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SCIENTIFIC MANAGEMENT OF BACKYARD POULTRY

ICAR - Krishi Vigyan Kendra, North Goa
ICAR - Central Coastal Agricultural Research Institute
Old Goa (Goa) - 403 402

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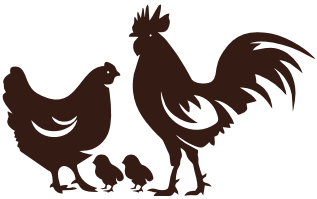

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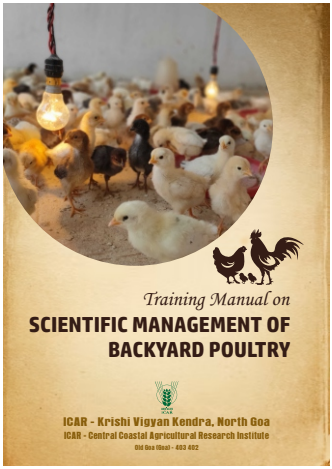

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PREFACE

Backyard poultry farming has emerged as one of the most effective livelihood-supporting enterprises for small, marginal, landless and women farmers in the coastal regions of India. With minimal investment and efficient utilization of locally available resources, this enterprise provides a regular source of income while simultaneously ensuring household nutritional security through the availability of eggs and meat.

The coastal agro-climatic regions of the country are characterized by high humidity, heavy rainfall, saline atmosphere and fluctuating temperatures. These unique environmental conditions have a direct bearing on poultry housing, feeding practices, health management and disease occurrence. Although backyard poultry rearing is traditionally practiced in coastal areas, productivity often remains sub-optimal due to inadequate scientific management, imbalanced feeding, absence of systematic vaccination and high disease pressure.

ICAR-Krishi Vigyan Kendra North Goa under the guidance of ICAR-Central Coastal Agricultural Institite, have been playing a pivotal role in promoting location-specific, scientific backyard poultry farming technologies. In this

context, the present manual has been developed to provide practical, need-based and climate-resilient guidance to farmers, extension personnel and trainers engaged in coastal regions. The contents of this manual are presented in a simple, easy-to-understand language, firmly grounded in scientific principles and enriched with field-level experience.

This manual is intended to serve as a comprehensive training and reference document for use in training programmes, farmer field schools, frontline demonstrations and capacity-building initiatives. It is sincerely hoped that the adoption of the recommended practices outlined in this manual will help farmers reduce poultry birds mortality, improve productivity and profitability, and ultimately strengthen livelihood and nutritional security in coastal farming communities.

Director

ICAR–Central Coastal Agricultural Research Institute

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Chapter. 1. Backyard Poultry Farming-Science and Practice

Backyard poultry farming is the art and science of rearing poultry birds in the farmer's own backyard or homestead. Under this system, birds are generally maintained in free-range or semi-scavenging conditions with night shelter, allowing them to utilize locally available feed resources such as kitchen waste, insects, worms and fallen grains. This system is simple, low-cost and well suited to rural, tribal and coastal farming situations.

Both indigenous/native poultry birds and improved backyard poultry germplasms can be successfully reared under this system. These birds are well adapted to local climatic conditions and usually lay light brown eggs, which are preferred by consumers. Improved backyard poultry birds developed by ICAR institutions show high survivability (around 90 per cent or more), better growth and improved egg production even under low or negligible input conditions. Another important advantage of backyard poultry farming is price stability, as the demand for desi birds and eggs remains high and less affected by market fluctuations.

Backyard poultry birds are generally more adaptive and disease resistant compared to commercial poultry, particularly in rural and tribal areas. This makes them suitable for resource-poor households, helping to meet small but regular requirements of nutrition and supplementary income. Women, elderly persons and children can easily manage this enterprise, making it an important tool for household livelihood security.

Importance of poultry farming

1. Poultry farming plays a crucial role in meeting the growing demand for animal protein in India. India is the second most populated country in the world and has a continuously increasing requirement for eggs and chicken meat. At present, the country ranks as the third largest producer of eggs and the fourth largest producer of chicken meat globally. Despite this progress, a considerable gap still exists between the demand and supply of poultry products.
2. The per capita consumption of eggs and chicken meat in India is much lower than the nutritional recommendations of the Indian Council of Medical Research (ICMR). The average egg consumption is about 103 eggs per person per year, against the recommended level of 180 eggs.

Similarly, per capita consumption of chicken meat is approximately 7.1 kg per person per year, compared to the recommended 11 kg (BAHS,2023-24) This clearly highlights the need to promote poultry farming, especially backyard poultry, to improve nutritional security.

3. Poultry products provide a cheaper and easily available source of high-quality protein. Eggs contain about 12.14 g of protein per 100 g, while chicken meat contains approximately 18.60 g of protein per 100 g. Poultry products are also difficult to adulterate, ensuring better food safety for consumers.
4. Poultry has the shortest generation interval among various livestock. A chicken will produce two generations in a year and a Japanese quail can produce as many as 4 generations in a year.
5. The space requirement for poultry farming is less as compared to other livestock.
6. Dressing yield from poultry is highest (70-75%) and disposing offals is also not only a cumbersome process.
7. Poultry can be reared successfully under a wide agroclimatic conditions and in any type of soil.
8. In addition to food and income, poultry farming provides valuable organic manure. A single layer bird produces

about 16 kg of dry manure per year under cage rearing and around 18 kg under deep litter system. Poultry manure is rich in nitrogen, phosphorus and potash and can be effectively used for crop production, kitchen gardening and even biogas generation. Thus, backyard poultry farming contributes not only to nutrition and income but also to sustainable and integrated farming systems.

System of rearing backyard poultry:

Based upon the availability of land and production practices, poultry are reared under Extensive/free rage system, semi-intensive system and intensive system comprising cage system, deep litter and slat/wire method. Welfare cages are also introduced for optimum comfort and productivity of birds.

(A) Extensive System/Free-range System:

In this system, the birds have free access to food by grazing and not controlled movement. During night, shelter may or may not be provided and very often in the villages the birds find shelter on the trees. One can rear 200 adult birds/acre of land (or) 400 to 500 young birds/acre. This system is adopted when there is adequate availability of land and for organic

farming. This system supports cleanliness of ground, and thereby decreasing the risk of diseases. Birds can freely express their natural behaviour such as scratching, dust bathing etc. But predation and less productivity is the major issue in this case.

Back yard system is a part of free-range system, since it includes either a large area or smaller land space of the homestead farming. This is also practiced in urban areas, also where houses with a little piece of land at the back may rear chicken or other poultry. Chicken reared within the backyard are also provided with some housing where they are protected. Supplementary feed such as broken rice, bran mixed with

watery, kitchen waste and byproducts etc were given to them

besides free grazing.These birds lay eggs within the provided land and normally lay them in a known place identified by the people in the house.

(B) Semi-Intensive System:

It comprises of a pen/shelter house (at the centre) and run fenced by wire mesh or other type of fencing. Pen is used as shelter in summer or in monsoon and run is used for grazing. This system is very useful with ducks and geese. This is mostly followed when land availability is limited. Generally, not followed for broiler farming.

C. Intensive systems:

This system confines the bird in a house to better protect them from predetors and inclined weather. It can be a deep litter system or cage system of housing. The birds are on continuous observation where balanced ration is given to them. But the cost of infrastructure is high and natural behaviour is compromised. Record maintenance is easier but spread of disease in the flock may be a concern.

C. Deep litter

Birds are reared on floor either in an open sided house or environmentally controlled house. They are provided with litter material such as paddy husk/ sand, /sugarcane baggasses /saw dust or other shredded leaves /papers etc that acts as bedding for the bird The open curtained system of house provides them with good cross ventilation. When compared to cage housing, this system requires a higher investment on land and housing due to a relatively lower stocking density compared to birds raised in cages.

D.Cage Rearing

Broilers and layers are reared in cages. Raising layers using the Californian systems of cages is very popular and they could be two, three or four tiered. In raised cage house system, the floor of the house is raised at 6 feet above the ground and various tiered cages are placed at this level. This system helps for better drying of manure and fly control. The birds do not come in contact with the droppings. In deep litter the layer

needs about2sq.ft of floor space but in the cage system the space requirement is only 0.65 ft^2 / bird. Presently most of the broiler breeders are reared in cages the floor of the cages is modified with plastic cushioning to prevent cracks in the eggs and to prevent any foot injuries. Welfare cages with better comfort and enrichment options for exhibiting natural behaviour is also practised in some areas.

E. Environmentally controlled house

These are houses complete with roof insulation, a ventilating systems and all necessary equipment. They are known as 'windowless houses'. Huge ventilating fans are used to ensure adequate air circulation during warm weather and to control the rate of air exchange during the cold season. The capacity of fans should be sufficient to supply 6 or 7 cubic feet of air / minute / hen at ⅛ inch static pressure. Both pressurized and exhaust ventilation systems must be used, exhaust fans must be regularly cleaned of feather and dust. There is controlled artificial lighting providing the required photo period and intensity. The house should be 'light tight' to have a complete control over the intensity and duration of light within the house. The feeders and waterers are all automated in these houses. Every aspect of the basic requirement is controlled and monitored continuously using a computer such as- the ventilation, air velocity, humidity, ammonia levels, warmth, and length of light, light intensity, feed and water requirement of the birds.(Asharajini et al., 2011)

Chapter 02: Poultry Birds - Indigenous and Improved by ICAR

Indigenous poultry birds developed from different geographical regions in India are registered as a breed by ICAR-National Bureau of Animal Genetic Resources, Karnal, Haryana. Total 21 chickens, 9 ducks and 2 geese have been registered till date.Most popular indigenous chicken breeds and duck breeds found among farmers of goa in field are given below:

Kadaknath

Kadaknath is a chicken breed originated from Madhya Pradesh and reared in all over India. It is known as Kalamasi due to the black coloured meat and blood. The skin, beak, shanks, toes and soles of feet are slate in colour. It gives brown coloured eggs. Adult birds lay 70-80 eggs per year.

Fig. Kadaknath chicken

Aseel

This is a chicken breed originated from Andhra Pradesh and found in many parts of country. Due to its fighting ability and better adaptability, it is preferred by the farmers. Aseel is reared under backyard poultry management systems and is a vital source of meat and income for small-holder poultry farmers. The bird is also used by the people for cock-fighting.

Characteristics

- Body weight at 20 weeks: 1,220 gms.
- Age at sexual maturity: 196 days.
- Average annual egg production is 92.
- Average egg weight at 40 weeks of age is 50 gms.
- Hatchability of fertile eggs: 63%.

Fig. Aseel bird

Ducks

Ducks are reared traditionally and contribute a significant livelihood after chicken farming in the poultry sector. The traditional system of duck keeping is still dominant in the country and even after four decades of modernization of commercial chicken production, the duck production in India remains unchanged as a traditional enterprise. Though various duck breeds like Khaki Campbell, Indian Runner, White Pekin and Muscovy are available at different research stations, indigenous duck varieties are still preferred by the farmers. Also known as desi ducks, indigenous ducks constitute more than 90% of the total duck population and are the second largest species contributing towards egg production in India. As per 20th livestock census (2019), the desi duck and improved variety of ducks contribute 0.89% and 0.26% of eggs respectively to the total egg production. Breeding and selection have led to the improvement of duck breeds. Ducks are mostly concentrated in the Eastern and Southern states, mainly coastal region with non-descriptive indigenous stocks, which are poor layers. West Bengal and Kerala are the major consumer states for duck egg and meat.

Indigenous duck breeds namely Pati, Maithilli and Andamani are registered till date. However, the nondescript

duck germplasms like Kuttanad, Chara, Chempally, etc. reared in the framers' field. The exotic breeds of ducks like Indian Runner, Khaki Campbell are used for egg production. White Pekin, Muscovy, Aylesbury, etc. reared for meat production in some of the farmers' fields.

Kuttanad ducks

Kuttanad ducks are local to Kerala and maintained in the institute poultry unit of ICAR-CCARI, Goa. Dual purpose indigenous breed with plumage colour varies from grey brown to bronze with spots. The performance of the ducks maintained in the institute poultry unit is evaluated. Annual egg production is around 220. Body weight at 6 week is 1.15 kg and at 12 week is 1.80 kg. Age at first egg is 135 days. Egg weight at 40 week is 70 gm. The fertile eggs and the ducklings were supplied to farmers of Goa in last few years.

Fig. Kuttanad ducks in institute poultry unit

The Indian Council of Agricultural Research (ICAR) has played a major role in developing improved backyard poultry varieties through its two premier institutes:

- ICAR–Directorate of Poultry Research (DPR), Hyderabad, Telangana
- ICAR–Central Avian Research Institute (CARI), Izatnagar, Uttar Pradesh

Based on their purpose, ICAR-developed backyard poultry birds are classified as follows:

1. **Egg purpose birds**: Grampriya, CARI–Nirbheek, etc.
2. **Dual-purpose birds**: Vanaraja, Srinidhi
3. **Meat purpose (broiler) birds**: CARIBRO–Dhanaraja, Krishibro

2.1 Difference between Desi Poultry Birds and ICAR-Developed Improved Backyard Poultry Birds

Particulars	**ICAR Improved Birds**	**Desi / Native Birds**
Usefulness	Suitable for both commercial and backyard poultry farming	Suitable mainly for backyard poultry farming

Age at first egg laying (weeks)	21–24	30–35
Broodiness character	No	Yes
Average egg production per month	12–18	5–7
Annual egg production (number)	110–150	40–60
Average egg weight (g)	55	35–40
Egg colour	Brown	Brown

2.2 ICAR-Developed Dual-Purpose Backyard Poultry Birds

2.2.1 Vanaraja: Vanaraja is a popular dual-purpose bird developed by ICAR–Directorate of Poultry Research (DPR), Hyderabad. It is especially suitable for backyard farming in rural and tribal areas due to its excellent adaptability to free-range conditions. The bird has attractive multicoloured plumage which is appealing and helps in easy identification.

Vanaraja birds are known for their productive performance, producing approximately 100–110 eggs annually. They typically start laying eggs at around 175–180 days of age and continue to produce eggs up to 72 weeks of age. These eggs are larger in size and can be hatched naturally by desi hens, making the breed suitable for low-input systems.

The Vanaraja bird has several special features that make it highly desirable for backyard poultry farming. It possesses an attractive feather colour pattern, shows better survivability under rural conditions, and requires low or negligible input cost. Additionally, it has high disease tolerance, which ensures better flock health and reduces mortality. Overall, Vanaraja is a hardy, productive and adaptable breed ideal for coastal and rural backyard poultry systems.

Comparison of Vanaraja and Desi Birds

Particulars	Vanaraja Birds (Improved)	Desi Birds (Non-descript)
Weight of day-old chick (g)	40–50	20–25
Body colour	Multicoloured	Multicoloured
Body weight at 8 weeks (kg)	1.0–1.5	0.5–0.75
Survivability (%)	98	40–50
Total weight of males at 4 months (kg)	3.0	1.2–1.5
Total weight of females at 4 months (kg)	2.5–3.0	1.0–1.2
Quality of meat	Less tender than broiler	Elastic
Taste of meat	Like desi	Desi
Dressing percentage (%)	60–65	40–50

2.2.2 Srinidhi: Srinidhi is another dual-purpose backyard poultry bird developed by ICAR–Directorate of Poultry Research (DPR), Hyderabad. These birds have attractive multicoloured plumage and lay brown eggs that closely resemble those of desi birds. Srinidhi birds are well suited for backyard conditions and are capable of escaping predators due to their longer shanks, making them hardy and adaptable.In terms of economic traits and performance, Srinidhi birds achieve a body weight of 400–500 g at 6 weeks of age, 1700–2000 g at 20 weeks, and 2200–2300 g at 40 weeks. The average egg weight at 28 weeks is 48–50 g, increasing to 52–55 g at 40 weeks. These birds typically start laying eggs at 165–170 days of age and produce around 140–150 eggs annually over a 72-week period. Srinidhi chicks have a high survivability rate of approximately 95% up to 6 weeks of age, reflecting their robustness under backyard conditions.

2.3 ICAR-Developed Egg-Purpose Backyard Poultry Birds

2.3.1 Grampriya : Grampriya is an egg-purpose backyard poultry bird developed by ICAR–Directorate of Poultry Research (DPR), Hyderabad. These birds start laying eggs at 160–165 days of age and continue to produce eggs up to 72 weeks, with an annual egg production ranging from 180–200 eggs per bird. In terms of economic traits and performance, Grampriya birds achieve a body weight of 400–500 g at 6 weeks, 1600–1800 g at 20 weeks, and 2300–2500 g at 40 weeks. The average egg weight is 52–53 g at 28 weeks and 57–58 g at 40 weeks. They start laying eggs at 160–165 days of age, produce 180–200 eggs annually, and have a high survivability rate of approximately 99% up to 6 weeks of age, reflecting their robustness and suitability for backyard systems.

2.3.2 CARI–Nirbheek CARI–Nirbheek is an egg-purpose backyard poultry bird developed by ICAR–Central Avian Research Institute (CARI), Izatnagar. It is a cross between the

Indian native breed Aseel and CARI Red. The bird is suitable for free-range and backyard poultry systems.

These birds produce 180–200 brown eggs annually, which resemble desi eggs. They start laying eggs at around 176 days of age and continue production up to 72 weeks. At 20 weeks of age, male birds weigh about 1.8 kg and females about 1.35 kg. Due to their active and fighting nature, they can protect themselves from predators and are well adapted to all climatic zones of India.

2.4 ICAR-Developed Meat-Purpose Backyard Poultry Birds

2.4.1 CARIBRO–Dhanaraja

CARIBRO–Dhanaraja is a broiler cross variety developed by ICAR–Central Avian Research Institute (CARI), Izatnagar. This variety is produced by crossing coloured synthetic male and female lines. The bird has bright multicoloured plumage, a single comb, and is less susceptible to adverse environmental conditions, making it suitable for backyard as well as semi-intensive rearing.

In terms of economic traits and performance, CARIBRO–Dhanaraja chicks weigh approximately 46 g at day-old. By 6 weeks of age, they attain a body weight of 1500–1700 g, increasing to 2000–2125 g at 7 weeks. The dressing percentage ranges from 73–75%, and the feed conversion ratio is around 1.92, indicating efficient growth and feed utilization.

2.4.2 Krishibro:

Krishibro is a broiler cross variety developed by ICAR–Directorate of Poultry Research (DPR), Hyderabad. This variety is suitable for meat production under both backyard and semi-intensive rearing systems, offering good adaptability and growth performance.

In terms of economic traits and performance, Krishibro birds attain a body weight of approximately 1440 g at 6 weeks and 2920 g at 7 weeks. The dressing percentage is around 72.6%, and the feed conversion ratio is 2.05, indicating efficient feed utilization and rapid growth.

In summary, ICAR-developed poultry breeds drive rural transformation by boosting income, ensuring nutritional security, and empowering marginalized communities through superior productivity and sustainable farming practices.

Chapter 3: Management and Husbandry of Improved Poultry Birds

The success of rearing improved dual-purpose birds like Vanaraja and Srinidhi depends on a structured two-phase management approach: an initial intensive nursery phase followed by a sustainable free-range phase. Proper care during these periods ensures high survivability and optimal production.

3.1 Nursery Phase and Brooding Management: Immediately after hatching, chicks are unable to regulate their own body temperature. They require a controlled environment (brooding) to stay warm, receive balanced nutrition, and remain safe from predators. This critical period typically lasts for the first 4 to 6 weeks. To ensure proper growth and prevent overcrowding during the nursery phase, a stocking density of **0.35 square feet per chick** is sufficient for their space requirements.

3.2 Housing Preparation

3.2.1 Litter Management: Prepare the floor by spreading a 2–3-inch layer of clean, dry material such as rice husk, sawdust, or groundnut shells. This acts as insulation and absorbs moisture. As a pro tip, you should cover the litter with old

newspapers for the first 3–5 days so chicks don't mistake the bedding for food.

3.2.2 Equipment Layout: Position feeders and waterers in an alternating circular pattern. This prevents crowding and ensures that even the weakest chicks can find food and water easily.

3.3 Temperature Control: Use incandescent electrical bulbs or

infrared lamps to provide warmth. A general rule is to provide 2 watts per chick.

3.3.1 Using Chick Guards: To prevent chicks from straying too far from the heat source and getting chilled, use chick guards. These are circular fences made of cardboard, tin, or plastic mesh, usually about 1.5 feet high. You should place the guard in a circle around the heat source. Gradually expand the circle as the chicks grow, and remove it completely after 7–10 days.

3.3.2 Monitoring Chick Behavior (The "Living Thermometer"): Technical thermometers are useful, but the best way to judge the temperature is by observing how the chicks distribute themselves in the brooding area. When there is an ideal temperature, chicks are evenly spread throughout the area, moving freely and chirping contentedly. If it is too cold, chicks huddle together directly under the heat source, which can lead to smothering and death. When it is too hot, chicks move to the outer edges, away from the light, and may pant or spread their wings. In drafty conditions, chicks huddle together in one specific spot on one side of the guard, indicating a cold wind is entering from the opposite side.

3.4 Early Nutrition (The First 48 Hours): For proper hydration upon arrival, dip the beaks of a few chicks into the water to teach them how to drink, and the rest will follow. Adding glucose, electrolytes, or vitamins to the drinking water for the first 2–3 days helps chicks recover from "travel stress." Some farmers offer maize grits, such as finely crushed maize or "broken rice," for the first 24 hours to help the digestive system start functioning before moving to high-protein starter mash.

Chapter 4: Nutritional Management for Poultry birds

Feed is the single largest item of expenditure in poultry production, accounting for about 60–70% of the total cost. Feed costs are increasing at a much faster rate compared to the market prices of eggs and chicken meat, which often results in reduced profit margins or losses. Poultry feed is a mixture of several ingredients combined to supply balanced nutrients required by birds at different stages of growth and production at a reasonable cost.

Some feed ingredients supply only a single nutrient, while others provide multiple nutrients. For example, limestone is mainly used as a calcium source, whereas cereal grains primarily supply energy along with some protein, minerals, and vitamins. No single feed ingredient is compulsory to meet the nutrient requirement of birds; therefore, economic feeding plays a crucial role in reducing feed cost without affecting bird performance.

Proper feeding is essential for growth, egg production, disease resistance, and the overall performance of backyard poultry. While ICAR-developed birds are excellent scavengers, scientific supplementation is the key to unlocking their full genetic potential. Commonly available feed resources are

categorized into energy, protein, mineral, and vitamin supplements, with energy sources comprising 60–70% of the total ration to provide bulk and satiety.

Primary energy ingredients like Maize, Bajra, and Jowar (Sorghum) serve as the foundation of the diet, while Ragi (Finger millet), Rice bran, and Broken rice are frequently used to balance fat and lean meat content. Supplementary energy can also be derived from Wheat, Wheat bran, Barley, Tapioca, and Molasses, alongside specialized additions like Mango kernel, Sal seed,coconut grates and Fats or Oils.

Protein requirements are met through diverse plant-based sources, most notably Soybean meal, Groundnut meal, and Sunflower meal, which offer high-quality nutrition when properly balanced. Other vegetable proteins include Maize gluten meal, Til (Sesame) cake, Cottonseed cake, and Ambadi cake, as well as Rapeseed/Mustard cake, Safflower meal, and Coconut cake. Minor plant protein contributors such as Guar meal, Linseed cake, Karanj cake, Niger cake, Kokum meal, and Rubber seed cake are utilized depending on regional availability.

Animal protein sources provide essential amino acids and include high-value ingredients like Fish meal, Meat and

bone meal, and Poultry by-product meal. Farmers may also incorporate specialized by-products such as Silkworm pupae meal, Squilla meal, Hatchery by-product meal, and Feather meal to round out the nutritional profile. Finally, non-traditional energy options like Dried poultry manure are sometimes explored, though they require careful processing to ensure safety and digestibility.

4.1. Phase- Feeding of poultry

To maximize returns, feeding should be categorized into three distinct life stages: Starter, Grower, and Layer.

A. Chick Starter Phase (0–6 Weeks): This phase focuses primarily on skeletal development and immune system priming, during which chicks should be reared on a standard chick starter ration. The feed composition for this stage should contain 20–22% Crude Protein (CP) and 2800 kcal/kg ME. A chick typically consumes approximately 1.2 to 1.5 kg of total feed during these first six weeks, while their water requirement remains roughly two times the feed intake by weight. For equipment, farmers should use "Linear" or "Circular" chick feeders and fountains, providing 1 inch of feeder space and 0.5 inch of waterer space per chick.

B. Grower Phase (7–20 Weeks): The purpose of the grower phase is to focus on steady muscle growth without allowing for excessive fat deposition before egg-laying begins. During this period, the protein level in the diet is reduced to 16% CP with an energy value of 2600 kcal/kg ME. Under this feeding method, birds are usually let out for scavenging during the day and supplemented with 30–50g of feed per bird in the evening to compensate for energy gaps. A grower typically requires about 60–80ml of water daily, though this amount fluctuates depending on the ambient temperature.

C. Layer Phase (21 Weeks onwards): The layer phase is dedicated to sustaining high egg production and maintaining essential shell quality. Layers require a diet consisting of 18% CP along with a massive boost in minerals, specifically where 3.5% to 4% Calcium is vital. Farmers should supplement the birds' scavenging with 60–80g of concentrated feed per day. Regarding water requirements, a laying hen can consume up to 250ml of water per day; it is critical to note that a lack of water for even 24–48 hours can completely stop egg production and trigger a "moult," or the loss of feathers.

Methods To Reduce Feed Cost:

A. Precision poultry feeding: Means Accurate feeding of birds based on their exact nutritional requirements of mostly energy and protein which will improve the FCR and performance of the birds significantly, resulting in considerable reduction in the feed cost.

- Due to precision nutrition, broiler farmers are achieving an FCR of <1.60, with a body weight of >2.20 kg in <40days, with < 5% mortality.
- Similarly, backyard farmers are getting 180-210 eggs /hen/ annum, with an FCR of 2 /dozen eggs.
- Moreover, these standards are showing an annual improvement of 3-5%, due to precision nutrition

Table 1 Requirements for Chicken Feeds

(*Clauses* 4.1.2, 7.1, E-4.2 *and* E-5)

Sl No.	Characteristic	Requirement for														
		Broiler Feed			Layer Feed				Broiler Breeder Feed				Layer Breeder Feed			
		Pre-starter	Starter	Finisher	Chick	Grower	Layer Phase I	Layer Phase II	Chick	Grower	Layer	Male	Chick	Grower	*Rom*	Male
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
i)	Moisture, percent by mass, *Max*	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
ii)	Crude protein (N × 6.25), percent by mass, *Min*	23.0	22.0	20.0	20.0	16.0	18.0	16.0	20.0	16.0	16.0	15.0	20.0	16.0	17.0	16.0
iii)	Ether extract, percent by mass, *Min*	3.0	3.5	4.0	2.0	2.0	2.0	2.0	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0
iv)	Crude fibre, percent by mass, *Max*	5.0	5.0	5.0	7.0	9.0	9.0	10.0	7.0	9.0	9.0	9.0	7.0	9.0	9.0	9.0
v)	Acid insoluble ash, percent by mass, *Max*	2.5	2.5	2.5	4.0	4.0	4.0	4.5	4.0	4.0	4.0	4.0	2.5	2.5	2.5	2.5
vi)	Salt (as NaCl), percent by mass, *Max*	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

B. Least-cost feed formulation

- Formulate feeds based on their digestible nutrients, instead of gross nutrient levels
- All integrators and big farmers are using feed formulation software for least-cost precision feed formulation by linier programming, to reduce feed cost/Excel based
- Make feed poultry software by CARI
- Use good quality Toxin-free feedstuffs, with known nutritional composition

C. Large Scale Poultry Operation

- Large Bigger farm needs more feed
- Buy feed ingredients & feed supplements in bulk, which will reduce the feed cost
- Hence have a layer farm, with >100,000 layers Broilers >20,000 /week
- Large size backyard farms with improved varieties of poultry.

D. Integration in poultry production

- An integrated layer or broiler operator will have several contract farms under his fold.
- The integrator will be having a breeding farm and several contract broiler /layer farms, having millions of birds.

- Hence their feed requirement is huge, more than the large poultry farms; resulting in lower cost of production of feed. They will also have credit facilities.

E. Use of Alternate feedstuffs

- If conventional feedstuffs like maize, soya and fish are costly /scarce / poor quality, go for alternate feedstuffs like jowar, millets, rice polish, broken rice /wheat, cheaper oil cakes, guar meal,BSF larvae meal, meat-cum-bone meal etc.
- Select alternate feedstuffs, based on their relative cost, quality and availability.
- Multiple energy and protein feedstuffs will not only reduce the feed cost, but also improve the feed quality and reduce the mycotoxin level; compared to maize and soya combination only.

4.2. Alternate/Unconventional feed stuffs for poultry:

Beyond traditional grains, farmers can utilize low-cost biological and hydroponic sources to slash feed costs

significantly. Azolla Cultivation involves a floating fern that acts as a "superfood" for poultry, containing 25–30% protein, and birds can be fed up to 100g of fresh Azolla daily. Sprouted Grains, produced by soaking and sprouting grains like bajra or wheat for 24–48 hours, increase enzyme content and vitamin B availability to make the feed easier to digest.

Phytogenic feed additives comprise a wide range of plants, like herbs and spices and plant-derived products like essential oils and oleoresins. Addition of phytogenic feed additives have gained prime importance in poultry nutrition following ban of antibiotic growth promoters in feed. These natural feed additives are generally considered safe and improve poultry production performances. Feeding of these herbs either alone or in combination had numerous antioxidants, antimicrobial, anti-inflammatory, gut stimulating, immunomodulatory effect on poultry.These natural, antibiotic alternatives as feed supplements can be rhizome based such as turmeric (*Curcuma Longa), ginger (Zingiber officinale*), alpinea (Alpinea galanga) or leave based viz Tulsi (*Ocimum sanctum*), drumstick tree (*Moringa oleifera*), Chekurmanis (*Sauropus androgynus*), neem(Azardichita indica) kalmegh/king of bitters (*Andrographis paniculata*) etc either given alone or in combination.

Ocimum sanctum

Moringa oleifera

Sauropus androgynus

Fig: Rhizomes of Zinger, turmeric and Alpinea

Hydroponic Fodder allows for the growing of maize or barley in water trays for 7–8 days to produce succulent green mats that are rich in vitamins and provide extra hydration. Additionally, Vermiculture (Worm Feeding) through the establishment of a small vermicompost pit allows birds to forage for earthworms, which serve as an excellent source of animal protein essential for high-quality egg yolks.

4.3 Practical Feed Formulation & Equipment

Locally Prepared Balanced Feed Formula: If commercial feed is unavailable, farmers can mix a balanced diet using the following proportions:

- 50% Cereals: Use maize, sorghum, pearl millet, or broken rice to provide energy.
- 28% Bran: Incorporate rice bran or wheat bran to provide necessary fiber.
- 20% Oil Cakes: Use soybean, groundnut, or sunflower meal to provide protein.
- 2% Supplements: Add a vitamin-mineral mixture and common salt.

4.4 Equipment Capacity:

In terms of feeder capacity, a standard 5kg capacity hanging feeder is sufficient to support 20–25 adult birds. For waterers, a 5-liter plastic drinker is enough to provide for 20 birds. It is vital to ensure that waterers are placed in the shade to keep the water cool, as birds will often refuse to drink warm water.

4.5 Daily Feed and Water Guidelines for Poultry birds

To ensure your birds grow healthy and produce plenty of eggs, you must provide the right amount of feed and water every day based on their age.

- For Young Chicks: During the first six weeks, each chick needs 15–30 grams of feed and 40–60 ml of

water daily. Their diet must have high protein (20%) to build strong muscles and feathers.

- For Growing Birds: As they move into the grower stage (7–20 weeks), their needs increase to 50–70 grams of feed and 100–150 ml of water per day. At this stage, the focus is on balanced growth to prepare their bodies for egg-laying.

- For Laying Hens: Once they begin laying eggs, adult birds require the most nutrition, consuming 80–120 grams of feed and 200–300 ml of water daily. Their feed must be high in calcium (at least 3.5%) to ensure they produce eggs with strong, healthy shells.

4.6 Special Management Guidelines for Coastal Poultry Farming

Farmers raising poultry in coastal and high-rainfall regions must take extra precautions due to high humidity, which can quickly spoil feed and affect bird health.

4.6.1. Freshness and Fungal Prevention: It is critical to use only fresh ingredients when mixing your poultry rations. During the monsoon season, humidity levels rise, making feed highly susceptible to fungal growth (molds)

which produce dangerous toxins. Always inspect your feed regularly and avoid using any material that appears damp, clumped, or smells musty.

4.6.2. Proper Feed Storage: Store your feed in a dry, well-ventilated room to prevent moisture absorption. To keep the feed safe from damp floors, stack the bags on wooden planks (pallets) rather than directly on the ground, and ensure they are kept away from the walls to allow air to circulate.

4.6.3. Small Batch Preparation: To ensure your birds always receive the highest quality nutrition, prepare or purchase your feed in small batches. In coastal climates, feed loses its quality quickly; therefore, mixing only what your birds can consume within one to two weeks helps maintain freshness and prevents spoilage.

Fig: Demonstration for preparing own poultry feed

4.6.4. Clean Water Management: Always provide a continuous supply of clean and fresh drinking water. Coastal heat can cause water to become warm or grow algae quickly, so ensure that waterers are cleaned daily and placed in a cool, shaded area to encourage the birds to drink.

Conclusion: Balanced and phase-wise feeding is the backbone of profitable poultry farming, as feed alone accounts for the major share of production cost. Scientific use of locally available ingredients, innovative feeds, and clean water ensures optimal growth, egg production, and disease resistance. Proper storage and coastal-specific precautions further safeguard feed quality and bird performance.

Chapter 5. Housing and Space Management for Poultry

Backyard poultry birds are highly versatile and can be reared in various systems, including specialized houses, cages, or simple night shelters in the backyard. Regardless of the system, providing the correct amount of space is vital for their growth, comfort, and egg production.

5.1. Space Requirements by Age: As birds grow, they need more room to move and breathe. Overcrowding is a major cause of stress, slow growth, and high mortality.

- **Chicks (0–6 Weeks):** Young chicks require 0.5 to 0.6 square feet of floor space each. It is critical to avoid overcrowding during this "brooding" stage to keep them warm and dry.
- **Growers (7–18 Weeks):** As birds develop muscle, they need 1.0 to 1.5 square feet per bird. Proper space at this stage ensures they develop strong immune systems and grow uniformly.
- **Layers (19 Weeks+):** Adult hens need the most room, requiring 2.0 to 2.2 square feet per bird. Providing enough space reduces stress, which directly leads to

more eggs. At this stage, you should also provide one nest box for every 4–5 birds for egg-laying.

5.2. Rearing Systems

Improved poultry varieties perform well across different environments:

- Deep Litter/Night Shelters: Birds are kept on a floor covered with dry material (husk or sawdust). This is the most common system for backyard farming.

Fig: Deep litter rearing of poultry birds

- Cages: Birds can be kept in cages for better hygiene and easier egg collection, provided the cages are spacious enough.
- Backyard Scavenging: Birds are let out during the day and kept in a secure house only at night to protect them from predators.

5.3. Special Housing Guidelines for Coastal Areas: In coastal regions, where heavy rain and humidity are common, the design of the house must protect the birds from dampness:

- Raised Floors: Build the floor of the house slightly above ground level to prevent waterlogging and dampness from the soil.
- Roofing and Drainage: Ensure the roof is leak-proof and has a sharp slope to shed rainwater quickly. Good drainage pits should be dug around the shed to prevent water from pooling.
- Litter Management: Use dry materials like paddy husk or sawdust on the floor. During the rainy season, you must regularly check for and remove any wet or clumped litter to prevent diseases like Coccidiosis.

- Ventilation: Keep the house well-ventilated to allow fresh air to flow and reduce the humidity inside the shed.

5.4 Summary of Space Needs: To ensure your birds grow healthy and remain productive, you must provide the correct amount of floor space based on their stage of life.

For Chicks: During the first six weeks, young chicks require approximately 0.5 to 0.6 square feet of space each to ensure they stay warm and avoid being crushed or stressed during the sensitive brooding phase.

For Growers: As the birds reach seven to eighteen weeks of age, their space requirement increases to 1.0 to 1.5 square feet per bird to allow for steady muscle development and better air circulation.

For Layers: Once the birds reach nineteen weeks and beyond, they need the most room, requiring 2.0 to 2.2 square feet of floor space per bird to reduce stress and maintain high egg production levels.

Conclusion: Adequate housing and correct floor space at each stage of growth are essential to reduce stress, improve health,

and maximize egg production. Well-ventilated, dry, and predator-safe shelters support better survivability, especially under backyard and coastal conditions. Thoughtful housing design directly translates into healthier birds and higher overall productivity.

Chapter 6: Common Diseases and Health Management

Backyard poultry birds are generally hardy, but because they scavenge outdoors, they are frequently exposed to infections and parasites. In coastal areas, high humidity and temperature fluctuations make birds even more prone to sickness. Early identification and prevention are the keys to saving your flock.

6.1. Major Viral Diseases

A. Ranikhet Disease (Newcastle Disease)

Ranikhet Disease is considered the most serious and highly contagious viral threat to poultry, capable of wiping out an entire flock overnight if the birds are not vaccinated. The virus spreads rapidly through the droppings, saliva,

and nasal discharge of infected birds, as well as through contaminated feed and water sources. Farmers should watch for sudden deaths without prior signs, though visible symptoms often include greenish or watery diarrhea, a twisting of the neck where the bird looks upward or backward, gasping for breath, and drooping wings. The golden rule for every farmer is that vaccination is the only way to prevent this disease, as there is no cure once a bird becomes infected.

B. Infectious Bursal Disease (IBD / Gumboro):

This viral disease primarily attacks young chicks between 3 to 6 weeks of age and is particularly dangerous because it destroys the immune system, leaving the birds too weak to fight off other minor illnesses. It spreads through contact with contaminated litter bedding and infected droppings. Affected chicks typically sit in a "hunched"

position with ruffled feathers, suffer from white and watery diarrhea, and may be seen pecking at their own vent region. To protect the flock, farmers must keep the shed floor dry and ensure timely vaccination, as vaccinated birds have much higher survival rates.

Figure 1: Ruffled feathers in a depressed and Haemorrhages on thigh and leg muscles of an indigenous chicken pullet suffering from infectious bursal disease

C. Fowl Pox: Fowl Pox is a slow-spreading viral disease that is most common during the rainy season when mosquitoes are most active. The virus enters the flock through mosquito bites, skin wounds, or direct contact. Symptoms include the appearance of wart-like sores or scabs on the comb, wattles,

and eyelids; if the sores grow inside the mouth (known as "Wet Pox"), the birds will have great difficulty breathing or eating.

Prevention relies on controlling the mosquito population around the poultry shed and sticking strictly to the vaccination schedule.

6.2. Common Bacterial Diseases

A. Infectious Coryza (Fowl Coryza): It is a highly contagious acute disease of upper respiratory tract of chickens and can turns into a chronic respiratory disease. The disease is caused by Haemophilus paragallinarum bacteria. Important clinical signs include serous to mucoid nasal discharges with foul smelling, facial edema, conjunctivitis, swollen wattles, diarrhoea and reduced feed and water consumption.

For treatment, antibiotics like Gentamicin, Penicillin and Streptomycin delivered in feed or drinking water can be given.

Proper disinfection of the poultry house and litter is necessary for prevention of the disease.

B. Salmonellosis: Salmonellosis is the foremost disease in broiler birds. There are two types of diseases found in the broiler: Pullorum disease and fowl typhoid. Source of infection is through contaminating eggs, water, and infected birds.

1. Pullorum Disease: Also known as Bacillary White Diarrhoea caused by bacteria Salmonella pullorum. The disease causes fatal septicemia of young chicks. Clinical signs include sleepiness or drowsiness weakness, loss of appetite, chalky white diarrhoea and pasty vent with yolk color or whitish feces.

Fig: Whitish and yolk color droppings in salmonellosis in poultry.

Fig: Yolk mass found in the abdominal cavity and the liver became small with yolk color in pullorum disease infected bird.

For treatment, antibiotics such as Enrofloxacin can be given along with supportive therapy with multivitamin.

2. Fowl Typhoid: It is caused by Salmonella gallinerum and it is the most devastating disease for broiler chicks. Clinical signs: Chicks quietly become underweight, hurdling, prostration, dullness, feed dejection, etc. In postmortem the yolk sac turns larger than normal. The liver became enlarged,

congested, and in severe cases, it turns a greenish color in broiler chicks.

For treatment, antibiotics such as gentamicin, amikacin, Neomycin, are effective in salmonellosis in the broiler

Cephalosporins 1st- 3rd generation- cefradine, ceftriaxone, ceftiofur @ 10mg/ kg bodyweight successfully control salmonella infection in oral & parenteral route. Sulphanomide, tetracycline, broad-spectrum penicillin are totally resistant to Salmanelllosis.

C. Bumble Foot (Pododermatitis): This disease caused due to injury to the lower surface of the foot and subsequent infection with Staphylococcus bacteria.

Common causes of injury are rough perches, splinters, wire floors, poor litter or bedding, poor quality of floor.

Clinical signs include Lameness, Swelling of the foot pad, and hard, pus-filled abscess on foot pad.

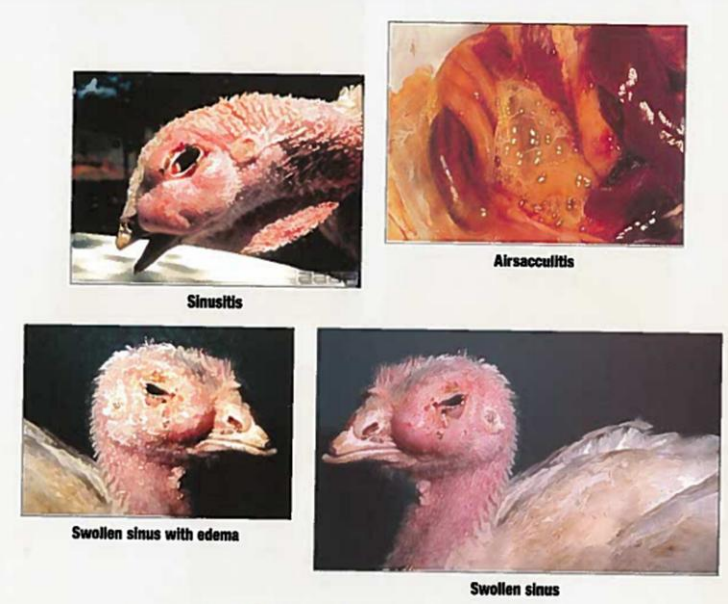
Treatment: Soak foot in warm water and Epsom salts (Magnesium sulphate). Disinfect with alcohol. If skin is open, drain pus from abscess. Flush abscess cavity with hydrogen peroxide to cleanout pus and debris. Pack the cavity with antibiotic ointment. Wrap the foot with gauze and elastic bandage. Repeat daily until foot heals.

For prevention and control, provide good quality litter or bedding, Keep bedding clean, dry, and deep, Keep perches less than 18 inches from the floor to prevent foot damage due to impact from jumping, Remove potential sources of injury such as sharp objects and/or surfaces.

D. Chronic Respiratory Disease (CRD): It is the most common disease in the broiler. It is caused by Mycoplasma gallisepticum which is gram-negative bacteria. CRD is seen in every weather condition but it is turned to severe in the winter season. There are two types of clinical signs are observed in the broiler:

Primarily, hacking cough without interruption in feeding & watering. There is no mortality that occurred.

Secondly, hacking cough with a reduction of feed & water, that might be Mycoplasma complicated with other gram-positive & gram-negative organisms.



In post mortem, the air sac found mildly dilated and drop bubble in the air sac. Besides, the air sac became congested, thickened, fibripurulant, yellowish plaque is seen in Complicated Chronic Respiratory infection.

Treatment: If the feeding & watering are normal, Just apply antimycoplasmal drugs like Tilmycosin, Erythromycin, Tylosin at recommended dosages with a gram-negative spectrum like florfenicol, neomycin sulfate, colistin sulfate at the oral route. On the other hand, if the starting mortality rate increased above drugs applied in both routes successfully control the infection in the broiler. If the decrease intake feed consumption, birds suffering from intestinal and caecal coccidiosis.

6.2. Common Parasitic Diseases

A. Coccidiosis: Coccidiosis is an intestinal disease caused by tiny parasites and is most frequently seen in young chicks during the monsoon when bedding stays damp. The most telling signs are bloody diarrhea, rapid weight loss, and birds appearing very dull or listless. The best prevention is to keep the floor litter bone-dry at all times, as wet floors are the primary cause of this parasite's growth.

B. Worms and External Pests: Internal parasites, such as roundworms and tapeworms, live inside the bird's gut and steal essential nutrients, causing the birds to look thin and weak even if they are eating well. External pests like lice and mites are tiny insects that live on the skin or feathers and suck the bird's blood, which can lead to a total stop in egg production. To manage these, farmers should follow a strict deworming schedule every three months and regularly inspect the birds' feathers for signs of lice or mites.

6.3 Recommended Vaccination Schedule for Poultry birds

To ensure your birds are fully protected from deadly diseases, follow this step-by-step vaccination timeline:

Age	Disease	Vaccine Strain	Dose	Route
Day 1	Marek's disease	HVT	As recommended	At hatchery
Day 5–7	Newcastle disease	Lasota	One drop	Eye drop
Day 14	Infectious Bursal Disease	Georgia	One drop	Oral

Day 21	Fowl pox	Fowl pox	0.20 ml	Subcutaneous
Day 28	Newcastle disease	Lasota	One drop	Eye drop
Week 9	Newcastle disease	R2B	0.5 ml	Subcutaneous
Week 12	Fowl pox (booster)	Fowl pox	0.20 ml	Subcutaneous

(Vaccines should be repeated at six-month intervals or as advised by veterinarians)

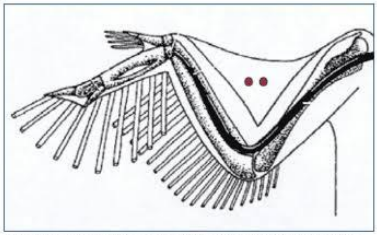


Figure 5. Proper location for wing web inoculation.

6.4. Essential Health and Biosecurity Rules for Poultry Farmers: Maintaining a healthy flock requires strict discipline and simple daily habits to prevent the entry and spread of germs.

6.4.1. Immediate Isolation and Care: The moment you observe a bird that appears dull, has drooping wings, or shows signs of strange diarrhea, you must isolate it immediately. Move the sick bird to a separate cage or area far away from the healthy flock to prevent the disease from spreading.

6.4.2. The 4-Hour Medication Rule: When adding medicine or vaccines to the drinking water, ensure the birds consume the medicated water within 4 hours to maintain the drug's effectiveness. To ensure they drink it quickly, you can temporarily remove waterers for an hour before treatment. Do not provide plain water until the medicated portion is completely finished.

6.4.3. Safe Disposal and Cleanliness: Properly disposing of dead birds is vital to stop the cycle of infection. You should bury dead birds deep in the ground covered with a layer of lime, or burn them completely. Never throw carcasses in the open, in fields, or into water bodies, as this can poison the environment and spread disease to other farms.

6.4.4. Managing Cannibalism (Debeaking): If you notice birds pecking at each other or causing injuries (cannibalism), the tip of the beak should be trimmed. This process, known as debeaking, must only be performed by a trained person to

ensure it is done humanely and correctly without causing excessive stress to the bird. Perform the **first debeaking at 31–42 days** and a **second between 13–16 weeks** only if cannibalism persists.

6.4.5. External Health: Controlling Pests and Parasites

- **Lice, Mites, and Ticks:** Regularly inspect your birds for external pests. If you see early signs of infestation, use **dusting or dipping** methods.
- **Safe Dipping:** Never dip birds on rainy days. When dipping, be very careful to prevent the medicated water from entering the bird's **eyes or nostrils**. Keeping the floor litter dry and the shed well-ventilated is the best way to prevent these pests.

6.4.6. Strengthening Biosecurity: Foot Baths: One of the most effective ways to keep germs out of your shed is to control what enters on your feet.

- The Foot Bath (Disinfectant Pit): A foot bath is a shallow tray or concrete pit placed at the entrance of the poultry house. Every person entering the shed must step into this solution to kill germs stuck to their shoes.

- How it Works: Shoes are the primary carriers of viruses (like Ranikhet) and bacteria from the outside world. A foot bath acts as a "chemical barrier" that neutralizes these threats before they touch your birds' bedding.
- Recommended Chemicals: * Potassium Permanganate (Lal Dawai): Use a mild 0.1% to 1% solution (the water should be light pink, not dark purple).
- Bleaching Powder: A mixture of 2-3% concentration is highly effective and affordable for farm entrances.
- Maintenance: The solution must be changed daily or whenever it becomes muddy, as dirty water loses its power to kill germs.

6.4.7. Visitor Control: Practice strict biosecurity by restricting visitors. People walking between different farms can carry diseases on their clothes and shoes. If someone must enter, ensure they use the foot bath and, if possible, provide them with a separate set of "shed-only" slippers.

6.4.8. Record Keeping and Monitoring

- **Culling:** Periodically remove (cull) sick or unproductive birds from the flock to save feed and prevent disease spread.

- **Maintenance:** Keep housing and equipment clean at all times.
- **Health Records:** Maintain a simple notebook to track **vaccination dates, deworming cycles, bird mortality, and daily egg production**. Accurate records are the best way to see if your farm is making a profit.

Conclusion: Maintaining a healthy poultry flock depends on a combination of timely vaccinations, strict biosecurity measures like foot baths, and the immediate isolation of sick birds. By keeping environment-dry and following a scientific deworming and record-keeping schedule, farmers can minimize mortality and maximize productivity. Ultimately, prevention through cleanliness and discipline is far more effective and affordable than attempting to treat an infected flock.

Chapter 7: Hatchery management

Egg is a biological structure meant for reproduction. It protects and provides complete nutrition to the developing embryo and serves as the principal source of food for the early chick. A fertile egg is obtained after successful mating of male and female birds. Such eggs are set for incubation, which refers to the efficient transition of a fertile egg into a live and healthy chick. Proper incubation and hatching practices, along with strict biosecurity measures, are essential for achieving optimum hatchability and quality chicks.

7.1. Types of incubation:

A. Natural Incubation

Natural incubation involves brooding of eggs by a broody hen using body heat as the natural source of warmth. A broody hen can incubate about 10–15 eggs in one cycle.

B. Artificial Incubation

Artificial incubation utilizes incubators and hatchers to maintain optimum temperature, humidity, ventilation, and egg turning for normal growth and development of the chick embryo.

7.2 Hatching Egg Production and Management

A. Collection of Eggs

Hatching eggs should be collected from nests or cages at least four times a day, which may be increased to five or six times during extreme weather conditions. Frequent collection helps reduce ontamination. Nesting materials should be absorbent, durable, porous, and economical, such as wood shavings, sawdust, rice husk, straw, dried sugarcane leaves, or shredded paper. Birds should be trained to lay eggs only in nests.

B. Transportation of Eggs

Eggs should be transported in plastic egg flats that allow maximum air circulation. Plastic flats are preferred over fibre flats. For long-distance transportation, egg boxes with ventilation holes may be used. Eggs should be protected from shaking and jerking during transit.

C. Egg Sanitation / Fumigation

Clean eggs can be sanitized using spray applications of warm disinfectant solutions that do not damage the cuticle. Dirty eggs may be gently cleaned using sandpaper. Quaternary ammonium compounds are effective sanitizers for hatching

eggs. Fumigation is the most effective sanitation method after receiving eggs in the hatchery. Hatching eggs may be fumigated at double concentration for 20 minutes, except during 24–96 hours of incubation. One-time concentration consists of 40 ml formalin and 20 g potassium permanganate per 1000 cubic feet of space.

D. Selection, Grading and Traying of Eggs

Eggs selected for hatching should be of standard breed size. Very small, oversized, misshapen, thin-shelled, porous, ridged, or dirty eggs should be rejected. A minimum egg weight of 50 g is recommended for quality chick production. Egg trays should match egg size, with separate trays for chicken, duck, and quail eggs.

F. Egg Storage in Cold Room

Selected eggs should be stored at 18.3°C (65°F) with 75–80% relative humidity to prevent embryonic development until setting. Eggs should preferably be stored for less than four days. For storage up to 7–10 days, temperature should be reduced to 13°C. Eggs from younger breeder flocks can be stored longer than those from older flocks.

Fig. Storage of eggs in cold room after fumigation, selection and grading

G. Warming of Eggs before Setting

Eggs should be removed from storage and kept at around 22°C (72°F) for 5–6 hours before setting. This prevents moisture condensation on the eggshell and reduces contamination risk. Warming eggs prior to incubation can improve hatchability by 1–2%.

G. Setting of Eggs and Transfer to Hatchers

Setting time should be adjusted according to chick supply schedule. For early morning chick delivery, eggs may be set between 5–6 PM.

7.3 Optimum incubation conditions are given below:

To ensure your chicken eggs hatch successfully, you must carefully manage the environment inside the incubator during two distinct stages.

During the First Stage (Days 1 to 18): The incubator temperature must be kept very steady between 99.5°F and 99.75°F with a moderate relative humidity of 50–60%. Throughout this period, it is vital to provide an adequate supply of fresh air and keep the eggs positioned with the large end facing up or placed horizontally. To prevent the developing chick from sticking to the shell, you must turn the eggs 6 to 8 times every day at a 90-degree angle.

During the Final Stage (Days 19 to 21): As the chicks prepare to hatch, the temperature should be slightly lowered to between 97°F and 99°F, but the relative humidity must be increased significantly to 75–80% to help soften the shell for easier pipping. You must continue to provide an adequate air supply and ensure the eggs are positioned with the large end up. Most importantly, you must stop turning the eggs during these final three days to allow the chick to position itself correctly for hatching.

Fig. Eggs in proper position in setter / inculbator and hatcher in hatchery of ICAR - CCARI

7.4 Incubation Period of Poultry Species

Species	Incubation period (days)	Transfer to hatcher (days)
Chicken	21	18–19
Duck	28	24–25
Turkey	28	24–25
Muscovy duck / Swan	35	30–31
Goose	28–34	25–26
Guinea fowl	26–28	24–25
Japanese quail / Pigeon	17	14–15
Peafowl	28–30	25–26
Ostrich	42	35–36
Emu	54	47–48

7.5 Candling of eggs: Candling should be done on the 7th–8th day and again on the 18th day of incubation to identify infertile eggs and dead embryos. This helps save space and energy. Eggs are examined under bright light to observe shell quality, air cell position, yolk movement, blood vessels, and embryo development. Transparent eggs indicate infertility, while opaque eggs indicate fertility. Individual or mass candlers may be used.

Fig. Candling of eggs at 7th day of incubation

7.6 Removal of Hatch: Chicks should be observed a few hours before pull-out time and removed when they are approximately 5% wet around the neck. After removal, chicks should be kept in a holding room at about 75°F temperature and 75% relative

humidity to prevent chilling and dehydration. Hatcher compartments should be thoroughly cleaned and fumigated after each hatch.

Fig. Removal of hatch in a farmer hatchery

7.7 Incubation and Hatching of Duck Eggs: The basic principles of incubation are similar to chicken eggs, but the incubation period for duck eggs is 28 days. Dirty eggs should

be properly cleaned and disinfected before fumigation. Duck eggs require higher humidity, about 86% during the first 25 days and 94% during the last 3 days of incubation. Warm water should be sprinkled on eggs from the second day until the 25th day. Eggs are turned at a 180° angle, unlike chicken eggs.

7.8 Biosecurity in Hatchery: Hatchery buildings should be located at least 500 feet away from poultry houses. Proper layout and physical separation of areas for personnel, egg receipt, egg storage, incubation, hatching, chick handling, equipment washing, waste disposal, and office space should be ensured. Eggs and chicks must move in a single direction without backtracking to prevent contamination.

7.9 Common Incubation Problems and Preventive Measures

Problems observed	Preventive measures
Clear eggs, enlarged germinal disc, no blood vessels	Store eggs <7 days, maintain proper storage temperature, ensure breeder flock is free from egg-borne infections, collect eggs frequently, maintain proper incubation temperature, avoid over-fumigation (especially 12–96 hrs)
Small embryo with blood ring	Proper egg handling, avoid prolonged storage, correct incubation temperature,

	ensure adequate breeder nutrition (Vit B2, B5, A, E, Cu, Boron)
Early embryonic death, yolk sac circulation present	Ensure proper ventilation and regular turning of eggs
Mid-incubation embryo mortality	Maintain correct temperature, humidity, turning, and ventilation
Late embryonic death (>18 days)	Maintain correct setter and hatcher temperature and humidity, prevent mould contamination, ensure good breeder nutrition and proper transfer management

Conclusion: Successful poultry production begins with the careful selection and scientific management of hatching eggs to ensure maximum hatchability. By maintaining precise temperature, humidity, and biosecurity protocols, farmers can ensure the efficient transition from fertile eggs to healthy, high-quality chicks. Adopting proper sanitation, candling, and storage techniques minimizes embryonic loss and prevents the spread of disease within the hatchery. Ultimately, integrating balanced breeder nutrition with modern incubation practices provides a sustainable foundation for a productive and profitable backyard poultry farm.

Chapter 8: Climate- adaptive practices for poultry

Poultry farming plays a critical role in supplying inexpensive protein and supporting livelihoods of millions of people throughout the world. However, having feathers and lack of sweat glands make them very vulnerable to the effects of climate change, which presents considerable challenges in sustaining and increasing poultry productivity. As the climate continues to change, with rising temperatures, shifting precipitation patterns, and more frequent extreme weather events, the poultry industry faces a complex set of challenges that must be addressed to ensure its long-term viability and resilience. One of the most immediate consequences of climate change on poultry production is rising ambient temperatures. Poultry, particularly hens, are extremely heat sensitive. Optimal temperature ranges are critical for the health and production of these birds. When temperatures rise above the comfort zone, which is normally between 18°C and 24°C, chickens undergo heat stress. This can result in decreased feed intake, slower growth rates, reduced egg production, and, in extreme situations, higher mortality. Heat stress also has an impact on the quality of poultry products, resulting in reduced meat quality and egg hatchability rates. These physiological stressors not only affect the economic efficiency of poultry

farms, but also have animal welfare implications. In addition to heat stress, variations in humidity levels caused by climate change can further exacerbate the issues that poultry growers face. High humidity, especially when combined with high temperatures, can create a conducive environment for the spread of diseases and parasites. Pathogens like avian influenza and Newcastle disease thrive in warm, humid environments, increasing the frequency of outbreaks that may destroy poultry populations and cause considerable economic losses. Furthermore, climate change might alter the geographical distribution of these diseases, potentially bringing them to new places that are unable to deal with such risks.

Managing heat stress in poultry

Key points:

- 10% extra floor space should be provided in summer.
- Overcrowding of birds should be avoided.
- Shifting, transportation and de-beaking should be done during night or cool hours of the day.
- Birds severely heat-stressed may be dipped in cold water for 2-3 minutes keeping their neck and head above water level.
- Provide proper cross ventilation.

- Fans (pedestal, ceiling or exhaust) may be fitted in sheds.
- Use foggers in the shed which could reduce the shed temperature up to 5-10oC depending upon quality.
- Use of paint, white lime etc. practically reduces the shed temperature up to 2oC
- Use side curtain in the shed which should be sprinkled with water.
- Provide 3 exhaust fans on one side and pad cooling on other side (200ft) which completely seals the shed sides and brings down temperature below 8oC.
- Use sprinklers on the top or inside shed.
- Surround the house with tall trees.
- Thatched roof is suitable for hot areas.
- House should be situated away from other buildings to facilitate free movement of air.
- High altitude of roof is ordinarily 2.6 to 3.3 m from foundation to the roof line to provide maximum ventilation.
- Provide one meter overhang to cut the direct sun and rain into the house.

Chickens should always have access to fresh, clean, cool water, especially in the summer heat. Provide multiple

water sources located in shady, cool areas to encourage hens to drink and wade. Add ice cubes, ice blocks, or frozen water bottles to keep water cool. Electrolyte mixes can be used. It's best to provide the mix in the chicken's water supply for only a few hours, then remove it and replace with fresh, plain water. Low sided dishes or pans will allow hot chickens to wade in and cool their feet, or high traffic areas can be temporarily flooded (provided the area will dry out fairly quickly). It is important to change open water daily to prevent coccidiosis from spreading. It is not uncommon to see extremely watery droppings during periods of high heat due to increased water consumption. This method, termed excretory heat loss, is one-way chickens are able to increase their capacity to cool themselves. Increase number of waterers by 25% and also frequency of watering. Provide electral energy (1-2 gm/liter) in water during hot hours/ Addition of 0.25% of salt to drinking water increases water consumption can be done. Incorporation of anti-stress vitamins like vitamin C in water should be advised in summer.

Management of poultry during heavy rainfall:

House preparation:

- The repair of poultry house in pre-monsoon and proper functional drainage system should be ready. The doors

should be closed and curtains be hanged to avoid entering of rain to shed causing wet of birds/litter or other associated problems.

- Proper ventilation and good litter practices should be provided to avoid accumulation of ammonia and other gases
- In heavy rainfall area like Goa, the floor should be raised with a generous roof overhang (4-5 feet), particularly over the entrance.
- For poultry houses of low-lying regions, measures should be taken to avoid water logging near houses, to keep the litter dry or remove the wet litter, preventive care against diseases particularly coccidiosis. Preferably, the birds should be transferred to a suitable place in covered vehicle if the situation demands.

Feeding and water management:

- Prevent the feed ingredients from getting wet, and the amount of feed should not be too much. The compound feed in the house should be placed on the platform above the ground to prevent the feed from regaining moisture. Energy rich sources like oil/fat should be added to the diet or level of other nutrients may be adjusted keeping the energy at same level.

- Contamination with mycotoxin is a crucial problem in high rainfall areas. Regular checking of feed storage area and feeders to avoid fungus contamination. Discard the fungus infested feed to avoid health issues.
- Purchase feed for an average of 15 days in small scale poultry feeding to prevent mycotoxin contamination. Fungal inhibitors and toxin absorbents can be premixed in feed with proper consultation with experts. Water sanitation can be done with 2gm of bleaching powder for 1000lt of drinking water for treating water. Avoid giving this with antibiotics and vaccines.

Litter management:

- Litter may get wet due to leakage/seepage of water/diarrhoea or excess salt consumption so proper recking and coarse material should be used.Wet litter condition should be prevented as it may lead to burnt/swell hock condition, E.coli infection, coccidiosis etc. Hence proper housing space or stocking density along with proper ventilation should be ensured.
- Wet litter can be prevented by frequent stirring of the litter. Super phosphate 7 kg per 100 sq.ft. floor space may be added into litter by stirring. Very little ammonia will be released when litter is kept below a pH of 7.0, but is rapid

at a pH of 8.0 or above. Phosphoric acid (1.9l/10.5ft²) and super phosphate (1.09kg/10.5ft²) are effective in controlling ammonia fumes of the litter.

- Insect proofing of the house may be required if litter is not taken care of properly.

Egg production:

- Less sunshine hours in rainy seasons reduced egg production, hence fluorescent lights may be given to make up the photoperiod upto 16 hr/day to sustain egg production.
- Immuno-modulators can be added in feed to boost the immunity and productivity

Health management:

- With rain comes many diseases also. So proper management, preventive care and deworming should be followed in time.
- Strict biosecurity measures like cleaning and disinfection of farm equipments and farm area with any standard disinfectant like bleaching powder/potassium permanganate, foot bath, separate clothing for working persons, rodent control and restricted entry for outsiders, vaccination and proper medication should be followed.

Poultry management during winter

1. Reduced hours of natural night causes reduced egg production in layers. Hence provision of artificial light in the laying shed to increase the total light period upto 16 hours is required.
2. In cold and hilly areas, provide side curtains without restricting proper ventilation (from sunset to sunrise in the next day) as birds naturally produce lot of moisture in breath and droppings.
3. The thickness of litter material in the deep litter poultry houses should be increased to six inches to provide warmth and insulation.
4. Balanced feed as per the feeding standard and ad lib fresh water should be given.
5. Increase the number of feeders or slightly increase the energy and protein content in the feed may be done for commercial broilers as it stimulates growth in winter. But care should be taken to avoid feed wastage.
6. Brooder room should be pre-heated a day before arrival of day-old chicks. Maintain the temp of the brooder house to 95ºF/35ºC during 1st wk of their life. Lower the temp each week by 5ºF/3ºC till it reaches 70ºF.

Observe the chicks in brooding, avoid hurdling by providing required warmth by bulbs/brooders.

7. Provide warm water to chicks during cool hours if necessary.

Chapter 9: Economics and Projects for Backyard Poultry

Requirements of good project

The bank officers also can assist in preparation of the scheme or filling in the prescribed application form. The scheme so formulated should be submitted to the nearest branch of bank. The bank will then examine the scheme for technical feasibility and economic viability.

A. Technical feasibility - this would briefly include:

(a) Suitability of climate and potentiality of the area

(b) Technical norms including schedule for replacement of flocks

(c) Facilities and infrastructure available

(d) Supply of inputs such as chicks, feed, equipments, medicines, vaccines etc.

(e) veterinary aid and disease diagnosis facilities within reach

(f) Marketing potential and demand

(g) Training/experience of the beneficiary

B. Financial viability - this would briefly include:

(a) Unit cost and loan requirement

(b) Input costs for chicks, feed, veterinary aid, labour and other overheads

(c) Output costs i.e. sale of broiler for meat, manure and other miscellaneous items.

(d) Calculation of annual gross surplus (income-expenditure)

(e) Cash flow analysis

(f) Repayment schedule i.e. repayment of principal loan amount and interest.

Other documents such as loan application forms, security aspects, margin money requirements etc. are also examined. A field visit to scheme area is undertaken for conducting techno-economic feasibility study for appraisal of the scheme.

Broiler farm on a bi-weekly batch system with 1000 birds per batch and with feed mill

Assumptions:

Sr. no.	Assumptions	Details
1.	Down time	**2 weeks**
2.	Rearing period	**6 weeks**
3.	Cost of poultry house construction	**Rs. 100/sq ft**
4.	Cost of other buildings construction	**Rs. 150/sq ft**
5.	Cost of equipment	**Rs. 10/bird**
6.	Cost of day-old broiler chicks	**Rs. 25/chick**

7.	Cost of medicine, vaccine, electricity, and litter etc.	**Rs. 4/bird**
8.	Extra chicks per batch provided	**2%**
9.	Mortality (other than extra chicks of 2%).	**3%**
10.	Average body weight at six weeks (market age)	**1.8 kg/bird**

I.	**Fixed Capital (Non-recurring expenditure):**		
	1)	Cost of construction of poultry house: @ Total floor space – 4000 sq. ft. (1sq.ft./bird; 1000 birds / batch; 4 batches (3 houses with birds + 1 house empty) @Rs. 100 / sq.ft. (4000x 100)	400000
	2)	Cost of construction of feed mill and store room @1,200 sq.ft.m @Rs.150 / sq.ft.(1200x150)	180000
	3)	Cost of bore well, water tank and rlated pipelines	50000

	4)	Cost of feed grinder (mini-type)	50000
	5)	Cost of equipment (feeder, waterers, platform weighing scale, brooders etc.) @ Rs.10 / bird for 3000 birds	30000
		Total fixed capital	**7,10,000**
II.	**Working Capital**		
	1)	Cost of chicks - 3 batches @ Rs.25 / chick	75,000
	2)	Cost of feed Average feed consumption by 3 batches (50% of total feed consumption up to 6 weeks, i.e.3.6 kg) – 1.8 kg / bird @ Rs. 18 / kg feed @ 3000 birds (1.8x3000x 18)	43,200
	3)	Cost of medicine, vaccine, electricity, litter etc. @ average cost for 3 batches (50% of total expense of Rs.4 / bird) – Rs.2 / bird @ 3000 birds (3000x2)	6,000
		Total working capital	**1,78,200**

Sr. No.	Particulars	Approx.
1	Average feed consumption up to market age	3.6 kg / bird (FCR-2)
2	Manure production	4 Kg / bird
3	Cost of feed	Rs.18/bird
4	Selling price of live chicken	Rs.50 / kg
5	Selling price of manure	Rs. 700 / tonne
6	Bank interest	12 % / annum
Total capital investment needed	**Fixed capital + working capital**	**Rs. 8,88,200/-**

III.	**Annual Recurring Expenditure:**		
	1)	Cost of day-old chicks @ 26 batches @Rs.10.50 / chick	Rs. 2,73,000
	2)	Cost of feed -26 batches	Rs. 7,48,800

		@ Rs.8 / kg feed (3.6x1000x8x26)	
	3)	Cost of medicine, vaccine, electricity, litter etc. - 26 batches @ Rs.4 / bird (26x1000x4)	Rs. 1,04,000
		Total annual recurring expenditure	**Rs. 21,33,000**

IV.	**Annual Returns:**		
	1)	By sale of live broilers @ 3% mortality (excluding free chicks of 2%) @1000 birds / batch @26 batches / year @ Rs.32 / kg live weight @ average bird weight – 1.8 kg (1000x0.97x26x32x1.8)	Rs. 14,52,672
	2)	By sale of manure @ 4 kg / bird @ Rs.700 / ton	Rs. 72,800

		@ 1000 birds / batch @ 26 batches / year (4x1000x26x0.7)	
		Total annual returns (Annual total gross income)	**Rs. 25,69,580/-**
		Gross profit per annum = Annual total gross income – total annual expenditure	**Rs. 4,36,580**
		Bank interest over capital investment (15% p.a.)	**0.12 x 8,88,200 = Rs. 106584**
		NET PROFIT PER YEAR = *Gross profit- Bank interest over capital investment - Depreciation cost*	**Rs. 4,36,580 – Rs. 106584- Rs. 35500**

Net profit = 2,94,496

Net profit/month = 2454133

Net profit per bird = 11.32

Bank loan repayment schedule (Rs. in lakhs):

Year	Gross receipts	Expenditure	Net surplus before loan repayment	bank loan
I	22,73,090	1886884.62	3,86,205	666150
II	25,69,580	2133000	4,36,580	532920
III	25,69,580	2133000	4,36,580	399690
IV	25,69,580	2133000	4,36,580	266460
V	25,69,580	2133000	4,36,580	133230

Year	Principal	Interest	Loan repaid	C.B. of bank loan	Net profit after loan repayment
I	133230	79938	213168	532920	1,73,037
II	133230	63950.4	197180.4	399690	2,39,400
III	133230	47962.8	181192.8	266460	2,55,387
IV	133230	31975.2	165205.2	133230	2,71,375
V	133230	15987.6	149217.6	0	2,87,362

***** The annual gross returns during first year will be Rs.13.49 only because returns were received from 23 batches instead of 26 batches as in subsequent years (Rs. 25,69,580 x 23 /26)

Kadknath Semi intensive Unit

Shed :- Cattle Shed any old structure with little changes

400 Day Old Chicks(₹ 30)

Separate male and female once visible. (Approx 200 Male :200 Female)

Once male bird weight 1 to1.25 kg sale them in local market.

Female birds will be reared for egg production

Kadkanth birds will start laying at 22 week onward

Feed required once egg production start (22-72 week)

90 gm/bird/day total feed required daily approx 18 kg

50 week =6300 kg @ ₹ 24 — **151200. 00**

Medicine

Per bird ₹ 5/- — **1000.00**

Per unit Expenditure ₹1,52,200.00

22-72 Week

Egg prod

One bird will lay 120 eggs @ **किंमत ₹ 10** — **₹ 2,40, 000.00**

200 birds will give 24000

Main Point here

72 week end each bird expected to attend 2 kg

190 bird weight 380 kg

380 kg X ₹ 100 = — **₹ 38,000.00**

5 % mortality

Gross Profit ₹2,78,000.00

₹ 2,78,000.00
– ₹ 1,52,000.00 =

फायदा ₹ 1,26,000.00

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Notes

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