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The Status of Laying Traits in Indigenous Chicken of Bangladesh: A Review

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ABSTRACT

This paper covers the review of diversified performance of laying traits of Bangladeshi indigenous chicken in both *in situ* and *ex situ* including few global studies. Indigenous chicken constitutes about 80% of the total chicken population in Bangladesh and their different genotypes distribute throughout the country having distinct morphological and productive characteristics. The common native genotypes (usually non-descript or *deshi*) provide 35-45 eggs annually with 83-96% egg fertility and 75-88% hatchability in free range while better performance is observed in extensive system. Although Naked Neck and Hilly chicken genotypes perform superior but they are not available like common *deshi*. The genetic improvement of laying traits is a challenging work for the village chicken in Bangladesh, however, the planned breeding strategies along with improvement management system could enhance the activity. The results presented in this review would be a guideline for selection of indigenous chicken to improve further its productivity and conservation aspect. Thus, a conceptual breeding strategy is proposed here for the improvement of laying traits in village chicken *in-situ* as uncontrolled mating occurs there compared to *ex-situ* condition.

Key words: Breeding strategies, Community breeding, Egg, Fertility, Hatchability, Native, Production.

Bangladesh is an agro-based country where its livestock contributes 2.79% of GDP and 17.15% of agricultural share (IUCN, 2011). Livestock rearing is a vital part of rural small or medium scale farming where the most popular poultry species is indigenous or native chicken followed by duck and pigeon under traditional or backyard (*in situ*) management system. About 130 million native chickens are distributed throughout the country (Sørensen, 2010) occupying 80% of the total chicken populations (DLS, 1998) and contribute a large part of meat (78%) and egg (75%) production locally (Bhuiyan *et al.,* 2005).

Bangladeshi native chicken are mainly classified into common native birds of non-idiosyncratic type or Non-descript (*Deshi* or ND), Naked Neck (NN), Hilly (H), Aseel, Yasine, Frizzle plumage and Native dwarf genotypes where *Deshi* chickens constitute about 90% of the total native chicken population and others are endangered or critically endangered or extinct (Bhuiyan *et al.,* 2005; Das *et al.,* 2008). The indigenous chicken genotypes of Bangladesh are considered as one breed for small genetic distances among them (Okada *et al.,* 1987), but their performance and morphological characters are distinct from each other. The village chicken is characterized by 35-45 eggs annually (Bulbul, 1983; Ahmed and Islam, 1985; Sazzad *et al.,* 1990; Huque and Huque, 1990; Amin and Bhuiyan, 1995; Ershad, 2005). Among the available indigenous chicken genotypes in Bangladesh, Naked Neck is still considered superior for egg production and quality (Barua *et al.*, 1992; Islam and Nishibori, 2009; Faruque *et al.,* 2013). Native chickens are a huge treasure of variable genotypes (Yeasmin and Howlider, 1998) and the reservoirs of various adaptive traits controlling useful genes (Horst, 1989).

As huge studies are performed with village chicken so far, a summarized review including all the vital laying traits is required to screen and further decision making on the development of those native chicken genetic resources. Therefore, the laying performance traits of indigenous chicken located in various geographical locations or agro-ecological zones in both free range and intensive systems are described here. In addition, the effects of possessing various plumage colours, genotypes and age on laying traits of Bangladeshi indigenous chicken are also shown along with research based justifications of other countries.

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Effect of geographical location on laying traits of indigenous chicken

The laying performance of indigenous chicken studied in different districts or agro ecological zones of Bangladesh has been depicted (Table 1). Age at first laying was observed earlier in the hen of Rajshahi district (Dutta *et al.,* 2013). Clutch length of chicken was found lower in Sherpur district (Shahjahan *et al.,* 2011) than south part of country at Noakhali after early weaning of chicks from hens (Sarkar and Bell, 2006). Sarkar and Golam (2009) identified an average 14.60 eggs per clutch and 3.10 clutches per year in local chicken of different districts of Chittagong division but annual clutch number was found higher in Mymensingh

district (Shahjahan *et al.,* 2011) followed by Saver region of Dhaka (Sazzad, 1993). The average annual egg production (68 eggs), egg weight (42.71 g) and hatchability (87.11%) were recorded highest in northern parts (Ahmed *et al.,* 2012) while fertility (93.83%) was in western parts (Dutta *et al.,* 2013) of Bangladesh. These variations in performance could be the results of individual genetic background, availability of feed or nutrients and care of birds.

In Ethiopia, Tadelle *et al.* (2003) studied egg production of native chicken in five ecotypes where average egg production per clutch (17.70 eggs) was found higher than the findings of Bangladesh but annual clutch number (2.60) was lower. Another experiment in Ethiopia by Mogesse (2007) depicted that age at first laying in the local chicken of Debre Elias (143.67 days) was lowest and Melo-Hamusite (168.33 days) ecotypes recorded highest out of seven ecotypes which was in concurrence to our country's findings.

Effect of plumage colours (gene pooled) on performance of local chicken

Various plumage colours were observed in the indigenous chicken while few of those appeared predominantly. Thus, gene pooled predominant plumage colours remain as a subject of interest for a basic traditional tool of selection, although studies are very limited in this aspect. The laying traits (Table 2) of Bangladeshi native chicken identified by Shahjahan *et al.* (2011) were based on six predominant plumage colours (Fig 1) while lower production was reported previously by Islam *et al.* (2007).

Table 1: Performance of indigenous in different region of Bangladesh.

Trait	Value	District or location	Reference
Age at first laying (d)	175	Jessore	Ershad (2005)
	151.67	Rajshahi	Dutta *et al.* (2013)
	192.60	Sherpur	Shahjahan *et al.* (2011)
	216	Mymensingh	Shahjahan *et al.* (2011)
Clutch length (d)	21	Noakhali	Sarkar and Bell (2006)
	16.83	Sherpur	Shahjahan *et al.* (2011)
	19.68	Mymensingh	Shahjahan *et al.* (2011)
Egg per clutch	14.60	Feni, Noakhali and Luxmipur	Sarkar and Golam (2009)
	15.23	Sherpur	Shahjahan *et al.* (2011)
	16.32	Mymensingh	Shahjahan *et al.* (2011)
Clutch per year	3.50	Dhaka	Sazzad (1993)
	3.10	Feni, Noakhali and Luxmipur	Sarkar and Golam (2009)
	3.17	Sherpur	Shahjahan *et al.* (2011)
	3.63	Mymensingh	Shahjahan *et al.* (2011)
Annual egg production	42	Dhaka	Sazzad (1993)
	44	Jessore	Ershad (2005)
	40-54	Noakhali	Sarkar and Bell (2006)
	45.50	Feni, Noakhali and Luxmipur	Sarkar and Golam (2009)
	68.27	Gazipur and Mymensingh	Ahmed *et al.* (2012)
	40.42	Rajshahi	Dutta *et al.* (2013)
Egg weight (g)	36.27	Jessore	Ershad (2005)
	42.71	Gazipur and Mymensingh	Ahmed *et al.* (2012)
Fertility (%)	93.83	Rajshahi	Dutta *et al.* (2013)
Hatchability (%)	66.67	Noakhali	Sarkar and Bell (2006)
	82.90	Feni, Noakhali and Luxmipur	Sarkar and Golam (2009)
	87.11	Gazipur and Mymensingh	Ahmed *et al.* (2012)
	85.67	Rajshahi	Dutta *et al.* (2013)

Table 2: Performance of laying traits in indigenous chicken based on predominant plumage colours.

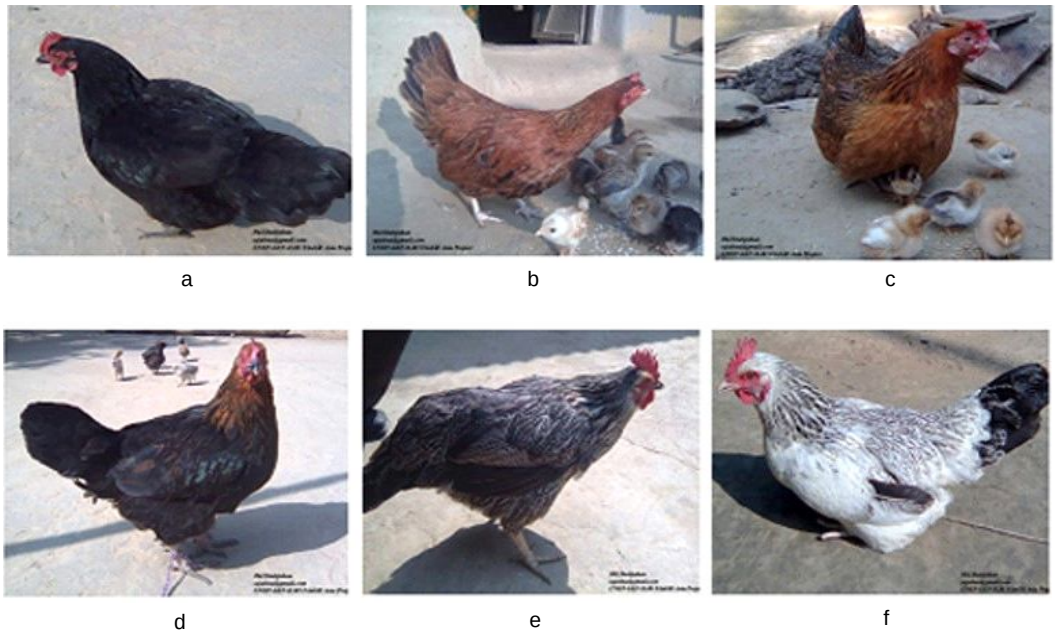
Trait	Predominant plumage colour						Reference
	Black	Red	Blackish red	Reddish black	Whitish black	Blackish white	
Egg per clutch	13.31	-	13.43	-	-	11.71	Islam *et al.* (2007)
	16.00	16.18	14.77	16.06	16.50	13.14	Shahjahan *et al.* (2011)
Clutch per year	3.25	3.32	3.03	3.41	3.00	3.00	Shahjahan *et al.* (2011)
Annual egg production	51.63	53.41	45.49	55.41	49.00	39.43	

Effect of genotype and age on the performance of laying traits in native chicken

Reproductive efficiency and egg production

The reproductive efficiency and egg production performance of indigenous chicken genotypes (Fig 2) of Bangladesh are presented in Table 3. Early sexual maturity is an important trait for egg production in hen which was revealed by laying of first egg. The findings of Faruque *et al.* (2007), (2010), (2013) and (2015) were investigated lower days for laying first egg in ND (155-157 days), NN (152.70-156.10 days) and H (152.10-159.10 days) chicken genotypes in *ex situ* which could be the reasons of better management and systemic selection overtimes in case rearing which was supported the findings of Dutta *et al*. (2013) at *in-situ* condition with better management too. But delayed sexual maturity was observed by Shahjahan *et al*. (2011) for laying first egg in ND/FF (203 days) and NN (202 days) genotypes were in agreement with the results of Barua (1992) for ND hen and Jahan *et al.* (2017) for NN chicken. Moderate sexual maturity in common *deshi* hen (ND) was identified within 175 days (Huque, 2001; Jahan, 2013) which was supported by the findings of Yeasmin *et al.* (2003). Similar observation was also reported in NN (234 days) and Aseel (240-300 days) genotypes by Huque (2001). Ahmed *et al.* (2012) found 14.93 and 15.18 days of clutch length in ND and NN hens, respectively. Another type of ND chicken named Cap Headed (CH) showed the average age at first laying in 182 days, 16.43 days length per clutch, 15.43 eggs per clutch, 3.50 clutch per year and 46 eggs annually (Shahjahan *et al.,* 2011) which was also supported by Jahan (2013).

The study of Shahjahan *et al.* (2010) revealed height egg production per clutch in village chicken at 37-66 month of age (17.33 egg) while Islam *et al.* (2007) showed comparatively lower at 25 months or above age (14 eggs per clutch) in village chicken of Bangladesh. The annual egg production of native ND hen was studied 35-40 (Sazzad *et al.,* 1990), 35-45 (Bulbul, 1983; Amin and Bhuiyan, 1995)



a b c

d e f

Fig 1: Six predominant (gene pooled) plumage colours in indigenous chicken; (a) Black, (b) Red, (c) Blackish red, (d) Reddish black, (e) Whitish black and (f) Blackish white. (Source: Shahjahan *et al.,* 2011).

a b c

Fig 2: Available indigenous chicken genotypes of Bangladesh: (a) Non-descript/Full Feathered/Common *Deshi* (ND/FF), (b) Naked Neck (NN) and (c) Crested/Crown/Cap Headed (CH) (Source: Shahjahan *et al.,* 2011).

and 40-45 (Ahmed and Islam, 1985; Huque and Huque, 1990; Ershad, 2005) which was supported by the findings of Sarkar and Bell (2006) and Sarkar and Golam (2009). Huque (2001) reported annual egg production in ND (45-50 eggs) and Aseel (33 eggs) genotypes of Bangladesh. The observation of Yoshimura *et al.* (1997) pertaining to annual egg production (50-55 eggs) of NN hen did not match with the results of Ahmed *et al.* (2012) who was found higher annual egg production in NN (71 eggs) and ND (67 eggs) genotypes. Paul and Huque (1996) also confirmed better annually egg production in NN (99 eggs) and H (91 eggs) genotypes but similar productive trait was not found in Yasine (58 eggs) and Assel (34 eggs) in *ex situ*. More than double laying performance (up to 99 eggs and 5.53 clutches per year) could be possible in free range by little changes in management practices like early weaning and creep feeding (Sarkar and Bell, 2006) which was agreed with Khan (1983) in intensive system.

In India, Sunder *et al.* (2005) and Sharma (2004) observed delayed age at first laying on 186 and 203 days in native hen, respectively, which were in agreement with the data of Bangladeshi native chicken. But early maturity age was comparatively lower to the Indian improved backyard Vanaraja (152 days), Gramapriya (145 days) breeds except in Aseel (184 days) chicken (Sree *et al.,* 2017). Benabdeljelil *et al.* (2001) supported the previous reports for age at first laying in the native Beldi chicken genotype with an average of 3 clutches per year, 13.5 eggs per clutch and 78 eggs annually in Morocco. The experiment of Farooq *et al*. (2003) confirmed maximum 14 days for clutch length in different seasonal variation of Pakistani *deshi* hen. Mwalusanya *et al.,* (2001) studied the average performance of Tanzanian native chicken on eggs per clutch (11.80), clutches per year (2.68) and annual egg production (31.60) which were lower than our country's findings mentioned before but similar results were observed in the traits of clutch length per year, egg per clutch and annual egg production in Ethiopian Shayi (4, 13 and 52), Selamber (4, 15 and 60) and Bechi (4 clutch per year, 14 eggs per clutch and 56 eggs annually) chicken, respectively (Abegaz and Gemechu, 2016). Petrus (2011)

Table 3: Reproductive efficiency and egg production performance of native chicken genotypes in Bangladesh.

Trait	Genotype				Reference
	Deshi (ND/FF)	Naked Neck (NN)	Hilly (H)	Assel	
Age at sexual maturity (d)	225				Barua (1992)
	175	234		240-300	Huque (2001), Ershad (2005)
	169				Yeasmin *et al.* (2003)
	155-157	152.70-156.10	152.10-159.10		Faruque *et al.* (2007), (2010), (2013) and (2015)
	203	202			Shahjahan *et al.* (2011)
	133-168				Dutta *et al.* (2013)
	175	185			Jahan *et al.* (2017)
Clutch length (d)	18.07	20.50			Shahjahan *et al.* (2011)
	14.93	15.18			Ahmed *et al.* (2012)
Egg per clutch	12-18				Sarkar and Bell (2006), Sarkar and Golam (2009)
	15.64	18.88			Shahjahan *et al.* (2011)
	13.47	19			Shahjahan and Bhuiyan (2016)
	11.04	12.03			Jahan *et al.* (2017)
Clutch per year	3-4				Sarkar and Golam (2009)
	3.38	3.63			Shahjahan *et al.* (2011)
	2.75	3.50			Shahjahan and Bhuiyan (2016)
Annual egg production	35-45			24-48	Bulbul (1983), Ahmed and Islam (1985), Huque and Huque (1990), Sazzad *et al.* (1990), Amin and Bhuiyan (1995), Ershad (2005), Sarker *et al.*, (2011), Huque (2013)
	135	99	91	34	Khan (1983), Paul and Huque (1996)
		50-55			Yoshimura *et al.* (1997)
	45-50			33	Huque (2001)
	40-54				Sarkar and Bell (2006)
	36-68				Sarkar and Golam (2009)
	50	53			Shahjahan *et al.* (2011)
	67	71			Ahmed *et al.* (2012)
	84	74	76		Faruque *et al.* (2015)

pointed out genotype and age pool annual egg production of indigenous chicken in Senegal and Kashmir (50-60 eggs) and Morocco (60-80 eggs) which were agreed with most of our country's findings but was not similar with Jordan (18-30 eggs), Somalia (100-144 eggs) and Namibia (100-150 eggs) and other Indian improved backyard chicken breeds *viz.* Vanaraja (160 eggs), Gramapriya (178 eggs) and Aseel chicken (62 eggs). However, due to the variation of two managements in the indigenous chicken rearing at Egyptian rural areas, it was found that there was an average of 183 and 87 eggs annually in full adoption package group and non-adoption package groups, respectively (Hamouda *et al.,* 2018) which were partially agreed with our findings.

Fertility and hatchability

In free range, it was observed that egg fertility and hatchability (Table 4) waslower (Hoque *et al.,* 1975; Barua, 1992; Sarkar and Golam, 2009) in common *deshi* (ND) chicken than intensive system (Islam *et al.,* 2001; Khatun *et al.,* 2005) except Dutta *et al.* (2013) who stated maximum 96% fertility and 88% hatchability and also Shahjahan *et al.* (2011) reported in ND (88.74%), NN (93.50%) and CH (89.20%) types of chicken while highest records were identified at 16-20 months of age group (90.64%) in the rural area of Bangladesh. Faruque *et al.* (2010) and (2013) studied egg fertility and hatchability on ND, NN and H genotypes in intensive system which was not in agreement with Huque and Salahuddin (2001) who pointed out much lower egg fertility and hatchability in NN, H, Assel and Yasine chicken genotypes of Bangladesh in same rearing system. In extensive system, average egg hatchability performance (85-87%) of native chicken could be influenced by incubation system (Bhuiyan *et al.,* 2005), availability of feed and routine physical exercise (Das *et al.,* 2008), egg fertility and hygiene, seasonal temperature and humidity, size and number of incubated eggs and body surface of hen. In addition, eggs fertility of hen mainly depends on the availability of breeding cock, maturity of chicken with functional gonads, nutritional and hormonal balance, mating preference, timing and sperm quality. However, the best HDEP (51.40%) and HHEP (49.70%) production were observed in ND chicken genotypes compared to others (Faruque *et al.,* 2015).

Hossary and Galal (1994) studied on fertility (87-96%) and hatchability (77-89%) for Egyptian Fayoumi native hen at one year of age in intensive care which was similar to the results of Bangladeshi village chicken and these results were supported by the findings of Abegaz and Gemechu (2016) for hatchability percentage in Ethiopian Shayi (80%), Selamber (82%) and Bechi (78%) chicken in confined areas. In addition, such hatchability percentage was supported by Khank (2004) of Vietnam and Mwalusanya *et al.* (2001) of Tanzania and showed slightly lower in Beldi chicken (71%) of Morocco (Benabdeljelil *et al.,* 2001). Mogesse (2007) reported 85-100% fertility in Ethiopian native chicken. In Pakistan, Parveen *et al.* (2013) stated season-based hatchability of native chicken in winter (65.43%), summer (49.70%) and rainy (44.45%) seasons which were much lower than previous studies.

Egg weight, feed conversion ratio and egg quality

The egg weight, feed conversion ratio to egg mass and various egg quality traits of Bangladeshi indigenous chicken genotypes in different ages are presented in Table 5. In scavenging system, several findings by Barua and Howlider (1990), Amin and Bhuiyan (1995), Ershad (2005) and Islam and Dutta (2010) reported average egg weight was around 35-40 g in native ND hen, although Ahmed *et al.* (2012) identified 42.07 g in ND and 44.17 g in NN chicken genotypes. In intensive system, Faruque *et al.* (2010) and (2013) recorded egg weight in ND, NN and H genotypes but they found lower egg weight in the age of sexual maturity for those chickens. These findings are also supported by Yeasmin *et al.* (2003) for the weight of first laying egg (29.76 g) and 46 week's egg (37.76 g) in ND genotype. Khan (1983)

Table 4: Egg fertility, hatchability and production percentage of local chicken genotypes in Bangladesh.

Trait	Genotype					Reference
	Deshi (ND/FF)	Naked Neck (NN)	Hilly (H)	Assel	Yasine	
Fertility (%)	83					Hoque *et al.* (1975)
	91-96					Dutta *et al.* (2013)
		71.50	52	53	57.80	Huque and Salahuddin (2001)
	92.7	87.60				Islam *et al.* (2001)
	94.86	88.09	88.40			Khatun *et al.* (2005)
	85.70-94.39	84.95-95.00	85.20-97.57			Faruque *et al.* (2013) and (2015)
Hatchability (%)	75	43.10	46.10	26	60.70	Barua (1992), Huque and Salahuddin (2001)
	84-88					Sarkar and Golam (2009), Dutta *et al.* (2013)
	86.38-89.00	57.66-77.50	77.82-85.60			Faruque *et al.* (2010), (2013) and (2015)
	88.74	93.50				Shahjahan *et al.* (2011)
HDEP (%)	51.40	48.10	44.00			Faruque *et al.* (2015)
HHEP (%)	49.70	42.80	41.70			Faruque *et al.* (2015)

and Yeasmin and Howlider (1998) observed feed conversion ratio 8.8 in local *deshi* (ND) chicken for egg mass production. Yeasmin and Howlider (1998) and Islam and Nishibori (2009) reported different egg quality traits of NN genotypes where dry matter of albumen (12.70-14.90%) was the common trait among the studied different traits on egg quality. Yeasmin and Howlider (1998) found comparatively lower values than NN in average egg weight (33.50 g), yolk index (0.390), yolk dry matter (51.03%), albumen index (0.080), dry matter of albumen (13.43%) and Haugh Unit (81.26) per egg in autosomal indigenous dwarf (adw) chicken genotype of Bangladesh.

In Kenyan native chicken, average egg weight of dwarf (38.1), normal (42.5) and NN (45.8 g) genotypes (Njenga, 2005) showed similar data to our country's findings which were partially agreed with the studies of Sunder *et al.* (2005) on Nicobari native hen (46.70-48.20 g) and improved native chicken breeds Vanaraja (51 g), Gramapriya (49 g) and Aseel chicken (41 g) of India (Sree *et al.,* 2017). In case of improved backyard chicken in West Bengal of India, the average weights of first laid egg were 49.80 g, 51.20 g and 41.40 g in Gramapriya, Vanaraja and Haringhata breeds, respectively (Roy *et al.,* 2018) while in another study of Egyptian native chicken at 46 and 94 weeks revealed that the egg weights were 44.26 and 28.60 g respectively (Hamouda *et al.,* 2018). The FCR for egg mass was recorded 10.50-16.20 in Ethiopian local chicken at 22-44 weeks of age (Mogesse, 2007). This study also pointed out egg weight (34.11-41.75 g), yolk colour (3-4), yolk weight (10.81-13.34 g) and Haugh Unit (55-65) which were lower than Bangladeshi research findings (Islam and Nishibori, 2009; Ahmed *et al*. 2012; Faruque *et al.,* 2010 and 2013) and similar to the parameters of egg weight (40.73 g) and yolk weight (13.03 g) in indigenous Fulani chicken of Nigeria (Fayeye *et al.,* 2005).

Conceptual breeding strategies for improving laying traits in village chicken

Genetic improvement of indigenous chicken is difficult in the rural (*in-situ*) areas because of uncontrolled mating, poor management and irregular vaccination or deworming. However, several attempts for upgrading or crossbreeding

Table 5: Egg weight, FCR and egg quality in indigenous chicken genotypes of Bangladesh**.**

Trait	Genotype			Reference
	Deshi (ND/FF)	Naked Neck (NN)	Hilly (H)	
Egg weight (g)				
Average	35-39	39.99	38-56	Amin and Bhuiyan (1995), Ershad (2005), Barua and Howlider (1990), Yeasmin and Howlider (1998)
		37.90-40.50		Islam and Nishibori (2009)
	40.04			Islam and Dutta (2010)
	42.07	44.17		Ahmed *et al.* (2012)
	42.94-43.50	44.15-45.49	40.32-43.24	Faruque *et al.* (2010) and (2013)
At sexual maturity		25.8-26	26.7-27.11	Faruque *et al.* 2013
Laying of 1st egg	29.76			Yeasmin *et al.* (2003)
Laying on 46 weeks	37.76			
FCR (feed: egg mass)	8.60-8.80			Yeasmin and Howlider (1998)
	8.80			Khan (1983)
Egg mass (g/d/bird)	16.74			Yeasmin *et al.* (2003)
Egg mass volume (cm^3)	34.99			Islam and Dutta (2010)
Egg quality				
Albumin height (mm)		4.10-5.30		Islam and Nishibori (2009)
Albumin width (cm)		6.30-7.10		
Albumin weight (g)		18.40-20.70		
Dry matter of albumin (%)		12.70-14.90		
Yolk height (mm)		16.20-17.40		
Yolk width (cm)		3.70-3.80		
Yolk colour		3.10-4.60		
Yolk weight (g)		12.30-14.40		
Yolk index (%)		0.39		Yeasmin and Howlider (1998)
Yolk dry matter (%)		52.27		
Albumen index (%)		0.08		
Dry matter of albumen (%)		14.24		
Haugh unit (%)		82.23		

was conducted in the early of 1970s for the development of indigenous chicken in Bangladesh using White Leghorn, New Hampshire and White Cornish birds with indigenous chicken (Hoque *et al.,* 1975). In another backward poultry development programme during 1970s carried out by Bangladesh Agricultural University (BAU) and UNICEF, farmers were suggested to dispose their native cocks from flock and exotic breeding cocks of Rhode Island Red (RIR) or White Leghorn (WLH) × RIR or Australorp cocks of 18-20 weeks were distributed in 100 rural villages with the aim to produce 50% Local-50% Exotic crossbred chicken (Ahmed and Islam, 1985). After that the government's initiative for the improvement of native chicken was undertaken through improved exotic cockerel (WLH, RIR, Fayoumi) exchange programme in the country which was continued up to 1990s (Bhuiyan *et al.,* 2005). The collaboration of Bangladesh Livestock Research Institute (BLRI) with several national and international organizations was introduced toimprove the *deshi* cocks in different districts of Bangladesh for the genetic improvement of native chicken. Unfortunately, all the aforementioned activities were not succeeded in respective goals perfectly or facing various difficulties so far. Considering all, strict breeding strategies (Fig 3) are required to control the desired breeding programme including upgraded management system towards the development of laying traits among the indigenous village chicken of Bangladesh (Fig 4). However, it would be quite impossible unless and until follow the following steps carefully:

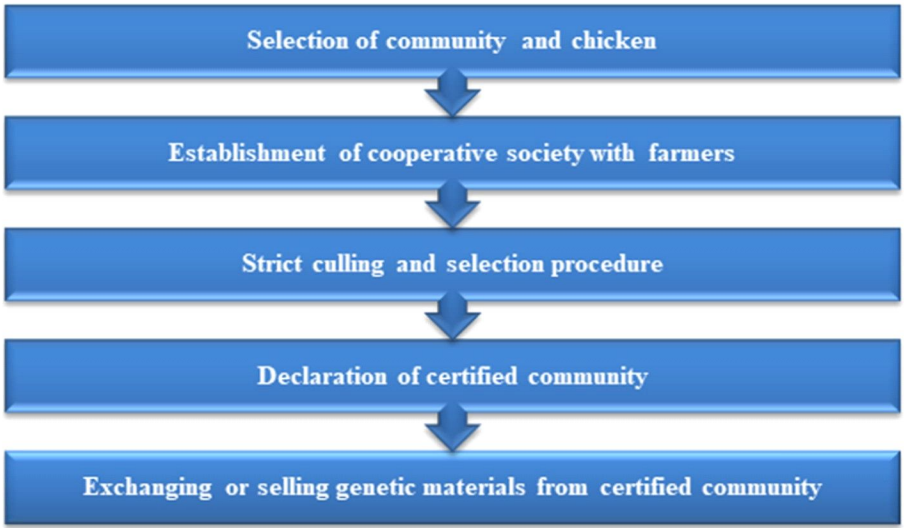


Fig 3: Flow chart of *in-situ* breeding strategies for village chicken.

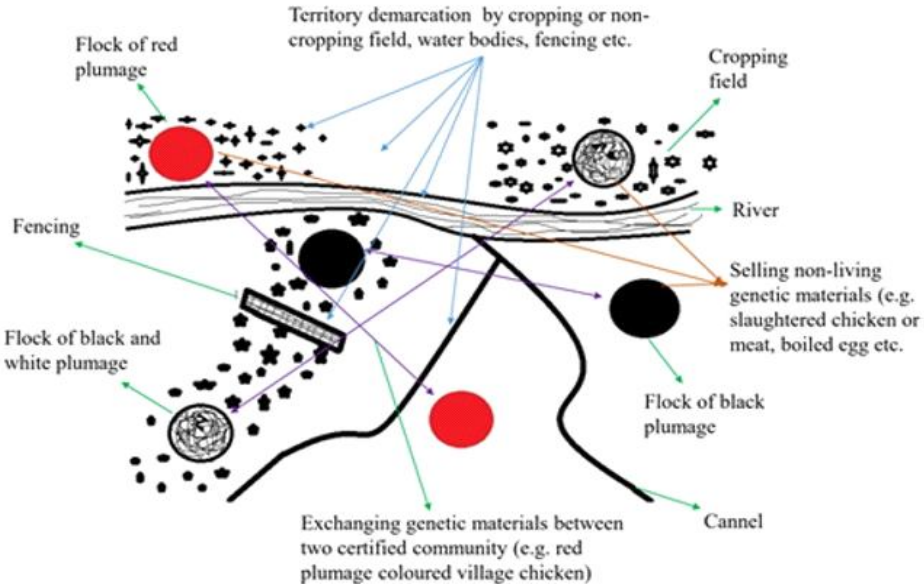


Fig 4: Demarcation and development of certified community having improved laying traits with specific plumage color and exchanging and selling genetic materials within certified community of village chicken.

Selection of community and chicken

Community selection is important to control natural mating using a confined area which might be separated from other areas by any water body or crop field or desert or forest or fencing or any other barrier. All of the households in a selected community should be under the same umbrella either by direct chicken farming or supporting the farmers for executing farming by following rules and regulation of that community. In brief, if any farmer doesn't agree for such chicken farming, he/she will also not be able to purchase or exchange any chicken from anywhere to rear during this project period. In each communal territory, only one genotype with similar plumage coloured (*e.g.* non descriptive chicken predominant red plumage) chicken will be allowed to rear.

Establishment of cooperative society with farmers

A group of selected farmers from a community should form a cooperative society in which money will be deposited from each farmer for 10 laying hens and 2 breeding cocks (G_0 population) with specific plumage color (*e.g.* red predominant), one year's vaccination and deworming cost and miscellaneous cost. This society will establish a quarantine shed centrally by which all the purchased chicken will be handed over to the farmers of this cooperative society after observing a quarantine period with required vaccination, medication and deworming. One of the farmers will have to take this responsibility and also for routine vaccination and deworming to the whole territory at a time according to prescribe schedule. The society will pay for this work to that volunteer.

Strict culling and selection procedure

The society will select another volunteer who will visit each farmer's farm regularly to collect mismatch plumage coloured (*e.g.* other than red plumage) cockerel and pullet as culling chicken (G_1 population) from community. All such chicken will be slaughtered and sold in market or in any suitable place from where 80% cash will be transferred back to farmer and 20% will be deposited to the cooperative society for serving various development works for this project. From each hatching batch, 10% cockerel and 50% pullet will be raised to attain sexual maturity and production based on selection of plumage colour (*e.g.* red predominant) in G_1 population. Inside the community, breedable chicken and their egg exchange are possible but not allowed to outside. Such selection and culling will continue to G_2, G_3, G_4 and G_5 population while laying traits will be considered beside a selected plumage colour. In addition, 50% of the breeding cocks of each farmhouse will be exchanged to other farmers of this community rotationally through cooperative quarantine procedure to minimize inbreeding.

Declaration of certified community

After five generations, the desire plumage colour and laying traits would be fixed in chicken flock of a community by about 3.5 to 4 years and such a community would be considered as a certificate community for a specific plumage based developed village chicken variety.

Exchanging or selling genetic materials from certified community

A certified community having a specific plumage coloured chicken flock could only be exchanged genetic materials to a similar community in a division or a country through respective cooperative society. Without certified community, the selling genetic materials would be non-living either by slaughtering (meat) or boiling egg. A certified community will produce and use specific wing or leg band for exchanging or selling live chicken to another similar certified territory to control genetic admixture among the plumage coloured based developed flocks.

CONCLUSION

It is concluded that indigenous chicken of Bangladesh showed diverse laying performances in different regions or locations which could be the abundance of natural resources associated with better production and survivability. In addition, genetic merit was formed after a long-time random mating in specific regions. Planned short- and long-term community breeding programmes should be implemented to find out more productive and sustainable lines from native genetic resources. Necessary supports and funds are always needed from GOs, NGOs and international organizations to execute such plans and, disseminate and explore the outcomes throughout the country. But nevertheless, quantitative and genome wide selection procedure and functional study of candidate genes are recommended to confirm and accelerate the aforementioned ideas.

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