Chapter 12
Revolutionizing Impact of Poultry Resources in Food Security and Rural Economy

R. N. Chatterjee, U. Rajkumar, and L. L. L. Prince

Abstract The impacts of poultry resources in food security and rural economy are discussed comprehensively in the present chapter. Poultry is the fastest-growing sector globally with significant growth rates over the years. About 300 estimated breeds of poultry contribute to the vast diversity and majority (63%) number of domesticated avian breeds. Poultry produce, eggs, and meat constitute a food source having high-quality and with essential macro and micronutrients and high bio-availability of vitamins. Eggs are having perfectly balancing nutrients to meet human dietary requirements. Food safety and security are very important issues globally which need priority in research, preservation, transport, etc. Antibiotic growth promoters should be strictly avoided to get rid of AMR problems. The potential contribution and impact of intensive and extensive production systems in rural and urban areas differs significantly. Poultry produce have multi-faceted benefits for the mankind; these need to be promoted extensively to tap the advantages of egg and poultry meat. Small-scale farming of poultry is a continuous source of income to the family especially in poor landless people across the globe. The value addition increases the return through nutritional manipulations, processing, and transgenesis which needs to be explored. Small-scale poultry farming contributes to many rural livelihood indicators such as income, quality nutrition, food security, savings, and insurance. Poultry farming provides assured income in exigencies such as crop failures, drought, sickness, etc. The impact of backyard poultry is not only limited to income generation but also to provide nutritional security in many of the underdeveloped and developing countries. Therefore, promoting poultry produce and its value addition enhances the impact of poultry products significantly, revolutionizing their role in global food security.

Keywords Food security · Small scale poultry farming · Rural economy

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1 Introduction

Poultry sector is a fast-growing sector of agriculture globally experiencing 6–10% growth constantly over the last decade. Smallholder poultry growth has been substantial in underdeveloped and developing countries, while commercial poultry growth has been rapid in developed countries. Poultry provides major and cheap source of animal protein needs of the world population contributing significantly to the food bowel. Poultry produce, eggs, and meat are preferred without any religious taboo and customs across the globe.

2 Global Scenario

China is the largest chicken egg producer (with 40% production) in the world. Till 2008, 77.6% of China's egg production was coming from smallholding poultry farmers. The contribution from smallholding farmers by 2016 reduced to 56.9% (Yang et al. 2018). Global egg production was 1577.53 billion. Poultry contributes the largest share (38.4%) in global meat production and is the second most consumed meat. The annual per capita availability is 167 eggs with wide variability ranging from as low as 5 eggs in Niger-Africa to as high as 413 eggs in China-Asia (Ritchie and Roser 2017). Development and availability of high producing layer (310–340 eggs) and broiler (2.4–2.6 kg at 6 weeks) chicken for commercial sector and improved rural chicken varieties (100–180 eggs) for free-range small-scale rearing with standard package of practices are the primary factors for the spectacular growth in the sector. In 2021, the USA produced about 20.4 MMT of broiler meat, the highest in the world. China being the second largest producer of broiler meat is expected to produce 15.00 MMT of chicken meat in 2021 followed by Brazil 14.15 MMT, Russia 4.7 MMT, and India 4.2 MMT.

3 Indian Scenario

India produces about 105.20 billion eggs with a global share of 6.6% and ranks third in world egg production (FAO 2019). In India, poultry contributes about 50% of meat production with 4.05 MMT of chicken meat per annum (BAHS 2019). The global poultry has undergone a paradigm shift and transformed from a small-scale traditional backyard farming into a dynamic agri-based industry over the last five decades. The constant scientific innovations and untired efforts in upgradation and application of new technologies in the field of breeding, nutrition, health, and mechanization had paved the way for the multifold and multifaceted growth in poultry (Chatterjee and Rajkumar 2015). The per capita availability of eggs and chicken meat is about 79 and 3.5 kg, respectively, in India. The availability of egg and meat

in majority of the countries is much below the recommended level of 180 eggs and 10.8 kg poultry meat per person per annum as per the Indian Council Medical Research.

4 Small-Scale Poultry Farming

Small-Scale Poultry Farming (SSPF) or backyard poultry is a traditional farming activity in rural areas with low inputs mainly depending on scavenging on the natural feed base available in the backyards with little supplementary feeding, provision of night shelter, and minimum healthcare practices (FAO 2007; 2010; 2014; Sharma and Chatterjee 2009; Rajkumar et al. 2021). The majority of farmers are engaged in rural poultry production mostly with indigenous native chicken or improved cross-bred chicken and other poultry species (Alders and Pym 2009). SSPF is characterized by growing chicken in small numbers (20–50 or even more) for family consumption. In this system of rearing, the birds scavenge for feed in the backyard, consume insects and household waste, and also utilize the resources which are not directly useful to human beings or livestock. Generally, native chicken breeds are utilized for SSPF over the years wherein the productivity of birds is low. However, for increasing the productivity under the SSPF, the improved chicken varieties with higher potential for enhanced growth and egg production are used in the present modern-day village poultry farming. These improved varieties resemble the native birds with multi-colored plumage and have longer shanks, better productivity, better adaptability, and immunity, besides being able to perform on a low plane of nutrition (Rajkumar et al. 2021). The SSPF has a proven potential to alleviate poverty, generate subsidiary income, eradicate malnutrition, empower women, and provide employment in rural and tribal areas of the country (Sharma and Chatterjee 2009; Rajkumar et al. 2010; Rajkumar and Rama Rao 2015; Chatterjee and Rajkumar 2015; Chatterjee 2018; Islam et al. 2020). The birds in the free-range system scavenge for feed; sometimes supplementary feed are also provided to the birds. Shelter/housing is mostly required during the night time. Many a times, SSPF is commonly incorporated with crops and other livestock, as mixed production systems. The birds are self-propagating with broody hens. The indigenous birds lay 30–100 eggs per year. A small poultry production system accounts for 60–90% of the population in most of the developing countries across Asia and Africa and are found mostly in rural, resource-poor areas. In the early part of this millennium, the share of rural poultry is about 70–90% of poultry products in Africa (Alabi et al. 2006; Mack et al. 2005) and contributed about 20–30% of the total animal protein intake (Tadelle et al. 2003). There is a high demand for meat from indigenous non-descript chicken produced in rural areas, and due to their local taste preference they are sold in premium price. SSPF is primarily managed by rural women including different farming activities, marketing, income, and employment (Weaver 2009) leading to women empowerment.

In Africa, poultry is the source of income for the rural people which are mostly reared by women of the family (Thieme et al. 2014) in Zimbabwe, Ethiopia, and Zambia (Chatterjee 2011). It was found that village chickens are being reared mostly by women (Mapiye et al. 2008; Chatterjee 2011). Mostly, the men are involved in construction of the night-shelters or in slaughtering, while women are taking care of rearing of the birds and selling in these countries. The sale of poultry products is often the main source of income for households headed by women. In many Asian countries particularly in SAARC countries, village poultry production systems are important means of income generation. In both the continents (Asia and Africa) different poultry species constitute chicken, duck, guinea fowl, etc. Guinea fowl is a part of poultry rearing in African countries and ducks in coastal areas of India, Bangladesh, and China.

5 Genetic Resources

There are about 300 estimated breeds of poultry used globally in food production (Rege and Gibson 2003). Chicken breeds make up the majority (63%) of the total number of domesticated avian breeds. India is the home to the red junglefowl (*Gallus gallus*) which is considered to be the progenitor of the modern domestic chicken (*Gallus domesticus*). The *Gallus gallus* is distributed from the foothills of the western Himalayas to Northeastern India. At present 19 native breeds of chicken, two duck breeds, and one geese breed are registered in India (Chatterjee 2019). The registered indigenous breeds of chicken in India are Ankaleshwar, Aseel, Bursa, Chittagong, Danki, Daothigir, Ghagus, Haringhata Black, Hansli, Kadaknath, Kalasthi, etc. The home tract of these breeds is in different regions of India. The growth and production traits of these native breeds have been studied in detail (Chatterjee and Yadav 2008; Rajkumar et al. 2016; 2017). Research suggests that up to 30% of avian breeds were at risk (FAO 2007; FAO 2010; Sorensen 2010). It is important to conserve poultry genetic resources because indigenous poultry breeds are more resistant to disease and can survive in more extreme climatic conditions (Chatterjee 2019).

6 Egg and Poultry Meat as Valuable Food Source

Animal proteins are having better digestibility than the proteins from plant sources. Vitamin A is found as precursor reared for absorption in the animal source of food items. Iron and vitamin A are the causes of micronutrient deficiencies (Wong et al. 2017). Micronutrient absorption is of concern when the feed ingredients are mainly from the vegetables and cereals sources. High level of fiber, phytate, and oxalate decreases absorption of the micronutrients which are from plant-based diets. The

bio-availability of nutrients from the egg and poultry meat is better than the plant sources.

Eggs and meat from chickens constitute a food source of high quality with densely packed essential macro and micronutrients, high bio-available iron, zinc, vitamin A, riboflavin, and vitamin B12, that are often deficient or absent largely in the vegetable diets, which is observed commonly in the rural areas (Wong et al. 2017). Poultry meat is also a good source of riboflavin, niacin, thiamin, vitamin A, vitamin B12, folate, iron, etc. (Williams 2007). Consumption of eggs and meat with such high concentration and bio-available nutrients is significant for infants and young children. Eggs are having perfectly balancing nutrients to meet human nutrient requirements; the small-scale poultry product utilizations are, thus, far superior than being a valued food source alone. Pregnant and lactating women need enhanced nutrient requirements than aging people.

One of the major food security apprehensions related to poultry products is the diversion of possible human food resources to livestock feed, particularly in case of monogastric animals. The scavenging feed resources utilized in extensive and semi-intensive poultry production transform feed ingredients in the environment that are less suitable for human consumption. These may be plant seeds, earthworms, and insects into palatable and nutrient-rich food for human being. Small-scale poultry production is regularly used as a part of integrated farming systems in many parts of Asia, Africa (Chatterjee 2011; Chatterjee 2017a, b), and Gulf countries.

7 Food Safety

Food safety is a very important parameter for all the poultry produce before introducing into the market. The poultry produce should meet all the food safety standards and guidelines mandated by the Government. There are certain diseases which are highly pathogenic like avian influenza (HPAI) and certain bacterial infections like Salmonella and Campylobacter which are zoonotic in nature and having health risks to human beings, especially when the chicken products are from sick birds. Many a times rearing of broilers in some of the countries encompasses antibacterial growth promoter (AGP). This creates problem for antimicrobial resistance (AMR) in human beings and other livestock species or fishes. Thus, AGP are given sometimes with feed material to get better growth in broilers. Therefore, food safety is very important, in the above circumstances. The poultry products must be free from zoonotic diseases. AGP should strictly be avoided to get rid of AMR problems.

8 Food Security

Food security commonly referred to food availability, domestic food production, stores, imports, and assistance at the national level and at the household level. Food availability refers to foods of optimum quality and those which are culturally and socially acceptable by a given population. Poultry are usually the most favored species in resource-poor rural and tribal regions of the globe. The poultry contribute to food chain through supplying nutrient-rich and acceptable products for human being in addition to providing manure to pest control (Wong et al. 2017). Poultry produce contribute significantly to the food security in terms of quality food products like eggs and chicken meat. The low input nature of scavenging or extensive system of small-scale poultry production makes it acceptable to the vulnerable or marginalized groups who are at high risk of food security in many Asian and African countries. The intensive systems of large-scale poultry need higher inputs and are often limited to rich people, and these birds are not suitable for scavenging system.

In general most parts of the developing and underdeveloped countries, the live birds and eggs are marketed in open-air or "wet" markets and in retail shops, where birds are slaughtered on sale (FAO 2007). Backyard poultry likely contribute to a larger proportion in areas where poultry farming is not developed. The village or backyard sector is commonly a traditional activity with local, native chicken breeds which are reared for both eggs and meat, often called as dual purpose chicken. Village or backyard production has been one of the potential activities which contribute to dietary protein and supplementary income for poor people (Acamovic et al. 2005; Sharma and Chatterjee 2009; Rajkumar et al. 2010). The high demand, niche market, and high market price for the local poultry reared in village backyard systems yield higher economic return and strengthen the rural economy in a big way.

9 Impact of Poultry Produce on Food Security

The poultry production system has been integrated with human livelihood ecosystem over thousands of years improving the rural economy and nutritional security of the rural poor (Alders and Pym 2009). The projected environmental and food impact system for increasing livestock production to meet the growing demand for animal source foods (Delgado 2003) is a big challenge. The potential contribution and impact of intensive and free-range small-scale production systems in rural and urban areas varies significantly. Moreover, intensive poultry requires reasonable costs for inputs, including stock, feed, labor, and health services as well as needs efficient marketing channels (Wong et al. 2017). In rural areas, access to markets, cold chains, and veterinary services is limited. There is a difference in rearing systems between the developed and developing countries. In developed countries the poultry rearing system is mostly under intensive system, while in developing

countries poultry rearing systems are under the extensive, scavenging, under family poultry production system and commercial poultry system.

10 Promoting Poultry Produce

Poultry produce has a multi-faceted benefits for mankind; these need to be promoted extensively to tap the advantages of egg and poultry meat.

1. **Consumer education**: Most of the rural/tribal farmers do not know the benefits of high-quality egg and meat. Mass awareness campaigns utilizing mass media, radio, TV, exhibitions, etc. need to be organized regarding the health and nutritive values of the poultry produce especially in rural areas.
2. **Promoting egg consumption**: Egg at times is not considered as a vegetarian food. The people need to be convinced with the fact that egg is a vegetarian food. The commercial eggs are produced asexually without any embryo development as birds are not crossed for the purpose.
3. **Mid-day meal program**: The local poultry industry/authorities should convince the Government to introduce egg in their social welfare schemes especially in schools.
4. **E-marketing:** E-marketing/online marketing is the new business strategy adopted by many sectors to reach the consumers effectively. Nowadays the Internet and mobile are common in every household. Promotion of poultry business through the social media platform is an easy option to create consumer awareness and market influence through your social media pages. Strong networking among the people and provision of special apps for placing order online will boost the marketing opportunities.
5. **Home delivery**: Home delivery service is also one of the marketing options to boost the sale. This concept is significant because most of them need fresh eggs in the comfort of their home as they don't wish to go to the nearby grocery store.

11 Economic Contribution of Smallholder Poultry

Small-scale poultry farming is a continuous income source to the family especially in poor landless peoples across the globe. The experiences of backyard poultry economics from India are summarized below. The economics, estimated using the popular and improved rural chicken varieties like Vanaraja, is as in Table 12.1.

The SSPF is largely a subsidiary income-producing activity for the household in India rather than the main source of income. *Vanaraja* chicken farming was lucrative compared to the native chickens with 46.78% additional net returns from a unit of 20 birds with a benefit-cost ratio of 2.84 from Arunachal Pradesh, India. A total of Rs. 10,578 (USD 145) was earned as the net income from a unit of 20 *Vanaraja*

Table 12.1 Economics of Vanaraja bird under free-range conditions per pair of birds, one male and one female

Input			Output		
Sex	Age of the bird	Cost in Rs/ (USD)*	Particulars/details of the bird	Receipt (Rs/ USD)	Profit (Rs/ USD)
Male	12 weeks	100 (1.37)	Bird at 12 weeks (1.5–1.8 kg) at Rs. 120/kg (USD 1.64/kg)	180–240/2.47–3.29	80–140/1.10–1.92
Female	72 weeks	225 (3.08)	Eggs: 100–110 at Rs. 5/ egg	500–550/6.85–7.53	515–565/7.05–7.74
			Birds: 3.0 kg at Rs. 80 kg	240/3.29	
			Total	740–790/10.14–10.82	
Total profit from a pair of birds		325 (4.45)		920–1030/12.60–14.11	595–705/8.15–9.66

Source: Rajkumar et al. (2019)
*Includes cost of day old chick, feed, medicines, healthcare, etc

birds with a net profit of Rs. 529 (USD 7.25)/bird. The economics of *Vanaraja* (Rajkumar et al. 2010, 2018) and *Gramapriya* (Rajkumar and Rama Rao 2015, 2018) in a traditional backyard rearing system was estimated with the net profit per pair of birds (cock and hen) as Rs. 595–705 (USD 8.15–9.66) for *Vanaraja* and Rs. 820–930 (USD 11.23–12.74) for *Gramapriya* chicken, respectively. The average net returns from a unit of 20 birds were about Rs. 5200 (USD 71.2) from *Vanaraja* and about Rs. 7000 (USD 95.9) from *Gramapriya* rearing (Rajkumar et al. 2018) by considering the minimum sale price for the egg and chicken meat.

12 Value Addition

Value addition is the process of enhancing the value to a product or service through special processing, marketing, or making. All poultry products can be value added to increase the acceptability and nutritive value. In poultry, value can be added to eggs, meat, feathers, and even other parts that are usually thrown away. Value-added services, for example, restaurants that primarily serve poultry products, poultry parks, training on poultry, etc., can be offered. When value is added to the product, it increases the perceived value of the product. By adding value to chicken, a farmer gives more value to chicken and its products before offering it to the customers making them to pay more.

Value addition in poultry plays a significant role in growing the profits. The value addition may be through nutritional manipulations, processing, and transgenesis. Omega-enriched eggs and chicken meats developed by nutritional approaches are available for premium price in the market. Feeding the chicks with rich sources of

omega fatty acids will aid in increasing the levels of omega 3 fatty acids in eggs and meat. Another approach is through biotechnological tools wherein the specific gene responsible for trait will be transgressed leading to transgenesis. However, this transgenic approach is still in nascent stage wherein research is being carried out. The commonly utilized method for value addition is processing of the poultry products. The low valued meats and by-products can be processed into highly nutritious finished products by using different technologies adding to the returns. Commercial meat products are emulsion-based products, sausages, smoked, restructured, etc. which can improve the acceptability by-products and increase the profits significantly. Similarly, different egg products can also be prepared and marketed.

13 Conclusion

SSPF contributes to many livelihood improvement indicators for rural people such as providing income, nutrition, food security, savings, and insurance. In terms of income generation and food security, the sale of those poultry and their products (e.g., egg, meat) is important. Poultry farming provides assured income in exigencies such as crop failures, drought, sickness, etc. Poultry farming also contributes to household food consumption, as many poor households rely on their own poultry products for animal protein needs and micronutrients such as iron and vitamin A. The impact is not only restricted to income earning but also to provide nutritional security in most of the underdeveloped and developing countries. Backyard poultry has the potential to reduce the malnutrition in the rural areas across the world. By promoting poultry produce and value addition, the impact of poultry products can be improved significantly revolutionizing their role in global food security.

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