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Review Article
Cattle Genetic Resources and their Conservation in Bangladesh

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Abstract

The present study attempts to examine the scenario of cattle genetic resources, their productive and reproductive performances and their conservation in Bangladesh. Cattle, among other livestock species available in Bangladesh are the most versatile component in relation to existing integrated agricultural farming system. Nearly 24.5 million heads of cattle are distributed throughout the country. About 85% of cattle are indigenous in origin and some types of them, like Red Chittagong, Pabna, North Bengal Grey and Munshiganj are far better producer than other in the existing low input management system. With rapid expansion of crossbreeding and urbanization, the indigenous cattle genetic resources of Bangladesh are under threat of extinction. Conservation of promising indigenous cattle genetic resources through utilization following pure breeding program and farmer managed *in situ* approaches may be an appropriate approach for cattle development and rural livelihood enhancement in Bangladesh. This review has tried to unearth the present scenario of cattle production, their distribution pattern, their productive and reproductive performances and their conservation in Bangladesh. This study has also discusses the strategy to meet the public priorities such as, food security, poverty reduction and employment generation through exploration of both native and as well as, where essential, exotic breeds in sustainable manner.

Key words: Cattle, genetic resources, conservation, germplasm, production performances, reproduction performances, indigenous, crossbred

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INTRODUCTION

The economy of Bangladesh is based primarily on agriculture and livestock is an essential component of the rural economy. Cattle among other livestock species available in Bangladesh are the most versatile component in relation to existing integrated agricultural farming system. Nearly 24.5 million heads of cattle are distributed throughout the country[1]. These cattle are of multipurpose in providing milk, draught, meat and dung as fuel and organic fertilizer and strongly linked with the livelihood of people[2]. About 85% of cattle of Bangladesh are of non-descript and indigenous in origin with low productivity compared to other existing exotic breeds and their crosses, but they are well adapted in the tropical harsh environment have the ability to maintain their body condition on poor quality feed stuffs and are well resistant to local diseases[3]. Among the indigenous[4], some types of cattle in different region of the country like Red Chittagong, Pabna, North Bengal Grey and Munshiganj are far better producer than other in the existing low input management system[5,6]. All of them are of Zebu type having developed hump and assumed that they have evolved in the areas over the country through natural selection and breeding among themselves for a long historic period and farmer's interest. Breeding tract of these cattle are characterized as low, flat and fertile land except the hilly region a bit in the Northeast and the Southeast and some areas of high land in the North and Northwestern part. Non-descript Deshi category of cattle are found everywhere in the country with no definite characteristics and constitute about 85% of the indigenous cattle providing wide range of diversity and are of main source of drought power for the subsistence farming system of the country. Red Chittagong cattle found in the Chittagong district (Chittagong coastal plain zone) having distinct identity with attractive red body color, delicious milk and meat compared to other indigenous make them top preferred in that region[7]. In terms of big body size and good milk production, Pabna type cattle are found in the Northern low-lying basins around the estuary of Pabna region and Jamuna river. North Bengal Grey are found scatteredly in the Northern district of Bangladesh (Tista meander-flood plain and lower atria basin zone). They possess good body size and some draft features and famous as a cart bullock in the market. Another improved variety of cattle i.e., Munshiganj type, mostly of creamy to dull pinkish coat color with milk type body conformation have great demand as milk cow in the surrounding regions. Since 1930's several attempts were taken scatterly to increase their production potential through infusion of foreign genes (both sub-continental and temperate) for different periods but no remarkable achievement achieved. The major constraints to cattle development in the country are lack of quality breeds/seeds, lack of feeds and their cost, disease outbreaks, lack of effective vaccines and medicines and uncontrolled/fluctuating market prices. Cattle development through the application of science-led methods of breeds and breeding in Bangladesh is still at a rudimentary stage, without any defined national strategy or concrete vision.

According to the national health strategy, an adult people need 250 mL milk and 120 g of meat every day. However, presently the availability is only 43.44 and 67.17%, respectively[1]. Under these circumstances, to meet up the deficiency of milk and meat, the government and private organizations should put efforts together to enhance the present milk and meat production status. Recently, the demand for animal derived products such as milk, meat, butter, cheese, ice-cream, baby foods, locally made sweets are increasing which are heavily dependent on milk plus sugar.

Though the cattle is an important part of livestock in Bangladesh, there is no documented research studies so far that investigated the cattle genetic resources and their conservation in Bangladesh. It is emerging for Bangladesh to develop cattle breeds, their production and reproduction performances through various scientific programs with quality breeds, improved management system, providing training, credit and finance, consultancy services, adequate veterinary services, feed conservation etc. In order to develop cattle production in Bangladesh, it would be worthy to know details about cattle genetic resources, their distributions, their physical and inheritance characteristics, their production and reproduction performances etc. Therefore, we did this review study to solve the problems related to cattle production and development in Bangladesh.

The purpose of the present study was to examine the existing cattle genetic resources, their distribution pattern, their productive and reproductive performances and their conservation in Bangladesh.

BREED TYPES, ORIGIN AND DISTRIBUTION

The breed/types of cattle, their origin and distribution are presented in Table 1. The non-descript indigenous cattle of Bangladesh are of Zebu type having developed hump. It is assumed that they have evolved in this area over the centuries for natural selection and farmers' interest on draft power to perform agricultural practices. Therefore, their production performances in terms of meat and milk are far below than specialized breeds as no selection pressure or attention was paid either on milk or meat yield from very beginning of

Table 1: Distribution pattern of cattle in Bangladesh

Breed/Type	Geographic distribution	Agro-ecological zone
Non-descript Deshi	Throughout the country	All agro-ecological (30) zones
Red Chittagong	Chittagong district and Chittagong Hill Tract	Chittagong coastal plain
Pabna	Sirajgonj and Pabna district	Active Brahmaputra and Jamuna flood plain
North Bengal Grey	Northern regions of Bangladesh more particularly in Rajshahi division	Tista meander flood plain and lowers atrai basin
Munshigonj	Munshigong and Manikgonj district	Young Brahmaputra and Jamuna flood plain

Source: ILRI[23]

domestication. The Pabna and North Bengal Grey varieties have evolved from crossbred foundation with mainly Hariana, Tharparker and Sahiwal bulls distributed in these localities in 1936 and an intensive visual selection during the last 1930-1950. However, in the Pabna region continual infusion of Sahiwal, Australian Friesian Sahiwal (AFS), Holstein-Friesian and Jersey are in process. On the other hand, there is no evidence of foreign blood in Red Chittagong and Munshigonj varieties. These two varieties have been developed in the locality by natural selection and breeding among themselves for a long historic period[8].

CATTLE GENETIC RESOURCES IN BANGLADESH

The native cattle of Bangladesh are considered potential in some locality and are identified by its local name, such as Pabna cattle, Red Chittagong cattle, Munshiganj cattle, North Bengal Grey cattle and other native types. Mating with *Bos indicus* bulls started in 1936 in some localities and resulted in improved cattle in the selected areas of the country. Artificial insemination program started in 1958 and is widely extended in the country and a good number of crossbred cattle have already been added to the herd of different parts of the country. Thus, cattle genetic resources of the country consists of Native cattle, Red Chittagong cattle, Pabna cattle, North Bengal Grey cattle, Munshiganj cattle, crossbred cattle and exotic breeds (Holstein and Friesian, Sahiwal, Sindhi and Jersey).

Native cattle (Non-descript Deshi): This category of indigenous cattle of Bangladesh are of Zebu type having developed hump and are found everywhere of the country has no definite characteristics and constitute about 80% of Indigenous cattle population of the country[9]. Their coat color varies from red, grey, white, black or a mixture of them in different proportion. They are of various sized animals possessing high level of phenotypic variation for most of the economic traits. The forehead is prominent, convex and broad like a bony shield. This overhangs eyes in such a way that they appear to be partially closed and the animal shows sloppy appearance. Ears are long and pendulous and folded like a leaf with a notch at the tip. Horns are curved turning back at the tip. They orient downwards and backwards from the base and incline a little upwards and forwards, thereafter. They have moderately developed dewlap: males have a large and pendulous sheath. The tail is long and whip like, hooves are medium-sized, hair is short and glossy, skin is loose and pliable, hipbones are prominent, the body is well proportioned, the udder in cows is well developed and round and teat tips are round. The body measurement of non-descript Deshi cattle is presented in Table 2.

Namikawa and Tsubota[10] stated that the height at wither, body length and hearth girth of non-descript Deshi cattle are 100.32±7.79, 105.78±5.36 and 129.26±6.12 cm, respectively. They are of sole source of draught power of the subsistence farming system of the country. Therefore, their production performances in terms of meat and milk are far below than standard breeds even than local improved varieties found in Chittagong and Pabna districts of the country[11]. The photograph of native (Non-descript Deshi) cattle is presented in Fig. 1.

Red Chittagong cattle: This variety of cattle has their distinct identity that differs it from other types of cattle found in Bangladesh. The coat color of Red Chittagong Cattle (RCC) is red (deep as well as light), their muzzle, eyeball, eyebrow, tail switch and hoof are whitish/brick red in color and small headed, its body size is comparatively small but physical condition is very strong and stout[8,12-14]. The body measurement of non-descript Deshi cattle is presented in Table 2. Habib *et al.*[12] stated that the height at wither, body length and hearth girth of Red Chittagong cow are 107.71±0.93, 114.38±1.56 and 139.85±1.63 cm and Red Chittagong bull are 125.00±0.87, 134.00±1.63 and 168.00±1.67 cm, respectively. Males are heavier than female (150-400 vs 150-200 kg[15]. It is found more or less everywhere in Chittagong district and Chittagong Hill Tract region but is rare in other parts of the country. Average number of Red Chittagong per holding in the habitat area varied[15] from 1.68-3.54. A relatively higher concentration of RCC is found in the upazilas of Raozan, Anawara, Potia, Chandonaish and Bashkhali of Bangladesh[8]. Attractive coat

Fig. 1(a-b): Photograph of native (Non-descript Deshi) cattle in Bangladesh

Table 2: Body measurement of cattle in Bangladesh

	Mean±SE		
Types of cattle	Height at wither (cm)	Body length (cm)	Hearth girth (cm)
Non-descript Deshi	100.32±7.79[a]	105.78±5.36[a]	129.26±6.12[a]
Red Chittagong	125.00±0.87 (Bull)[b]	134.00±1.63 (Bull)[b]	168.00±1.67 (Bull)[b]
	107.71±0.93 (Cow)[b]	114.38±1.56 (Cow)[b]	139.85±1.63 (Cow)[b]
North Bengal Grey	92.88±2.35 (Bull)[c]	99.64±3.48 (Bull)[c]	122.23±4.67 (Bull)[c]
	93.91±1.13 (cow)[c]	105.16±1.21 (cow)[c]	126.95±1.53 (Cow)[c]
Pabna	118.21±3.25[d]	164.39±2.36[d]	147.56±1.70[d]

Source: [a]Namikawa and Tsubota[10], [b]Habib *et al.*[12], [c]Al-Amin[17] and [d]Udo *et al.*[16]

color with delicious milk and meat compared to other Indigenous made peoples first preference to have RCC in their family. The photograph of Red Chittagong cattle is presented in Fig. 2.

Pabna cattle: The cattle of Sirajgonj and Pabna district, an administrative area above the meeting point of the Padma and the Jamuna rivers, more specifically of milk producing pockets of the districts is called Pabna cattle. This variety of cattle was evolved in these localities from crossbred foundation with Hariana and Sahiwal bulls and an intensive selection during the last 50 years for increasing milk production potential in high input production system as compared to other areas of the country. The coat color of the variety/type is red or grey or a mixture of both (male coat color is mostly deep grey to white with different shades). Skin are pigmented, muzzle, eyelid, hoof, horn, switch are black. The body measurement of Pabna cattle is presented in Table 2. Udo *et al.*[16] stated that the height at wither, body length and hearth girth of Pabna cattle are 118.21±3.25, 164.39±2.36 and 147.56±1.70 cm, respectively. Cows are good sized and possess better milking ability. Males are bigger in size and have prominent characters of a beef breed. The adult male and female weigh about 350-400 and 250-280 kg, respectively[15]. The photograph of Pabna cattle is presented in Fig. 3.

North Bengal Grey cattle: An improved variety of grey colored cattle is scattered in the areas of Northern districts of Bangladesh known as North Bengal Grey (NBG) variety. This variety of cattle has been originated from crossbreeding of local cattle with that of cattle imported from Northern part of India in pre-independence days for long time. The coat colour of NBG cattle was mostly deep grey to white with differing shades. The neck regions of adult bulls were an ashy shade, which is prominent and increases with age. The head was small and the colour of the muzzles, eyelids and hooves was black. The tail switch was white in all animals. The horns were small to medium and curved inward with pointed tips. The body measurement of North Bengal Grey cattle is presented in Table 2. Al-Amin[17] stated that the height at wither, body length and hearth girth of North Bengal Grey cow are 93.91±1.13, 105.16±1.21 and 126.95±1.53 cm and North Bengal Grey bull are 92.88±2.35, 99.64±3.48 and 122.23±4.67 cm, respectively. The bulls are of good size and possess draft features. This variety of cattle has good market

Fig. 2(a-b): Photograph of Red Chittagong cattle in Bangladesh

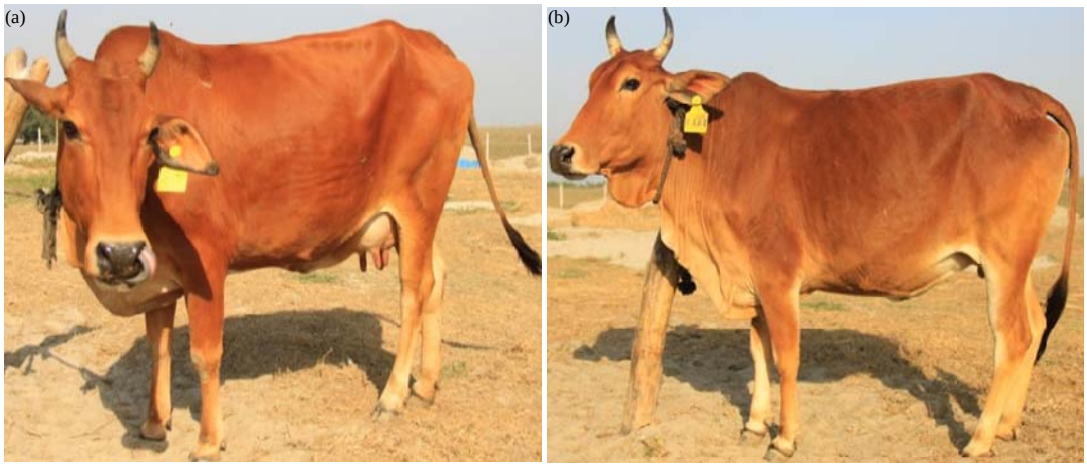

Fig. 3(a-b): Photograph of Pabna cattle in Bangladesh

as cart bullock[8]. Presently they are under pressure of extinction due to indiscriminate crossbreeding and lack of attention. The photograph of North Bengal Grey cattle is presented in Fig. 4.

Munshigonj cattle: Another improved variety of cattle found in Munshigonj, Manikgonj and adjunct areas of the districts. This is a typical milk type variety, mostly of creamy to dull pinkish in coat colour and looks different from other varieties. Skin are pigmented, muzzle, eye brow, hoof, horn and switch are black. The cows are good milker and have great demand as milk cows in the surrounding localities and Dhaka city[8]. It is presumed that this variety has evolved in the localities by selective breeding and no authentic history of crossbreeding could be traced. The photograph of Munshiganj cattle is presented in Fig. 5.

Crossbred cattle: In Bangladesh, during the last decade a large number of non-descriptive cattle have been replaced by crossbred cattle. It was started in 1958 by Directorate of Livestock Services (DLS) with Artificial Insemination (AI) program which was strengthened in 1975-76. In 1960s Savar dairy farm was established for dairy development program of the government. The farm started to work with Sindhi, Sahiwal and Tharparkar breed to cross with indigenous cattle. In 1973, some Friesian and Jersey bull were imported from Australia and this was the initiating point of new dimension. These bulls were used for semen production for upgrading the indigenous cattle. In 1975, the AI program was extended throughout the country for cattle development. Haque[18] stated that there are 2.3 million high yielding crossbred cattle are available in Bangladesh. They can produce 1800-3000 kg milk in a lactation period if they are well managed. They mature at 18-24 months and have calving interval of 13-15 months. The photograph of Crossbred cattle is presented in Fig. 6.

Fig. 4(a-b): Photograph of North Bengal Grey cattle in Bangladesh

Fig. 5(a-b): Photograph of Munshiganj cattle Bangladesh

Fig. 6(a-b): Photograph of crossbred cattle in Bangladesh

PRODUCTIVE AND REPRODUCTIVE PERFORMANCES OF CATTLE IN BANGLADESH

The production and reproduction performances of indigenous and cross-bred cattle are summarized in Table 3 and 4, respectively. The birth weight of different cattle ranged from 10.8-40.0 kg according to breed (pure or exotic or crossed). The highest daily and total milk production was observed in Friesian cattle (10-15 kg day^{-1}) and the lowest (1.18±0.10 kg day^{-1}) recorded in non-descript Deshi. Moreover, there was great variation in daily total milk production of different indigenous, exotic and crossed cattle. Lactation length varied from 221-250 days in non-descript Deshi, 258-286 days in Pabna cattle, 214-261 days in Red Chittagong cattle, 250-270 days in Sahiwal and 305-360 days in Friesian cattle. The highest and lowest lactation length was found in Friesian and Red Chittagong cattle respectively. Among the three different types of indigenous cattle, the variation in milk production performances was relatively low in Pabna and Red Chittagong cattle as compared to non-descript Deshi. This could be an indication that both Pabna and Red Chittagong cattle has more genetic similarity and may support them to treat as a type/variety.

Table 4 shows the reproduction performance of indigenous cattle of Bangladesh. Non-descript cattle attains puberty relatively earlier than Red Chittagong type. It was found that the same number of services is required for conception and gestation length more or less similar for all

Table 3: Production performance of indigenous and crossbred cattle in Bangladesh

Breed	Birth weight (kg)	Daily milk yield (kg)	Lactation length (days)	Lactation yield (kg)
Non-descript Deshi	20.95±0.52[a]	1.18±0.10[b]	276.75±0.13[a]	819.51±55.8[a]
	10.8±0.67[c]	2.80±0.12[a]		
Pabna	20.88±2.63[d]	4.02±0.99[d]	258.59±48.72[d]	1053.58±380.56[d]
Red Chittagong	16.7±0.48[e]	3.20[f]	220[f]	650[f]
Sahiwal	15-22[g]	3-5[g]	250-270[g]	800-1200[g]
Friesian	30-40[g]	10-15[g]	305-360[g]	3500-4800[g]
Local×Friesian	18-30[g]	5-11[g]	270-360[g]	1500-3000[g]
Sahiwal×Friesian	26.35±0.35[h]	10.56±0.14[h]	260.38±4.48[h]	2000-3500[g]
Sahiwal×Pabna	21.83±0.29[h]	6.78±0.19[h]	227.98±7.31[h]	1500-2000[g]
Friesian×Pabna	23.40±0.20[h]	8.28±0.22[h]	249.84±7.62[h]	2000-2500[g]
Sindhi×Local	21.85±1.77[h]	7.00±1.58[h]	280.6±26.24[h]	-
Holstein×Local	24.14±2.07[h]	12.03±3.73[h]	295.0±33.96[h]	-

Source: [a]Uddin[11], [b]Husain and Mostafa[24], [c]Majid *et al.*[25], [d]Roy[26], [e]Habib *et al.*[12], [f]FAO[15], [g]Haque[18] and [h]Das *et al.*[27]

Table 4: Reproduction performances of cattle in Bangladesh

	Types of cattle				
Parameters or traits	Non-descript Deshi	Pabna	Red Chittagong	North Bengal Grey	Exotic crossbred
Age at first service (days)	977.86±50.9[a]	468±12[d]	1216±121.66[f]	869±29.6[e]	876±192[i]
	1179±2.06	#491±66[c]			750±31[g]
Service per conception	1.76±0.19[a]	1.29±0.60[l]	1.25±0.12[k]	1.4±0.06[e]	1.62±0.63[i]
	#1.78±0.22[b]	1.57±0.07[m]	1.57±0.53[l]		1.5±0.01[g]
	1.76±0.08[l]		1.2[q]		1.6±0.6[n]
	1.6±0.86[p]		1.61±0.09[m]		
Gestation period (days)	273.48±2.3[a]	#282±11[c]	283.69±11.20[f]	281±1.3[e]	278.7±5[i]
	#274.9±2.51[b]	#284.61±4.56[f]	287±3.46[k]		278.3±4.2[n]
	278.5±6.88[p]		281.30±1.43[m]		
	281±10[c]				
Calving interval (days)	484.21±11.50[a]	#485±137[c]	430.86±76.86[f]	442±7.4[e]	420-528[h]
	#449.9±27.87[b]	489.5±75.70[f]	409.9±0.12[k]		438±49[j]
	#536±110[c]	453.6±12.80[q]	365[q]		487.5±17.4[n]
	489.52±75.70[f]				#445-487[j]
	#446±107.92[p]				
Postpartum service period (days)	120.04±7.84[a]	160.7±80.26[o]	157[q]	110±4.2[e]	139±47[i]
	141.3±88.36[p]	103.64±6.61[q]			110±2.81[g]
Dry period (days)	#189.3±13.46[b]	#222±134[c]		180±6.8[e]	160±49[j]
	#275±136[c]				

Source: [#]Farming system, [a]Majid *et al.*[25], [b]Sultan and Bhuiyan[28], [c]Hossain and Routledge[29], [d]Udo *et al.*[16], [e]Al-Amin *et al.*[30], [f]Ghose *et al.*[31], [g]Al-Amin and Nahar[32], [h]Shamsuddin *et al.*[33], [i]Sarder[34], [j]Rahman and Haque[35], [k]Habib *et al.*[12], [l]Ahmed and Islam[36], [m]Khan *et al.*[13], [n]Alam *et al.*[37], [o]Mondal[38], [p]Rahman *et al.*[39] and [q]FAO[15]

three types of indigenous cattle. The calving interval ranged from 409-536 days among the Indigenous cattle. The lowest and highest calving interval recorded in Red Chittagong and non-descript Deshi, respectively. The postpartum service period was higher (161 days) in Pabna than non-descript Deshi (120-141 days) cattle. The reproductive data thus clearly favors RCC as valuable cattle genetic resource.

CONSERVATION OF CATTLE GENETIC RESOURCES

A programme for conservation involving identification, characterization, improvement and utilization of Red Chittagong cattle following the scientific concept of Open Nucleus Breeding System (ONBS) was initiated since 2004 with an initial tenure of 5 years through USDA funding[15]. The project is being carried out in collaboration with US scientists having a nucleus herd at the Bangladesh Agricultural University with its farmer societies located in the Chandanaish and Anwara Upazila of Chittagong district. This project is being undertaken incorporating multidisciplinary approaches of animal production such as breeding, nutrition, management and preventive animal health care. The main goal of the project is development of a small dairy breed utilizing the germplasm of Red Chittagong Cattle (RCC) under the appropriate feeding and management practices. The expected outputs of the project are to develop need based technology to conserve with a concomitant improvement of the Red Chittagong Cattle both at farm (*ex situ*) and village conditions (*in situ*), provide a chain to distribute the development achieved on-station to the wider RCC population in the Chittagong area of the country and produce a group of trained manpower in the field of cattle breeding, nutrition, dairy production and preventive health care along with cattle raisers at the villages having knowledge on scientific and profitable methods of dairy cattle production.

With rapid expansion of crossbreeding and urbanization, the said cattle genetic resources of Bangladesh are under threat of extinction. The most successful way could be through genetic screening and Open Nucleus Breeding Strategies (ONBS) for the improvement of most promising indigenous breeds/types. The programs may operate through both selection and distribution of males to participating and non-participating village farmers on agreed breeding goals. Another way may be through sire selection and multiplication for distribution. The said approaches will not only improve the indigenous genetic material but will also conserve them *in situ* for the benefit of the livestock keepers. There is possibility of achieving success with this approach due to the fact that the strategies will be based on the indigenous animal populations under their adaptive environments. For example, animal breeding philosophy in many European countries near the end of the last century stressed the importance of local populations which resulted in the development of a large number of local breeds of various species. So, conservation through utilization following pure breeding programme may be useful for cattle development in Bangladesh. Regionally resourceful farmers' participatory *in situ* approaches could be initiated for germplasm development and rural livelihood enhancement. Farmer managed nucleus villages such as "Red Chittagong cattle village" with very best screened breeding samples could be established. The said villages would be the source of best seed material production and distribution in the said indigenous cattle population of Bangladesh. Exchange of male among the nucleus villages would ensure further enhancement of those valuable genetic resources.

JUSTIFICATION FOR CONSERVATION

Different reasons for conservation of animal genetic resources include[19]:

Economic and biological reasons:

- Genetic variation both within and between breeds is the raw material with which the animal breeder works. Therefore, any loss of genetic variation will limit our capacity to respond to changes in economic forces for the exploitation of animal production in future.
- Breeds with specific qualities like disease resistance, heat tolerance, ability to survive and produce under stress and low input conditions need to be preserved for future use.
- Future requirements of type and quality of animal produce (milk, draught power) may change and this requires conservation of animals with better performance in specific production traits.
- Magnitude of heterosis depends upon the breeds crossed. For exploiting the heterosis in animal production, it is necessary to maintain breeds which are complementary to each other and on crossing result in maximum heterosis

Scientific reasons:

- Breeds with unique physiological or other traits are of great value as they provide missing links in the genetic history of a livestock species by the study of blood groups

or polymorphic traits. To identify the DNA sequences causing the distinctive traits, preservation of breeds with unique traits will be essential for long term research in molecular engineering
- To evaluate the magnitude of genetic change due to selection, maintenance of a sample as control population is very much essential
- Investigations in different areas like physiology, biochemistry, genetics immunology, etc. require maintenance of diverse populations
- Variety of populations are an asset for research work in biological evolution, behavioural studies, etc
- Diverse populations form an excellent teaching material for students of animal science, ecology, ethology etc

Historical and cultural reasons: Conservation of historically important, culturally interesting and visually unusual and attractive population is very important for education, tourism etc. Further, conservation of breeds:

- Can be a valuable material of nature and culture
- Serve as research and teaching material in history and ethnography
- Will be preservation of populations with diverse sizes, colours and other morphological features, for aesthetic reasons
- Need be done to take care of existence of different creations of the nature for posterity. A range of motives are often put forward for conservation of genetic resources. These can be grouped into matters of principle and pragmatic considerations. A summary of these motives for conservation of animal genetic resources, with conservation being treated both in the narrow and broader sense is presented here[20]

Approach for conservation: Broadly, there are two means of conservation i.e., *in situ* and *ex situ*[21]. Conserving the live animals that exist in nature is *in situ* conservation. The animals are maintained in their original habitats under native conditions with no interference in their mode of management, feeding and other conditions. The main problem of *in situ* conservation is inbreeding and genetic drift typical of small populations. The *ex situ* conservation is to be used when the endangered population is dismally low in numbers, as this process has its own innate problems. It may suffer from spread of disease, or neglect during periods of institutional weakness, besides being costly in long term preservation and losing the relatedness of current genotype with environment when one of these is preserved for long time[22].

CONSERVATION STRATEGIES

***Ex situ* conservation:** Generally sperm, oocytes, embryos, DNA and embryonic stem cell are conserved. It is possible now to store a wide variety of living cells for long periods of time[21]. The techniques can be used for the conservation of endangered breeds as follows:

- **Sperms and oocytes:** Deep freezing of semen is suitable for most of the species of domestic animals
- **Embryos:** Cryopreservation of embryos of cows, buffaloes, sheep, goats and horse has successfully been done to produce offspring. This is a better tool for conservation as all the genetic information is stored in one diploid zygote
- **Storage of DNA:** Cryogenic storage of DNA is another method of preservation of genetic material
- **Cloning of somatic cells:** Cloning offers the advantage of producing series of exact replica/copy of the concerned animals
- **Embryonic stem cells:** Embryonic stem cells are derived from culture of inner cell mass of a young blastocyst. These embryonic cells are totipotent and have potential to develop into viable embryos

***In situ* conservation:** Explicit efforts to select males from superior dams under farm conditions and making wider use of the selected best bulls and also preserving their semen are necessary[21]. The process has been initiated for some of the breeds by NBAGR. The strategies are:

- **Data bank strategy:** Maintenance of a database containing all relevant breeds, population census and ecological data is essential for designing and implementing conservation strategies. Several agencies are engaged in generation and dissemination of data/information on Animal Genetic Resources. A useful body of knowledge has already been generated/gathered at NBAGR and at other locations
- **GenBank strategy:** Semen from indigenous breeds has been cryopreserved for use in the future. Ideally sufficient doses should be stored at least at two locations remote from each other. The preserved material should be periodically evaluated and put into use
- **DNA bank strategy:** Genetic material can be preserved in the form of DNA fragments under cryogenic conditions. This has the advantage over storage of live cells as it is

economical, occupies less space and there is no spread of diseases. Within and across different countries the storage of DNA has been made feasible

- **Somatic cell strategy:** With the advent of Dolly sheep, somatic cell technology has received a great adventure. In future, it may be possible to produce a live animal from stored somatic cells. This possibility is very important since the protocols for collecting somatic cell samples are less demanding and inexpensive than for collection of spermatozoa and embryos

CONCLUSION

This study aims to discuss the cattle genetic resources, their productive and reproductive performances and their conservation in Bangladesh. Bangladesh is rich in cattle genetic resources and diversity both at phenotypic and genetic level is enormous. Efforts to manage and utilize these resources efficiently are however, lacking both due to lack of awareness as well as due to weakness of government and private institutions. Most of these institutions not only lack financial and human resources, but drive to achieve any tangible breed improvement and improved utilization is also very weak. There is a need to realize that it is our collective responsibility to leave the available genetic resources in a better form than what we inherited to the coming generations.

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REFERENCES

1. DLS., 2015. Annual report on livestock. Division of Livestock Statistics, Ministry of Fisheries and Livestock, Farmgate, Dhaka, Bangladesh.
2. Hasnath, M.A., 1999. Studies on crossbred cattle. Department of Animal Breeding and Genetics, Research Bulletin No. 2, Bangladesh Agricultural University, Mymensingh, Bangladesh, pp: 37-39.
3. Majid, M.A., T.N. Nahar and M.A. Jalil, 1992. Breeding for cattle improvement in Bangladesh. Proceedings of the 4th National Conference on Pediatric Trauma, September 24-26, 1992, Indianapolis, Indiana, pp: 169-181.
4. Mason, I.L., 1988. Sheep a World Dictionary of Livestock Breeds, Types and Varieties. 3rd Edn., CAB International, Wallingform, Oxon, UK.
5. Bhuiyan, A.K.F.H., M. Shahjalal, M.N. Islam, A.K.M.A. Rahman, J.F. Keown and L.D. van Vleck, 2005. Characterization conservation and improvement of Red Chittagong cattle of Bangladesh. Bangladesh Agricultural University Research System (BAURES), pp: 13-21.
6. Khan, M.K.I., K.S. Huque, A.G. Miah and M.J. Khatun, 2000. Study on the performance of red chittagong cows under different production system. Pak. J. Biol. Sci., 3: 318-319.
7. Hossain, M.M., M.S.A. Bhuiyan, A.K.F.H. Bhuiyan and O. Hanotte, 2005. Red Chittagong-indigenous cattle genetic resource with promise in Bangladesh. Proceedings of the AHAT/BSAS International Conference, Volume 2, November 14-18, 2005, Khon Kaen, Thailand, pp: 82-83.
8. Nasim, M., 1965. A thought on cattle breeding policy for East Pakistan. Proceedings of the Seminar on East Pakistan Livestock, (SEPL'65), Dhaka, pp: 21-32.
9. DLS., 2014. Annual report on livestock 2014. Division of Livestock Statistics, Ministry of Fisheries and Livestock, Farmgate, Dhaka, Bangladesh.
10. Namikawa, T. and Y. Tsubota, 1984. Coat color variations, body conformation, blood groups and blood protein polymorphisms in the local cattle populations in Bangladesh, genetic studies on breed differentiation of the native domestic animals in Bangladesh. Tokyo University of Agriculture, Tokyo, Japan, pp: 11-24.
11. Uddin, M.M., 2001. A comparative study on some productive and reproductive economic traits of different genetic groups of dairy cows in military farm, savar and central cattle breeding station, Savar, Dhaka. M.Sc. Thesis, Bangladesh Agricultural University, Mymensingh.
12. Habib, M.A., A.K.F.H. Bhuiyan, M.S.A. Bhuiyan and A.A. Khan, 2003. The red chittagong cattle: An animal genetic resource of Bangladesh. Bangladesh J. Anim. Sci., 32: 101-108.
13. Khan, A.A., A. Ali, S.S. Husain and A.K.F.H. Bhuiyan, 1999. Reproductive performances of different genetic group of cows under farm condition. Bangladash J. Anim. Sci., 28: 59-64.
14. Hasnath, M.A., 1974. Studies on crossbred cattle. Research Bulletin No. 1, Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh, pp: 1-24.
15. FAO., 2004. State of the World (SoW) animal genetic resources. Food and Agriculture Organization (FAO), Ministry of Fisheries and Livestock, Government of the Peoples Republic of Bangladesh, pp: 65.
16. Udo, H.M., C. Hermans and F. Dawood, 1990. Comparison of two cattle production systems in Pabna district Bangladesh. Trop. Anim. Health Prod., 22: 247-259.

17. Al-Amin, M., 2004. Characterization of North Bengal grey cattle in Bangladesh. M.Sc. Thesis, Bangladesh Agricultural University, Mymensingh.
18. Haque, M.A., 2014. Artificial insemination in Bangladesh-A road to cattle development. Proceedings of the 2nd International Exhibition on Dairy, Aqua and Pet Animal, February 27-March 1, 2014, Dhaka, Bangladesh, pp: 48-57.
19. Rao, M.K. and A.O. Reddy, 1995. Livestock genetic resources in southern region: Conservation for posterity. Proceedings of the Symposium on Breeding Strategies for Optimum Animal Production, February 24-25, 1995, Bangalore.
20. Hammond, K. and H. Leitch, 1995. Towards better management of animal genetic resources. World Anim. Rev., 84/85: 48-53.
21. Das, A.K., D. Sharma and N. Kumar, 2008. Buffalo genetic resources in India and their conservation. Buffalo Bull., 27: 265-268.
22. Singh, R.V., G.K. Sachdeva, R.C. Garg, S.N. Kaushik and K. Singh, 2004. Conservation and Genetic improvement of important indigenous cattle breed of India. Proceeding of the National Symposium on Conservation and Propagation of indigenous Breeds of Cattle Buffaloes, February 26-28, 2004, Pantnagar, India.
23. ILRI., 2004. Status, Trends, Utilization and Performance of FAnGR of Bangladesh, Consultancy Report of GEF-UNEP-ILRI FAnGR Asia Project. ILRI., Kenya, pp: 49.
24. Hussain, S.S. and K.G. Mostofa, 1985. Reproductive potentialities of local and crossbred animals under farm and village condition. Livest. Adviser, 10: 15-19.
25. Majid, M.A., T.N. Nahar, A.H. Talukder and M.A. Rahman, 1995. Factors affecting the reproductive efficiency of crossbred cows. Bangladesh J. Livest. Res., 2: 18-22.
26. Roy, B.K., 1999. A comparative study on the productive and reproductive performances of different genetic groups of dairy cows in Military Farm, Savar, Dhaka and Ishwardi, Pabna. M.Sc. Thesis, Department of Dairy Science. Bangladesh Agricultural University, Mymensingh.
27. Das, P.K., S.Z. Ali, A.B.M.M. Islam and B.K. Roy, 2003. A comparative study of productive and reproductive performance and estimates of heritability for economic traits in different genetic groups of cattle available at baghabarighat milk pocket area of Bangladesh. J. Biol. Sci., 3: 726-740.
28. Sultan, R. and A.K.F.H. Bhuiyan, 1997. Quantitative analysis on the reproductive potentialities of different genotypes of cattle in Bangladesh. Bangladesh J. Agric. Sci., 24: 55-58.
29. Hossain, M.A. and S.F. Routledge, 1982. Performance of crossbred and local cattle under village condition in Pabna District of Bangladesh. Proceedings of the Maximum Livestock Production from Minimum Land Seminar, September 23-24, 1982, Dhaka, Bangladesh, pp: 161-167.
30. Al-Amin, M., A. Nahar, A.K.F.H. Bhuiyan and M.O. Faruque, 2007. On-farm characterization and present status of North Bengal Grey (NBG) cattle in Bangladesh. Anim. Genet. Resourc. Inform., 40: 55-64.
31. Ghose, S.C., M. Haque, M. Rahman and M. Saadullah, 1977. A comparative study of age at first calving, gestation period and calving interval of different breeds of cattle. Bangladash Vet. J., 11: 9-14.
32. Al-Amin, M. and A. Nahar, 2007. Productive and reproductive performance of non-descript (local) and crossbred dairy cows in costal area of Bangladesh. Asian J. Anim. Vet. Adv., 2: 46-49.
33. Shamsuddin, M., W.J. Goodger, M.S. Hossein, Azizunnesa, T. Bennett and K. Nordlund, 2006. A survey to identify economic opportunities for smallholder dairy farms in Bangladesh. Trop. Anim. Health Prod., 38: 131-140.
34. Sarder, M.J.U., 2006. Comparative study on reproductive performance of cross-bred dairy cows at greater Rajshahi district. J. Anim. Vet. Adv., 5: 679-685.
35. Rahman, M.M. and M.N. Haque, 2001. Productive and reproductive performances of native cows under farm conditions. J. Biol. Sci., 1: 1085-1087.
36. Ahmed, Z. and T.S. Islam, 1987. Cattle Breeding Program through Artificial Insemination in Bangladesh. CCBS, Dhaka, pp: 68.
37. Alam, M.M., M.J.U. Sarder, Z. Ferdousi and M.M. Rahman, 2008. Productive and reproductive performance of dairy cattle in Char areas of Bangladesh. Bangladesh Vet., 25: 68-74.
38. Mondal, S.C., 1998. A comparative study on the productive performance of different dairy breeds of BAU dairy farm. M.Sc. Thesis, Department Dairy Sci., BAU, Mymensingh.
39. Rahman, M.M., M.A.S. Khan, M.N. Islam, M.N. Haque and M.S.K. Sarker, 2001. Genetic differences in the performance of local, pure and crossbred cows. Bangladesh J. Anim. Sci., 30: 155-164.