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Review Article

Insights of Improved Backyard Poultry Farming in India with Special Reference to Hilly Regions: A Review

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Abstract

Backyard poultry farming has been inevitable part of sustainable livelihood of Indian farmers. It provides not only food security but also employment to the farmers and rural youth. Hilly areas, especially the north-eastern states of India are still growing in terms of commercial poultry production yet they have considerable experience in traditional backyard poultry husbandry. There has been a common practice to use indigenous breeds in backyard poultry but these days improved chicken breeds are introduced in farming. Native breeds have been used due to their ability to withstand harsh climatic conditions, good survivability but they are poor and slow producers of egg and meat. Several apex institutions in this field have evolved improved breeds which have got characteristics of both native as well as that of high and quick producing strains. The factors that play crucial role in inhibiting and proliferation of backyard poultry husbandry may determine the success of backyard poultry in a particular region. This review covers works which are done in this field and aims at suggesting key points for improved backyard poultry production for sustainable rural development with a special focus over the important works done in rural hilly areas.

Keywords: Backyard Poultry, Indigenous Breeds, Improved Breeds, Management, Sustainability

Introduction

Livestock and poultry sector are upcoming as one of the rapid growing sectors in Indian agriculture adding considerable proportion to National GDP (Singh *et al.*, 2018; Adbhai *et al*., 2019; Thakur *et al*., 2020a). India has 19 registered indigenous breeds which are given below in table 1 (NBGAR, 2020). Backyard poultry farming is an age-old traditional practice in rural hilly areas in India since time immemorial. It plays an indispensable role in poverty alleviation through income generation by the sale of eggs or chicken (Hussain *et al.*, 2017; Roy *et al.*, 2017; Thakur *et al*., 2020b), maintains family food security (FAO, 1997; Gondwe, 2004; Abdelqader *et al.*, 2007; Nagar *et al*., 2020) and also provides quality protein for growing and malnourished children. Even with proliferation of the industrial poultry on a large scale, backyard poultry constitutes a significant proportion of the total poultry population at the national level and the demand of eggs and meat of rural areas is fulfilled by rearing of backyard poultry (Nath *et al.*, 2012). In spite of low productivity of local birds, the contribution of backyard poultry towards Indian egg production is about 21% (DADF, 2018). Backyard poultry farming by and large is a low input or no input venture maintained by rural families. Hence backyard poultry has a tremendous contribution in the upliftment of rural families with reference to socio-cultural and nutritional needs, thus boosting poultry sector of the country.

Table 1: List of indigenous chicken breeds of India (NBGAR, 2020)

S. No.	Name	Home tract
1	Ankaleshwar	Gujarat
2	Aseel	Chhattisgarh, Orissa and Andhra Pradesh
3	Busra	Gujarat and Maharashtra
4	Chittagong	Meghalaya and Tripura
5	Danki	Andhra Pradesh
6	Daothigir	Assam
7	Ghagus	Karnataka and Andhra Pradesh
8	Haringhata black	West Bengal
9	Kadaknath	Madhya Pradesh
10	Kalasthi	Andhra Pradesh
11	Kashmir Favorolla	Jammu and Kashmir
12	Miri	Assam
13	Nicobari	Andaman & Nicobar
14	Punjab brown	Punjab and Haryana
15	Tellicherry	Kerala
16	Mewari	Rajasthan
17	Kaunayen	Manipur
18	Hansli	Orissa
19	Uttara	Uttarakhand

Native breeds of fowl are used in rural and tribal family due because of their coping capability with varied and harsh agricultural conditions (Khan, 1984; Sonaiya, 1996; Kitayli, 1966; Sheldon, 1998; Begli *et al.*, 2010; Adbhai *et al*., 2019) but they are low producers of eggs and slow producers of meat. Therefore, to enhance the production rate of backyard poultry production, the improved varieties similar to indigenous fowl are now been introduced on a large scale. Many research institutions have developed different backyard chicken varieties in different parts of country (Singh *et al.*, 2018). Some recent review papers (Rath *et al.*, 2015; Adbhai *et al.*, 2019; Kumar *et al.*, 2019) have discussed different aspects of backyard poultry farming. However, none of the review papers, to our knowledge, has presented insights of backyard poultry farming in hilly regions. This review paper was framed with an objective of not only providing details about backyard poultry practiced in hilly regions but also attempts to provide different strategies to overcome the constraints for improvement of backyard poultry farming community.

Backyard Poultry Production

Backyard poultry is a low input or no input venture (Mandal *et al.,* 2006). As per an estimation, nearly 15% of total Indian poultry production is obtained from backyard poultry (Landes *et al.,* 2004). Features of backyard poultry production includes - poor productivity of birds (Rashid *et al.,* 1995), generally consumed in local market (Saha, 2003) may be due to poor feeding. These poultry birds mostly rely on scavenging (Okot, 1990) which was pointed to have insufficient nutrients for local chickens (Gunaratne, 2013), with less supplementary feeding (Dana, 1998). They undergo natural hatching of chicks (Singh and Pani, 1986) and no health care practices are provided to them (Dana, 1998, Saha, 2003). Generally, rural backyard chickens are low producer of meat and eggs (Ghosh *et al.,* 2005). Use of native breeds is common in backyard poultry production but some places are found to have crosses of these indigenous breeds too. Free range backyard native breeds contributed about 11 % of total egg production in India (Kumaresan *et al.,* 2008).

Government of India directs to help Below Poverty Line (BPL) persons to achieve subsidiary income and sustainable food for livelihood (Singh *et al.,* 2018). There are several governmental schemes such as Rural Backyard Poultry Development program (2009-10) has helped as many as 6.13 lakhs BPL people (DAH annual report, 2013-2014).

Backyard Poultry Farming in Rural Hilly Areas

In India poultry farming under backyard system is as old as its civilization (Randhawa, 1946). Poultry production system is being recognized as an entry point into livestock production system, which is associated with breaking out of poverty traps (Gueye, 2000). Backyard poultry is a manageable and encouraging enterprise to improve the socio-economic, nutritional status and poverty reduction of rural people, especially landless or poor families with low initial investment and high economic return (Chakrabarti *et al.,* 2014) because large shares of the rural poor are dependent on backyard poultry for food and income (Deka *et al.,* 2013). Landes *et al.* (2004) assessed that in India about 15% of total poultry output is derived from backyard poultry production. Omonona and Oni (2004) reported that poultry was one of the quickest ways for rapid increase in protein supply in the short run. Sonaiya (2007) reported that poultry production constitutes a fast and high-return investment opportunity for improving any one or all of these livelihood indicators (income, nutrition, food security, and savings and gender equality). Rosenzweig and Binswanger (1993) observed that in rural areas poultry functions as insurance to protect against stresses at places where credit markets are not located. Obi *et al.* (2008) reported that poultry functions as a "savings account" and helps poor people to meet household needs such as school fees and costs of weddings. India stands 3rd in egg production and 5th in broiler production in the world with annual production of 88 billion eggs and 3.46 million tonnes broiler meat (DADF, 2018). The present per capita availability of eggs and meat is 79 and 2.96 kg per annum respectively, is lesser than the recommendation of the nutritional advisory committee, ICMR i.e., 180 eggs and 10.8 kg poultry meat per annum (BAHS, 2019).

Thus, there is a huge gap between the supply and demand of the poultry egg and meat in India. To reduce this huge gap between demand and supply of poultry eggs and meat, there is a need of proper training of poultry rearing farmers and scientific poultry farming technique like proper and balanced feed supply, timely vaccination and better housing management. Meat and eggs produced from backyard poultry constitute a high-quality food source with essential macro and micronutrients as well as vitamins. Panda *et al.* (2008) reported that demand of eggs and meat in the rural areas could be met through backyard poultry rearing as observed by various researchers have sufficient amount of folate, selenium, vitamin D and vitamin K (Applegate, 2000). Vizard (2000) reported that eggs contain all the nutrients needed for the development of a chick as well as to meet human nutrition requirements. Eggs also contain two important nutrients named as lutein and zeaxanthin. Recent studies have shown that consuming lutein and zeaxanthin can significantly lower risk of blindness affecting people over the age of 65 and there is a less probability of cataracts (Kumar *et al.,* 2019). Poultry meat is an important source of protein, vitamins and minerals such as iron, selenium, zinc, vitamins as well as rich source of omega-3 fatty acids. Backyard chickens are a good source of minerals and vitamins because of their varied diet. Women empowerment through self-employment and entrepreneurship training in different socioeconomic sectors like backyard poultry sector results in new opportunities for up-liftment of socioeconomic status. Several workers (Nielsen *et al.,* 2003; Okitoi *et al.,* 2007) reported that though rural backyard poultry production cannot contribute more income but this poultry farming system improve the skill of most of the poor women and help them for boosting their socioeconomic and nutritional status. Hence, backyard poultry farming practices should be encouraged by government and non-government development agencies as it increases independent decision-making ability and the involvement of women in their

family affairs, which enhances the socioeconomic development of the rural sector. Singh *et al.* (2017) studied the usage pattern of the additional income from backyard poultry farming to improve socioeconomic standards and they found that farmers gave priority to essential facilities like electricity (23.48%), latrine (15.65%), bathroom (23.48%) and also 12.66% of farmers converted their Kaccha houses to Pucca houses and some farmers also bought luxury things like mobile (26.96%) and DVD player (0.87%). Iannotti *et al.* (2009) observed that 33 % and 30% of the surplus income from poultry rearing was used on education and food respectively. In India, poultry keeping in Tamil Nadu is a way for generation of income or main source of livelihood for people whereas in Rajasthan poultry were kept for household consumption or main source of family protein (Conroy *et al.*, 2005). Where the success rate has increased 1.5 times according to current census there are many constraints in this field which need to be eradicating to get the highest success rate. Limitations involved in this field are disease control, protection against virus predators, better feeds and medicine availability, separate house, improved breed, proper marketing, training and management for efficient backyard poultry farming, capital and farmer organization. Modern intensive backyard poultry farming methods, new breeds and improved preventive disease control measures have to incorporate to improve the traditional system and to fetch better income. But the scope is limited due to high input cost, its availability and skills required. It is suggested that the native chicken varieties adopted in the free-range backyard conditions in tribal areas have low productivity and their contribution to the total egg output is almost static for the last few decades.

Therefore, the consumption of eggs is far below then it is recommended by the ICAR. Increasing the genetic potential of the local chicken varieties greatly helps in increasing the availability of poultry products. The chicken varieties being used in the intensive poultry farming cannot survive in free-range, where the disease challenge is high, climatic variations are harsh, adverse and vary greatly from place to place and season to season. It is indicated that adapting the intensive poultry farming in small scale in tribal areas may not be economically viable due to limitations in management, high input cost and non-availability of inputs in rural/ tribal areas. However, due to non-availability of poultry products, the prices are up to double in tribal areas compared to those prevailing in the other part of the country. Therefore, it is necessary to popularize suitable chicken varieties, which can thrive in backyard free-range conditions without expensive inputs like commercial feed, supplement and medicine etc. Predator menace, harsh and diversified climatic conditions, diseases, consumer preferences, lack of commercial feed etc. are some of the major issues which need attention while popularizing birds suitable for free range backyard farming. Adapting rural poultry farming in backyards of household can ensure the availability of eggs and meat in rural and under developed areas; which will hail in alleviating the incidence of protein deficiency particularly in tribal and rural areas. Deka *et al.* (2013) have done a study in Jorhat district of Assam and constraints as perceived by the rural tribal community is displayed in the (Table 2) provided below.

Table 2: Constraints faced by tribal community in backyard poultry farming

Responses to constraints faced by tribal community in backyard poultry farming		
Constraints	**Frequency**	**Rank**
Mortality due to disease outbreak	100	(i)
Low production performance of native birds	91	(ii)
Low hatchability	84	(iii)
Early Chick mortality	84	(iii)
Non-availability of day-old chicks round the year	84	(iii)
Lack of financial support	67	(iv)
Lack of technical knowledge	52	(v)
Lack of feed ingredients	34	(vi)
Week market linkage	30	(vii)
Attack of predators	13	(viii)

In their study they (Deka *et al.*, 2013) found, mortality due to high incidence of disease was reported by all the respondents followed by low production potential of native birds (91%), low hatchability/ early chick mortality/ non -availability of day old chicks round the year (84%), lack of financial support (67%), lack of technical know- how (52%), lack of feed ingredient (34%), weak market linkage (30%) and attack of predators (13%) were the most serious constraints reported by the farmers.

In order to overcome the constraints there is need for introduction of hybrid variety suitable for backyard farming, skill up gradation on feeding, housing and disease prevention management, availability of day old chicks establishing hatchery in district level, development of mother unit of hybrid variety in block level to supply grown up chicks for the farmer round the year, credit linkage and establishment of market linkages can bring about a significant improvement in sustainable poultry production of the down trodden poor community. Nath *et al.* (2011) have done a study on adoption and constraints of scientific backyard poultry rearing practices in rural tribal areas of Sikkim and found that adoptions of scientific poultry farming depend on farmers' personal as well as social and economic condition. They have presented correlation coefficients of six independent variables in the (Table 3) presented below.

Table 3: Correlations of adoption of improved poultry rearing practices

Correlations of adoption of improved poultry rearing practices with independent variables		
S. No.	**Variables**	**Coefficient of correlation (r)**
1.	Age	0.547 **
2.	Education Level	-0.309 **
3.	Flock size	0.668 **
4.	Income from poultry	0.936 **
5.	Training received	0.475 **
6.	Credit facility	0.227 *

S.N. means serial number; "" means results are significant at p<0.05; "**" means results are significant at p<0.01*

These tables indicated the relationship between variables of poultry farmers with adoption behavior. Age had a significant relationship with adoption level, so it gave an idea that young generation might try to adopt new technologies in their farms. Education was negatively and significantly associated with adoption level as it indicates that educated persons had less interest to do farming than other government jobs. Flock size of poultry had a positive and significant relationship with adoption level. It indicates that farmers having large number of poultry in their farms adopted improved technologies in their farms and training received showed a positive and significant correlation with the adoption level of the respondents. Training might have given knowledge to the farmers to know the scientific poultry rearing practices. Financial help received was positively and significantly associated with adoption level. It indicated that those who received financial help either from government or financial institution adopted new technologies in their farms. They suggested for improving backyard poultry farming by making availability of good germplasm. The availability of high yielding varieties of backyard poultry chicks and feed can improve backyard chicken varieties. A small quantity of compounded layer feed should be provided to the birds with good germplasm because they won't be able to survive with only scavenging like local variety. Veterinary and health services, availability of veterinary aids and skilled persons for vaccination is important to survive the threat of disease. Supply of immunized birds to backyard is important. Predators are the devastating factor to the village poultry as chick stage is most vulnerable, so care should be taken at this stage. A proper marketing channel should be established so that the poultry farmers can get proper benefit from poultry and poultry products. To aggregate the produce, farmer's co-operative societies need to be facilitated at village or higher level.

Focus should be on augmenting the advantages of smaller decentralized units in terms of better efficiency, faster and better disease control. There are certainly some production technology advantages for poor; in terms of adaptability for scaling down and the significant labour component. It is important to conserve the indigenous gene pool and there should be check on introducing high yielding breeds of backyard poultry. It is necessary for an effective disease surveillance mechanism and quick response system to overcome related problems. There is also need for more information to update and validate existing constraints and opportunities in light of the land redistribution process and current economic challenges.

Important Features of Backyard Poultry Production

Breed/Strains

Climatic region has always favored the potential for production performance of different livestock breeds including poultry in different agro-climatic zones of India. According to several studies conducted over the year a well-known

dual-purpose breed Vanaraja chicken is much reared in hilly regions of the country alongside with desi birds. Vanaraja bird under backyard farming had been reported to derive much benefit in terms of more egg production and higher body weight and adaptability. In a study conducted by Roy *et al.* (2017) shows that the performance of Vanaraja breed of backyard chicken was comparatively better than RIR in hill agro-climatic region in West Bengal in terms of body weight gain and reduced mortality rate. Nath *et al.* (2012) showed that rural families of hilly tract in Sikkim showed much interest towards desi chicken and have been rearing desi or local birds as backyard poultry which are found to be effective. Vanaraja chicken could be effectively managed for egg and meat production with low expenditure under scavenging condition by rural women under agro-climatic condition of Assam as an entry point for promoting gender balance especially in rural areas (Deka *et al.,* 2014).

Improved Breeds of Indian Backyard Poultry

Steps adopted for developing improved chicken breeds dual type (Fig. 1), egg type (Fig. 2) and meat type (Fig. 3) in India (AICRP on Poultry, 2017) are as follows:

CB/ Improved broiler Germplasm X Local native

↓

(Farm) Evaluation of F1 --- (F1) X RIR/ DR --- and crossing with improved line

(50% Improved germplasm + 50% Local native)

↓

Crossbred evaluation under farm & field conditions

(25% Improved germplasm + 25% Local native + 50% RIR/ DR)

↓

Repeat of the above

↓

Selection of parental populations

Figure 1: Development of dual type chicken

Improved egg type breed/ line (RIR/ DR) X Local Native

↓

(Farm) Evaluation of F1 --- (F1) X RIR/ DR --- and crossing with improved line

(50% Improved Germplasm + 50% Local native)

↓

Crossbred Evaluation under farm & field conditions

(25% Local native + 75% RIR/DR)

↓

Repeat of the above

↓

Selection of parental populations

Figure 2: Production of egg type chicken

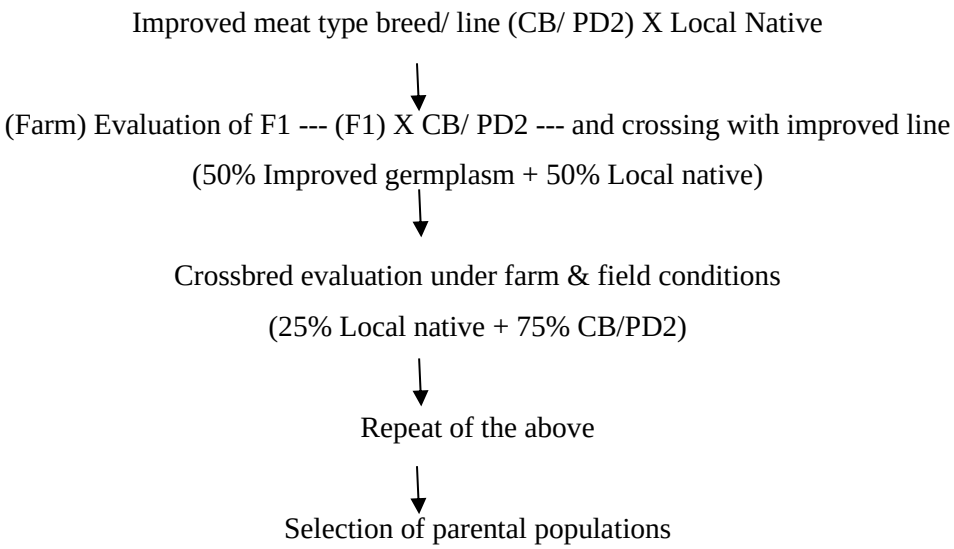

Figure 3: Creation of meat type chicken

Note: RIR – Rhode Island Red; DR – Dahlem Red; CB – Control Broiler; PD2 - Colored synthetic female broiler line

Salient Features of Improved Varieties of Chicken as Compared to Indigenous Chicken (Haunshi *et al.*, 2009)

List of important breeds developed at different organizations for backyard poultry farming is provided in tables (4).

1. Improved varieties have found to have significantly higher body weight (Both Average and sex specific body weight)
2. Higher age at sexual maturity
3. Better egg production rate with more mass
4. Mostly have brown colored egg shells
5. Heavier and Abridged plumage of body

Table 4: List of improved varieties/ strains of chickens developed at different organizations of India

Table 4.1: List of improved strains of dual type chickens

S. No.	Poultry breed	Purpose	Developing Organization	References/ URL
1	Jharsim	Dual	AICRP, BAU, Ranchi Centre	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
2	Kamrupa	Dual	AAU, Assam	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
3	Pratapdhan	Dual purpose	AAU, Assam	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
4	Cari Nirbheek	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
5	Cari Shyama	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
6	Hitcari	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
7	Upcari	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
8	Kadakanath x Dehlam Red	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
9	Aseel x Dehlam Red	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability

10	Naked Neck x Dehlam Red	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
11	Frizzle x Dehlam Red	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
12	Cari Priya layer	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
13	Cari Sonali Layer (Golden - 92)	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
14	Cari-Devendra	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
15	Caribro-Vishal (caribro-91)	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
16	Caribro-Dhanraja (Multi-Coloured)	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
17	Cari-rainbro (B-77)	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
18	Caribro-Mrityunjay (CARI Naked Neck)	Dual	CARI, Izatnagar	https://vikaspedia.in/agriculture/poultry/backyard-poultry/breeds-availability
19	Cari Gold	Dual	CARI, Izatnagar	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pf
20	Athulya	Dual	AICRP-KVASU, Mannuthy, Kerala	Rathod P. (2020). A Guide to Backyard Poultry Farming for Sustainable Livelihoods. Hyderabad 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. 28 pp. http://idc.icrisat.org/idc/wp-content/uploads/2020/02/Final-Backyard-Poultry-Farming_A5_Full-2.pdf
21	Gramapriya	Dual	DPR, Hyderabad	https://www.agrifarming.in/country-chicken-breeds-and-rearing-practices#:~:text=Country%20Chicken%20Breeds%20%E2%80%93%20UPCARI%3A%20I
22	Sinidhi	Dual	DPR, Hyderabad	https://www.agrifarming.in/country-chicken-breeds-and-rearing-practices#:~:text=Country%20Chicken%20Breeds%20%E2%80%93%20UPCARI%3A%20I
23	Vanaraja	Dual	DPR, Hyderabad	https://www.agrifarming.in/country-chicken-breeds-and-rearing-practices#:~:text=Country%20Chicken%20Breeds%20%E2%80%93%20UPCARI%3A%20I
24	Vanashree	Dual	DPR, Hyderabad	
25	Krishibro	Dual	DPR, Hyderabad	https://www.agrifarming.in/country-chicken-breeds-and-rearing practices#:~:text=Country%20Chicken%20Breeds%20%E2%80%93%20UPCARI%3A%20I
26	Himsamridhi	Dual	AICRP-CSKHPKV, Palampur, Himachal Pradesh	Rathod P. (2020). A Guide to Backyard Poultry Farming for Sustainable Livelihoods. Hyderabad 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. 28 pp. http://idc.icrisat.org/idc/wp-content/uploads/2020/02/Final-Backyard-Poultry-Farming_A5_Full-2.pdf
27	Narmadanidhi	Dual	AICRP-NDVSU, Jabalpur, Madhya Pradesh	Rathod P. (2020). A Guide to Backyard Poultry Farming for Sustainable Livelihoods. Hyderabad 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. 28 pp. http://idc.icrisat.org/idc/wp-content/uploads/2020/02/Final-Backyard-Poultry-Farming_A5_Full-2.pdf
28	Giriraja	Dual	KVAFSU, Bangalore	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
29	Girirani	Dual	KVAFSU, Bangalore	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf

30	Nandnam-99	Dual	PRS, Tamil Nadu	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
31	Krishipriya	Dual	KVASU, Kerala	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
32	Satpuda Desi	Dual	Dr. YAP Ltd., Jalgaon	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
33	SatpudaSPK	Dual	Dr. YAP Ltd., Jalgaon	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
34	Srinidhi	Dual	ICAR-DPR,Hyderabad, Telangana	Rathod P. (2020). A Guide to Backyard Poultry Farming for Sustainable Livelihoods. Hyderabad 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. 28 pp. http://idc.icrisat.org/idc/wp-content/uploads/2020/02/Final-Backyard-Poultry-Farming_A5_Full-2.pdf
35	Nico- rock	Dual	CARI, Portblair	Key points of Organic Poultry Farming. https://thepoultrypunch.com/2019/10/key-points-of-organic-poultry-farming/
36	Nandanam	Dual	IPPM, TANUVAS	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
37	IBB 83	Dual	AICRP, Bangalore	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
38	RAJA II	Dual	AICRP, Bangalore	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
39	Nandanam Chicken-1	Dual	TANUVAS, Chennai	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
40	Nandanam-Broiler II	Dual	TANUVAS, Chennai	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf

Table 4.2: List of improved varieties of egg type chicken

1	Krishilayer	Egg	ICAR-DPR, Hyderabad	Rathod P. (2020). A Guide to Backyard Poultry Farming for Sustainable Livelihoods. Hyderabad 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. 28 pp. http://idc.icrisat.org/idc/wp-content/uploads/2020/02/Final-Backyard-Poultry-Farming_A5_Full-2.pdf
2	Swarnadhara	Egg	KVAFSU, Bangalore	https://www.agrifarming.in/country-chicken-breeds-and-rearing-practices#:~:text=Country%20Chicken%20Breeds%20%E2%80%93%20UPCARI%3A%20I
3	Kalinga Brown	Egg	CPDO, Bhubhaneswar	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
4	Kaveri	Egg	CPDO, Bangalore	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
5	Gramalakshmi	Egg	KVASU, Kerala	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
6	Rajasri	Egg	SVV, Hyderabad	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
7	Krishna. J	Egg	JNKVV, Jabalpur	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous___lit.pdf
8	Nishibari	Egg	CARI, Portblair	Key points of Organic Poultry Farming. https://thepoultrypunch.com/2019/10/key-points-of-organic-poultry-farming/

Table 4.3: List of improved strains of meat type chicken

1	Charbo	Meat	CPDO, Bangalore	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous lit.pdf
2	Kuroiler	Meat	Kegg Farms, New Delhi	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous lit.pdf
3	A.V.M	Meat	A. V. M. Coimbatore	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous lit.pdf
4	B2	Meat	IPPM, TANUVAS	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous lit.pdf
5	Varna	Meat		KAU Agri-infotech portal. http://www.celkau.in/Animalhusbandry/Chicken/breeds.aspx

Table 4.4: Miscellaneous varieties of developed chickens

1	Caribro Tropicana	CARI, Izatnagar	https://cari.icar.gov.in/varieties_deve.php
2	Gramashree	KVASU, Kerala	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous lit.pdf
3	Rainbow Rooster	IRBF Pvt. Ltd., Hyderabad	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous lit.pdf
4	Shipra	Shipra Hacharies , Patna, Bihar	Indigenous & low input technology chicken. https://lpmstudy.weebly.com/uploads/1/1/9/9/119926340/indigenous lit.pdf

Housing Management

Good husbandry and housing are vital for the wellbeing of backyard poultry as it is for other livestock (Houghton-Wallace *et al.,* 2012). Appropriate housing and nutrition of backyard poultry are necessary to prevent overcrowding, stress and nutritional deficiencies that may predispose birds to illness (Grunkemeyer, 2011). Suitable housing also provide shelter from the wind and rain, protection against predators, provide dry, safe area to sleep and lay eggs (Kusina *et al.,* 2001). Similar in the case of other livestock species, housing of poultry is an important aspect of poultry rearing and lack of good housing systems by small farmers may become a prime reason for failure of this enterprise (Thakur *et al.,* 2013; Singh *et al.*, 2020a; Singh *et al*., 2020b; Thakur *et al.*, 2020). They also reported that majority of the farmers/beneficiaries constructed newer poultry sheds from locally available material such as mud, wood, wire mesh, bamboo etc to house their birds. About 97.5% households in India provided separate housing for their chicken as night enclosures (Mandal *et al.,* 2006) as indigenous night shelter system (Dana, 1998; Saha, 2003). Nath *et al.* (2012) found that all the farmer's rear backyard poultry in extensive system where they provide night shelter to their birds. Wooden sheds were constructed from locally available material that had two compartments (upper and lower) meant for younger and older stock (Thakur *et al.,* 2012).

Feeding and Watering Management

Feeding is the basic essential management practices in all livestock farming including poultry for better productive performance. However, inadequate feeding schedule greatly affects the health of the birds. Mapiye and Sibanda (2005) stated that timing and frequency of feeding, what, how to feed and quantity to feed are important aspects to consider in developing strategies to improve nutrition of village or local chickens. Mostly in the rural hilly areas, the birds scavenge feeds of their choice in the daylight hour. Scavenging is commonly seen by backyard chicken; in addition to that extra feeds that are offered are small amounts of cereals, which include millets, sorghum, and maize (Kyule, 2014). Nath *et al.* (2012) reported that the birds ate insects, earthworms, grass, grains, crop residue, kitchen left over and vegetable in the backyard poultry system of rearing. Pathak and Nath (2013) mentioned that maize is the main feed component for backyard poultry in rural areas. As per the findings of Thakur *et al.* (2017), all the households in rural hilly tract of Himachal Pradesh had resorted to open scavenging of birds in the vicinity of their houses for poultry feeding but they also provide concentrate feeding by quite high percentage (86.79%) due to easily availably of maize/rice/wheat grains in the region. Kothandaraman *et al.* (2019) found that most of the rural farmers reared birds in free-range/backyard system with little supplementary feeding. Thakur *et al.* (2012) reported that none of the family was providing any nutritional supplementation to the birds. Generally these supplementary feeds are offered to the chicken by throwing feeds on ground in front of chickens. Supplementing chickens with nutritious feeds is always helpful for them to grow. It yields high flock size, high growth and less

prone to diseases (Ogle *et al.*, 2004). Desalew *et al.* (2013) and Moges *et al.* (2010) found about 96% of respondents were provided water free to access. Farmers should be trained to formulate good and economic rations. This will improve overall performance of chickens.

Brooding Management

Brooding, in case of backyard poultry farming, is done by hen only. She will use its body temperature to give warmth to very young chicks. Provision of some cushioning material like rice straw, husk, finely chopped *bhusa* will help in this regard. Regular feeding and watering should be made available to them in this period. Artificial brooding can be provided to chicks up to 6 weeks of age to maintain body temperature and hence to reduce the mortality of young chicks. Brooding materials can be prepared in a cost-effective manner by locally available resources such as bamboo, woods or metals of low cost. Electric bulbs (2 Watts/chick) are used as source of heat to the chicks (Pathak and Nath, 2013). Availability of a breeding unit along with chick centers at block level will help in improving the rural backyard poultry farming.

Litter Management

Litter management in poultry farming plays a vital role in curbing the disease occurrence in the farm. In deep litter system of rearing, litter material is used. Litter helps to absorb the moisture from the poultry droppings and it helps in easy management of floor of the house. Apart from this it also provides warmth in winter and coolness in summer. Litter should be light, friable, non-compressible, absorbent, quick to dry, of low thermal conductivity and very important, cheap. Wood shavings, sand, wood dust, rice husk, finely chopped straws, etc. are common, readily and cheaply available materials as litter for chickens. The thickness of the litter should not be less than 5-10 cm and it can also be treated with slaked lime to avoid caking (Pathak and Nath, 2013). Litter should be frequently stirred and changed on regular basis for proper cleanliness and hygiene. Improperly managed litter causes serious health problems in the birds which are derived from dried feces, feathers, skin and litter. Their adverse effects arise because they carry or incorporate bacteria, fungi and gases.

Health Care Management

Health care facilities for backyard chicken are negligible. High mortality is majorly seen backyard rearing. Hussain *et al.* (2017) found that none of the respondents was known to vaccinate their chicks. No systematic care was taken with regard to the avian diseases and even vaccination of the birds was not carried out in the villages (Kothandaraman *et al.*, 2019). Thakur *et al.* (2013) found that most of the farmers used herbal medicines for routine poultry infections as they are easily accessible, inexpensive and apparently effective. Rahman (2017) found that all farmers did not practice vaccination and deworming of birds and mortality rate in birds due to Ranikhet disease was the highest, followed by fowl pox, greenish diarrhea, respiratory problems etc. Vaccination schedule must be strictly followed to obtain profitable results. Animal husbandry departments of states as well as centre need to formulate and implement good policies in this regard.

There are many other reasons of such mortality right from poor housing, harsh weather, diseases, parasites and predators. It was found that Newcastle disease (ND) in scavenging chickens in India was not the major cause of mortality but the main cause was predation, by birds of prey and mammals (Conroy *et al.*, 2005). Eggs are collected and stored mostly in pot over husk/ bhusa to protect from getting it broken. No use of any chemical is done to preserve them. Chickens can be slaughtered and used for home consumption when needed.

Constraints

Poultry farmers face a significant variance of constraints in adoption of backyard poultry farming. Lack of technical knowledge (71.50%), high mortality in day old chicks (63.50%), less availability of chicks and its feed (51.00%), economic problems (48.00%) were the major constraints perceived by backyard poultry farmers in adoption of poultry farming in hill areas (Singh *et al*., 2016). In another study conducted by Kothandaramani *et al.* (2019) revealed that mortality due to high incidence of disease were the major constraint which was reported by all the farmers, followed by lack of suitable germplasm (91.25%), attack of predators (86.67%), hatching mortality (75.00%), lack of financial support (67.50%) and high cost of inputs/chicks (54.56%). Sailo and Rahaman (2017) conducted a study on backyard poultry farming and also reported that high mortality due to disease outbreak,

complaint by neighbors and predators problem were the main constraints in backyard poultry farming as perceived by the respondents. In another study conducted by Thakur *et al.* (2012) opined that lack of superior native germplasm, predators and health disorders were major constraints in promoting poultry enterprise in hilly regions of the country. Singh and Jilani (2005) also reported in a study that non-availability of day-old chicks, infrastructure facilities, high mortality rate of day-old chicks, non-availability of vaccines and medicines were the main constraints in Garhwal Himalayan region. Nath *et al*. (2012) found that the input (82.25%), economical (74.60%), veterinary / health service (73.50%) and market (63.5%) were the major constraints in the North Sikkim. Rahman (2017) also conducted study on backyard poultry farming and reported that non-availability of improved fowls for rearing, predators and occurrence of disease were the constraints. Nath *et al.* (2012) reported that non availability of backyard poultry chicks, non-availability of medicine, high incidence of diseases, lack of knowledge about scientific practices, lack of market, attack of predators etc. were the major constraints faced by backyard poultry farmers.

Strategies to Improve Backyard Poultry Farming in India

Self-help Groups (SHGs)

Formation of self-help groups is one of the best approaches for rural development. It is a financial intermediary committee usually composed of 10 to 20 local women or men between 18 to 40 years. More than 70% of farm work is done by women in India (Chayal *et al*., 2013). Women farmers do not have equal access to productive resources and this significantly limits their potential in enhancing productivity. SHGs provide financial stability which in turn helps empowerment of women in Backyard poultry farming (Singh *et al*., 2018).

Training Programs

Backyard poultry farming practices should be encouraged by government and non-government development agencies by arranging training programs for the women and unemployed youths of the rural area. Skill up gradation of these farmers should be given importance on regular basis with respect to scientific feeding, housing and disease prevention management and adoption of improved technologies in their farm.

Insurance

For the sustainability of the backyard poultry farming, mortality due to predation and disease are the most important concerns. Community managed bird insurance should be taken out to protect flock against these threats, as well as to ensure the replacement of properties.

Vaccination

Village residents may be trained for vaccination of chicken. Total vaccination can be scheduled by SHGs at the level of the village or gram panchayats. Help of animal husbandry department is essential to organize vaccination at rural level through trained women vaccinators.

Establishment of Hatcheries

Availability of day-old chicks through the establishment of hatcheries at district level, development of hybrid variety mother unit at block level is most important factor to provide grown up chicks for the farmers throughout the year. Selling immunized chicks at reasonable rate can attract the farmers towards poultry rearing (Sheikh *et al*., 2018).

Marketing Facilities

At present scenario middlemen in poultry industry leaves nothing fruitful for farmers. The middlemen always seek opportunity to grab highest benefit from the trade at cost of poor farmers and consumers. To overcome this problem, awareness program for the farmers in setting up of their own retail outlets where nearly 20 per cent of their produce can be marketed directly should be done by Animal Husbandry Department. Establishment of Poultry Mandis on the analogy of Fruit Mandis at every District Headquarter is most essential where the farmers and retailers shall be handling the market directly.

Conclusion

Improved backyard poultry farming may play a vital role in sustainable rural development. Better management practices are anticipated to improve the productivity and profitability of the backyard poultry. Major challenges are unavailability of superior germplasm, poor health services, improper housing and high mortality. Overcoming these challenges to a considerable level in coming couple of years will boost up farmers income from improved backyard poultry husbandry. Use of native as well as improved breeds will increase the production as per the demand of local market. Improved backyard poultry farming is anticipated to provide substantial food security to small and marginal farmers along with generating considerable income for their sustainable development.

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Conflict of Interests

There is no conflict of interest.

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