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Backyard poultry production: the future source of egg and meat under fast changing climatic scenario

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Giri SC
Principal Scientist, ICAR-Directorate of Poultry Research, India

Correspondence: Giri SC, ICAR-Directorate of Poultry Research, Bhubaneswar, India, Email scgir12@rediffmail.com

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Introduction

Food and nutrition is the essential part of life. Among different components of food, protein plays vital role which is needed at all stages of life. Poultry is a major contributor of protein among other animal species which shares 49.64 percent of total meat consumption in India (source: Livestock Production Statistics of India – 2017). It also contributes 6.30 percent of total animal protein source through egg for human consumption (Source: 19th Livestock Census: 2014; DADF, Ministry of Agriculture, GoI). In our country per-capita availability of egg is 79 against minimum requirement of 182/person/yr as recommended by ICMR and FAO. Therefore, efforts are made to increase the egg production of country in a much faster rate from all avian species of birds like chicken, duck, turkey, guinea fowl, emu and quail (Figure 1).

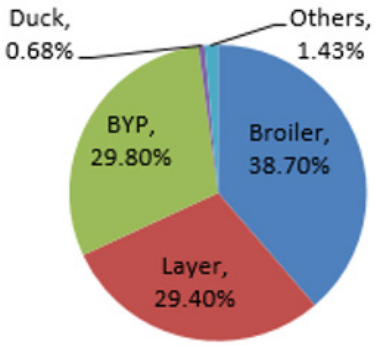

Figure 1 The distribution of poultry population in India.

(**Source:** 2015 Livestock census, GOI).

Background of poultry production

Poultry rearing initiated as a backyard crop from time-immemorial. Man used to carry few birds in a basket on his head while moving from one place to other during nomadic life of human civilization and every day few eggs were made available for his consumption. Over a long period of time a lot of changes occur in this practice. Poultry becomes a highly mechanized, sophisticated commercialized sector through scientific research and development, ultimately given the status of industry. Developing varieties of birds specific for meat and egg, modifying houses and management practices, feeding balanced diet to achieve desirable growth and egg production, protecting birds from various diseases and proper value addition to the product are the milestones achieved through selective breeding, optimizing nutritional requirements and other management practices. Fast growing broiler birds as a short period crop meets the ever increasing demand of meat for human consumption. Similarly, small sized feed efficient layer birds producing maximum number of eggs in one laying period are still trying to fulfill our per-capita egg requirement as recommended. Now India is fourth in world egg production table. To bring further modernization and more profit, scientists are contributing a lot to bring changes in all types of poultry birds that are suitable to the environment. Changes in genetic make-up, in feed, in housing, reproduction characters and disease management with need-based technology have made the industry viable. However, in the fast changing global climatic condition it becomes a challenge for scientists, farmers and policy makers to bring much progress in the poultry industry to cater the need of egg and meat for the whole population of the globe.

Heat stress and thermoregulatory mechanism in poultry

Normal body temperature of poultry bird is 107°F which is much higher than human being. Birds do not have sweat glands. To lose heat, they depend upon evaporation of water from the surfaces of their lungs and air sacs. Evaporation turns water to vapour and the rate of evaporation increases with higher temperature. Heat stress is a worldwide problem in poultry production, especially in broiler and layer varieties. Heat stress begins when the ambient temperature climbs above 80°F and is readily apparent above 85° F. High ambient temperatures can be devastating to commercial broilers; coupled with high humidity they can have even more harmful effect. Heat stress interferes with the broilers comfort and suppresses productive efficiency, growth rate, feed conversion and live weight gain.[1,2] Poultry birds are subjected to frequent stress factors, and therefore it is important to have an effective management programme to minimize their effects on the performance and health of birds.

Broiler production

Broiler production usually suffers loss during summer months. Heat stress is known to depress the growth rate and to reduce the net yield of commercial broiler chickens.[3] Broiler chickens are very fast growing birds and attain 1.6 to 1.8 kg body weight by 6th wk of age. They consume more feed and their body metabolism is high. Due to very fast growth rate they have less tolerance to atmospheric change especially to sudden rise of ambient temperature and humidity. Panting and respiratory distress is the immediate symptoms observed in broiler farms during hot and humid summer in coastal states of

the country which many times resulted in sudden high mortality. Again High temperature and heat stress appears to affect intestinal development negatively (Garriga et al., 2006) especially the integrity of the intestinal epithelium.[4] The intestinal mucosa is continuously exposed to a heavy load of antigenic molecules from ingested food and microorganisms, such as resident and invading bacteria and viruses (Keita & Soderholm, 2010). It was observed that chronic stress (31.8C) applied from days 35 to 41 of broiler bird life may have activated the chicken hypothalamo–pituitary–adrenal (*HPA*) *axis*, increasing corticosterone serum levels and inducing intestinal cytokine production which in turn decreases both food intake and body weight gain.[5]

Layer production

In a commercial layer farm, the birds are usually kept in cages. They used to start egg laying by 16-18 wks and continued to lay eggs up to 72-75 wks of age which is the optimum economically viable productive life. So almost one year the laying of eggs continue which is a stress to the bird. Therefore, any change in climate (high / very low ambient temperature), very high humidity, insufficient drinking water, change in feed, vaccination etc causes further stress to bird resulting into restlessness, panting, less feed intake, reduction in egg production and finally mortality above normal range. However, layer birds resist to the stress little better than broiler chicken. Supplementation of anti-stress medicines, adding vitamins and electrolytes in water, balancing protein requirement through synthetic amino acid in feed and covering thatch of the shed with green leafy crippers (reduces temperature inside shed with more oxygen) help to certain extent in combating with the heat stress of the birds. In recent years the Environment controlled (EC) houses are constructed for layer birds which regulate the temperature and humidity inside the layer house and provide a comfortable environment to the birds that result in disease control, negligible mortality and consistency in egg production round the year. However, construction of EC house needs much investment and may not be feasible for small and medium layer farmers.

Cold stress

Poultry farming suffers to a great extent due to severe cold weather especially in high altitude regions. Brooding of chicks (both broiler and layer) is not only difficult but also experiences high mortality and severe loss during winter months even in coastal states. The ideal brooding temperature is 31-33°C in chicken. To maintain the optimum brooding temperature electric bulbs (1 watt per chick) are used as a normal practice. But during cold months and extreme cold days, this may not serve the purpose. So gas flames are used for maintaining required temperature which is costly and need to be regulated properly, else more heat will cause dryness and dehydration in chicks leading to death. In high altitudes there is insufficiency in oxygen concentration in the atmosphere which coupled with extreme low temperature causes much difficulty in poultry production.

Bad weather and natural calamities

Cyclone, super-cyclone and heavy rain for a prolonged period causes distress in birds. Due to lack of sun-shine for 4-5 days continuously, the reproductive performances of laying birds altered and egg production drastically reduced. Incidences of few diseases found in large poultry farms immediately after the calamity. Due to high humidity fungal (Aspergillus spp) growth takes place in feed produces aflatoxin which causes aflatoxicosis in chicken and ducks affecting liver cirrhosis followed by neural symptoms and death. Transportation of inputs to farm and disposal of farm produce are affected many times causing serious loss to the farmer.

Backyard Poultry production

For sustainable livelihood of landless and marginal farmers, backyard poultry rearing is a successful technology. Rural poultry farming using native breeds is being practiced in many developing and underdeveloped countries throughout the world (Guèye 1998). The importance of native breeds of poultry birds for rural economy in developing and underdeveloped countries mostly in Asia and Africa is very high. They are part of balanced farming system that have vital roles in the rural households as a source of high quality animal protein and emergency cash income that play significant role in the socio-cultural life of the rural community including woman empowerment.[6]

Backyard poultry production: The source of egg and meat for masses

In recent years a lot of measures have taken by government and non-government organizations (NGO) to encourage the rural farmers for backyard poultry production. Many schemes and programme are being implemented through Rural Development Department, Tribal Welfare Department, National Co-operative Development Corporations (NCDC) and many other national and international projects to augment rural poultry production by landless, small and marginal farmers. All these programme in a broad way aim at:

a) Nutritional security for farmers family through egg and meat production (Eradication of mal-nutrition programme)

b) As a mean of livelihood

c) Employment generation and

d) Women empowerment

However, a lot of benefits and prospects can be achieved through backyard poultry production. In contrast, commercial poultry production has several limitations and uncertainty in the changing climatic scenario to which rural poultry production may be the only alternative. The potentiality of backyard poultry production needs to be exploited fully in order to fulfill the gap between availability and requirement of egg and meat in our country. The GOI has fixed target to increase the production of egg and poultry meat from time to time. The recent target (As per ICAR data and Basic Animal Husbandry Statistics) fixed by tear 2020 was:

Indicators	Year	2020	CAGR
Poultry Meat production	3.3 million tonnes (2015-16)	4.20 million tonnes	5%
Per capita meat availability	2.22 Kg/annum (2014-15)	3.21 kg/annum	6.30%
Total poultry population	729.21 million -2012	1290.45 million	7.40%

CAGR, compound annual growth rate.

For commercial poultry production, the major resource required is poultry feed in which maize and soybean are two important components. The productions of these two ingredients are mostly dependent on climate even though the area under irrigation is increasing every year in our country. Adverse climate even during the final stage of harvest causes drastic reduction in yield. Sometimes the high moisture content in maize and soybean causes quick fungal growth leading to undesirable / unacceptable level of aflatoxin in the grain. Consumption of such infected ingredients by chicken and duck

causes serious health problem leading to drastic production yield and serious economic loss to the farmer. Backyard poultry production on the other hand requires very little or no commercial feed for growth and production of the bird. The concept of backyard poultry production lies with recycling / conversion of waste food material of the family to protein (egg and meat) for human consumption. As a rough estimate, 30 percent of human food is wasted in the form of left-over food, vegetable peels, fish scales and offal, leafy vegetable and unsuitable raw food material that cannot be consumed. These waste and unsuitable food materials can be utilized by backyard poultry in a much better way for their growth and production. Observation revealed that a flock of 25 color chicken birds reared in backyard can be maintained with the waste food material of a farmer family of 5-6 members in tribal districts of Odisha state besides normal scavenging outside.[7]

Backyard poultry varieties (Vanaraja, CARI-Devendra, Grama-Priya etc) have tremendous adaptability to the environment. Rise of temperature does not affect much for these varieties of birds if drinking water is available in the premises of house. Since they used to scavenge outside during day time, they find shady places during peak heat period of the day and never feel stress. They like to consume certain green leaves which contain more water and prevents dehydration in body. Collecting feeding source from environment in the form of insects, earthworms, white ants etc helps in increasing the immunity level and the birds are less affected by the common poultry diseases found in farm condition. Similarly during severe cold days, these birds sometimes do not like to go out and prefer to remain in the shelter house and sustain with the leftover food / waste food material of the family which is a self accommodating process. In general, the backyard poultry birds are good foragers and they collect the required nutrition along with sufficient minerals like calcium from environment which helps in prolonged egg laying period. The eggs laid are light brown shell with yellow colored yolk (due to green foraging) which are not only attractive but higher price fetching also.

Enrichment of soil is one of the important aspects of backyard poultry rearing. Moderate to heavy rain fall in most part of the country causes leaching of surface soil containing major nutrients responsible for plant growth and production. However, the droppings (rich in nitrogen, phosphorus etc) of birds scattered on premises help in enriching soil and benefit the kitchen garden of farmer family. Ducks on the other hand maintained in village ponds enriches the nutrient quality of water to grow planktons which are much benefited for aquaculture in terms of growth and profitable fish production. At the same time raising ducks in backyard which collects feeding source from both land and water adds significantly to the rural egg and meat production contributing to livelihood and nutritional security of the farmer family. Ducks as one of the poultry species are considered hardy that withstand severe adverse climatic changes. In commercial poultry farming, the construction of poultry house becomes a major investment of the farmer. Normally the layer birds for egg production and breeding birds (both broiler and layer variety) are reared in cages which are called California cage. The birds drink water through nipple drinkers and fed by movable feeding channels. In automated production system, the eggs laid are collected by movable rubber belt. In this system the fecal material dropped on the floor from at-least 10 ft height which are cleaned from time to time. The egg laying birds are maintained in these cages for the whole production year with least involvement of manpower. However, the cost of construction of such cage house is exorbitantly high. Earlier the cages were covered with asbestos or tin sheets as thatching material on the top and it was opened on the four sides keeping the house fully ventilated. But during course of time and to withstand rapid climate change, the construction design is modified and the cage house is now-a-days covered from all the sides so as to maintain required temperature and humidity artificially to provide optimum comfort to birds for maximum production yield. The construction of such houses is made in accordance with the norms of pollution control board. This type of EC (Environment Controlled) houses is very much cost effective from both construction and maintenance point of view. All the capital investment reflects on the production cost of eggs and subsequently on consumer's pocket. European countries have started closing these cage poultry houses as practice of cage rearing is against the animal welfare law. Backyard poultry production on the other hand requires low cost indigenous poultry house constructed from locally available material which not only provide comfort to the birds against environmental stress and hazards but also add to the economic egg production for farmers. Animal welfare society strongly recommends the backyard poultry production throughout the globe for future egg production as there is no cruelty to the birds observed.

Duck is another important avian species which has potential for contribution significantly towards egg production. Ducks like Khaki Campbell variety used to lay 300-320 eggs in a production year and each egg weighs ~ 10 grams more than average chicken egg. Ducks in our country are mostly maintained in backyard ponds from where the birds collect the feeding source. They are hardy, very much adaptive to natural environment and withstand the immediate climatic change in a particular place. Since they prefer to swim in water body, the increase in ambient temperature during hot summer does not affect much as in case of commercial poultry farms. They are good scavengers, lay egg for a long period and integrated with aquaculture nicely with added advantage to fish production. Therefore, production potentialities of ducks in backyard need to be exploited fully for faster growth in egg production of our country. China, Malaysia, Philippines, Vietnam and so many European countries successfully propagated ducks in rural area and are producing eggs which are exported to other countries at higher price. Cheap egg production in India is only possible through rural duck production.

Economics of Backyard poultry and duck production

Backyard poultry production can be expanded as a practice by masses to strengthen nutritional security as well as financial status of a landless or marginal farmer family. Sometimes it is practiced as group activity (Self Help Group) by village women who are not engaged directly in any income generating activity. The groups manage a big flock of color birds suitable for backyard production with the participatory mode. They collect waste food material from their houses, watch the birds outside on rotational basis and marketed the eggs and live birds throughout the production period to generate substantial money for the group account from which they avail loans for their need. Individual farmer family used to purchase 25-30 day old color chicks, brood them inside the same living house for 15-20 days, feed them from environment and house hold waste, provide the birds night shelter in a low cost house prepared by the available materials and maintain the adult birds as a part of their family. Chances of early mortality are minimized due to the carefulness of the members of the house. They used to sell or consume the adult male birds by 5-6 months of age when the hens start egg laying in the flock. Many a times it is found that each family from their backyard poultry unit gets 7-8 eggs every day which fetch a good regular source of income besides availability of eggs for family consumption throughout the production period of one year. It was observed that a farmer family could able to earn the average net income of Rs 20,000/- (twenty thousand rupees) by maintaining a flock of 25 adult birds (CARI-Devendra variety)

in backyard under "CARI-Model of backyard poultry production" in three tribal districts of Odisha state (ICAR-Reporter: October to December 2012: Reported by S C Giri). Many state Governments in our country encourage the rural landless or marginal families towards backyard poultry production through various schemes through Animal Resources Development department, Water-shed Mission, Tribal sub-plan and so many other programme. NABARD and other nationalized banks are also funding the rural educated youth for development of entrepreneurship in backyard poultry production sector. Government (Krishi Vigyan Kendras) and non-government organizations (NGO) providing training, mass vaccination camp against Ranikhet disease and many capacity building programme for the unemployed youth and women to encourage for backyard poultry production. The aim of all such attempts to augment backyard poultry production by various organizations is to increase the egg production of country through unconventional means where investment will be very less, no need of commercial feed, protection of environment and no cruelty to birds in captivity. In this way the production cost of egg will be very less and availability of protein from infants to adults will be easier and better. The market demand for such eggs (organic) is very high as the consumers have keen interest for the product from better aesthetic point of view. On the other hand if this activity will be systematized though formation of unions and federations in different parts of country with proper coordination for supply of chicks and essentials commodities as well as collection of eggs from farmers doorstep to storage place and can be marketed through proper transport and supply on demand driven mode, then true revolution of egg production will be made in the country. This will hasten the country's egg production status in a much faster rate and definitely meet our minimum per-capita availability to eradicate malnutrition in the society.

Challenges and solutions to boost up backyard poultry production

In the fast changing climatic scenario, improvement in overall agricultural productivity for the country is undoubtedly a challenge for the researchers, policymakers and the farmers. In India egg production needs a major thrust with a holistic approach so as to meet the requirement of 134 crore population as per ICMR recommendation. Commercial poultry farms trying hard to minimize the demand-production gap for eggs; but the interest on huge capital investment, ever-increasing feed cost, prevalence of disease like "Bird-Flu", disaster like repeated cyclones, environmental pollution and fluctuating market made the poultry industry puzzle to sustain and grow. Thus the need and effort to produce egg from backyard poultry rearing realizes its importance and challenge ahead. Few suggestions are enlisted to overcome the problems associated with backyard poultry production in our country:

a) **Suitable variety of bird:** The poultry birds (chicken) for backyard rearing need to have ability to protect itself from predators besides having color plumage, early onset of laying, free from broodiness, disease resistance and good scavenging quality. The varieties available in present time need to be genetically modified or up-graded by the poultry researchers through incorporation of certain genes from native fowls. This will significantly improve the survival rate of backyard poultry population in farmer's field.

b) **Eradication of Ranikhet disease (RD):** The most common dreaded disease found in poultry under backyard production is Ranikhet / Newcastle disease for which full-proof vaccine is available. This disease is not at all a threat in commercial farms because in-time vaccination against R.D. is undertaken as per the schedule. However, the existing native / country birds the villages need to be vaccinated (cent percent) at regular interval prior to the introduction of more developed varieties of chicks for backyard poultry production. This will create Ranikhet Disease free villages in the country where there will be no threat of mortality to birds during any stage of growth and production. The sincerity of Animal Husbandry department and due concern of farmers will be the combined responsibility in eradicating RD from every village so as to make the backyard poultry production a successful programme in the country.

c) **Controlling "Bird Flu":** Avian influenza / Bird Flu is a viral disease and poultry birds are highly sensitive to this disease that causes high mortality and serious economic loss for both commercial poultry farm and birds in free range. No vaccine is available till date against this disease. Sanitation and bio-security measures are the only means to handle the disease outbreak till vaccine is to come. Therefore precautionary measures need to be adopted in every step by Govt and NGOs to check the occurrence / spread of disease especially during winter when migratory birds from Siberia and other countries (carrier birds) fly to India. This will protect the poultry population of our country in a great extent and help in egg production in both the sectors.[8, 9,10]

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Conflicts of interest

Author declares that there are no conflicts of interest.

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