houses or they may remain in the brooder-cum-grower house.
- Floor space allowance has to be increased to 1260 cm^2 per bird. Growers can also be reared in cages.
- The floor should be made up of weld mesh of 1.25 X 5.0 cm size.
- In a cage of 180 X 90 cm size, 50 birds can be reared with a space allowance of 325 cm^2 per bird. Feeders and drinkers may be fitted lengthwise on the sides, one below the other.

LAYER SPACE REQUIREMENTS

- Layers can be reared either on deep litter or in cages. When reared on litter, litter material must be provided to a height of 12-15 cm.
- A floor space allowance of 1800 cm^2 per bird must be given. Circular or linear feeders may be provided; feeder space allowance of 10-12 cm per bird must be given.
- A linear feeder of 180 cm long and 10 cm deep will suffice for 35 layer birds. Free supply of feed at all times has to be ensured.
- Most often, layer birds are reared in cages. Cages of various sizes are used to house three to five birds in a cage.
- Currently, reverse cages are used, with longer sides fitted to remain in front. Lately, raised platform houses are being constructed, to facilitate quicker drying of droppings and their easy removal. The cages are constructed on a platform at a height of about 180-240 cm.

Cages of the following sizes may be made and fitted in rows:

  - 45 X 30 cm - for 3 birds
  - 45 X 40 cm - for 4 birds
  - 50 X 35 cm - for 4 birds
  - 50 X 45 cm - for 5 birds
  - 60 X 37.5 cm - for 5 birds
- These cages are arranged in two or three such rows next to each other on either side. They are called Californian cages.
- A floor space allowance of 420-450 cm^2 is provided inside the cages. Conventionally, the bottom of the lower most cage is fitted at 75 cm height from the floor.
- Nowadays, they are fitted at 180-240 cm height above floor level, with walking platforms constructed on the sides.
- The layer cage will be 40 cm in height. The floor is fitted with 2.5 X 5.0 cm 14 gauge weld mesh. On the sides, 7.5 X 7.5 cm 16 gauge mesh is fitted. The bottom floor is provided with a one-sixteenth slope downwards to the front to enable the egg to roll to the cage front. The mesh rails on the cage floor should run from back to front and not sideways; otherwise they will block the free run of the eggs to the front. Drinkers are fitted above the feeders in the front. Feeders and automatic drinker nipples or buttons may be provided in the cages.
- Cages are fitted in two or three tiers on either side of the row under the Californian system. Two to three such rows of cages are arranged in a caged layer house.
- Depending on the number of rows and the number of tiers in each row, the breadth of the caged layer house ranges from 5-8 m. There is no stipulation for the length of such houses, which can be adjusted to the number of birds to be housed.
- No sidewalls are required for cage houses, as the mesh is stretched down to the floor level to facilitate better ventilation to dry the moisture in the droppings.
- The 'elevated cage houses' or raised-platform cage arrangement widens the gap between birds and their droppings, and facilitates quicker drying and easy removal of droppings.
- Cage rearing facilitates easy management, lesser space requirement, easy collection of eggs, lesser percentage of broken eggs, better egg weight, clean egg production, easy culling and reduced mortality level.

DUCK HOUSING

- In general, ducks do not require elaborate houses. The house should be well ventilated, dry, and rat proof.
- In semi intensive system of rearing, the house should have easy access to outside run as the ducks prefer to come out during the day time, winter and rainy time.
- The run should have slope away from the house to provide drainage.
- In the house of semi intensive system, a continuous water channel of size 50 cm wide and 15-20 cms depth should be constructed at the far end, on the both sides, parallel to the pen in the grower and layer house.

REARING METHODS - GUINEA FOWL

Free Range

- Free range guinea fowl farming constitutes a noteworthy resource for pheasants in some countries.
- A system ranges from providing night shelter to a complete outside rearing where birds spend their nights on the trees around the farmer's dwelling. Improvements, even small ones, in this type of farming are of economic and social importance. Among easily effective improvements are providing drinking water and health care.

Semi-free range

- For meat type guinea fowl, aviary rearing in enclosures surrounded by wire mesh and roofed over by netting is very common.
- For 1000 guinea fowl chicks, a starter house of 24 m^2 is required for housing during first three weeks. This communicates with the rearing house to which chicks are then transferred. This comprises of 40 m^2 shelter equipped with perches and further leads into an aviary of 200 m^2. This accommodation should be located on a permeable soil showing slight slope for water drainage.
- For egg type guinea fowls, hens are made flightless by amputating extremity of wing at the most distal joint. The hens lay eggs wherever she chooses and nests need not be provided.

SEMI INTENSIVE AND RANGE SYSTEM - TURKEY

- Turkeys are also reared under range systems in the backyards of rural households.
- Popular commercial production is through a semi-intensive system. Under this system, turkey poults are reared up to four to six weeks of age in closed, confined houses, after which they are allowed to forage for a few hours in an open yard during the day and then housed in the shelter for the rest of the day and night. Growers and breeders are reared under this type of semi-intensive system.

INTENSIVE SYSTEM OF REARING TURKEYS

- Management of turkeys is similar to that of chicken. The building should be located at an elevated place, and cement floors are preferred.

Management of Turkey poults

- Turkey poults grow rapidly and for the best performance they should never be over crowded. About 900 $cm^2$of floor space per poult is required during the first 3-4 weeks and thereafter up to the eighth week the floor space is increased to 0.135 m^2per poult.
- A compartment of 3 x 3 m will therefore be suitable for housing 100 poults up to 4 weeks of age, when they may be transferred to a compartment of 3 x 4.5 m for further floor brooding until 8 weeks.
- From 9-12 weeks of age, the floor space must be increased to 0.18 m^2 per growing poult, and thereafter until sixteen weeks of age, the minimum floor space allowance is 0.23 m^2 per poult.
- After sixteen weeks, they require 0.36m^2per turkey. For small type turkeys, the floor space requirements may be reduced slightly. The floor space is reduced to almost one-third under the range system, since only a small shelter is required to protect them from rain and sun.
- Turkeys require warmer conditions than chickens, and a temperature of 95°F should be maintained during the first week of brooding. After this age, the brooder temperature may be reduced approximately 5°F weekly until it reaches 70°F or the equivalent of the prevailing environmental temperature. Artificial heat may be discontinued during the sixth week in winter brooding, and in the fourth week in summer brooding. Debeak the birds at about 10days of age. Remove the upper part of the beak halfway between the tip and the nostrils with an electric debeaker.

FLOOR SPACE ALLOWANCES FOR TURKEYS UNDER SEMI-INTENSIVE SYSTEM

Age (weeks)	Space per bird	
	Shelter	Open yard
7-12 weeks	0.09 m^2	0.18 m^2
13-16 weeks	0.16 m^2	0.32 m^2
17 weeks-market age	0.22 m^2	0.45 m^2
Breeders	0.27 m^2	0.54 m^2

- When the turkeys forage, they consume the sparse cultivated grass and greens available in the open yard and the feed cost is reduced. The farmers claim that they are able to get better fertility and hatchability under the semi-intensive system than under the intensive system.
- The feeders and drinkers are provided inside the shelter in a shaded environment.
- Turkeys are better foragers than chickens, and can digest fibre better than chickens. They are therefore also fed cut legumes like lucerne (alfalfa), desmanthus, stylo, etc., in the yard, which helps to reduce the feed cost.

JAPANESE QUAIL HOUSING

- In a brooder guard circle of 3 feet diameter (90 cm), about 150 chicks can be accommodated. It is not advisable to allow more than 300 chicks inside one circle.
- An electric bulb with a hood cover can be provided at 15 cm height at the centre of the circle, providing approximately 1 watt per chick. The heating arrangement has to be continued day and night during the first week, but only during the night in the second week. The brooder house temperature at the level of the birds has to be about 98°F, which may be reduced by about 3°F every 3 days.

- During winter and rainy seasons, heating has to be continued during the third week as well, while during the summer, the practice may be restricted to only 10 days. From the third week onwards, Japanese quail chicks do not require night lighting.

Drinkers and feeders -Space requirements

- Drinkers and feeders should not be kept under the source of heat inside the brooder circle. A drinker space of about 0.3 cm, and a feeder space of 0.6 cm per bird, must be provided during 0-2 weeks, and this has to be increased to 0.6 and 1.2 cm respectively from 3-5 weeks of age.
- The drinker size should be adjusted so that the gap between the brim of the plate and the cup should not be more than 1 cm, otherwise the chicks will get into the drinker and get drowned.
- Upto two weeks, two chick drinkers of 10 cm diameter and 1.5 cm high on the sides, each of 500 ml capacity, and two feeder plates of 22 cm diameter and 2 cm high will be sufficient for 150 chicks in each brooder circle.
- From the third week, a linear feeder 45 cm long, 2.5 cm height and 10 cm wide, and a drinker of 15 cm diameter and 2.5 cm high at the brim and 1200 ml capacity will be sufficient for 75 quail chicks.

MODULE-15: MARKETING OF POULTRY AND POULTRY PRODUCTS

Learning objectives

- This module deals with marketing trend for eggs and meat in rural and urban India.

MARKETING

- Marketing may be defined as the performance of business activities that direct the flow of goods and services from producer to the consumer at the appropriate time, place and in the form the consumer desires.

EGG MARKETING

Egg Marketing Channels

- Direct marketing of eggs include the following methods of selling:
  - sales from the farm (farm gate)
  - door-to-door sales
  - producers' markets and
  - sales to local retail shops.
- A typical marketing channel is made up of :
  - Collectors
  - Assembly merchants
  - Wholesalers
  - Retailers

Organised Marketing Channel

  - Direct Channel: Producer – Consumer
  - Producer –Collector–Assembly Merchant – Wholesaler – Retailer – Consumer
  - Producer – Wholesaler –Retailer – Consumer
  - Producer – Collector- Assembly Merchant – Consumer
  - Producer – Retailer - Consumer
- The efficiency of marketing channel is reflected by the share of the consumers rupees received by the producer. The higher the share, greater the efficiency of marketing channel
- Egg prices vary from one market to another and from one season to another. In summer, wholesale egg prices were low to the level which is sometimes lesser than the cost of production. Therefore proper attention has to be given to efficient disposal of market eggs

EGG MARKETING ORGANIZATION

National Egg Coordination Committee (NECC)

- NECC was formally registered under the Societies Registration Act in May 1982. With a membership of more than 25,000 it is the largest single association of poultry farmers in the world. Most of today's egg production in India comes from NECC members.
- NECC has various centres and they exchange information among themselves which help them to determine price for each zone. Co-ordination between zones permits judicious movement of eggs dependent upon supply and demand.

NECC Objectives

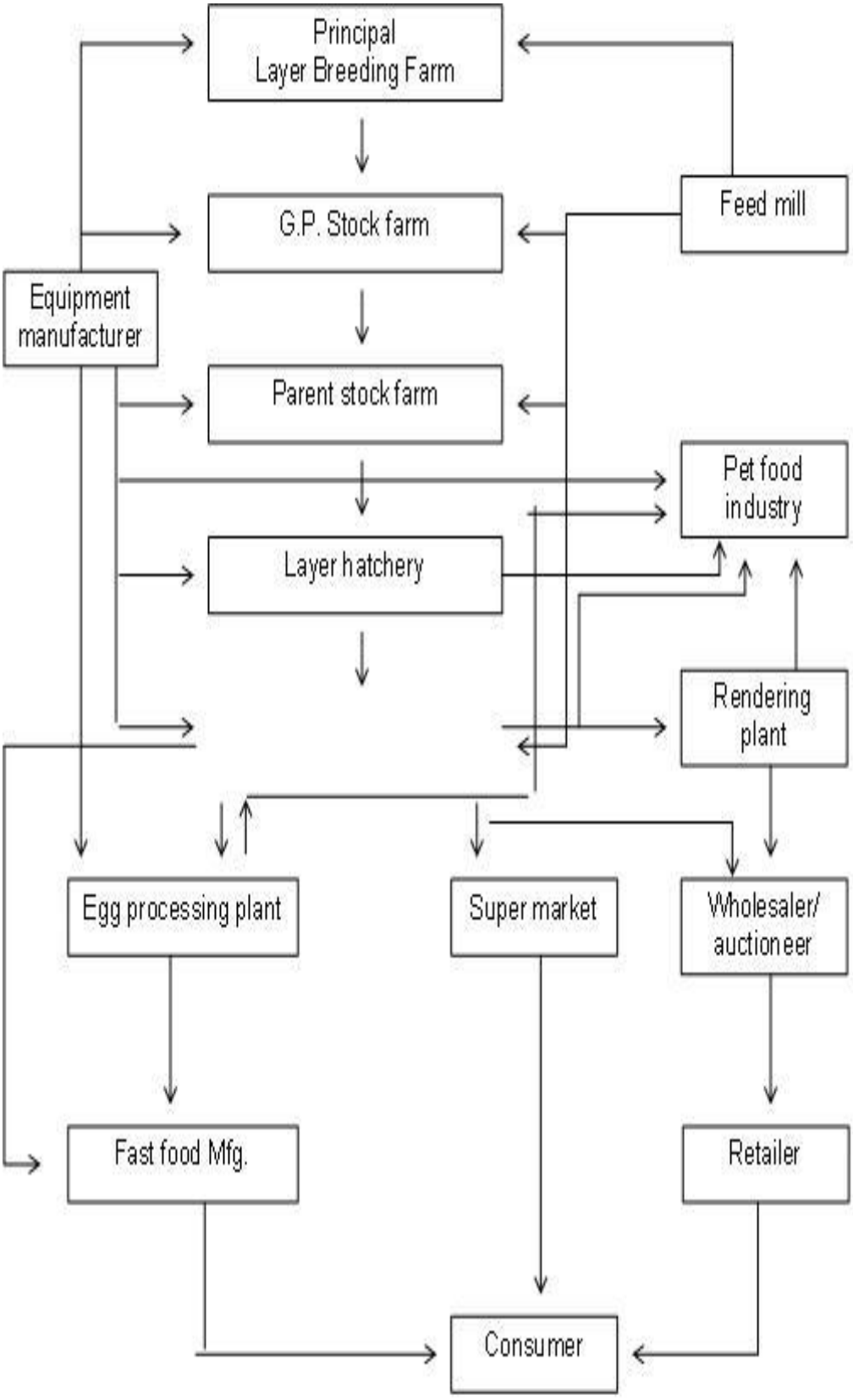
- Price declaration
- To decide upon a reasonable price for eggs this ensures a fair return to the farmers, decent margins to the middleman and a fair price to the customer
- To monitor the egg stock level in different production centres
- To organize and unite poultry farmers across the country
- To generate employment by encouraging people to take up egg farming and egg trading
- To promote exports and develop export markets

National Agricultural Co-operative Marketing Federation of India (NAFED) has taken up egg marketing in New Delhi and extended to terminal markets like Mumbai, Chennai, Calcutta, Hyderabad and some other important industrial areas.

Main Objectives of NAFED

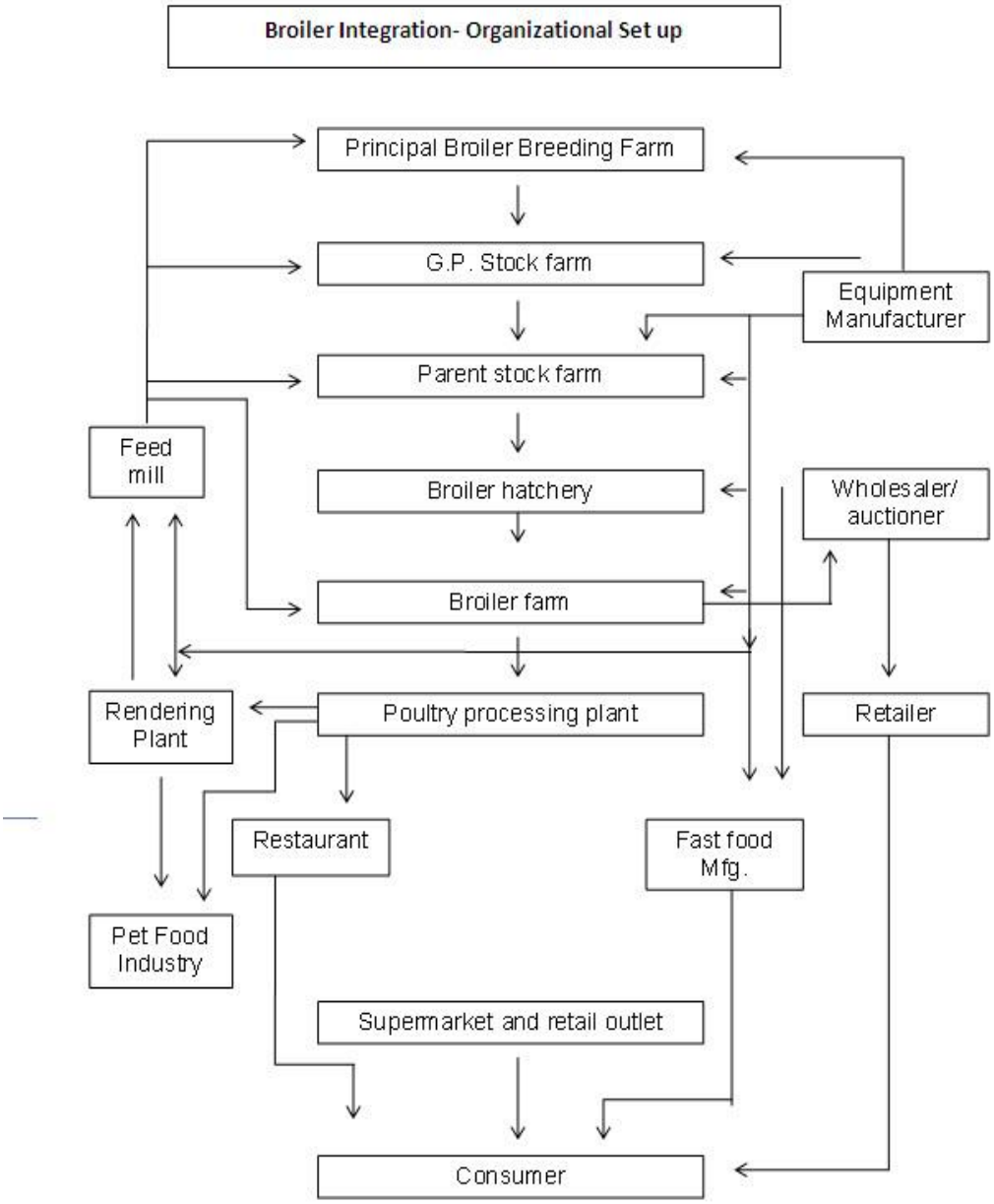
- Provision of reasonable remuneration to the poultry farmers
- Economic price to the consumer
- Employment to the weaker section of the society

Layer Integration


Principal
Layer Breeding Farm
G.P. Stock farm
Feed mill
Equipment
manufacturer
Parent stock farm
Pet food
industry
Layer hatchery
Rendering
plant
Egg processing plant
Super market
Wholesaler/
auctioneer
Fast food Mfg.
Retailer
Consumer

BROILER MARKETING - INTEGRATION

- Integration is the association, coordination, amalgamation of companies engaged in various stages of production of particular product, or related products, so that, there will be a smooth flow of inputs and outputs from one unit to other, leading to overall reduction in the cost of production of the final product
- In all developed countries, the poultry production at present is an integrated operation from the primary breeder to the consumer. Each stage or unit is associated with the other stages
- An integrator will coordinate all these activities. Usually, an integrator is the owner of the processing plant, hatchery and the feed mill and pay commission to others for the services rendered by them
- There are only few integrators in each developed country, who will control the entire poultry production in these countries
- The poultry farmers are acting only as *contract growers* receiving commission for the eggs, broilers and turkeys produced by them. The farmers are not the owners of the birds, but the integrators are the real owners



ACTIVITIES - BROILER INTEGRATION

- In broiler industry, the integrator may be owning the breeding farms, parent stock, growers, hatchery, feed mill, rendering plant and poultry processing plant
- He will integrate with few contract parent stock farms, who will supply hatching eggs on commission basis. The integrator is the owner of the parent stock and will supply ready-to-lay parent stock and feed to the contract breeder farms.
- Similarly, the integrator will supply day old broiler chicks and feed to the contract broiler growers and take back grown up broilers, after paying growing commission to them
- The integrator will process all the birds in his processing and further processing plants and later supply to the super markets and restaurants for sale
- The hatchery waste and offals are processed in the rendering plant and the meat meal and chicken fat are used in the feed

ADVANTAGES OF INTEGRATION

- The cost of production of the final product will come down, for the ultimate benefit of the consumer
- It will be possible to go for diversified products and newer fast foods
- Due to large volume of operation, the integrator can go for advertisement for promoting his products
- All main and by products will be utilized and recycled without any wastage. This will not only prevent environmental pollution; but also reduces the cost of production of the main product
- It will stabilize the prices, by balancing the supply and demand

MARKETING-PROCESSED CHICKEN

- The market for frozen or chilled poultry products is only limited to few institutions i.e. hotels, fast-food restaurant chains and to a negligent extent to urban consumers
- This very small segment of consumers is served by processing sector, whose volume account for hardly 2% - 3% of production. However, certain State Governments are envisaging to discourage slaughtering of birds within the Municipal jurisdiction limits due to pollution and other issues
- If such measures are pursued, the sale of slaughtered chicken is expected to increase and the processing units if simultaneously advertise on the quality aspects of dressed chicken the consumers could be advised to pay slightly higher amount for frozen/chilled chicken for their health.

RURAL MARKETING

- Rural Marketing is still in dormant stage and is like a sleeping dog. It is not organized but has a great future.
- An attraction yet to be exploited by rural farmers, is the production of organic poultry meat and eggs this would be a special market in the cities and has a great potential for export as developed countries would pay a premium proce for these.
- In India the eggs and meat obtained from the country chicken is normally sold within the community or used for the family and the marketing system is informal and poorly developed.
- Slow and steadily, people from the villages are realizing that the meat and the eggs of the country chicken fetch a premium price but are unable to form an organized sector to market the meat and eggs. The sale of poultry products enable poultry keepers to obtain money to premium spent on their own and family needs.
- A traditional product that can be sold at a premium price can help small producers to compete with industrial type commercial production. Ways and means of improving the production of local chicken that will bring better revenue to the rural poor must be planned.
- Presently in India eggs are bought by the local shop keeper. In some places merchants from urban areas use local agents to purchase eggs and chicken from farming families and sell them in the cities. The intermediaries involved in this business are the main beneficiaries.
- The existence of a local market offering good sales opportunity and adequate transport facilities are an obvious pre requisite for the development of rural poultry.
- Rural consumers are far less homogenous than their urban counter parts. The rural markets are less exploited and are more agricultural based. There are many opportunities in the rural market that need to be tapped. Unfortunately rural marketing is beset with various problems, mostly due to the geographic spread of the villages and the distance from the main market.
- Rural salesmanship is inefficient and this could be attributed to illiteracy.

MAJOR HURDLES

- The traditional marketing activities of promotion, distribution, sales and servicing undertaken in the urban and semi-urban areas are not available to the rural poor. The major hurdles are:
    - High distribution cost
    - High initial market development expenditure.
    - Inability of the small retailer to carry stock without adequate credit facility.
    - Generating effective demand for goods.
    - Mass communication and promotion problems.
    - Banking and credit problem.
    - Management and sales management problem.
    - Market research problem.
    - Inadequate infrastructure facility.
    - Highly dispersed and thinly populated markets.
    - Low per capita, lower standards of living condition, social, economic and cultural backwardness of the rural masses.
    - Low level of exposure to different product categories.
    - Cultural gap between urban based markets and rural consumers.

STRATEGIES FOR RURAL MARKETING

- The practice of treating rural markets as an appendage of the urban market is not right since rural markets have their own independent existence. These markets should be ruralised rather than trying to make them into a convenient extension of the urban market.
- A focus on injecting a marketing culture into the villagers must be planned and accomplished. The educated unemployed youth can be used for this mission.

Concept

- Decentralise rural markets from urban bases. Buying and selling should have an interaction and not just be one way.
- Educated youth can be trained in salesmanship.
- Villagers can be educated on their right and know the market trend.
- The youth can be trained to be in line with newer developments.
- A computer centre where the educated youth are trained must be established and become a centre point for learning latest trends, rates etc.

MODULE-16: OPTIMUM CONDITIONS FOR INCUBATION OF EGGS

Learning objectives

- This module deals with optimum conditions for successful incubation of eggs.

INTRODUCTION

- They are also known as principles of incubation or ideal conditions for incubation or factors essential for incubation of eggs.
    - Temperature
    - Ventilation
    - Humidity and
    - Turning of eggs are physical conditions essential for optimum hatchability, irrespective of methods of incubation.
- These principles of incubation vary as per the species of birds.

TEMPERATURE

- Temperature plays a major role in obtaining optimum hatchability with strong, viable chicks. Variations in temperature directly affect hatching per cent and quality of chicks.
- The period of hatching, size of chicks, embryonic mortality and viability of chicks are directly controlled by temperature.
- Similarly, the stages of variations in temperatures also have a considerable effect on hatching, i.e. altered temperatures during critical stages of incubation is more deleterious than in other stages of incubation.
- On an average 37.5 to 37.8^{o}C temperature is required for incubation for poultry species in forced draft incubator during first phase of incubation, i.e. up to transfer of eggs to the hatcher. It is reduced by about 36.5^{o}C in separate hatchers.
- The same temperature can be maintained throughout incubation and hatching in case of incubator-cum-hatchers.
- The higher temperature leads to smaller and dull chicks; deformed chicks with crooked necks and toes, spread legs, etc.
- A high temperature results in delayed hatch and poor hatchability. Physiological zero is that temperature below which embryonic growth is arrested and above which it is initiated. The optimum incubation temperature as mentioned above can vary based on the following factors.
    - Size of the egg
    - Shell quality
    - Breed or strain of chicken
    - Age of the egg when it is set
    - Humidity of the air during incubation

HUMIDITY

- The amount of moisture in the air within the incubator is very important to the normal development and subsequent hatching of eggs. In order to create space for growing embryo weight loss of about 12 percent is expected through water loss of hatching eggs during first phase of incubation.
- More weight loss will lead to smaller sized chicks and vice versa. Hence, abnormal fluctuations in humidity during incubation should not be allowed. The excess moisture loss from eggs due to low relative humidity during incubation will result in small and hard chicks while extreme low humidity during actual hatching will lead to embryos dried out in shell or dead in shells.

- Similarly, large and soggy chicks will be produced due to high humidity during incubation with tendency of delayed hatch and lowered hatchability. The chicks may stick to shells.
- The relative humidity is measured by comparative reading of dry and wet bulbs of the thermometer and by calculating the difference of these reading (dry bulb reading – wet bulb reading). Maintaining a relative humidity of approximately 55% under normal conditions prevents excessive moisture loss from the eggs.
- There is an interaction between temperature and humidity during the embryonic process. Higher temperature requires lower humidity and vice versa.

VENTILATION

- Oxygen is required for respiration of all living beings and the same is the case of developing embryo also. The optimum hatchability is achieved with 21 per cent oxygen level in incubator.
- The lower level of oxygen in incubator is more detrimental than higher level. It has been observed that about 5 per cent reduction in hatchability was noted for every one percent decrease in oxygen content.
- As the embryo advanced in age, its oxygen requirement increases and more carbon dioxide is given off.
- The concentration of CO_2 should not be more than 0.3 to 0.5 percent for optimum hatchability. More than 1% concentration of CO_2 leads to increased embryonic mortality while 5 percent carbon dioxide in incubator is lethal to all embryos.
- Hyper-ventilation also should be controlled and taken care off.
- Ventilation is more important from 13^{th} day of incubation in case of chicken eggs than in initial period.
- It has been observed that the percentage of hatchability has been drastically reduced in places at an altitude of 3500 feet and above. This is due to reduction of pressurized concentration outside limits of 0.2 to 1.5%.

TURNING OF EGGS

- Once the egg is placed under incubation the specific gravity in egg lessens and the yolk settled in the thin albumen raises to come in contact with the outer thick albumen if the egg is not turned. Therefore frequent turning of egg is essential for movement of embryos in the eggs during first phase of incubation to avoid sticking and setting of embryos to shell and deaths. Similarly, turning facilitates uniform heating of egg contents in auto operated incubators.
- Usually tilting of egg through 45^{o}angle on both the sides on their perpendicular axis for 4-5 times a day leads to maximum hatchability. Turning is not required in hatchers or it is stopped from one day before the actual commencement of hatching.
- The turning must be gentle as vigorous turning may lead to blood ring formation with increased mortality.

SETTING OF EGGS

- It is general practice to set eggs at broad end up in incubator which is called as up-right position.
- Setting of egg in up-right position will hold the air cell in a regular position and controls malposition of embryos. This also facilitates development of the head of embryo towards air-cell due to which it is easy for the developing chick to penetrate through the air-cell for commencing of pulmonary respiration. It has been observed that reverse setting results in lowered hatchability by about 8 percent and the quality of chicks are also impaired.

TRANSFERRING OF EGGS TO THE HATCHER

- At the end of 18 days of incubation in chicken eggs the eggs are transferred to the hatcher. Here they are placed in trays and kept horizontal.
- Turning of egg has no value in the hatcher. The temperature in the hatcher is 36.7^{o}C, while the humidity is maintained at 70%.
- Too little moisture at the time of hatching will produce chicks smeared with egg or shell, stuck down or partial dehydration. Too much humidity will cause chicks to be smeared with egg and the navel will not be properly closed.
- In the hatcher the oxygen level should be maintained at 21% as large amount of CO_2 are being liberated by the newly hatched chick.
- The embryo pips the shell by a change is the oxygen supply within the egg at the time pulmonary respiration begins.
- It pips the shell using the egg tooth which is a small projection above the beak.

MODULE-17: FEEDING NORMS FOR POULTRY

Learning objectives

- This module deals with feeding norms for various species of poultry.

NUTRIENTS

- Nutrients are essential substances present in different types of foods which perform various life-sustaining functions in the body
  They are required for growth, maintenance and thereby productive process and a deficiency of nutrients in the feed below the required level results in the development of diseases referred to as "deficiency diseases"
  Poultry require more than 40 such nutrients, which are classified into six major groups based on their chemical nature, their functions or role, and the method in which they are determined
- The groups of nutrients are:
  - Proteins
  - Carbohydrates
  - Fats
  - Vitamins
  - Minerals
  - Water
- These groups of nutrients are present both in the poultry feed and in the bodies of the fowls. However, they are not directly transferred from the feed to the tissues, but are split in the bird's body during digestion, absorption and the metabolism process. The various functions performed by each nutrient and the requirement needed by poultry vary from nutrient to nutrient.

CLASSIFICATION OF NUTRIENTS

Proteins

- Proteins are considered the building blocks of the body.
- They are essential for proper growth and for building health.
- Most materials used as ingredients in poultry feeds contain some protein.
- Grains generally contain 8-9 percent of crude protein but cannot meet the bird's total protein requirement.
- It is therefore necessary to include other ingredients, which contribute higher levels of protein.
- Oil cakes are good sources of vegetable protein, while dried fish and meat meal supply animal protein.
- The amount of protein required by broilers varies considerably according to age and level of performance.
- There is a high demand for protein at the early stages of development.
- Moreover, the energy level of the ration also decides the protein requirement; the higher the energy level, the greater the percentage of protein required.
- Protein is made up of several amino acids and it is necessary to know the composition of any protein-rich ingredient in terms of its constituent amino acids and its requirements.

Amino acids			
Non essential	**Essential**	**Critical**	**Limiting**
Alanine	Lysine	Lysine	Lysine
Aspartic acid	Methionine	Methionine	Methionine
Glutamic acid	Methionine+ Cystine	Methionine + Cystine	Threonine
Hydroxy proline	Tryptophan	Tryptophan	Tryptophan
Proline	Threonine	Threonine	
Glycine + Serine	Arginine	Arginine	
	Isoleucine	Isoleucine	
	Leucine		
	Valine		
	Histidine		
	Phenylalanine		
	Phenylalanine + Tyrosine		

Carbohydrates and Fats

- Birds require energy or fuel to maintain their body heat, to keep the body systems running continuously and to perform different types of functions.
- Birds derive their supplies of energy from two major groups of nutrients: carbohydrates and fats/oils.
- Carbohydrates and fats are not actually taken into consideration when defining the nutrient requirements for poultry. Instead, the metabolisable energy (ME) value is the one most frequently used to describe the energy value of ingredients and compound rations for poultry.
- The ME values of most of the feed ingredients have been compiled and are available for ready use.
- These are calculated as gross energy minus energy voided through droppings (faeces+urine) and gases, and is expressed as kilocalorie per kilogram of feed (1 KCal =4.18 KJ).
- The energy content of the feed determines the quantity of feed intake by birds. If the energy level is lower, the feed consumed per day is higher, and *vice versa*.
- The total intake of other nutrients in the feed is therefore also influenced by the energy content of the feed.
- It is then necessary to adjust the density of different nutrients present in poultry feed, not only to the requirements of the bird but also to the expected feed intake per day which is determined by the energy content of the feed.
- Since most of the vitamins and minerals are normally provided in poultry feed well in excess of the daily requirement, it is customary to adjust only the protein content to the energy content. This relationship is referred to as the calorie: protein ratio or the C:P ratio , which is more important than the total requirement of energy or protein.

Vitamins

- Vitamins are complex compounds, which play an important role in metabolism.
- Even though they are required in relatively small amounts, the presence or absence of vitamins makes all the difference between profit and loss in poultry farming.
- Good growth, prevention of leg weakness and thickness of eggshells, all need precise vitamin levels. Vitamins occur in many naturally available feed ingredients. They can also be added as supplements to meet the birds' requirements.
- Vitamins are classified into two groups, namely, fat-soluble vitamins and water-soluble vitamins.
- The fat-soluble vitamins are vitamin A, D, E and K. The water-soluble vitamins are the B complex group of vitamins, and vitamin C.
- Vitamins in the B complex group are thiamin (B_1), riboflavin (B_2), niacin, pantothenic acid, pyridoxine (B_6), biotin, choline, folic acid and cobalamine (B_{12}). Vitamins, A, B_2 and D_3 are called "critical vitamins" for poultry, as any deficiency in their availability severely impairs the growth rate and egg production.

Minerals

- About one percent of the broiler meat and 11 percent of the eggs are made up of minerals, while bones contain about 40 percent minerals.
- Minerals are also found in all body tissues and fluids, and perform many important functions like the formation of bone and eggshell, clotting of blood, etc.
- Feed ingredients of animal origin contain more minerals; those of vegetable origin have a lower proportion.
- As minerals found in common feedstuffs may not supply the birds' requirements, mineral supplements are added to the ration to overcome the possible development of deficiency symptoms.
- The minerals required for poultry are classified as "macro", "micro" and "trace" minerals, depending on their requirement level.
- The macro minerals are calcium, phosphorus, potassium, sodium, and magnesium; the micro minerals are iron, manganese, zinc, copper and iodine, and the trace minerals are cobalt, fluorine, selenium, molybdenum, etc.

Water

- Water makes up about 60 percent of the composition of the bird's body. Birds can survive for a long time, even two to three days, without taking in solid mash, but suffer very quickly, within 12 hours, if there is a shortage of water.
- A free supply of cool, fresh, clear, potable water should therefore be ensured throughout the day.

NUTRIENT REQUIREMENTS - POULTRY

Nutrient requirements - Poultry

- Under intensive system of rearing poultry in confinement, they need a complete feed, having all the essential and non-essential nutrients, for optimal performance
- The nutrient requirements are not common for all poultry. They vary with species, breed, variety, age, purpose of rearing (such as for meat, table eggs, hatching egg production, Hatching Chicks etc.), season, environment and rearing system (cages, deep litter etc)

Feed quality

- A good quality feed must have all the essential nutrients in the right proportion and specified quantities. For the guidance of the feed manufacturers and poultry farmers, several organisations, standards have stipulated the nutrient requirements for different types of poultry feeds
- In India, the Bureau of Indian Standards (B.I.S.); which was formerly known as Indian Standards Institutes (I.S.I.) has specified the nutrient requirements of chicken. But it has not stipulated any such standards, for other species of poultry. Hence for these, we have to follow some other standards like National Research Council (NRC) of U.S.A. and Agricultural Research Council (A.R.C.) of U.K. These standards are used in feed formulations; so that the feed prepared will supply all the nutrients in the right proportion.

CLASSIFICATION OF FEED SUPPLEMENTS

Feed Supplements / Additives

- A feed additive or a supplement is a substance or mixture of substances other than the bulk and basic feed stuffs
- Used in small quantities, usually at less than one percent level in the compounded feeds in order to supplement certain nutrients and non-nutrients to improve the quality of the feed and the performance of the birds fed
- Feed supplements are broadly classified into two categories, namely:
    - Nutrient Feed Supplements
    - Non-Nutrient Feed Supplements

FUNCTIONS OF FEED ADDITIVES

Different feed additives perform different functions. They are added to poultry feed in order to:

- Improve the nutritive value of the feed and feed efficiency
- Improve the growth rate and egg production
- Protect the birds from stress and improve their immune status
- Prevent spoilage of feed due to microbes, fungi, rancidity and other physical conditions
- Enhance colour, flavour, palatability and general appearance of the feed and make it more attractive to both the farmer and the bird
- Help to prevent caking, dustiness and loss of feed during storage, handling and feeding
- Improve the quality of the egg yolk colour, shell thickness and meat quality
- Have sparing action on certain nutrients and prevent nutritional imbalance
- Certain non-nutrient feed additives cause thinning of the gut wall and thereby facilitate better absorption of nutrients
- Prevent various deficiency diseases, other diseases of nutritional origin, and certain bacterial and parasitic diseases

NUTRIENT FEED ADDITIVES

- Nutrient feed additives contain certain essential nutrients necessary for the normal growth and production of the birds.
- Deficiency of these nutrients in poultry will lead to various anatomical and physiological abnormalities, deficiency diseases, poor growth rate, low egg production and low resistance to disease. They need to be added if the formulated feed is not expected to contain such nutrients at required levels.

Nutrient feed additives can be further classified into the following categories:

Vitamin supplements

- Fat-soluble vitamins, supplying such vitamins as vitamin A, D_3, E and K.
- Water-soluble vitamins such as B-Complex group of vitamins and vitamin C

Mineral supplements

- Macro minerals such as calcium, phosphorus, magnesium, sodium, potassium and sulphur
- Micro minerals such as manganese, zinc, iron, copper and iodine
- Ultra trace elements, like selenium, cobalt, molybdenum and chromium

Essential amino acids

- Additives supplying lysine, methionine and tryptophan

Protein hydrolysates

- A pre-digested protein such as hydrolysed feather meal, hair meal, etc. supplying essential amino acids and other nutrients

Liver extract

- Supplies essential nutrients in the most suitable form for absorbtion

Live yeast and yeast extract

- Supplies essential nutrients, digestive enzymes and unidentified growth factors (U.G.F.).

Fermentation by-products

- Supply various essential nutrients and U.G.F.

NON-NUTRIENT FEED ADDITIVES

- This group of feed additives do not have any direct nutritional role, but are added to the feed to reduce mortality and morbidity caused by various diseases and stress factors; to improve feed efficiency by better digestion, absorption and utilisation of nutrients; to enhance colour, flavour, consistency and quality of feed, and to improve the shelf life of the feed by curbing, caking, moulds, mustiness, oxidation and other physical, chemical and micro-biological degradation

Classification, Uses and Examples

Non-nutrient feed additives are classified based on their nature and functions:

- **Antibiotic feed supplements:** U sed to control sub-clinical bacterial infections and thereby boost the performance. Examples are tetracyclines, tiamutin, lincomycin, tylosin, erythromycin, colistin, doxycycline, bacitracin, flavomycin, virginiamycin, etc. It is advisable to use antibiotics which are not used in the treatment of human and animal diseases. Introduction of probiotics with favourable microbes has now limited the usage of antibiotics in feed.
- **Non-antibiotic anti-microbial feed supplements:** Check bacterial infections and promotes performance. Examples: Furazolidone, chlorhydroxy-quinoline.
- **Antimycotic agents:** Prevent mould growth and production of toxins. Examples: Gentian violet, copper sulphate, propionic acid, calcium propionate and sodium benzoate.
- **Coccidiostats:** Prevent outbreaks of coccidiosis. Examples: Dinitro-ortho-toluamide, salinomycin, robenidine, nicarbazine, monensin and maduramycin.
- **Anti-parasitic additives** : Check various parasitic infestations. Examples: Dichlorophan, Niclosamide and Praziquantel.
- **Anti-oxidants:** Prevent oxidative rancidity of fats and oils. Examples: B.H.T., B.H.A. and Ethoxyquin.
- **Enzymes** : Help in better digestion of the food. Examples: Protease, lipase, cellulase, amylase, phytase and pectinase.
- **Hormones** : Promote growth rate, feed efficiency and egg production. Examples: Caseated iodine, melengestrol acetate, ethylestranol and stanazol.
- **Arsenicals** : Promote growth rate, feed efficiency and carcass finish.Examples:3 Nitro-4-hydroxy phenyl arsanilic acid.
- **Adsorbents** : Adsorb or bind toxins and prevent their absorption from the intestine. Examples: Zeolites, activated charcoal.
- **Pellet binders** : Used for pelleting the feed in preparation of crumbled feed for broilers. Examples: Bentonite, sodium alginate, carboxy methyl cellulose, gelatine, lignosulphonate, carragenan and guargum.
  Deodorising agents : Reduce the ammonia production in the litter. Example: Yucca extract.
- **Flavouring agents** : Improve feed flavour and thereby feed intake, growth rate and production. Examples: Essential oils, fish oils,etc.
- **Pigments** : Impart attractive colour to the feed as well as to the products like egg yolk and skin. Examples: Canthaxanthin, leutin, zeaxanthin,etc.
- **Herbal preparations:** Tone up the liver, improve the appetite and increase disease and toxin resistance power of the birds. Examples: Extracts of herbs.
- **Performance boosters:** Improve overall performance of the birds by various means. Examples: Nitrovin,avoparcin,etc.
- **Immuno-stimulants:** Stimulate anti-body production, cell-mediated immunity and general resistance to disease. Examples: Tetrahydrophenylimidazole, immogen, levamisole,etc.
- **Other miscellaneous feed additives:** Perform certain specific functions in the body or feed and thereby improve the performance. Examples: Electrolytes, egg-up, egg toner, etc.

PROBIOTIC or DIRECT FED MICROBIALS (D.F.M.)

- Probiotic is a live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance resulting in a better performance in terms of growth or feed efficiency. Probiotic preparations are made from bacteria, yeast and fungi. Commonly included probiotic preparations in various combinations are:
    - Bacteria: Strains of *Lactobacillus* , *Leuconostoc* , *Bifidobacterium* , *Pediococcus* and *Streptococcus*
    - Fungi: Strains of *Aspergillus*
    - Yeast - Strains of *Saccharomyces.*
- Probiotics act by suppressing viable counts of pathogenic bacteria such as *Escherichia coli,* producing antibacterial compounds, by competing for nutrients and adhesion site in the intestinal epithelium. In general, probiotics increase growth rate in broilers, egg production in layers, and reproductive performance in breeders.However, the effect of probiotics is more noticeable in stressed birds than in healthy ones.

BUREAU OF INDIAN STANDARDS (B.I.S.) SPECIFICATIONS -CHICKEN

- **Bureau of Indian Standards (B.I.S.) specifications-Chicken: IS - 1374-1994**

Characteristics	Broiler starter feed	Broiler finisher feed	Chick feed	Grower feed	Layer feed	Breeder feed
Moisture max %	11	11	11	11	11	11
Crude protein min %	23	20	20	16	18	18
Crude fibre max %	6	6	7	8	8	8
Acid insoluble ash max %	3	3	4	4	4	4
Salt (as (NaCl) Max %	0.6	0.6	0.6	0.6	0.6	0.6
Calcium min %	1.2	1.2	1.0	1.0	3.0	3.0
Available phosphorus min %	0.5	0.5	0.5	0.5	0.5	0.5
Lysine min %	1.2	1.0	0.9	0.6	0.65	0.65
Methionine min %	0.5	0.35	0.3	0.25	0.3	0.3
Metabolizable energy (ME) Kcal/ kg	2800	2900	2600	2500	2600	2600
Manganese, mg/kg	90	90	90	90	90	90
Vitamin A, IU/kg	6000	6000	6000	6000	6000	6000
Vitamin D_3, IU/kg	600	600	600	600	1200	1200
Vitamin E, mg/kg	15	15	15	10	10	10
Vitamin K, mg/kg	1	1	1	1	1	1
Riboflavin, mg/kg	6	6	6	3	3	3
Biotin, mg/kg	0.2	0.2	0.2	0.15	0.15	0.15
Choline	1400	1600	1300	900	800	800
Pyridoxine, mg/kg	5	5	5	5	5	8
Aflatoxin, max, P.P.b.	50	50	50	50	50	50

NRC REQUIREMENTS - TURKEYS

Nutrient requirement of Turkeys as % or units kilogram of diet as per National Research Council-1994 (NRC 1994) specifications

Nutrient	Growing turkeys - males and females						Breeders	
	0-4 weeks	4-8 weeks	8-12 weeks	12-16 weeks	16-20 weeks	20-24 weeks	Holding	Laying
M.E. (KCal/kg)	2800	2900	3000	3100	3200	3300	2900	2900
Protein %	28	26	22	19	16.5	14	12	14
Linoleic acid %	1	1	0.8	0.8	0.8	0.8	0.8	1.1
Calcium %	1.2	1	0.85	0.75	0.65	0.55	0.5	2.25
Non-phytate phosphorus %	0.6	0.5	0.42	0.38	0.32	0.28	0.25	0.35
Magnesium mg/kg	500	500	500	500	500	500	500	500
Manganese mg/kg	60	60	60	60	60	60	60	60
Zinc mg/kg	70	65	50	40	40	40	40	65
Selenium mg/kg	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Vitamin A IU/kg	5000	5000	5000	5000	5000	5000	5000	5000
Vitamin D_3 ICU/kg	1100	1100	1100	1100	1100	1100	1100	1100
Vitamin E mg/kg	12	12	10	10	10	10	10	25
Vitamin K mg/kg	1.75	1.5	1.0	0.75	0.75	0.5	0.5	1.0
Vitamin B_{12} mg/kg	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Biotin mg/kg	0.25	0.2	0.125	0.125	0.100	0.100	0.100	0.200
Riboflavin mg/kg	4.0	3.6	3.0	3.0	2.5	2.5	2.5	4.0

NRC REQUIREMENTS-DUCKS

Nutrient requirement of ducks as % or units kilogram of diet as per NRC (1994) specifications

Nutrient	0-2 weeks	2-7 weeks	Breeding
M.E. (KCal/kg)	2900	3000	2900
Protein %	22	16	15
Lysine %	0.90	0.65	0.60
Methionine %	0.40	0.30	0.27
Methionine + Cystine %	0.70	0.55	0.50
Calcium %	0.65	0.60	2.75
Non-phytate phosphorus %	0.40	0.30	--
Manganese mg/kg	50	--	--
Selenium mg/kg	0.20	--	--
Zinc mg/kg	60	--	--
Vitamin A IU/kg	2500	2500	4000
Vitamin D_3 ICU/kg	400	400	900
Vitamin E mg/kg	10	10	10
Vitamin K mg/kg	0.5	0.5	0.5
Niacin mg/kg	55	55	55
Pantothenic acid mg/kg	11	11	11
Pyridoxine mg/kg	2.5	2.5	3.0
Riboflavin mg/kg	4.0	4.0	4.0

NRC REQUIREMENTS-JAPANESE QUAIL

Nutrient requirement of Japanese quail as % or units per kilogram of diet as per NRC (1994) specifications

Nutrient	Starting and growing	Breeding
M.E. (KCal/kg)	2900	2900
Protein %	24	20
Lysine %	1.30	1.00
Methionine %	0.50	0.40

Linoleic acid %	1.0	1.0
Calcium %	0.8	2.5
Non-phytate phosphorus %	0.30	0.35
Manganese mg/kg	60	60
Selenium mg/kg	0.2	0.2
Zinc mg/kg	25	50
Vitamin A IU/kg	1650	3300
Vitamin D_3 ICU/kg	750	900
Vitamin E mg/kg	12	25
Vitamin K mg/kg	1	1
Vitamin B_{12} mg/kg	0.003	0.003
Biotin mg/kg	0.3	0.15
Riboflavin mg/kg	4	4
Thiamin mg/kg	2	2

NUTRIENT REQUIREMENT FOR GUNIEA FOWL

Nutrients	0-4 weeks Pre-Brooder	5-8 weeks Brooder	9-24 weeks Grower	24 weeks Layer
Crude protein – (CP%)	24.5	20.5	17	18
Metabolizable energy (Kcal/kg)	2850	2800	2750	2650
Calcium-Ca(%)	1.18	1.08	1.10	3.41
Phosphorus (%)	0.52	0.51	0.50	0.45
Lysine (%)	1.45	1.15	0.85	0.84
Methionine (%)	0.42	0.38	0.37	0.35
Courtesy: IPPM, TANUVAS, Chennai				

MODULE-18: ORGANIC FARMING AND MIXED FARMING

Learning objectives

- This module emphasizes the importance of organic farming and mixed farming of poultry.

INTRODUCTION

Organic farming is a system of farming which aims to promote animal health and environmental sustainability through holistic management for positive health based on a biologically active soil

- To be certified as *organic egg,* the hen should have been fed with organic feed, which is produced without synthetic pesticides, drugs, antibiotics or Genetically Modified Crops
- Hens used to produce organic eggs should not be fed rations containing meat by-products, such as meat and bone meal
- The *"organic"* label has also been applied to eggs produced by hens that are consuming diets, which do not contain any drugs or hormones. These organic eggs must come from the hens reared in deep litter systems, with sufficient access to free-range

PRINCIPLES OF ORGANIC FARMING

Basic Principles of Organic Farming

- A precautionary approach to health issues
- Positive rather than reactive health management
- A focus on the fundamental causes of health problems rather than the symptoms
- Preference for the use of natural rather than artificial processes.

Organic standards and practices include the following

- Limits on unit sizes and stocking density avoid intensive housing conditions
- Slower growing breeds encouraged
- No routine prophylactic drug treatments-usually only individual animals which are actually ill are treated, and then are required to be treated
- Homeopathic and/or Ayurvedic treatments are preferred to Allopathic
- Animal health plans obligatory for each farm, to identify weaknesses and improvements required in the system for positive health
- Record keeping
- Breeding strategies are being developed to improve health including fertility.

AIMS OF ORGANIC PRODUCTION

- To produce food of high quality in sufficient quantity
- To interact in a constructive and life-enhancing way with natural systems and cycles
- To consider the wider social and ecological impact of the organic production processing system
- To encourage and enhance biological cycles within the farming system involving micro-organisms, soil flora, plants and animals
- To maintain and increase the long-term fertility of soil

- To maintain the genetic diversity of the production system and its surroundings, including the protection of plant and wildlife habitats
- To use as far as possible renewable resources in locally organised production systems
- To create a harmonious balance between crop production and animal husbandry
- To minimise all forms of pollution

CONDITIONS FOR CERTIFIED ORGANIC EGG

To produce a certified organic egg, the chicken which lays the egg must be certified organic itself or if from a conventional source, must be from those layers fed with organic feed for atleast six months before the eggs are certifiable. Some of the regulations which apply to organic egg production are as follows:

- All the ingredients used to feed the laying hen must be from certified organic sources. No herbicides, fungicides, insecticides or chemical fertilizers are allowed.
- The farmer must replenish the soil naturally with the goal of sustainable production.
- Housing must allow for "reasonable liberty, normal socialization, maximum fresh air, day light and shelter from inclement weather conditions". The birds must have access to free range or large open air runs and has contact with the natural ground.
- No antibiotics, prohibited parasiticides or coccidiostats are allowed in the egg producing flock. In the event of treatment, birds must be withdrawn from organic production for a period of 90 days or twice the official waiting period, which ever is greater. Only after the producer has met all the production regulations and had his birds, his own land and his books inspected farm can only be recommended for organic status. Once approved, a certificate will be issued stating that the eggs are certified organic.

MANDATORY REQUIREMENTS-LAYERS

Mandatory Requirements - Organic Farming

- 100% certified organic feeds.
- 1.75 square feet per bird in the hen house.
- Uninterrupted supply of clean water.
- Natural light in the house.
- Adequate ventilation to prevent ammonia build-up.
- Access to the outdoors when seasonally appropriate.
- Outdoor area providing five square feet per bird.
- Egg storage area holding eggs at 60 ° F

RECOMMENDED PRACTICES

- *Temperature:* 40 - 80 degrees F
- *Humidity:* 60 - 80%
- *Waterers:* At least one bell waterer per 75-100 birds, or one nipple per 10-15 birds on line waterers.
- *Roost Area:* Flat roost area that hens cannot get under, with waters over this. Periodically dust with Calcium Phosphate or lime to keep ammonia down. Six inches per bird on roost area.
- *Litter:* Should be sawdust, shavings, certifiable hay or straw, or ground cobs.

- *Floor:* Area should be dry with certifiable scratch feed on the floor to encourage turning of the litter. If using the deep litter method, it must be microbially alive, and turned periodically with moisture to aid break down. Lime the floor periodically to disinfect.
- *Transition :* Rest time of two weeks between batches is encouraged to break parasite cycle. Clean house thoroughly, lime heavily, or spray a mild bleach solution to disinfect.
- *Ventilation:* Should maintain adequate air movement to avoid an overwhelming ammonia smell. *Ammonia levels in house should be less than 20 PPM*. Ridge vents are highly encouraged to remove ammonia and moisture.
- *Lighting :* Supplemental lighting not mandatory but encouraged. Fourteen to sixteen hours recommended. Never decrease for hens once they are laying.
- Vaccination permitted against certain diseases may also be carried out
- *Feed:* All laying hens must be fed 100% certified organic feed from day one.
    - Do not feed kitchen scraps. High-quality certifiable hay (either ground into feed or as bedding) keeps the yolk color dark. Feed constituting a major component of any animal production system and in the case of egg production, the major cost, it is vital that every aspect of the diet is correct in order to ensure optimum performance. When formulating rations suitable for organic egg production it is necessary, as with any ration, to take into consideration not only the nutritional requirement of the bird and the legislative standards applicable to the diet.
    - Organic standards prohibit the inclusion of genetically modified material and products produced using genetically modified organisms. Those of plant origin currently permitted, along with their by-products, include cereals, oil and legume seeds, tuber roots and forages. However, a further restriction on these products is the fact that they must not have been produced or prepared using chemical solvents. Animal products permitted for inclusion under the regulations include milk and fish or other marine animals, plus by-products.
    - All yolk pigments must be of natural origin

The cost of the diet

- Due to the aforementioned issues it is obvious that organically produced raw materials are going to cost more to buy than their conventional counterparts.

Outdoor Access

- Some form of pasture rotation (or a very large area provided) to maintain at least 30% plant cover.

Organic chicken meat standards

- Reared in movable housing
- Stocking rate 833 birds per hectare
- Birds selected from slow growth potential and higher age at slaughter
- Large, shaded open spaces and controlled flock sizes.
- Feed contains 75% cereal content and remaining 25% is composed of vegetable based protein.

House

    - In France the maximum size of house is 400 m^2 with range areas on both sides.
    - In U.K. it is wooden houses 2M x 5M x 1.5 M height on skids moved by tractor.
- Density requirement in France is 11 birds/M^2, maximum threshold for broilers in mobile home is a maximum of 16 birds or 30 kg per M^2.
- Slaughter age – minimum 81 days

- Minimum free range – 2 M^2/bird, under EU Standards it is 2.5 M^2 per bird.
- Birds must not be transported for more than 100 kms or 2 hours by road.

Feeding for organic egg/meat production

- There are two regulations within the legislation that need to be considered
  - Feed is intended to ensure quality production rather than maximizing production.
  - Disease prevention is by the use of high quality feed, together with regular exercises and access to pasturage, having the effect of encouraging the natural immunological defence of the animal.
  - The ingredients must be clear and traceable.

Health

- Generally it is accepted that mortality rates are likely to be higher in birds kept under range.
- The estimated mortality rate is 10% for organic table birds.
- The development of an animal health plan is an essential part of any organic farming system.
- It takes account of all aspects of the individual including stress, general well being as well as physical symptoms.

Label rouge

- The label rouge traditional free range poultry is found in France.
- The label rouge system has a unique label on the finish product.
- Each bird serves as a label which serves as its individual "identity card".
- A detailed summary of the bird's history on the label offers the consumer total reassurance with respect to the quality and safety of the product.

MIXED FARMING AND POULTRY RAISING - INTRODUCTION

- This is also known as "Integrated Farming" and eco-agricultural approach. This term of mixed or integrated farming is used for denoting farming practices that adopt and integrate components of crops, livestock, aquaculture and agroforestry in a manner that mimic natural feed back loops whereby enhancing the overall synergy of the system
- The main consideration in this system is to minimize the use of external inputs by enhancing the recycling of materials within the system through a process of value addition, which is achieved by intermediate components that make use of the by-products (wastes) from one component (Poultry) as inputs (fertilizers, food) for another
- The nature of the components that are integrated or "Mixed" will depend on the local resources, ingenuity of the farmer and marketing opportunity
- Normally under the integrated or mixed farming system a few key components would be the main stay around which the other activities would be inter linked and build upon, this takes a holistic approach, where every linked operation using the best available knowledge and technologies would improve production to maximize it
- A symbiotic relationship is formed between the farming families and their natural resource endowments

POULTRY AND FISH PRODUCTION

- Poultry cages (Chicken or Duck) can be constructed on the top of the ponds. The dropping will serve as a potential source of feed for the fish as well as manure. Additional advantages are elimination of unwanted insects in the pond by the ducks
- Pigeon cages have been constructed above the fish pond with just an initial stock of two pairs, this later multiplied to nine pairs within 14 months
- The integration of poultry and fish can increase overall production intensity and economics on land, labour and water requirements for both poultry and fish
- One hectare of static water fish ponds can process the wastes of upto 1500 poultry, producing fish in quantities of upto 10 MT/ha.
- Poultry wastes are more nutrient dense than other livestock wastes, they contain less moisture, fibre and compounds such as tannins that discolour water. Integration of village poultry system with backyard fish culture has brought much benefit with little extra cost

POULTRY INTEGRATION WITH CROPPING SYSTEMS AND AGRO FORESTRY

- Poultry integrated with cropping systems and Agro forestry has provided very good returns to the farmer. These farms have cows, goats and poultry comprising of chicken, ducks, turkeys etc. They graze on the grasses and leftover crops and grains and while wandering they also become biological mowers
- Geese have been used in many cropping systems as deweeders. In India the rearing of ducks go along with Paddy cultivation where the land is fertilized with duck dropping, while the ducks get the left over grains, snails, insects etc. A symbiotic relationship is maintained
- The movement of these birds and livestock tend to disturb the insect pest which takes refuge in ground covers and chicken feed on these insects. Where crop-livestock integrated farming system is practiced, several factors need to be considered – these include the choice of livestock, stocking density, fencing and security, eradication of noxious weeds, feed supply and a possible damage to crops
- Involvement of women is more in the mixed farming systems
- Integrated farming systems having many more crops and enterprises, require more labour, but each enterprise needs a small amount of labour everyday. Hence, family labour is necessary, it also adds value to the women labourers
- The special features of integrated farming system are the provision of balanced diet to all the members of the family instead of giving one cereal. Mono-cultivation provides yield after some months, whereas integrated or mixed farming systems provide diet in various forms around the year. In addition mixed farming system provided steady income through sale of various farm products

BENEFITS OF MIXED FARMING

- Offer scope of getting income throughout the year
- Reduced dependency on external inputs
- Provides employment opportunity throughout the year
- Eco friendly
- Reduces risks due to vagaries of nature
- Brings about a general level of self-reliance in the community

MODULE-19: HILL FARMING

Learning objectives

- This module deals with hill farming of poultry at higher altitudes.

INTRODUCTION TO HILL FARMING

- The dominant features in hill farming are the small land holdings and sloping marginal land with poultry raising.
- In the high hill temperature zones, it is more feasible to raise the available local/indigenous poultry breeds since they are most fit for scavenging on hilly tracts.

CONSTRAINTS UNDER HILL FARMING

- Undulating topography, small fragmented and scattered land holdings with limited availability of inputs.
- Slopes and soil erosion.
- The land is inaccessible, infrastructure, communication and mobility are affected due to various physical, climate and socio economic factors.
- Water quality.
- Natural hazards.
- Difficulties of Marketing

HILLY AREAS-SYSTEM OF REARING POULTRY

- Poultry provides economic and livelihood security to both land holding and landless hill families. Chicken are traditionally reared by the tribal's and their husbandry is integrated within the whole farming system. In village communities, almost every farmer rears a few chicken near their homes and mostly the birds are managed under a scavenging system. Very little time and money is spent on rearing them and they become a part of the family. In some hilly tracts some exotic birds have also been introduced like the Rhode Island Red, White Leghorn, New Hampshire etc. later the improved variety of birds that have indigenous blood in them have been introduced and are doing well.
- Under the scavenging system, particularly during the colder months, the birds are let loose to roam freely for part of the day (during the warm part of the day) and then are shut in, and supplemented with extra feed. This system allows the bird to be protected from inclement weather and are also protected from predators. Also, the manure from these birds is used to fertilize the soil. This system is adaptable to a range of flock sizes and is also able to produce more eggs and meat compared to the scavenging system.
- In the hill and mountain regions, where food grain is deficient, the scavenging system could provide eggs for the family without duly worrying about feeding the birds. Local consumers prefer egg and meat from the indigenous birds rather than from the exotic birds.
- Under the semi-scavenging system, since the birds are reared indoors for a large proportion of time, they are more prone for managemental diseases like coccidiosis and mortality and morbidity levels can be high. In this system, the farmer needs to construct a small house depending on the size of the flock. The house is of low cost and is made with locally available materials.

HIGH ALTITUDE AND HATCHABILITY

- A decrease in 10% hatchability has been observed for every 300 meter increase in altitude.
- There are reports that the hatchability decreased to 30% at 2000 meters.
- It has been observed that locally produced eggs may reveal lower porosity of the shell which may restrict the diffusion of gases at lower atmospheric pressure.
- Adoption can develop through a greater ability of the embryo to form haemoglobin in the red blood cells and through the development of a greater heart column of the growing embryo to compensate for the lower oxygen level.
- In most cases it may be preferable for birds to lay the hatching eggs at a higher altitude and hatch them in a lower area. Transportation of eggs have to be carried out with great care

REARING OF BROILERS IN HILLY TRACTS

- Rearing of broilers in higher altitude reduced growth rate and also increased mortality.
- Broilers being fast growing birds have a high metabolism and their requirement of oxygen is high, therefore they could be raised in an environmentally controlled house in high altitude areas

INTENSIVE SYSTEM OF REARING BIRDS-HILLY TRACTS

- In this system due to the terrain, the houses have to be smaller in length and many in number. In order to conserve heat, planning and construction of poultry house in hilly areas should be made square to the extent possible.
- Under this system of rearing in hilly areas, the birds have to be fed with a balanced feed and the cost of feed increases as it has to be transported up the hill.
- As the temperature is cool, the requirement for feed increases to maintain body warmth.
- During the cold seasons the birds have to be protected from ‘wind chill’ factor, and the open sides of the house are closed with gunny bags or plastic sheets.
- The wind direction should be observed and the curtains on that side must be closed up more.
- The opening and closing of the curtains in the open curtained house must be monitored and closely to prevent a build up of ammonia due to reduced ventilation.
- Small air inlets can prevent the house from becoming very chill as the cool air can drop on the birds, chilling them

HEALTH AND FEEDING

Health

- The major problem in intensive rearing of chicken in hilly areas is respiratory disease and coccidiosis. The cold air falls rapidly on the floor displacing warm air, leading to chilling- this cold air cannot absorb the water in the atmosphere and therefore as it falls on the litter, the litter gets caked and due to lower ventilation there is increase in ammonia,leading to respiratory disease. Also wet litter can lend itself to coccidiosis problems. In young birds the gut is chilled by contact with cold and humid litter and this leads to enteritis.

Feeding

- The bird has to maintain its body temperature and requires high energy feed. Chicken eat more feed when the environmental temperature is cold. A practical rule for the extra feed required for body maintenance is to provide 1% more feed for each 1°C temperature below the required house average of 18 to 20°C.Provide the birds with a balanced feed to control body weight and egg production. Prevent feather loss in these birds as this could 'chill' the birds excessively.

Training

- The farmers and those who intend to take up poultry farming in hilly areas must be trained. Training must be organized in such a way,to inform farmers of recent developments and suitable technologies concerning small scale poultry production in hilly terrain. Training on rearing meat and egg birds, selection of good layers, incubation and hatching methods, formulating rations with locally available ingredients, vaccination and health care must be regularly planned.

Breeding

- Breeder farms can be maintained in higher altitudes but the hatchery must be built at a lower altitude. Frequency in collection of egg must be more, to prevent chilling of the hatching egg which lowers hatchability.