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Technical Bulletin-32

Empowering Farm Women Through Rural Poultry Farming

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(ISO 9001:2008 Certified)
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Preface

Poultry eggs and meat with high quality nutrients and micronutrients provide food for good human nutrition. The importance of small scale poultry farming in rural areas has been recognized globally to alleviate poverty, hunger and malnutrition in developing countries. Rural poultry sector contributes to 21% of the total egg production in India. In the present scenario, most of the commercial poultry activity is concentrating in and around urban and peri-urban areas of the country. Presently 70% of the poultry products like eggs and meat are consumed in urban and semi-urban areas and their consumption in rural areas is very low due to limited availability and higher price. Small scale poultry farming has found special interest among rural people because of its simplicity of operation, minimal initial investment and ability to provide supplementary income in the shortest possible time. Rural women traditionally play an important role in family poultry farming and are often in control of the whole process. Rural poultry production represents an appropriate system to contribute to feeding the fast growing human populations and to provide income to poor small farmers, especially women. It offers advantages over other agricultural sectors and is an entry point for promoting gender balance in rural areas. Rural poultry farming with chicken varieties having better production potential than the native chickens is slowly developing into a viable and sustainable activity among the rural and tribal people for enhancing the nutritional and economic conditions. An attempt has been made in this bulletin to bring update and relevant information on different aspects of rural poultry production especially the varieties of rural poultry, gender equity through rural poultry production, housing and management, nutrition, health coverage and cost economics. It is expected that the compilation will be of much helpful for the extension functionaries, farming community preferably farm women and other stakeholders involved in poultry farming.

S. K. Srivastava
Director

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1. Rural Poultry Production in India: Need in the Present Context

Poultry keeping for commercial production of egg and meat is one of India's most innovative industries. Chicken rearing on large scale has achieved spectacular growth and is serving as the dependable source of animal protein for ever increasing human population. Chicken has also the unique distinction of the best converter of agricultural by products and nutritionally poor feedstuffs into high quality meat and egg. The success behind commercial poultry production in India is modernization of poultry production practices, import of pure lines/grandparent stocks, least-cost feed formulation, vaccines against major diseases, provision of essential health care and other input services, improved quality breeder management and private sector partnerships through contract broiler faming. The popularity of poultry meat is on the rise during the last three decades and is presently accounting for more than half of the total meat consumed in the country. However, the commercial poultry activity is concentrated to few pockets of the country and that to urban and peri-urban areas only. But the rural poultry sector remained unchanged. Adapting poultry farming in rural/tribal areas utilizing chicken varieties which demand low inputs in terms of nutrition and management and perform better is a potential tool to increase the availability of poultry products and economic status of the rural people.

The leading five states in poultry production in India are Andhra Pradesh, Tamil Nadu, Maharashtra, Haryana and West Bengal. The total egg production in the country was 1832 million numbers in the year 1950-51 and since then the production of egg continues to rise over the period. There was a steady increase in production of egg up to the year 1999-2000 and subsequently the egg production improved substantially and it reached to 88139 millions in 2016-17. The largest producer of egg is Andhra Pradesh which produces 32.0% of the total egg production in the country followed by Tamil Nadu that produces 17.1% of the egg production. The per capita availability of egg was 5 eggs per annum during the period 1950-51 to 69 eggs per annum in the year 2016-17. Considering 180 eggs requirement per person per year, there is still a deficit of 111 eggs to meet the requirement. Nearly 45% of the production of meat in India is contributed by poultry. Contract broiler farming (CBF) is playing a major role in the growth of the broiler sector, especially in structure, size and number of broiler farms in India. Of the total CBF across the country, it is estimated about 78 percent of CBF is concentrated in southern India. From the above data, it is very clear that poultry production is highly non-uniform in India and there is a greater scope for growth of poultry. Rural poultry sector contributes nearly 21% of the national egg production in India and is the most

neglected one. Poultry production in rural/backyard areas is one promising strategy to enhance the nutritional and economic conditions of population in these areas.

Feed is an important and critical input for the poultry industry as it costs around 70% of total production cost. Availability of feed resources could be one of the major constraints in the intensive poultry production in future as the area expansion for cultivation is limiting. Further the annual growth of agricultural production is far below the annual growth of poultry industry. Adaptation of rural poultry farming will certainly minimize the load on the availability of ingredients. Availability of eggs is highly non-uniform in different parts of the country primarily due to wide variation in the production levels. Much of the eggs produced are consumed by the urban population while the rural and tribal areas have little access to the eggs and meat produced from the industrial sources and the availability is very low. The present setup of marketing of the products (egg and meat) of intensive poultry production is predominantly catering the needs of urban areas. Just 25% population living in urban areas consumes about 75-80 % of eggs and poultry meat. Eggs and meat are to be transported to long distances and their cost rises by 20-30% in rural areas compared to the urban areas. Non-availability of poultry products and low purchasing power of the rural people devoid them of access to the highly nutritious products like egg and meat, thereby, resulting in malnutrition. The incidence of protein deficiency among the susceptible groups like children, women, pregnant mothers and aged people can be alleviated by adopting small scale poultry farming in back yards of rural households. In order to meet the rural demand for poultry eggs and meat it is imperative that production for the masses should catered by the mass scale adoption of poultry farming in rural areas using low input cost technologies.

Table1. Per capita meat availability in India

Meat source	**Kg**
Bovine	2.1
Sheep and Goat	0.7
Pig	0.4
Poultry	3.6
Others meat	0.1
Total	6.9

The rural people are practicing backyard poultry keeping since time immemorial in India and other Asian and African countries. Traditionally women are involved in

backyard poultry keeping. Poultry farming is an essential activity of the typical rural/tribal household system in India, touching their social, cultural and economic lives. Small and landless farmers as well as those belonging to weaker sections, including tribal and scheduled castes people traditionally keep local breeds for their subsistence. These birds forage and scavenge for their food in the back yards of human dwellings and provide eggs and meat at insignificant cost. They provide rich nutritional food and regular source of income for the rural / tribal poor. Generally desi birds are used for rearing in backyards in rural and tribal areas of the country. Though generally considered secondary to other agricultural activities by smallholder farmers, poultry production makes an important contribution to supplying local populations with additional income and high quality protein. Though the native chicken reared in the backyard contribute about 20% of the total egg production in India, their productivity is far below (55-65 eggs/year) than those reared under intensive farm conditions (330 eggs/year). The chicken varieties available are not suitable for this purpose as the production potential is very low. Therefore, the need arises to develop chicken varieties which can produce significantly better than native chickens and can survive and sustain under adverse climatic conditions utilizing minimum inputs in terms of nutrition, health care and management. While going for rural poultry production, it is essential to understand the local production system, their limitations and opportunities, the circumstances under which such traditional system came into existence and how they can be improved further.

Why Rural Poultry Production?

- ❖ Studies in neighbouring countries like China, Bangladesh and Sri lanka have shown that rural poultry farming has a useful role and is worth studying to take up appropriate steps to improve the productivity.
- ❖ Adoption of commercial exotic breeds in rural / backyard system of rearing is a difficult scenario because of the limited resources.
- ❖ The lack of basic infrastructure, compounded feed and proper health coverage still make, it a dream to go for organized poultry production in rural areas.
- ❖ A new avenue for poultry exports is also opening up as a result of the growing worldwide trend towards the consumption of eggs and meat from birds reared under free-range conditions. The demand for these products is largely from the developed countries and is rising steadily in response to the concern for animal welfare.

- ❖ Family poultry keeping can be done without leaving the homestead and does not usually conflict with the other duties of women. It promotes gender equity.

Advantages of Rural Poultry Farming

- ❖ It is easy to manage and handle.
- ❖ It needs minimal use of land, labor and capital.
- ❖ There is higher demand and higher price for eggs and birds of native fowl.
- ❖ It requires little intervention in rearing, the major intervention is in the areas of feed and water supplementation, over night housing and to a much lesser degree in health management.
- ❖ It can easily integrate with other agriculture, aquaculture and livestock farming.
- ❖ It can contribute to the village economy.
- ❖ The most important is women in rural areas can operate family poultry with maximum involvement.
- ❖ Rural poultry plays a significant role in the cultural life of rural people as a gift to visitors and relatives, as starting capital to youths and newly married maidens, as sacrificial offerings in traditional worship, as a potential source of employment and easy source of income for small scale farmers.
- ❖ The poultry products such as egg and meat are highly nutritious and the biological value of egg is very high. Poultry meat is low in fat and cholesterol and hence choice of health conscious people.
- ❖ Poultry farming in rural areas not only assures the availability of eggs and meat to cater the food need but also provides additional income. Thus has a potential to fight poverty and malnutrition and provide scope for high employment generation and solving gender issues in employment

Table 2. Comparative nutritive values of egg and other food stuffs

Foodstuffs	Biological value	PER*	NPU#	Chemical Score	Digestibility %
Egg	96	4.5	93	100	97
Milk	85	3.0	81	65	94
Meat	80	2.8	76	70	82
Chicken	82	2.9	78	71	85
Fish	85	3.0	72	70	85
Soybeans	64	2.0	54	57	73
Peas	56	1.6	45	42	72

*PER = Protein Efficiency Ratio, #NPU = Net Protein Utilization

India has a great potential for poultry production in the free range conditions and capturing a great share of the international market due to its varied agro-climatic conditions and vast expanse of flora in most parts. Free range birds reared by the farmers have the advantage of small body size, coloured plumage, broodiness to hatch chicks, adaptation to harsh climatic conditions and lower disease incidence. The good experiences of other South East Asian and African countries where the commercial poultry farming and village poultry farming are working simultaneously for improving local poultry production will aid as guiding forces for the Indian poultry industry to march ahead in this direction. There is a need for coexistence of rural and commercial poultry farming for sustaining the growth in poultry production and bridging the gaps in the supply chain of poultry products between rural and urban areas in the country. **Therefore, it is necessary to promote free range and backyard poultry farming in rural, tribal and underdeveloped areas of the country.**

2. Promoting Gender Equity through Rural Poultry Production

India is home to the fourth largest agriculture sector in the world with an estimated 180 million hectares of farmland. According to 2011 statistics, the average farm in India is about 1.5 acres, minuscule when compared the average of 50 hectares in France, 178 hectares in United States and 273 hectares in Canada. Women's involvement in agriculture is complex and diverse as they are involved in wide ranging activities in agriculture and at home unlike their male counterparts. In rural India, the percentage of women who depend on agriculture for their livelihood is as high as 84%. Women make up about 33% of cultivators and about 47% percent of agricultural labourers. These statistics do not account for work in livestock, fisheries and various other ancillary forms of food production in the country. India still faces a big challenge in job creation and maintenance of food security and women's role in farming is still inadequately acknowledged. In India traditional agriculture is still dominant as many farmers depend on livestock in crop production, for manure as fertilizers, and the use animal powered ploughs. It is estimated that 78% of India's economically active women are involved in agriculture. Across the poor farming communities care of animals is the women's domain, but not in the rich families. Poultry represent an important system to feed the fast growing human population of developing countries of South Asia and to provide income to poor small farmers, especially women.

The United Nations Food and Agriculture Organization (FAO, 2014) estimates that about 805 million people of the 7.3 billion people in the world, or one in nine, were suffering from chronic hunger or undernourishment, of which 791 million people are from the developing countries, representing 13.5 percent, or one in eight, of the population of developing countries. Poultry represent an important system to feed the fast growing human population of developing countries of South Asia and to provide income to poor small farmers, especially women. Increased production of poultry, both commercial and rural, is a vital contribution to food security at both the household and community levels. Rural poultry production continues to make a significant contribution to poverty alleviation and household food security in many developing countries. Village poultry production is ideally suited to rural areas where the conditions for a successful commercial poultry sector are rarely met. Indigenous poultry breeds are excellent scavengers, transforming feed resources considered unsuitable for human consumption into high quality products such as poultry meat and eggs. The ability of indigenous breeds to scavenge, to flee predators, to lay and hatch their own eggs and to contribute to pest control results in a production system that complements other farm activities without directly competing with humans for cereal crops. Village poultry are generally owned and managed by women and children and are often essential elements

of female-headed households. In spite of the rapid development of commercial poultry activities worldwide, it has been estimated that around 80 per cent of the global poultry population occurs in traditional family-based production systems and that the latter contribute up to 90 percent of the total poultry products in many countries.

Gender is defined by FAO as 'the relations between men and women, both perceptual and material. It describes the characteristics of men and women which are socially determined in contrast to biological differences. It means the socially constructed differences in roles and responsibilities assigned to women and men in a given culture and location. Gender is not determined biologically, as a result of sexual characteristics of either women or men, but is constructed socially. It is a central organizing principle of societies, and often governs the processes of production and reproduction, consumption and distribution. Despite this definition, gender is often misunderstood as being the promotion of women only. However, as we see from the FAO definition, gender issues focus on women and on the relationship between men and women, their roles, access to and control over resources, division of labour, interests and needs. Gender relations affect household security, family well-being, planning, production and many other aspects of life. Gender issues have, thus, become very important in the context of higher, inclusive and sustainable growth. The role of family poultry in poverty alleviation, food security and the promotion of gender equality in developing countries are well documented. Family poultry production represents an appropriate system to contribute to feeding the fast growing human populations and to provide income to poor small farmers, especially women.

Livestock and Poultry production in the rural areas is generally considered as a key asset for rural livelihoods. It offers advantages over other agricultural sectors and is an entry point for promoting gender balance in rural areas. This is because all household members have access to livestock and poultry and are involved in production, processing and marketing of these products. Rural women traditionally play an important role in poultry sector and are often in control of the whole process from feeding to marketing, which is not the case in production systems for other livestock species. Poultry is easy to manage, requires few external inputs, and enjoys good market demand and prices. Rural poultry keeping can be used to reduce poverty among women and children in rural areas. By increasing women's income, poultry farming also enhances women's social status and decision making power in the household. For women who stay at home, poultry enables them to (a) help the family in times of need, and have cash for emergencies; (b) save money for future investments; (c) obtain an income to provide for the needs of their children and the household; and (d) supplement the family's protein intake.

In developing countries nearly all families at the village level, even the poor and landless, are owners of poultry. Poultry are mainly owned and managed by women and are often essential elements of female-headed households. The role of family poultry in poverty alleviation, food security and the promotion of gender equality in developing countries are well documented. Family poultry production represents an appropriate system to contribute to feeding the fast growing human populations and to provide income to poor small farmers, especially women. It makes good use of locally available resources, requiring low inputs. Though generally considered secondary to other agricultural activities by smallholder farmers, poultry production makes an important contribution to supplying local populations with additional income and high quality protein. Poultry products can be sold or bartered to meet essential family needs such as medicine, clothes and school fees. Village chickens are active in pest control, provide manure, are required for special festivals and are essential for many traditional ceremonies. Feeding of backyard poultry is a good example of the recycling of household and farm waste. Women in particular devise innovative ways of using waste products.

The Bangladesh Poultry Development Model is a good example of how poultry can have an impact on the empowerment of the poorest women and on poverty reduction. The Department of Livestock Services and the Bangladesh Rural Advancement Committee developed a model for semi-scavenging poultry production during 1980s, based on women groups. The idea was to replicate large-scale commercial poultry production with service, production and consumer units, but bring it down to the village level where women groups would act as the production units. The main feature of the model was that the supply of inputs and services is turned into an income earning opportunity for poor people, carefully sequencing its components and ensuring appropriate linkages between various factors. The main components are the involvement of NGOs that have access to groups of very poor women, the provision by NGOs of micro-credit and training to help groups establish small, semi-scavenging, egg laying units, and special training for poultry workers, feed distributors and egg traders.

Rural women traditionally play an important role in poultry farming and are often in control of the whole process. In spite of considerable involvement and contributions, women's role in poultry production has often been underestimated, if not ignored. Access, control and management of resources empower women and lead to an overall positive impact on the welfare of the household. Involving women in poultry activity will not only increase their decision-making but also economic power within both the household and the community. The management, processing and marketing of poultry products generate more income than most of the activities women tend to be involved in, and bring benefits for the whole family. Owning, controlling and benefiting from

poultry production increases women's self-esteem and strengthens their role as producers and income generators within the household and in the community. Greater involvement of local Non-Government Organizations (NGO'S) and Self-Help-Groups (SHGs) amongst women needs to be encouraged by the government to promote rural poultry production.

Understanding and considering the gender roles in family poultry production is crucial to identifying the most appropriate approach when designing and implementing development activities. Despite regional differences in family poultry production, women generally undertake the day-to-day care and management of birds often with assistance from their children. Men usually construct night shelters, procure inputs and assist occasionally with the marketing of products.

There are a number of reasons for the key role played by women:

- Family poultry production requires little initial investment and generates quick and frequent returns. This model suits well the types of day-to-day expenditure of women.
- Family poultry keeping can be done without leaving the homestead and does not usually conflict with the other duties of women.
- In places where religious beliefs or societal norms require women to remain in their household compound or village, poultry keeping is a suitable income-generating activity.

Women are the backbone of marginal and small farm families in India, however, they remain relatively unattended. The ICAR-Central Institute for Women in Agriculture, Bhubaneswar is a unique institute in the world, working hard to ease the work of women and bring smile to their face. The scientists of the institute are undertaking research on issues affecting women and opportunities in agriculture. The institute is focusing on participatory action research in different technology based theme areas involving rural women to develop and test suitability of technologies for women and suggest for their refinement. Rural/ backyard poultry farming is an important tool for nutrition security, house hold income and empowering women. Traditionally women play an important role in backyard poultry farming. Understanding and considering the gender roles in family poultry production is crucial to identifying the most appropriate approach when designing and implementing development activities. The scientists are working hard to address these issues. In addition they are conducting training programmes on various aspects of rural poultry farming for updating the information and to maximize the profit out of it.

3. Nutritive Value of Poultry Egg and Meat

Poultry egg and meat are important animal protein sources and essential in providing balanced diets for nutrition and health. It is estimated that animal protein consumption per capita per day in India is 10.8g compared to the World's average of 29g. Based on health requirement, it is essential to have 20g animal protein in the human diet. The poultry industry throughout world is mainly confined to chicken and major contribution to World's egg production is hen egg.

Nutritive Value of Egg

Poultry eggs are considered as a wholesome food because of its excellent nutritious properties. It is an excellent source of high quality protein, vitamins and trace minerals. Eggs are classified in the protein food group with meat, poultry, and fish. Egg contains 44 out of the 45 essential nutrients for the human body. Although, egg is a multi functional food with superior nutritional quality, it is available at a relatively lower price. Thus, egg is within the reach of poor people. Availability, lower cost, ease of preparation and good taste give eggs a deserved place in diets of humans.

Eggs are composed of mainly three parts: shell, albumen and yolk. Egg contains 70- 74% water. However, they have four major nutritional components: proteins (12 - 13%), lipids (11-12%), all necessary vitamins (except vitamin C), and minerals. Hens' egg contains 73.6% water, 12.8% proteins and 11.8% lipid. Egg proteins consist of an ideal balance of nutritionally indispensable amino acids. An egg will supply about 6.9g wholesome protein of the highest biological value (94). Egg proteins are distributed in both yolk and albumen and are nutritionally complete proteins. An egg provides about 6 g fat. Egg yolk contains triglycerides, phospholipids, and sterols. Hen eggs are a rich source of linoleic acid, which is essential in human nutrition. The hen egg is also a useful food as a source of minerals and vitamins. Eggs are valuable and readily acceptable in diets for the elderly people who may have low caloric needs but have greater difficulty in digesting and absorbing nutrients. Eggs are easily digested and absorbed to provide several essential nutrients. Thus egg yolk is considered a potentially important source of energy.

Table 3. Composition of edible portions of egg from different species

Constituents	Chicken	Duck	Turkey	Quail
Water	73.6	69.7	72.6	73.7
Solids	26.4	30.3	27.4	26.3
Organic matter	25.6	29.3	26.6	25.2
Proteins	12.8	13.7	13.1	13.2
Lipids	11.8	14.4	11.8	11.0
Carbohydrates	1.0	1.2	1.7	1.0
Inorganic matter	0.8	1.0	0.8	1.1

Nutritive Value of Poultry meat

Poultry meat is well accepted, relatively cheaper natural food and a valuable source of nutrients for human being. Nutritionally poultry meat is a valuable source of proteins, vitamins and minerals and has a relatively low fat content (Table 5). The protein content of chicken meat is about 22% with a biological value of 79. The fat content of cooked chicken varies depending on whether it is cooked with the skin on or off, the portion of the bird, and the bird's diet and breed. Breast meat contains less than 1 g fat/100 g. An average value for dark meat (skin off) is 3 to 5g/100 g. About half of the fat from chicken meat is made up of the desirable monounsaturated fats, and only one-third of the less healthy saturated fats. The poultry meat and meat products are good source of many B-group vitamins which only occur naturally in animal foods and cover a significant part of recommended daily intake. Poultry meat is also important source of bioactive compounds such as carnosine, anserine and L-carnitine. Poultry meat is low in sodium (<80 mg/100g) and contains minerals like potassium, magnesium, zinc, iron and selenium that are easily absorbed in significant amounts. Poultry meat is tender due to less connective tissue and requires less cooking, hence retain more nutrients. Poultry meat has less bone and cartilage and more muscle and adipose tissue with higher nutritional value.

Table 4. Composition of chicken meat (without skin)

Nutrients	(%)
Water	75
Protein	20
Fat	3
Ash	1-2
Energy (kcal/100g)	115

Poultry egg and meat: Contribution to Human Nutrition

Humans need a wide range of nutrients to lead a healthy and active life. The required amount of nutrients for different physiological groups can only be derived from a well balanced diet. Therefore, the components of the diet must be chosen judiciously to provide all the nutrients to meet the human requirements in proper proportions for various physiological activities. The amount of each nutrient needed for an individual depends on several factors like age, body weight, physiological status and activity. Adult humans need nutrients for maintenance of constant body weight and for ensuring proper body function. Infants and young children grow rapidly and require nutrients for maintenance and growth. The nutrients requirement of young is relatively more (2-3 times) per kg body weight than adults. In physiological conditions like pregnancy and lactation, adult woman needs additional nutrients to meet the demand for foetal growth and maternal tissue expansion in pregnancy and milk secretion during lactation. The body needs energy for maintaining body temperature and metabolic activity and for supporting physical work and growth. Dietary proteins provide amino acids for the synthesis of body proteins, both structural proteins and biologically active enzymes and other biologically important nitrogenous compounds in the body. Dietary fat (lipids) provides energy and essential fatty acids, serves as a vehicle for fat-soluble vitamins and facilitates their absorption. Since fat provides high energy value (9 kcal or 37.7kJ/g) as compared to carbohydrates or proteins (4 kcal or 16.7 kJ/ g), the fat content of a diet contributes significantly to its caloric density. Vitamins are required for carrying out many vital functions of the body and many of them are involved in the utilization of the major nutrients like proteins, fat and carbohydrates. Although, they are needed in small amounts, essential for health and well being of the body. Minerals are required for maintenance and integrity of skin, hair, blood and soft tissues in the body. They also help in maintaining acid base balance, nerve cell transmission, enzyme and hormone activity as well as blood clotting process.

A balanced diet is one which provides all the nutrients in required amounts and proper proportions. The major food and nutritional issues of concern in India are insufficient or imbalanced intake of nutrients. Extensive diet surveys carried out in different part of India (rural and urban areas) indicate that diets are predominantly based on cereals. Diets of poor income groups are deficient in several nutrients, namely; energy, vitamin A, calcium, riboflavin and iron. Dietary deficiency of these nutrients occurs more frequently and to a greater degree among children, pregnant and lactating women whose nutrients requirement is higher. The common nutritional problems of

public health importance in India are low birth weight, protein energy malnutrition in preschool children, chronic energy deficiency in adults, micronutrient deficiencies like vitamin A, iron, iodine, vitamin B-complex etc. A large segment of population suffers from nutritional anemia which is more prevalent among pregnant women. Iodine deficiency disorders are very common in large sections of population in several parts of the country. Hence there is a need for nutritionally adequate diet balanced with all essential nutrients to ensure nutritional adequacy of these people. The cereal based diet have to be supplemented with food items like pulses, vegetables, fruits, animal products including milk, meat and egg to make the diet more balanced and adequate in all nutrients.

Table 5. Contribution of nutrients to RDA through consumption of one hen egg per day

Group	Category	B. wt (kg)	Protein	%RDA	Energy	%RDA	Calcium	%RDA	Vitamin	%RDA
Man	Sedentary work	60	60	11.5	2320	3.6	600	4.5	600	30
	Moderate work	60	60	11.5	2730	3.1	600	4.5	600	30
	Heavy work	60	60	11.5	3490	2.4	600	4.5	600	30
Woman	Sedentary work	55	55	12.5	1900	4.4	600	4.5	600	30
	Moderate work	55	55	12.5	2330	3.6	600	4.5	600	30
	Heavy work	55	55	12.5	2850	2.9	600	4.5	600	30
	Pregnant woman	55	82.2	8.4	+350		1200	2.25	800	22.5
	Lactating woman (0-6 months)	55	77.9	8.9	+600		1200	2.25	950	18.9
	Lactating woman (6-12 months	55	70.2	9.8	+520		1200	2.25	950	18.9
Children	1-3 years	12.9	16.7	41.3	1060	7.9	600	4.5	400	45
	4-6 years	18.0	20.1	34.3	1350	6.2	600	4.5	400	45
	7-9 years	25.1	29.5	23.3	1690	4.9	600	4.5	600	30
Boys	10-12 years	34.3	39.9	20.1	2190	3.8	800	3.4	600	30
	13-15 years	47.6	54.3	12.7	2750	3.1	800	3.4	600	30
	15-17 years	55.4	61.5	11.2	3020	2.8	800	3.4	600	30
Girls	10-12 years	35.0	40.4	17.1	2010	4.2	800	3.4	600	30
	13-15 years	46.6	51.9	13.4	2330	3.6	800	3.4	600	30
	16-17 years	52.1	55.5	12.4	2440	3.4	800	3.4	600	30

RDA- Recommended Dietary Allowance

Table 6. Contribution of nutrients to RDA through consumption of 100g poultry meat /day

Group	Category	B. wt (kg)	Protein (g)	%RDA	Energy (kcal)	%RDA	Iron (mg)	%RDA	Zinc (mg)	%RDA
Man	Sedentary work	60	60	33.3	2320	5.0	17	5.9	12	10
	Moderate work	60	60	33.3	2730	4.2	17	5.9	12	10
	Heavy work	60	60	33.3	3490	3.4	17	5.9	12	10
Woman	Sedentary work	55	55	36.4	1900	6.0	21	4.8	10	12
	Moderate work	55	55	36.4	2330	4.9	21	4.8	10	12
	Heavy work	55	55	36.4	2850	4.0	21	4.8	10	12
Boys	10-12 years	34.3	39.9	50.1	2190	5.3	21	4.8	7.8	15.4
	13-15 years	47.6	54.3	36.8	2750	4.2	32	3.2	6.4	18.8
	15-17 years	55.4	61.5	32.5	3020	3.8	28	3.6	5.8	20.7
Girls	10-12 years	35.0	40.4	57.1	2010	5.7	27	3.7	7.8	15.4
	13-15 years	46.6	51.9	38.5	2330	4.9	27	3.7	6.4	18.8
	16-17 years	52.1	55.5	36.0	2440	4.7	26	3.8	5.8	20.7

RDA- Recommended Dietary Allowance

4. Chicken Varieties Suitable for Rural Poultry Farming

Realizing the importance of rural poultry farming in India, research efforts were initiated in the past at ICAR Institutes and SAUs for developing suitable chicken varieties for rural farming. These chicken varieties developed have multicoloured plumage and resemble the native chicken in their feather pattern, produce more meat and eggs than the natives. Due to these advantages the improved varieties of birds gained wider acceptability across the country. Some of the chicken varieties developed for rural poultry farming are given in Table.

Table 7 : Chicken varieties developed for rural poultry production

Variety	Type	Developing agency
Giriraja	Dual	KVAFSU, B angalore
Girirani	Egg	KVAFSU, Bangalore
Swarnadhara	Egg	KVAFSU, Bangalore
Vanaraja	Dual	ICAR-DPR, Hyderabad
Gramapriya	Egg	ICAR-DPR, Hyderabad
Krishibro	Meat	ICAR-DPR, Hyderabad
Srinidhi	Dual	ICAR-DPR, Hyderabad
CARl Debendra	Dual	ICAR-CARI, Izatnagar
CARIBRO Dhanraja	Meat	ICAR-CARI, Izatnagar
CARI Nirbheek	Egg	ICAR-CARI, Izatnagar
CARI Shyama	Egg	ICAR-CARI, Izatnagar
Upcari	Dual	CARI, Izatnagar
Hitcari	Dual	CARI, Izatnagar
Krishna J	Egg	JNKVV, Jabalpur
Narmadanidhi	Dual	JNKVV, Jabalpur
Nandanam IV	Dual	TANUVAS, Chennai
Gramalakshmi	Egg	KAU, Kerala
Kalinga Brown	Egg	CPDO, Bhubaneswar
Rajasree	Egg	SVVU, Hyderabad
Nicrorock	Dual	ICAR-CIARI, Portblair
Nishibari	Dual	ICAR-CIARI, Portblair
Jharsim	Dual	BAU, Ranchi
Himsamridhi	Egg	CSKHPKV Palampur

1. Vanaraja- Dual purpose bird for backyard poultry

Parameters	Performance
Day old chick weight (g)	42
Six week body weight (g)	640
Male body weight at 12 weeks (kg)	1.8-2.0
Age at sexual maturity (days)	175-180
Annual egg production in backyar ds (72 weeks)	110-120
Average egg weight at 40 weeks (g)	54-56
Colour of egg	Brown
Survivability up to 6 weeks (%)	98

2. Gramapriya- Egg type chicken for backyard poultry

Parameters	Performance
Day old chick weight (g)	36
Six week body weight (g)	420
Age at sexual maturity (days)	165-170
Average egg weight at 40 weeks (g)	53-55
Annual egg production in backyards (72 weeks)	180-200
Egg colour	Brown
Survivability up to 8 weeks (%)	98

3. Srinidhi - Dual propose bird for rural poultry production

Parameters	Performance
Day old chick weight (g)	48
Six week body weight (g)	600-650
Age at sexual maturity (days)	152
Average egg weight at 40 weeks (g)	54-55
Annual egg production	220-230
Survivability up to 6 weeks (%)	95

4. CARl Debendra- dual-purpose bird

Parameters	Performance
Body weight at 8 weeks	1100-1200 g
Body weight at 10 weeks	1400 to 1500 g
Body weight at 12 weeks	1700 to 1800 g
Feed conversion ratio (0-8 week)	2.5-2.6
Age at sexual maturity	155 - 160 days
Annual Egg production no.	190-200
Livability (Growing)(%)	94

5. Krishibro - Coloured broiler for rural poultry

Parameters	Performance
Day old chick weight (g)	40-42
Six week body weight (g)	1400-1600
Eight week body weight (g)	2000-2200
Feed	Broiler ration
Feed conversion ratio (6 wks)	2 : 1
Survivability up to 6 weeks (%)	96

5. Rural Poultry Housing and Management

Housing of birds is necessary to protect them from sun, wind, rain, cold and predators. Suitable housing is a prerequisite for profitable poultry production.

Systems of poultry production

Usually poultry are reared in three systems such as free range, semi intensive and intensive.

1. **Free-range:** In the free-range system, birds are allowed free to roam for scavenging with provision for night shelter. The birds are let out for foraging during day time while in night they are provided shelter. Small number of birds (10-20) can be reared under this system and this is suitable for backyard poultry farming. This system is most common in rural areas.

2. **Semi Intensive:** Under this system birds are reared partially in confinement and partially free range with the scavenged feed accounting for a substantial part of the total feed consumed. This system of production is suitable for rural poultry farming when limited numbers of birds (30-40) are kept for rearing.

3. **Intensive System:** This system is suitable for commercial poultry production. In this system of production birds are confined entirely to the poultry shed. This system is most efficient, convenient and economical as compared to other systems. The intensive system of housing can be broadly categorized into **Cage system** (conventional cages, reverse cages, colony cages and California cages) and **Floor system** (Deep litter, litter and slat, litter and wire, all slat and all wire). Some of the housing conditions usually followed for rearing of birds are described below.

    - **Deep litter:** In this system birds are reared on litter floor with bedding materials spread on the floor to a depth of 10-12 cm. Bedding materials such as paddy husk, saw dust, dried leaves etc., can be used. By and large broilers and broiler breeders are reared in deep litter system. The system is most appropriate for farmers rearing poultry under tropical climate where birds have to face all extremes of weather. Deep litter system is also convenient to the farmers who feel difficulty for paying high initial cost of cages.

    - **Cage rearing:** This is the most efficient poultry housing system. In cage rearing birds are reared in metallic cages and stocking density in cage

rearing is higher than the deep litter system of rearing. Cage system of keeping poultry is quite good for areas where the climate is moderate throughout the year. The Cage system of rearing is most popular in India and commercial laying hens and breeders (layers and broilers) are reared in this system of housing.

Cage rearing

- **Slat and litter house:** In this type of house the floor is partly covered with slats and partly with litter material. These types of house have advantages of deep litter system of house and all slat houses. This system is used for meat-type breeders.
- **All slat house:** In this system the house floor is entirely of slat type and fecal material is accumulated beneath the slat.

Conventional poultry house

Poultry House

If the birds are reared under free range or semi intensive system of rearing, then birds are to be provided place for night shelter. The night shelter house can be made of bamboo, wood earth with minimum expenditure. There should be provision of clean drinking waters inside the house during night time. When birds are reared under intensive system of production, construction of poultry house is essential. The site for construction of poultry houses should be selected preferably in elevated areas with good drainage facility. Availability of the basic infrastructure facilities such as water, electricity and access to roads must be taken into account. The orientation of the houses should be in east-west direction to avoid direct sun light, draft and rainfall into the building.

The poultry houses are preferably constructed on elevated areas with a plinth of 0.6 - 0.9 m to keep the floor above the ground level in order to avoid seepage of moisture from surrounding of the houses. The floor of poultry houses must be pucca and free from cracks, rat proof and rain proof, easy to clean and disinfect. The height of the poultry house at sidewall should be 2.2 to 2.4 m and 3.0 to 3.2 m at the centre to provide slope on either side. The roofing materials like tins, asbestos sheets, tiles or thatches may be used for construction. The overhang of roof should be sufficient (1 to 1.2 m) to offer full protection from sun and rain. For small scale intensive poultry farming, low cost housing utilizing locally available construction materials like bamboo, wooden planks, thatch, grass, etc. may be used and housing system should be economical and safe.

The management of the chicken from day-old to the production level in terms of egg and meat are manifold. Effective and strict management techniques are required for the birds to exhibit their production potential. This starts right from the arrival of the day old chicks at the farm and continue till the last day prior to disposal of the bird from the farm at the end of production cycle. As such managemental programme can be divided into three stages as given below.

- ❖ Chick Management (0-6/8 weeks)
- ❖ Grower Management (7/9-18 weeks)
- ❖ Adult (Layer) Management (19-72 weeks)

Irrespective of the system of poultry production, birds need brooding during the initial four to six weeks age. In the rural/backyard system of poultry production, the young chicks also need brooding at least up to 4 weeks of age, usually called nursery management after which they are let out for free range farming. The brooder house

where young chicks are grown up to 4 - 6 weeks of age should be constructed with 1/3rd portion of the side wall made up of solid material from floor level and remaining 2/3rd portion may be fitted with chicken mesh (wire-netting) for open air ventilation. For broilers reared on deep litter system, half of sidewall of the houses should be constructed with bricks and another half with wire netting. The width of poultry house may not exceed 9 m (30 feet) to have effective cross ventilation and length of the house may be as per the requirement. For proper ventilation, distance between two houses for the birds of the same age group should be a minimum of 15-20 m. The brooder and grower houses should be completely isolated from layer houses. All in-All out brooding and growing reduces the risk of poultry diseases.

Brooding Management

The baby chicks cannot maintain their body temperature due to lack of well developed body feathers to conserve body heat, therefore, heat is provided to maintain their body temperature. The management and care of baby chicks till 4 to 6 weeks of age is known as brooding. This is the most critical period in the rearing of chicken as proper brooding management is essential in achieving desired growth and preventing mortality of chicks.

There are two types of brooding such as natural and artificial.

1. Natural Brooding: In the natural brooding, the hen, which incubates and hatches out chicks, broods the chick. A broody hen can brood around 10-12 chicks comfortably. The broody hen takes out newly hatched chicks in daytime for foraging of food. During night time they are provided brooding nest and protection from predators. This system is commonly practiced in backyard poultry farming.

2. Artificial Brooding: When the chicks are reared separately from their mothers, artificial source of heat is used to provide heat to maintain their body temperature. The temperature at brooder during first week of brooding period is 35^{o}C, which is subsequently reduced by 2.8^{o}C per week during each successive week till it reaches 21^{o}C. After the sixth week brooders are not necessary unless and until the environmental temperature is too low. The source of artificial heat used may be electricity, wood, gas, sawdust, kerosene, and infrared light depending on type of brooder used.

Preparation of Brooder House

- The brooder house should be thoroughly cleaned and disinfected much before the placement of chicks.

- All movable equipments like brooders, waterers, feeders, etc. should be removed from the shed and should also be cleaned thoroughly in water and disinfected well.
- The interior and exterior of the house should be cleaned using a pressure sprayer with hot water and again with disinfectant solution and should be kept vacant for a minimum period of 2 to 4 weeks.
- The house must be fumigated overnight, 24 hours before housing chicks and should be ventilated it at least for 3-4 hours to remove traces of poisonous gas.
- One day before arrival of chicks, set the heating system at 32 - 35°C at chick level for floor brooding. Spread adequate bedding material such as dried sawdust, rice husk or wood shavings on floor with 5-10 cm thickness. Check the water system and adjust to proper height for chicks. The temperature inside the brooder house should be approximately 10°C less than the brooder temperature.
- On the day of arrival of chicks, arrange waterers, feeders, etc. in wheel-spoke pattern around brooder for easy accessibility of feeder and waterers by baby chicks. Fill the waters with clean water and on placing chicks, trigger water cups to encourage drinking. Check the brooder temperature. Feed or maize grit has to be sprinkled on papers for feeding of chicks in initial stages and subsequently provide the feed (mash/crumble) in the feeder. Provide adequate light continuously during the first two days.
- Supplement electrolytes/antibiotics in drinking water to reduce transportation or environmental stress and also to reduce early chick mortality.
- During the initial 7 days, news paper may be spread over the litter material to prevent accidental intake of litter material by the chicks. Remove the top layer of paper daily to clean, turn it upside down after 3 or 4 days and remove it altogether after 7 days.
- About 50 – 66 cm^2 space per chick under brooder is recommended. A hover of 1.8 m diameter can hold 500 chicks.

Important Tips

- Poultry diseases are highly contagious. All in all out system helps in the control and prevention of disease.
- A foot-bath containing disinfectant solution should be provided at the entrance of the house.

- ❖ The movement of workers and equipments from building to building in the farm premises should be restricted. Visitors to the farm should be restricted.
- ❖ The litter material to be used should be inexpensive, light in weight, should have medium particle size, be highly absorbent, should dry rapidly, be soft and compressible.
- ❖ The bedding materials should be stirred at frequent intervals to prevent caking. Mouldy litter materials should not be used. Wet litters, if any should be replaced immediately by dry litters to prevent ammonia odour.
- ❖ The brooders should be switched at least 12 hours before the arrival of the chicks. The brooder temperature during the first week should be 35°C.
- ❖ The brooding equipments should be spaced around the hover like the spokes of a wheel to offer all chicks equal opportunity for warmth, feed and water.

Brooder Guard: Also known as chick guard is a barrier provided around brooder to prevent the straying away of baby chicks from source of heat, feed and water and to prevent floor drafts. A cardboard or metal sheet of 0.40 to 0.45 m height placed in circular manner at a distance of 0.85 to 0.90 m from the edge of brooder acts as brooder guard. The type of the brooder will determine the distance; the guards should be from the edge of the hover. But normally the distance should be about 0.75 m in winter and 0.90 in summer. For the first two days, fed is sprinkled on the paper and after which feeders are provided. Usually brooder guard is removed after 7-14 days. The feeders and waterers are arranged in cartwheel manner so that chick needs not to walk long distance to access feed and water.

Floor Brooding: The chicks are reared on deep litter in floor brooding and there are two types of floor brooding such as **Incandescent bulbs brooding** in which incandescent bulbs of 40 to 100 watts are used and canopy is required to preserve the heat in brooding area and **Infrared bulb brooding** in which infra-red and white bulbs of 150 or 250 Watts for 75 to 90, and 125 to 150 chicks respectively are used. Usually there is no need for canopy to preserve the heat since the materials or chicks get heated which directly come in contact with the infrared rays. Floor brooding is recommended for rural poultry farming.

Brooding Temperature: The brooding temperature is regulated by adjusting the height of hover or with the number of bulbs, but a minimum clearing space of 12 to 15 cm above the chicks is recommended. The brooding temperature during first week of brooding

period is 35°C, which is subsequently reduced by 2.8°C per week during each successive week till it reaches 21°C. The suggested brooding temperature for chicks is given in Table 1.

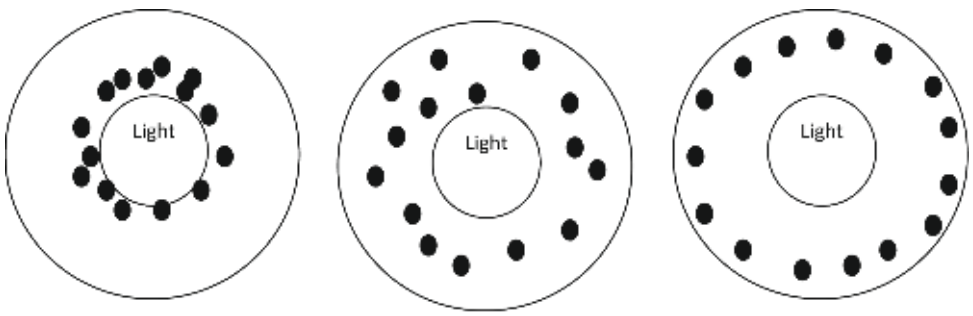
Table 8. Brooder temperature for chicks

Age of chicks (wk)	Brooder temperature (°C)
1	35
2	32.2
3	29.4
4	26.6
5	23.8
6	21

The correct brooding temperature is known by the behavior of the chicks. Under ideal temperature, the chicks will be uniformly spread under the hover of the brooder. If the hover temperature is higher they will be away from the hover. On the other hand, when the hover temperature is lower, the chicks will huddle together.

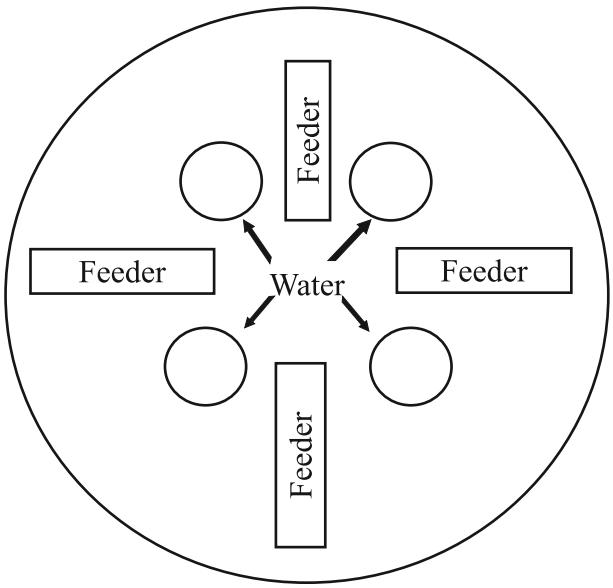
Table 9. Optimum floor, feeder and water space per bird at various stages of growth in deep litter system of rearing for layers

S. No.	Particulars	Floor-space (cm^2)	Feeder space (cm)	Water-space (cm)
1	Brooding period (0-8 weeks)	450	2 - 7	0.5 - 1.5
2	Growing period (8-18 weeks)	900-1900	7 - 10	1.5 - 2.5
3	Laying period (above18 weeks)	1800-2200	12 - 15	2.5

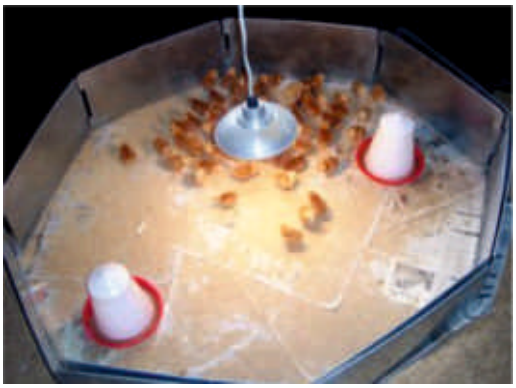


Low temperature Right temperature High temperature

Brooding behavior of chicks with varying temperature conditions



Feeder and waterer arrangements around the brooder



6. Feeding Management

Irrespective of the system of production, a regular supply of low cost feed over and above maintenance requirements is essential for sustaining performance in poultry. The productivity of the birds under extensive system ultimately depends on the human population and its household waste and crop residues, and on the availability of other scavengable feed resources (household cooking waste; cereal and cereal by-products; roots and tubers; oilseeds and its byproducts, insects, worms etc.). Under the free-range and backyard systems, feed supplies during the dry season are usually inadequate for sustaining production. When vegetation is dry and fibrous, the scavenging resources should be supplemented with sources of minerals, vitamins, protein and energy. Under most traditional village systems, a grain supplement of about 35 g per hen per day is given. Under the semi-intensive system, the birds meet part of its requirement through scavenging and rest of the nutrients required by the birds must be provided in the feed, usually in the form of a balanced feed. The feed for birds should be made at a cheaper cost utilizing the locally available feed resources like grain by products, oilseed by products and unconventional feedstuffs and may not necessarily be a balanced one. Calcium must be supplemented in the feed of laying hens. Under the intensive system of production the feed must be of good quality and should contain adequate nutrients to express the genetic potential of the birds.

In poultry, feed accounts for 65-70% of total cost of production. Therefore, feeding of adequate amount of balanced and wholesome feed is important for optimum production. Feed should be formulated to contain optimum nutrient concentration obtainable at reasonable cost for maximum growth, production and efficiency of feed utilization. For the preparation of balanced and economic feed detailed knowledge on the nutrient contents and availability in the feed ingredients used to formulate the diet is a basic requirement. The objective of feed manufacturing is to produce feed that should meet the intended specifications both in nutritional composition, palatability, and desired medication level and should be free of contaminants. Therefore, the poultry farmers should have a comprehensive knowledge about the different feed ingredients that are used as poultry feed. Several feed ingredients are mixed together to provide nutrients in the diet at levels required by the birds. Some feed ingredients are employed for providing only a particular nutrients, while others provide only more than one nutrients. The feed ingredients are mainly divided into four groups such as energy feed, proteins supplements, mineral supplements and vitamin supplements.

Nutrients are essential for maintenance, growth, health and reproductive process of the body. Poultry also require continuous supply of nutrients in their diet for maintenance, growth (weight gain) and egg production. The need of birds for various nutrients depends on several factors such as the genotype, level of growth, production and stress. Besides, the dietary factors like digestibility, bioavailability and actual content of nutrients in feedstuffs and the presence of anti-nutritive substance in them. The birds need a steady supply of energy, protein, essential amino acids, essential fatty acids, minerals, vitamins and water (most important). The required nutrients supply is partly made through the natural feedstuffs (energy and protein) and rest are supplemented while formulating the diets (vitamins, minerals and synthetic amino acids). All the above nutrients are supplied to the chicken through mixture of feedstuffs and supplements called the 'Feed'. The feed for different categories of birds are formulated with an emphasis on providing the right quality and quantity of various nutrients to realize optimum productivity at the least cost. Therefore, availability of balanced feed adequate in all nutrients and in easily available form is an integral part of successful poultry production.

Energy Sources

Energy is not a nutrient but a property of energy yielding nutrients when they are oxidized during metabolism. In case of birds, carbohydrates and fats in feed ingredients are the major sources of energy. When feed is consumed, these nutrients are digested. During this process, the bound energy is released from the ingredients and available to the body. Poultry cannot digest and utilize complex carbohydrates (fibre), so feed formulation should be based on available energy. The common expression of energy requirement in poultry is metabolizable energy (ME) which takes account of energy losses in the faeces and urine. Birds eat primarily to satisfy their energy needs. Once their energy requirement has been met, they will not consume any more feed even if the requirement for other nutrients like proteins, vitamins or minerals have not been met. This makes necessary for the nutritionist to know the relationship between energy and other nutrients content of the diet.

Cereal grains and agro-industrial by-products are mainly used as a source of energy. The energy sources are used at 50-70% levels in the diet of chicken. The energy feedstuffs are classified again into two categories like high energy sources (maize, wheat, sorghum, broken rice, fat and oils, etc.) and low energy sources (Bajra, Ragi, Korrra, deoiled rice bran, wheat bran molasses, etc.). Maize is the most commonly used

feed ingredient in poultry diets, but other ingredients can be replaced partly or completely, if available at an economic price. About one third protein requirement of poultry is also contributed by the energy sources.

Protein Sources

In poultry, dietary requirement of proteins are actually requirement for the amino acids contained in the dietary protein. Amino acids obtained from the dietary protein are used by poultry to fulfill a diversity of functions. The synthesis of muscle and egg proteins requires all the 20 amino acids. However, some of the amino acids are synthesized in the body to meet the requirements. While 10 amino acids are either not synthesized or if synthesized but too slowly to meet the requirements and they are termed as essential amino acids (EAA). These need to be supplied in the diet. Of the EAA, lysine, methionine, threonine and tryptophan are the most limiting amino acids in practical poultry diets. Besides dietary supply, availability of amino acids to the bird is important to meet the requirements. The quality of a proteinous feed stuff is determined by the constituent protein fractions, the quality of which, in turn, is primarily controlled by their amino acid composition and their availability. Therefore, amino acid rather than total protein requirement is the primary consideration of the nutritionist in formulating poultry rations.

Next to energy supplement, protein supplements group constitute the largest component of poultry diets. The protein supplements are used at 25-30% levels in the diet of chicken. Protein supplements are those ingredients which contain more than 18% protein. The protein supplements are divided into two groups such as vegetable protein supplements and animal protein supplements. Poultry production throughout the world relies more on plant protein supplements to supply the major portion of dietary protein requirements. These include mostly oil seed meals (soybean meal, groundnut cake, sunflower cake, mustard cake etc.), the protein rich residue remains after the extraction of oil from oil-bearing seeds. Soybean meal is generally considered as the standard protein supplement. Plant proteins are generally imbalanced nutritionally. Thus plant-based diets may not meet the requirement of certain essential amino acids requirement unless supplemented with animal proteins or synthetic amino acids in the diet. Thus, adequate supplies of animal protein sources are important in poultry feeding. Animal protein sources are superior to oil seed meals as a source of EAA particularly lysine, the first limiting amino acid in cereals. Several animal protein supplements such as fish meal, meat meal, meat cum bone meal, poultry by-product meal etc. is available for

poultry feeding. If properly processed and care taken for preventing adulteration, animal protein sources can be used to a substantial extent in the poultry feed.

Mineral supplements

Minerals are the inorganic part of feeds and based on the requirements, they are divided into two categories such as major or macro minerals which are expressed as percentage of diets or minor or trace minerals which are expressed as milligrams per kg of diets or as parts per million (PPM). Minerals are required for the formation of skeletal system, for general health, as components of general metabolic activity and / or maintenance of acid - base balance. Calcium and phosphorus are necessary for the formation and maintenance of skeleton, and also for good egg shell quality. Dietary sodium, potassium and chlorine play an important role in maintaining acid-base balance in the body for maintaining the physiological pH. Trace minerals such as iron, manganese, copper, zinc, selenium and iodine, function as component of large molecules and cofactors of enzymes in various metabolic reactions. These minerals are required in minute quantities in the diets. While formulating the diets, all major and trace minerals should be supplemented in the diets.

The minerals are usually supplemented through either mineral mixture or specific mineral supplements. Several mineral mixtures (MM) are available commercially with or without addition of salt. The MM without salt is usually preferred and salt is added separately. Generally specific mineral supplements are added like lime stone or oyster shell is used as a source of calcium and di-calcium phosphate is used as a source of both calcium and phosphorus. The trace minerals are added in the form of premix (TM-premix) which can be either procured commercially or can be prepared at feed mill.

Vitamin supplements

Vitamins are classified as fat-soluble (vitamins A, D, E and K) and water soluble (vitamin B complex and C). All vitamins are dietary essential except vitamin C which is synthesized by the body. However, under adverse condition such as heat stress, supplementation of vitamin C is also required. The requirements of most vitamins are given in terms of milligrams per kg of diet. Practical poultry diets should be supplemented with all the vitamins.

Vitamins can be supplemented through either as individual vitamins or premix. Two types of vitamin premix are available in the market. One premix contains vitamin A, $D_{3,}$ riboflavin (B_2), vitamin E and K. The other premix contains water soluble

vitamins including members of B-complex group and vitamin C. Generally it is included at 100-200 grams per ton of feed. Because of the simple digestive tract and rapid time of passage in poultry, there is little intestinal synthesis of B-complex vitamins in poultry. Birds do not utilize the vitamin D_2 efficiently, so poultry diets should be supplemented with vitamin D_3. Under normal physiological conditions, adult birds synthesize vitamin C to meet their requirement. Therefore, all vitamins except vitamin C must be provided in the diet. However, under stress conditions the synthesis may not be adequate, so additional synthetic vitamin C should be supplemented in the diet. Vitamin C deficiency is more common in chicks under stress (rapid growth, hot or cold temperatures, starvation, vaccination and disease condition such as coccidiosis). Supplementation of ascorbic acid @ 100 – 200 mg/kg diets of birds exposed to stress is beneficial.

Feed additives

In the intensive system of poultry production birds are stressed by several factors such as transportation, overcrowding, debeaking, medication/vaccination, hot/cold weather, etc. This stress resulted in adverse effect on the productive performance of the birds. Feed additives are generally added in the feed to alleviate such adverse effects, which consequently resulted in enhanced productivity. Thus, feed additives are defined as the substances of non nutritive nature that are added in small quantities to a basic feed mix for the purpose of improving the feed utilization and/or growth promotion in poultry. In the modern feeding practices, feed additives are assuming a position of prime importance in poultry nutrition. Several additives are being used for enhancing feed quality, productivity and health.

Antibiotics are primarily added to the feed for three main purposes such as growth promotion and improvement in feed efficiency at low dosage, prevention of common infectious diseases and treatment of specific diseases (antibiotic chemotherapy). Some of the commonly added antibiotics in poultry feed are zinc bacitracin, virginiamycin, tylosin, lincomycin, tetracycline, etc. These are added in the diets at very low concentrations (1-50 mg/kg). **Anticoccidial agents** are added to the feed of birds routinely which are reared on floor to prevent the incidence of coccidiosis. Ionophores such as monensin is most widely used drugs for coccidiosis prevention. **Toxin binders** are added to the poultry feed to counteract the mycotoxin if any present in the feedstuff. Activated charcoal, alumino-silicates, bentonite, and zeolites have been found beneficial in alleviating the toxic effect of feed mycotoxins. Hydrated sodium

calcium alumino-silicate (HSCAS) has strong affinity for aflatoxin, and is generally used at a concentration of 0.1% in the diet and to reduce the toxic effect of aflatoxin.

Making of feed with locally available ingredients:

Feed Ingredients	**Quantity**
Maize/ Bajra/ Jowar/ Broken Rice etc.	50 parts
Rice bran/ wheat bran/ De-oiled rice bran etc.	20 parts
Soybean meal/ Groundnut meal/ Sunflower meal/ Till cake/ Linsed cake	28 part
Vitamin and minerals	2 parts

Low cost feed preparation

7. Health Care and Management

It is generally said that a healthy flock lives, lays and pays. So maintaining a healthy flock is necessary for successful poultry production. During intensive system of production, the birds are reared at high stocking densities, therefore, infectious disease causing agents spread through the flock very quickly. A disease is any condition that interferes with the normal functioning of the cells, tissues, organs or systems of the body. For effective poultry health management, three components are very important such as bio-security, vaccination and medication. Prevention should be the approach as the cost of medication is relatively high and once disease occurs, the productivity is affected and profit margins are reduced despite effective treatment.

Vaccination

The very purpose of the vaccination is to protect flocks against infective agents. Vaccination can be considered a strategy of controlled exposure to an organism for the purpose of evoking an immune response. Proven vaccines produced under rigid quality control, from a reputed manufacturer should be used for vaccination. The vaccination should be done at a time when the host is immunologically competent. A rational vaccination program maximizes the potential of the immune response. The antigens must be presented in such a way as to elicit the best response possible. It is important to remember that a good nutritional state and absence of stress are necessary for an optimal immune response.

General Precautions

- ❖ Vaccine should be stored in a clean area and under the conditions specified by the manufacturer. Live freeze-dried vaccines are always stored under refrigerated conditions.
- ❖ Vaccination should be scientifically inoculated/ introduced into the flock to stimulate its immune system.
- ❖ The vaccines should be kept in an organized manner with proper identification. The serial number, type, name of the manufacturer and expiration date of each vaccine should be recorded.
- ❖ Check the vaccine type and the vaccination schedule for each flock to be vaccinated prior to leaving the storage area.
- ❖ If more than one age flock is to be vaccinated on a given day or different vaccines are to be used on different flocks, use separate insulated storage boxes for each flock.

- ❖ Use the correct number of doses and vaccinate only healthy birds.
- ❖ Live vaccines must be kept alive until they are administered to the birds. Keep live virus vaccines away from sunlight and in a cool location.
- ❖ To learn and adopt correct schedule and methodology of vaccination, the local veterinarians or technical expert may be consulted.

Table 10 : Vaccination schedule

Age	Vaccine	Dose	Route
1st day	Marek's disease	0.2 ml	Subcutaneous (S/C)
7th day	Newcastle disease	1 drop	Ocular or nasal
14th day	Infectious bursal disease	1 drop	Ocular or oral
24th day	Infectious Bursal disease	1 drop	Ocular or oral
28th day	Newcastle disease	1 drop	Ocular or nasal
6th week	Fowl pox	0.2 ml	Intramuscular (I/M)
8th week	Newcastle disease	0.5ml	I/M
18-20 weeks	ND+IBD killed	0.5ml	I/M or S/C
40th week	ND+IBD killed	0.5ml	I/M or S/C

Medication

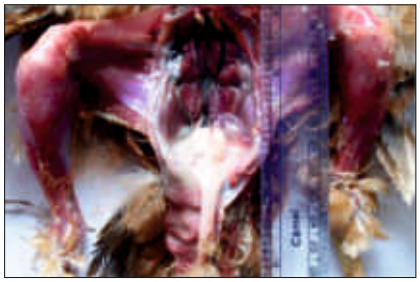
In spite of proper vaccination and biosecurity measures, sometimes disease may strike the flock. If the same happens, immediately consult the veterinarians. Disease in poultry may cause high mortality and morbidity which result in heavy economic loss to the poultry farmer. Depending on the age, managemental conditions, the following preventive medication is suggested for preventing early chick mortality, stress, mycoplasmosis and coccidiosis in the flock.

Table 11 : Preventive medication, deworming and control of external parasites

Prevention	Age	Drug	Route
Stress	1 day	Electrolytes	Water
Early chick mortality	1-5 days	Antibiotic	Water
Coccidiosis	Continuous in dip litter system (floor)	Anticoccidials	Feed
Mycoplasmosis	Continuous	Antimycoplasmal	Feed
Internal parasites	Prior to R2B vaccination	Anthelmintics	Water
External parasites	On detection of infestation	Ectoparasiticides	Dipping

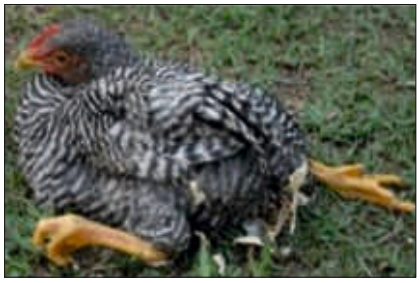
Common diseases of poultry

Causal agent	Example
Infectious	
Virus	Newcastle Disease, Fowl Pox, Marek's Disease, Infectious Bronchitis, Infectious Laryngotracheitis, Gumboro Disease (Infectious Bursal Disease),
Mycoplasma	Chronic Respiratory Disease
Bacteria	Fowl Cholera, Salmonellosis, Fowl Typhoid, Infectious Sinusitis, Colibacilosis
Parasites	Ectoparasites: lice, mites, ticks Endoparasites: Nematodes, Histomoniasis, Haemoparasites, Round worms, Protozoa: Coccidiosis,
Fungus	Aspergillosis, Mycotoxicosis
Non-Infectious	
Deficiencies Toxicities	Rickets, curled toe paralysis, Encephalomalacia Salt poisoning, Food poisoning (Botulism), poisonous plants



Infectious Bursal Disease

Ranikhet Disease



Marek's Disease

Fowl Pox

Coccidiosis

8. Cost Economics of Rural Poultry Farming

The consumption of poultry products such as egg and meat in rural areas is very low due to limited availability and to some extent poor purchasing power of rural people. Rural poultry production using low input technology is gaining popularity to bridge the gaps between demands and supply. The rural poultry farming requires very little attention and provides good returns with minimum investment. It not only generates income levels, employment opportunities to small farmers including women but also bring about desired socio-economic change in rural areas.

The birds developed for rural/backyard poultry farming is a multicoloured dual purpose bird capable of producing more number of eggs and good quality of meat. The birds can survive and thrive well on the adverse climatic conditions in the rural areas utilizing the resources naturally available in the village. Since day old chicks cannot maintain their own body temperature, unable to meet their own nutrients requirement and vulnerable to predators, they can be reared in confinement using scientific practices which can be termed as brooding in mother units. Farms encouraged mother units or brooding centres run by rural entrepreneurs for brooding of day old chicks under reasonably controlled conditions for 4 weeks after which the birds can be reared in open range conditions. So the modus operandi will be as follows:

Breeding Farm / Hatchery (Supply chicks)

↓

Mother units (Brooding – up to 4 weeks)

↓

Rural Farmers (for rearing)

↓

Sale of eggs and meat

Project cost (To establish a mother unit of 2500 chicks for brooding up to 4 weeks)

The assumptions taken for calculating the economics of establishing of a mother unit for nursery rearing of 2500 chicks up to 4 weeks of age is as follows:

1. The farmer should have his own land for construction of the shed.
2. Initial investment has to be made by the farmer himself.
3. The chicks are to be grown on deep litter system.

4. The roof of the house should be either thatched or asbestos one.
5. Floor space requirement per chicks up to 4 weeks is @ 0.5 sq ft per chicks.
6. The mortality is 5 % during 0-4 weeks of age.
7. No of batches of chicks should be reared should be minimum of 6 batches per year.
8. The mortality of the chick during 0-4 weeks should be 3%.

Capital cost

Items of Investment	**Thatched roof**	**Asbestos roof**
Shed - 1250 sq.ft	@ 80/sq.ft 1 00 0000	@120/s.ft 1 50 000
Equipment cost Feeders-50 @ Rs.400 Waterers-25 @ Rs.200	 20 000 5 000	 20 000 5 000
Electrification and others	15 000	15 000
Total (Rs.)	**1 22 000**	**1 72 000**

Recurring cost (for one batch of 2500 chicks)

Particulars	**Total cost (Rs.)**
Cost of DOCs 2500 @ Rs.15 / chick	37 500
Feed up to 28 days @ 700g gm / bird @ Rs 18 / kg	31 500
Medicine, vaccine @ Rs. 1 / bird	2 500
Misc. litter, electricity, etc. @ Rs. 1 / bird	2 500
Total	**74 000**

Economics

Particulars	Total (Rs.)
Income	
Sale of growers per batch 950 @ Rs 35 per chicks	84 875
Sale of litter (@ Rs 0.50 per bird	1 250
Total	**86 125**
Expenditure	
Chick cost	37 500
Feed cost	31 500
Medicine/Vaccine cost	2 500
Others	2 500
Total	**74 000**
Profit (Income – expenditure)	**12 125**
For 6 batches	**72 750**

If the farmers rear at least 6 batches a year total profit per year = 72 750 and net profit per month = Rs. 6 063 say around Rs. 6000/month

After completion of the brooding period of 0 to 4 weeks of age, the birds will be sold to the local farmers at the farmer's door. The number of birds to be reared for free range farming should be around 20 and under semi intensive system conditions should be around 50. Generally, males are sold for meat purpose and hens are retained for egg production. A night shelter is provided with small built up nest costing for rearing of birds under free range conditions. Birds scavenge in the natural habitat like in gardens, village alleys and surroundings of the farms by feeding on crop residues, green forage, insects and worms. No formulated balanced supplementary feed is given to the birds, but they are accessed to kitchen waste as and when available. Sometimes the birds are offered small amount of grain and very little expenditure is incurred on feed. The economics of rural poultry units with size of 20 birds (10 male and 10 females each) is presented below.

1. Economics of dual purpose bird under scavenging conditions (20 numbers)

Capital investment (initially)

Particulars	Total cost (Rs.)
Cost of night shelters for birds	2 000
Cost of feeders and waters	500
Total	2 500

Cost Economics

Particulars	Total (Rs.)
Expenditure	
Chick cost @ Rs.35/ birds (4 week bird)	700
*Rearing cost of birds from 4 to 12 weeks of age @ Rs. 30 / bird	600
*Rearing cost of female birds from 12 to 72 weeks of age @ Rs. 150 / bird	1350
Total	**2650**
Income	
Sale of males at 12 weeks (1.5 kg body weight) @ Rs. 150/ kg	2125
Sale of eggs (120eggs / bird) @ Rs. 5 per egg	5400
Sale of culled birds (2.5 kg body weight) @ Rs. 75 / kg	1688
Total	**9113**
Profit (Income – expenditure)	**6463**

*Includes cost of feed, medicines and healthcare etc.

These economics were estimated under the assumption that the natural food base under free range system is fairly reasonable to meet the bird's essential requirements. The estimates were calculated hypothetically taking into consideration the present market price and demand for eggs and chicken, however the profit varies based on many factors such availability of natural food base in the backyards, supplementation of feed ingredients in free range system and price of the poultry produce (eggs and meat). The farmer can earn a net profit of about Rs. 100 /bird on males and Rs.450/bird on female birds by rearing improved dual rural chicken varieties.