First Report on the State of the World's Animal Genetic Resources (AnGR)

Animal Genetic Resources of Bangladesh

The Govt. of the Peoples' Republic of Bangladesh

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BANGLADESH

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1.0 INTRODUCING THE COUNTRY

1.1 GENERAL INFORMATION ON BANGLADESH

Bangladesh is the largest delta in the world and is situated between $88^0 10'$ and $92^0 41'$ East longitudes and between $20^0 34'$ and $26^0 38'$ North latitudes. The great delta is flat throughout and stretches from near the foot-hills of the Himalayan Mountains in the north to the Bay of Bengal in the south. The vast plain is washed by mighty rivers-the Meghna, the Padma, the Jamuna and the Karnafuli and their numerous tributaries. Tropical monsoon rains drench the land and the rivers. Onrush of rain waters in summer overflows their banks flooding low and outlying areas every year.

The monotony of flatness has been relieved by two elevated tracts-the Madhupur and the Barind tracts, and on the north-east and south-east by rows of hilly forests. The great plain lies almost at sea level along the southern coast and rises gradually towards north. The maximum elevation above the mean sea level is about 1220.0 meter at Keocradang Hill in Rangamati Hill district. The topography is, however, variable and can be divided into i) high, land above normal flood level; ii) medium, land normally flooded up to about 90.0cm; iii) low, land normally flooded up to 300cm; iv) very low, normally flooded deeper than 300.0cm during the flood season and v) the hilly types.

Fig1: Map of Bangladesh

According to variations in agroecology, soil physiography and climatic factors the total area of the country is divided into 30 agro-ecological zones.

The history of Bangladesh has been one of extreme turmoil and peace. It has thrived under the glow of cultural splendor and suffered under the ravage of wars. The name of Bangladesh has been cited in the history as early as 9th century B.C. The Aryan, Dravidian, Mughal and the British invaded the western and central part of the country. The Mongoloid (Assamese & Tripurese of India, and Arkanese of Myanmar) invaded the eastern and southern part of the country (Harvey, 1925; Momin, 1992). The country received new animal species in addition to its own every time when it was conquered by the invaders. Thus, the political changes along with geographical and ecological changes resulted in the present day's animal species, types and breeds of livestock in Bangladesh.

1.2 CLIMATE OF BANGLADESH

Land, crop, climate and water being the primary biotic structures of the ecosystem coexist and interact with livestock and affect their productivity. Bangladesh has tropical and moderate climate with summer, monsoon, autumn, late autumn, winter and spring seasons. Annual minimum temperature varies from 8.0^0C to 13.4^0C and maximum temperature 25.5^0C to 36.8^0C. Annual rainfall is over 2000.0mm with seasonal and regional variations from 5500.0mm in the north-east to 1500.0mm in the west. During the dry winter season from November to March about 60.0% of the total land remains uncultivated because of the non-availability of water for irrigation. The highest rainfall in the monsoon season (June to September) varies from 750.0mm per month in the north-east to about 500.0mm in the west. The humidity is the highest (95%) in July and the lowest (36%) in December.
During the monsoon (June to August) heavy rains resulted in overflowing of the rivers, canals and ultimately inundated about 30% of the plain land. On the other land, during the dry season (February to mid May) the country use to experience a high sunshine and low humidity and compels to pump up a huge amount of underground water to cultivate rice and other crops. During the flood period the livestock farmers in the low lying area and during the dry period most of the farmers except some of those from the river basin area face a serious feed shortage that limits livestock production. Thus, variations in crop productions due to climate and land types greatly affect livestock development system of the country.

1.3 PROFILE OF AGRICULTURAL SECTOR

Bangladesh having about 0.13 acres per capita net cropped area has to provide food security to the total population of about 140.4 millions which is growing annually at an average rate of 1.80% (Table1.1) and create annual employment opportunity for 1.50 million working age people. Most of the peoples of the country live in the rural area (74.43%) and an increasing trend of shifting of peoples from rural to urban may be found in Table1.1. The rate of literacy of the population >7.0 years of age is about 48.0% and per capita income is about US$410.0.

Table 1.1: Human Population

Year	Total (millions)	Rural or Farming (%)	Urban or Non Farming (%)	Total
1992	115.42	79.27	20.73	100
2001	140.40	74.43	25.57	100
Av. annual growth rate	1.80	-	-	

(Roy and Islam,2003)

The number of total farm holdings in Bangladesh is about 11.8 millions consisting absolute landless, small (having 0.05 to 2.49 acres of land), medium (2.50 to 7.49 acres) and large farm (>7.50 acres) holdings of 10.18, 52.58, 11.65 and 1.37%, respectively (Table1.2).

Table1.2: Farm structure and distribution (Agric. Census, 1996)

Catagory	Farms/Households (Millions)	%
Landless (of the total households)	1.81	10.18
Small (0.05-2.49 acres)	6.20	52.85
Medium (2.509-7.49 acres)	1.37	11.65
Large (>7.50 acres)	0.20	1.67

About 67.5% of the total land area is cultivable and covered with single, double and triple crops resulting in a crop intensity of 180% and 7.4% is cultivable waste. Rice, Jute, Sugarcane and Wheat are the major crops and covers about 72.8, 4.50, 1.10 and 5.30%, respectively of the gross cropped area. Table1.3 shows that the total operated and gross cropped area of the country is reducing but the total homestead area has been increasing during the last decades.

Table1.3: Land use and current trends

Category	Area (x000 hectare)	Area (x000 hectare)	Current Trend
	1983-84	1999	-
Operated area	9319.8	8293.3	-
Cultivated area	8160.95	7194.9	-
Gross cropped area	13175.7	11585.4	-
Homestead area	391.1	533.8	+
Permanent Pastures	NI	NI	-

BBS (2000)

Subsistence farms with close interlinking of crops, livestock and household were the predominant feature in Bangladesh agriculture before the intensification of high yielding variety (HYV) of rice cultivation to meet the increasing cereal demand due to population pressure. During the last four decades rice cultivation intensified affecting close interlinking of crop, livestock and households. Traditional legume and non-legume crop rotations or crop and livestock integration are replaced by single crop for grain production only in many regions of the country affecting soil health. Legume cropping supported livestock keeping and helped enriching soil fertility through recycling nitrogen and facilitating animal grazing during a part of the crop cycle, especially, in the winter season. Intensification of HYV rice cultivation through application of fertilizer and pesticide and a huge pumping of underground water during the dry period for irrigation gradually reduced the soil flora & fauna, soil water holding capacity and changed the soil health. Thus, input costs increased affecting

environment, livestock production system and nutritional balances of available foods, especially, to rural poor. This also results impaired health of livestock, especially, large ruminants and leads to natural resource degradation.

Livestock in Bangladesh consists of 22.32millions of large ruminants, 14.61 millions of small ruminants and 126.67 millions of chicken and duck (Table1.4). The number of different types of livestock and poultry and the total number of households rear each of the type are shown in Table1.4. The highest number (millions) of households (13.60) rear fowls followed by the rearers of cattle (8.17), ducks (7.0), goats (5.60), sheep (0.50) and the lowest was found with buffaloes (0.27).

Table1.4: Livestock population and number of households owned each type (Agriculture Census, 1996)

Types	Livestock population (Millions)	Number of households (Millions)
Cattle	21.60	8.17
Buffalo	0.72	0.27
Goat	12.92	5.60
Sheep	1.69	0.50
Fowls	97.55	13.60
Duck	29.12	7.0
Pig	NI	NI
Horse	NI	NI

NI=Not Informed

Management system of these animals is a combination of both tethering and scavenging with or without little inputs for breeding, feeding & health care. This type of subsistence farming system covers nearly 85% of the livestock farming while the rest is of commercial production system (Saadullah, 2000).

Table1.5: Importance of livestock to the gross value added agriculture production at constant (1984-85) prices (BBS, 2000)

Activity	US$ (1.0US$=58.0BDT, Millions)
Livestock Production	426.31
Other Agricultural Production	3686.3

The gross value of livestock according to BBS (2000) is equivalent to about 426.31 million US$ and the other agricultural production is about 3686.3 million US$ (Table1.5) which is mostly shared by the smallholders. Small holders' share in total large (cattle and buffalo) and small ruminants (goat and sheep), and in poultry (chicken and duck) population (BBS,1996 Agricultural census) is 62.6%, 75.8% and 69.0%, respectively. The annual growth rate of the different categories of livestock from 1983/84 to 1996 at smallholder level was 4.08%, 3.90% and 5.53%, respectively. On the contrary,

medium (1.0-3.0 ha) and large (>3.0 ha) farmers share 37.4%, 24.2% and 30.0% of large and small ruminants and poultry, respectively and their growth rate declined at the rate of -3.56%, -4.85% & -1.05%, respectively during the period.

Table1.6: Gross Domestic Product (Million US$) of livestock at constant price (Base 1995-96=100), (BBS, 2000)

Commodity	GDP (1.0US$=58.0BDT)
Milk and milk products	311.6
Meat	474.7
Poultry eggs	137.7
Hides and skin	58.10
Others (bone, fat, hair etc)	44.91

The gross domestic product of livestock (milk and milk products, meat, poultry eggs, hides and skin and others) expressed in US$ was 311.6, 474.7, 137.7, 58.10 and 44.91, respectively (Table1.6). Livestock contribution to GDP is about 3.97% (2000-01) and it grows at a rate of about 7.88% (2000-01). It contributes to 4.31% of the total foreign exchange earning, 20.0-25.0% of the employment, 10.5% of the total fuel requirement and add about 80.0 million tons of manure to soil annually. The direct labor coefficient of livestock sub-sector is 81.3 (Mujeri, 2002, Planning Commission, 1998). The per capita availability of animal protein in the country is about 11.8 g/day (including fish) against the FAO recommendation of 28.0 g (Table1.12).

Table1.7: Major livestock and primary productions

Species	Produces (x1000 m. tonnes)				
	Meat	Milk	Eggs	Hides & Skin	Fiber
Cattle	334.0	1690.0 (including buffalo)	-		-
Buffalo	7.00		-		-
Goat	45.0	NI	-		-
Sheep	5.00	NI	-		NI
Fowl	154.0 (including duck)	-	2405.0	-	-
Duck		-	1521.0	-	-
Pig	NI	-	-	-	-

BBS, 2000, NI= Not informed

The primary productions of major livestock species in 2000 are shown in Table1.7. The present production would be higher than that is presented in Table1.7. The egg production has been increased from 1941.0 million in 1989-90 to 4424.0 millions in 2001-2002. The annual growth rate was 6.3 percent. Much of the increased egg production has come from the commercial poultry sector. The present milk and meat production in the country is about 1.76 and 0.62 million tons, respectively and may meet only 14.70 and 9.70%, respectively of the total requirement (DLS, 1999). Moreover, every year the country has to import milk powder spending about US$ 50.0 to 60.0 millions. Similar to

other livestock products, only 14.6% of the total demand of egg is met from domestic production. This urges to develop livestock and poultry production through increasing the economic and biological efficiency of existing animal population in the country. This will also help more income generation leading to rural poverty alleviation.

The value of primary livestock products import is shown in Table1.8. The major import of livestock products are powder milk and live poultry. The value of milk powder importation in 1995-96 was 36873.2 thousand US$ and increased to 70120.3 thousand US$ in 1999-2000, and that of live poultry was 2143.4 and 2722.86 thousand US$, respectively. This has indicated that the expenditure for import of powder milk and poultry increased 90.2% and 27.03%, respectively during the period. The expenditure for edible meat, and fresh and chilled poultry is low but found to increase during the period from 1995-96 to 1999-2000. The value of live animal import is also low but showed a decreasing trend during the period.

Table1.8: Major livestock primary product imports (in x1000US$)

Species	Meat		Milk		Eggs		Skin		Animal	
	1995/96	2000	1995/96	2000	1995/96	2000	1995/96	2000	1995/96	2000
Cattle	4.51	9.23	36873.2	70120.3	-	-	-		18.05	7.37
Buffalo					-	-	-	-		
Goat	-	-	-	-	-	-	-	-	-	-
Sheep	-	-	-	-	-	-	-	-	-	-
Chicken	-	-	-	-	-	-	-	-	2143.4	2722.86
Ducks	-	-	-	-	-	-	-	-	-	-

BBS, 2000

The major export of livestock products is leather, skin and animal casings. Table1.9 shows that the export value of the products decreased during the period from 1995-96 to 1999-2000. Traditional system of raw leather and skin collection, processing and marketing, and illegal trafficking may have affected the trend.

Table1.9: Major livestock primary product export (in x1000 US$, 1US$=BDT58.0);

Species	Meat		Milk		Eggs		Skin & others		Animal	
	1995/96	2000	1995/96	2000	1995/96	2000	1995/96	2000	1995/96	2000
Cattle					-	-	115171.34	83161.2	-	-
Buffalo					-	-				
Goat	-	-	-	-	-	-	15972.4	6614.17	-	-
Sheep	-	-	-	-	-	-	2288.3	602.8	-	-
Chicken	-	-	-	-	-	-	329.3(of birds)	413.95 (of birds)	-	-
Ducks	-	-	-	-	-	-				

BBS, 2000

Nevertheless, Table1.10 shows that the export of live animal and animal products exceeded imports throughout the period resulting in a positive balance in export and import of livestock sub-sector. Moreover, an increasing trend of both export and import are also found from the data presented in the Table.

Table 1.10: Trends of export and import of live animals and animal products (in x1000 US$, 1US$=BDT58.0); BBS, 2000

Years	Export	Import
1994-95	223.7	39.8
1995-96	228.4	44.41
1996-97	221.22	62.19
1997-98	225.1	60.93
1998-99	233.5	62.17
1999-00	279.9	88.29

The domestic animal genetic resources in the country are rich sources of valuable organic livestock products like meat, milk and genes of economic importance (disease resistance, capacity for production on poor quality management and product of special flavor or other quality). Thus, conservation and sustainable development of native AnGR for food and agriculture may further increase export earnings of the country.

Like other developing countries of Asia, Bangladesh is rich in domestic animal genetic resources (AnGR). The species of interest are cattle, buffalo, goat, sheep, chicken, duck, geese, pigeon and pigs. The horse, dog and cat are also found in all areas of the country whereas elephant, deer, tiger, & gayal (*Bos frontalis*) live in specific forest areas. Most of these species are indigenous types except that only about 10.0% cattle & 20.0% chicken are exotic cross & commercial types. The indigenous types have higher adaptability to fluctuating climate, poor nutrition and management system, resistance to local diseases and parasites and suitable for subsistence farming. However, their productivity is lower compared to improved breeds/types of livestock available in the country. A wide variations in terms of coat colour, size, live weight, production and reproduction has been found to exist among all indigenous AnGR of Bangladesh. However, in the last 60 years or so exploitation of cattle, buffalo, chicken & duck germplasm has taken place in Bangladesh. As a result, some quasi-indigenous animals have been generated but their impact on the total production system is not considerable from the point of meeting of the present demand. Early effort to improve local cattle through Hariana, Tharparker, Red Sindhi etc produced positive results and considered as the basis of higher performance of cattle in several milk shed areas of the country.

Breeding males (bulls, bucks, rams etc) now a days are scarce at the village level. Sound national breeding policies have never been formulated and implemented for any species of livestock in the country. Commercial broiler and layer farming has gained momentum since last decade but the industry largely depends on continuous importation of germplasm. For ruminants, particularly cattle,

several consignments of importation of live bulls, cows and semen in the form of both donation and purchase has taken place during the last 45 years without any sustained policy to harvest benefits from these imports (Bhuiyan, 1997). On the other hand, neglect of indigenous breeds led to a situation where a number of native breeds/types of livestock are now under the threat of extinction. No sustained policy has been pursued to maintain the selection process for continuous improvement of native animal genetic resources.

1.4: LIVESTOCK PRODUCTION SYSTEMS AND FEED AVAILABILITY

Livestock production system in Bangladesh may be characterized as follows.

a) Poultry production – mainly includes chicken and ducks
   - i) Rural poultry production
   - ii) Semi-scavenging system
   - iii) Commercial poultry production
   - iv) Rural duck production
   - v) Smallholder duck production
   - vi) Duck cum fish production

b) Dairy production – mainly includes cattle and buffaloes
   - i) Rural dairy production
   - ii) Smallholder dairy production
   - iii) Pocket dairy production

c) Meat production – includes large and small ruminants and poultry.

There is no permanent pastureland in the country and livestock, especially, ruminant animals depend mainly on agricultural by-products. Most of the roughages produced in the country (about 27.0 million tons dry matter) are of low quality and only 50% of the total roughage production is available to animals. Limitations in land availability, competition for land between crop and livestock and disappearance of cultivable land at the rate of 1.0% annually are considered major hindrances for livestock feed production in the country. The available concentrate (about 1.39 million tons) is shared by livestock, poultry and fish and found to meet only 10.0% of their total requirement. The commercial poultry developed recently is totally depended on imported feeds. Recently, the Govt. introduced multipurpose crops like maize in the existing cropping system but it may meet only 20.0% of the total maize requirement of the country. Both quantity and quality of feeds are important for livestock and poultry production. Immediate steps need to be undertaken for mitigating livestock feed problems in the country. Health management, especially, control of infectious and contagious diseases

and control of sanitary and phytosanitary measures are important for production of safe food of animal origins.

1.5: STATE OF FOOD SECURITY AND RURAL DEVELOPMENT

Human diets should be blended with energy and protein of both vegetable and animal sources. Table1.12 shows that daily energy and protein intake per head is lower than that is required for normal functioning of a human body. The total protein availability from animal and fish sources is only 11.8 g/day in place of average requirement of about 60g/day. This indicates that animal protein availability need to be increased by about five times of the present production.

Table 1.11: Level of food self-sufficiency (BBS, 2000)

Sl.No	Items	Annual per capita availability (Kg)	Sufficiency (%)
1.0	Food grains	203.9	100.0
2.0	Fish	13.3	30.40
3.0	Milk	13.2	14.50
4.0	Meat	5.20	11.87
5.0	Eggs (Nos)	32.0	16.00

Table1.12: National food balance (BBS,2000)

Sources	Energy (Kcal)		Protein (g)	
	1998-99	1999-2000	1998-99	1999-2000
Vegetable products	2244.6	2309.4	50.8	51.5
Animal products	57.1	58.6	5.0	5.1
Meat and offals	*16.0*	*16.2*	*3.2*	*3.3*
Milk	*24.2*	*24.8*	*1.2*	*1.2*
Eggs	*7.1*	*7.5*	*0.5*	*0.5*
Animal oil & fats	*9.8*	*10.0*	*0.1*	*0.1*
Fish products	43.3	46.4	6.2	6.7
Total	**2345.0**	**2414.3**	**62.0**	**63.3**

The availability of animal protein per day is found to be lower than that is available in other Asian countries like China, Thailand, India, Pakistan. The low per capita consumption of animal and poultry products is reflected in lower calories and protein consumption than that is required for the average diet of the peoples (Table1.12).

The average annual growth rate of meat and milk products is 3.68% and 4.21% and that of eggs is about 7.67%. This emphasizes to increase growth rate of meat, milk and eggs to attain the production target to meet the growing demand of the country (Table1.13).

Table1.13: Present availability and estimated demand of livestock products (Million tons)

Food items	Present production (2002)	Estimated demand (considering 5.0 to7.0% income growth)		Growth rate required
		2005	2010	
Milk	1.76	2.46	3.50	5.70%
Meat	0.68	0.89	1.30	6.20%
Eggs (Millions)	4733.7	5330.0	9180.0	7.30%

The concentration of ruminant animals per square kilometer in Bangladesh is one of the highest in the world. From the comparison of data on livestock population of 1983/84 and 1996 (BBS, 1999) it is found that per capita cattle and buffalo number reduced about -30.8% and that of goat and sheep – 29.5%. However, the per capita number of poultry increased about +14.3% during the period. This means the number of ruminant animals is not increasing with the increase of human population. Thus, to meet the increasing demand of animal produces the productivity of available AnGR should be increased through judicial management and genetic improvement.

The livestock sub-sector has been given due priority by the government. Giving subsidy to dairy farmers, goat production for poverty alleviation, exemption of duties on importation of inputs in terms of equipment and seeds, and micro credit distribution by the local government to poor farmers are the few steps taken by the government for the development of livestock in the country. Livestock is considered as one of the potential domestic resources for rural development and included in the recently formulated **Poverty Reduction Strategic Plan (PRSP)** of the Govt.

However, to face challenges of poverty reduction, employment generation and food security for the growing population under global open market policies sustainable exploration of smallholder livestock and poultry resources should be addressed in away to develop rural industries that links produces of small farmers with superstores both at home and abroad. Present livestock development policies of the public sector are poorly organized, coordinated and implemented; and are not responsive to gain market-led, commercialized, competitive and dynamic for sustainable livestock development. The development polices should be formulated based on the potentiality and problems of the resources available in the country and the inputs available in the public sector should be utilized efficiently to achieve the goals. The smallholder production systems exist in the country must be linked vertically with the systems for processing and marketing of the produces. Production of quality produces abiding SPS regulations is also important to consider for sustainable development in future. This will help to create employment for a huge population, especially, of rural origin and will help income generation and poverty reduction, especially, for the rural women and youth.

Chapter 2. THE STATE OF PRODUCTION SYSTEMS

The livestock of Bangladesh mostly include cattle, buffalo, goat and sheep and the most important species of poultry is chicken and ducks. Most of the farm animals and poultry birds are still reared under traditional production system except the considerable development of commercial poultry production system based on imported germplasm, feed and medicines. The production systems of different farm animals and poultry birds are described below.

2.1 Cattle production

Cattle (21.57 millions) is one of the most desired livestock species in the subsistence agriculture of Bangladesh. They provide almost all the market milk (about 99%) of the country. About 1.32 million MT of cow milk is produced annually. The country produces about 0.372 million MT of beef annually from cattle, the most popular type of meat. Cattle and buffalo provide 65% of the total draught power of the country at present. Landless and small farmers hold about 62.6% of the total large ruminants and are used as sources of income and nutrition, and considered to be resources for employment and poverty alleviation. Cattle fattening, dairying and heifer rearing are the production systems for exploration of cattle germplasm in the country. About 4.0 million cattle are slaughtered annually and used as sources of beef and leather. There are about 7.0 million cows that are either used for milking or remain dry.

Major contribution of native cattle and buffalo and their productive and reproductive performances are shown below

Species	Average performances under traditional production system		Contribution to food and agriculture
	Production	Reproduction	
Cattle			
Pabna	Male adult weight: 350.0 Kg	Age at puberty: 35.0 months	Milk, meat, draught power, income generation and poverty alleviation
	Female adult weight: 250.0 Kg	Calving interval: 15.0 months	
	Fat%- 5.60	Post partum heat epriod-75.0 days	
	Lactation yield: 700.0-1500.0 litres	Birth weight: 20.0Kg	
Red Chittagong	Male adult weight: 350.0Kg	Age at puberty: 15.0 months	Milk, meat, draught power, income generation and poverty alleviation
	Female adult weight: 150.0Kg	Calving interval: 12.0 months	
	Fat%- 6.0%	Post partum heat period: 40.0 days	
	Lactation yield: 800.0 litres	Birth weight: 16.0 Kg	
Crossbred cattle	Male adult weight: 350.0-550.0Kg	Age at puberty: 30.0 months	Milk, meat, draught power, income generation and poverty alleviation
	Female adult weight: 300.0-350.0Kg	Calving interval: 15.0 months	
	Fat%- 4.0	Post partum heat epriod-70.0 days	
	Lactation yield: 800.0-2000.0 litres	Birth weight: 20.0 Kg	
Native Cattle	Male adult weight: 180.0Kg	Age at puberty: 36.0 months	Milk, draught power, meat, income generation and poverty alleviation
	Female adult weight: 120.0Kg	Calving interval: 14.0 months	
	Fat%- 5.50	Post partum heat period: 60.0 days	
	Lactation yield: 225.0litres	Birth weight: 26.0 Kg	
Native water buffalo	Male adult weight: 500.0Kg	Age at puberty: 37.0 months	Milk, draught power, meat, income generation and poverty alleviation
	Female adult weight: 375.0Kg	Calving interval: 15.0 months	
	Fat%- 8.0	Post partum heat period: 50.0 days	
	Lactation yield: 600.0litres	Birth weight: 26.0 Kg	

The dairy production system, as described below, is classified into Rural, Smallholder and Pocket dairies. The rural production system, being supported with low inputs, is still considered to be the major source of milk and meat.

Dairy Production

Rural dairies: About 68% of village families keep cattle traditionally. A family on an average produces 8.3 litres of milk in a week and average production of cow was found as 0.8 litres per day. This is marketed in the rural area. The price of milk is very low and considered as one of the major hindrances for increasing milk production in the country.

Smallholder dairy: This type dairy is developed based on higher milk prices in urban and semi-urban areas and most of them have crossbred cows. Mia (2001) reported that the total number of smallholder dairy farms is 36,449.0 in the country. Data collected from the different regions of the country showed that about 73% of these farms has got 4 to 10 cows and the rest has 11 to 50 cows. An average dairy of 4.79 cows daily produces 14.07 litres of milk and average daily milk yield of each cow was 3.55 litres. The relationship ($r^2 = 0.498$) between herd sizes and milk yield may be significant but problems of feed availability and health management often affect production efficiency and fertility of dairy herds. The range of milk price per kilo ranged from BDT.10.0 per kilo to BDT.30.0. The farmers raised the problems of unavailability of high yielding cows, bank loan, training facilities, quality feeds, vaccines and medicines.

Pocket dairies: Certain potential areas in the country support higher milk production due to its typical nature in the agricultural production systems. The cattle germplasm of the area is developed and used to be supplied with good quality forages at least in certain periods of a year. Baghabari milk shed area under Sirajgonj district is one of the best milk pocket areas in the country. The other areas are Takerhat, Munshiganj, Tagail, Manikganj, Rangpur, Pabna Bhairab, Raipur, Natore, Ishordi and Jessore. Haque (2003) stated that Milk Vita (Bangladesh milk producers' cooperative union Ltd.), the only cooperatvie dairy organization under the Ministry of Local Govt. has increased milk marketing from 6.22 million litres in 1992 to 53.81 million litres in 2002 and now covers 75.0% of the processed milk marketing of the country. Milk Vita supplies inputs such as vaccines, treatment facility, semen and training to farmers. Milk vita operates its milk processing and marketing systems in some other potential areas but support of training and technology always acts as barriers for the development of this milk marketing organization. Being coordinated by a different Ministry, Milk Vita failed to harvest training and technological help from the organizations under the concerned Ministry of Fisheries and Livestock. Incordination in dairy activities exists among the public organizations in the country. Immediate attention of the concerned authorities on the development of milk processing, preservation and marketing may help to increase milk production in other potential areas of the country and may save immediately at least foreign exchanges required to import powder milk.

Arong dairy of BRAC, Amomilk, Shelaidha dairy, Bikrampur dairy, Aftab dairy, Safa dairy and Tulip dairy are also involved in processing and marketing of fresh milk but their share in the total processed milk production vary from 2.0 to 3.0%.

Meat production

Rearing ruminant animals as sources of meat is subsistence and smallholder in nature. The live animals are transferred from local markets to local butchers for slaughtering to market meat without any control of its quality and price or grading. A huge number of cattle and goat are sacrificed in Eid-ul-Azha festival, which are reared with more care as the Muslims use to collect the best and healthy

animals for sacrificing. About 0.25 to 0.30 millions ruminant animals are sold every year in Dhaka city only during the festival time. Cattle fattening package developed by Bangladesh Livestock Research Institute helped to some extent producing quality beef, which is mostly available in the Eid market.

Identification of production systems considering input supply is difficult due to unavailability of data. Consideration of farm holding characteristics and data available on the total smallholder or commercial farm led to estimate the distribution of production system of different species according to the extent of availability of inputs (Table2.1). It shows that about 64.0% of the total cattle is reared under low input, about 24% under medium input and the rest 12.0% under high input system.

Table 2.1: Distribution of livestock by production system (%)

Species	Production systems			Total
	Low input	Medium input	High input	
Cattle	64	24	12	100
Buffalo	90	10	0	100
Goyal	100	0	0	100
Goat	73.20	26.80	0	100
Sheep	84.80	15.20	0	100
Chicken	61.70	22.20	16.46	100
Duck	65.03	34.97	0	100
Pigs	100	0	0	100
Rabbit	NI	NI	NI	NI
Dog	NI	NI	NI	NI
Horse	NI	NI	NI	NI

Estimated data; NI=Not Informed

High-input system as described in the guide for the country report preparation is a production system where all rate-limiting inputs to animal production can be managed to ensure high levels of animal survival, reproduction and output. Output is constrained primarily by managerial decisions. Medium-input production system is defined as a production system where management of the available resources have the scope to overcome the negative effects of the environment, although it is common for one or more factors to limit output, survival or reproduction in a serious fashion. Low-input production system, on the other hand, is described as a production system where one or more rate-limiting inputs impose continuous or variable severe pressure on livestock resulting in low survival, reproductive rate or output. Output and production risks are exposed to major influences, which may go beyond human management capacity.

Table 2.2: Changes in distribution of production systems during the last 20 years

Species	Production systems			
	Low input	Medium input	High input	Total
Cattle	-	+	+	0
Buffalo	-	+	0	0
Gayal	-	0	0	0
Goat	-	+	0	0
Sheep	0	0	0	0
Chicken	-	+	++	0
Duck	0	+	0	0
Pigs	0	0	0	0
Rabbit	NI	NI	NI	NI
Dog	NI	NI	NI	NI
Horse	NI	NI	NI	NI

--=strongly decreasing,-=decreasing, 0=stable, +=increasing and ++=strongly increasing

The most limiting inputs are feed and health management and these results in low productive and reproductive performances of cattle. However, both cattle productions under medium and high input systems is increasing gradually but decreasing under low input system (Table 2.2). This indicates that cattle rearing is gradually developing into a profitable agro-business replacing the subsistence system in the country. Of the total cattle 37.0%, 51.0% and 12.0% are distributed in the subsistence (less than 50.0%of production is marketed), smallholder (small family farms with more than 50.0% of production is marketed) and small-scale-commercial (medium family farms with more than 50.0% of production is marketed) operations, respectively (Table 2.3). A major fraction of cattle under subsistence and smallholder production system (25.0% and 42.0%, respectively) is reared under low input system. Cattle reared under medium and high input systems are about 31.0% (subsistence 12.0%, smallholder 8.0% and small-scale-commercial 11.0%) and 2.0% (smallholder 1.0% and small-scale-commercial 1.0%), respectively (Table 2.3). However, large-scale commercial (large farms or companies with all production is marketed) farms of dairy or beef in considerable number are not established yet in the country.

Table 2.3: Type of livestock farm by production system for cattle (%)

Type of Operation	Production systems			
	Low input	Medium input	High input	Total
Subsistence	25.0	12.0	-	37.0
Smallholder	42.0	8.0	1.0	51.0
Small-scale-commercial	-	11.0	1.0	12.0
Large-scale-commercial	-	-	-	-

Estimated data

2.2 Buffalo Production

Buffaloes, more precisely domestic water buffaloes are valuable animal genetic resource of Bangladesh. There are 0.567 million of water buffalo heads in Bangladesh and are reared by 270230.0 households (BBS, 2001). They are found throughout the country but are concentrated in particular agro-ecological zones e,g. sugar cane belt located in the western and central part of the country, in the sandy islands of river Brahmaputra and Jamuna of central part, in the marshy land of the eastern part and in the coastal area of the country. The average number of buffalo per household is 2.67. The number of water buffalo per household is the lowest in the sugar belt i.e. 2.0 per household and the highest in the coastal area i.e. 250.0 per household (Faruque, 2000). Natural mating is a normal practice for breeding the animal. Buffalo milk is used mainly for making yogurt and soft cheese. They are still preferred as draught animals in the muddy field and pulling curt. Single animal ploughing with water buffaloes is practiced only in the Sylhet district.

Buffaloes in Bangladesh are reared under semi-intensive or extensive system. In semi-intensive system, water buffaloes are allowed to graze green grasses on fallow land or roadsides after morning milking. They are driven back to home in the evening and allowed to feed rice straw, if available, with or without any concentrate supplements. The animals are kept in open air at homestead areas. They are not usually vaccinated but dewormed against *ascaris*. The semi-intensive management system is practiced all over the country except the lower part of coastal area where water buffaloes are reared in extensive system, especially, in Bathans, a fallow land covered with green grasses. Buffalo raising in bathans is also practiced in the central part of the country throughout the year but in the western part it remains only for the dry season. Hundreds of water buffaloes belong to different farmers in a particular locality are allowed to graze in a bathan of 2.0 to 5.0 square km area covered with natural pasture. The animals in a bathan are not housed and are managed by paid cowboys under the supervision of an adult person known as **Karbari**. The animals are often infected with contagious diseases and in most cases are treated by non registered local doctors.

Faruque (2000) reported that the average birth weight of water buffaloes of Bangladesh is 25.4 ±2.75 kg and vary from 15.0 to 36.0 kg and the rate of daily live weight gain of growing buffaloes ranges from 300.0 to 450.0g. Heifers attain at puberty within 48 months and calving interval is reported to be more than a year. Milk cows produce 1.0 to 10.0 litres of milk daily with total lactation yield ranging from 278.0 to 776.0 litres in a lactation period of 270 to 274 days. August to October is the peak calving season of buffalo in Bangladesh. Nevertheless, better management and nutrition may help to increase productivity of buffaloes.

The water buffaloes of the western and central parts or the eastern part are used for draught purpose. But those found in the sandy island of Jamuna and Bramhaputra rivers of the western and central parts are used for dairy purpose. The water buffaloes found in the upper part of coastal area in the south are used for draught purpose but those of the lower part of the coastal area are used for dairy purpose.

Culled buffaloes are used as sources of beef both in the rural and urban areas. Buffalo hides are processed and marketed and dung is used as fuel or manure.

Data on gender issues involved in buffalo keeping are not available but males compared to females are more involved in buffalo than cattle production. BBS (1999) reported that only 2.03% of the total labour holdings was female.

Buffalo farming as described above may be classified as shown in Table2.1 The Table shows that about 90.0% of the total buffaloes are reared under low input system and the rest (10.0%) is supported by medium input supply. However, the low input production system is decreasing due to non-availability of land and feed supply and the production system under medium input is increasing slowly during the last 20 years (Table2.2).

Table 2.4: Type of livestock farm by production system for buffalo (%)

Type of Operation	Production systems			
	Low input	Medium input	High input	Total
Subsistence	10.63	0	0	10.63
Smallholder	29.37	0	0	29.37
Small-scale-commercial	50.00	10.00	0	60.00
Large-scale -commercial	0	0	0	00.00

Estimated data

Unlike cattle, 60.0% of the total buffaloes are reared under small-scale-commercial system and major fraction (90.0% of the total) of it is supported by low input supply. Rearing buffaloes in bathans is commercial but are poorly supported by nutrition supply and disease control programmes.

However, the advantages associated with water buffalo production over cattle production like disease resistant power, ability to utilize coarse roughages, higher price for fluid milk etc. are the causes for gradual increase of water buffalo population. However, there are changes in the production system and are highlighted below.

The demand of draught power requirement from animal source has reduced due to mechanization of cultivation and transportation system. The draft requirement (from animalnpower) of the country has reduced from 95% to 65% during the last 10 years and is still reducing. So, farmers are rearing more and more dairy buffaloes instead of draught buffaloes.

i. Another change that happens is the severe lack of natural pasture. Buffaloes have been reared in Bangladesh under natural pasture for years. Farmers are habituated to feed their buffaloes on natural pasture. So, they are underfed nowadays and suffering from malnutrition that is affecting their production and health. However, high yielding buffalo breeds/types are not available in the country.

These two factors are affecting the population structure of water buffaloes in Bangladesh nowadays and will determine their future existence.

2.3 Gayal production

Gayal (*Bos frontalis*) is a feral animal of *Bovidae* family found only in the forest of Bandarban district located in the south-eastern part of Bangladesh (Fig.1). The animals are reported to be very hardy and capable of thriving well on the natural habitat in the hilly forest. Gayals browse leaves and twigs of plants and grazes on hill slopes and move freely on the hills and hillocks. The whole population remains under browsing and found to be affected by low availability of inputs (feeds, health care, management etc.) is low (Table 2.1). They use to come out of the deep forest and spend nights in the nearby homestead areas of tribal peoples. They feed them salt and often catch the adults, especially, the males which are used as sacrifice animals or sometimes use to be sold to traders. The traders sell Gayals as beef animals.

No attempt was taken to identify the habitats of Gayal and its population in that particular region. However, the number of Gayal is decreasing gradually due to deforestation as reported by the local people. Once Gayals were found all over the forest of the south eastern part covering an area of about 18,000.0 sq. km. Continuous deforestation and degradation of plant habitats is reducing the area and pushing the animals to the deep forest of Bandarban district facilitating migration to Myanmar. Gayal may be identified as one of the extinct animals in the country.

2.4 Goat production

Goat occupies an important place as an animal genetic resource in the agro-based economy of the country having greater importance, particularly, in subsistence agricultural operation. The goat population of Bangladesh is 13.67 million (BBS, 2001). Goats are used for meat and milk. The native breed Black Bengal is reputed for its high prolificacy, quality skin & tasty meat. Black Bengal goat is reared by rural peoples under semi-intensive or extensive production system. About 52.4% of the total goats are kept by landless and small farmers and the rest 47.67% is kept by the medium and large farmers (BBS, 2001). However, some commercial goat farms have already been established during the period of the last 2 years as government has put forward a strong national policy to alleviate poverty of the landless and marginal farmers through goat rearing. Mia (2001) reported that there are about 65,000.0 smallholder goat farm in the country. Investing low capital and utilizing easily available feedstuffs, goat rearing may be potential for poverty alleviation in Bangladesh. There are six goat farms in the public sector where goats are reared under semi-intensive system.

Goat and sheep are kept mainly for meat production and risk management. However, Black Bengal goat skin is famous for its quality and has priority demand in the world market. The average production and reproduction performances of Black Bengal Goats and Sheep and are shown below.

Production and reproduction performances of Black Bengal Goats and Sheep

Species	Average performances under traditional production system		Contribution to food and agriculture
	Production	Reproduction	
Black Bengal Goat	Male adult weight: 30.0 kg	Age at puberty: 241 days	Meat, skin, poverty reduction and income generation
	Female adult weight: 26.0 Kg	Kidding interval: 200days	
	Weight at 1.0 year of age: 12.7 Kg	Fecundity: 1.0 to 4.0	
	Rate of daily live weight gain: 40.0g	Birth weight: 0.9 Kg	
	Daily milk yield: 110.0ml	Kid mortality: 35.0%	
Jamuna puri Goat	Male adult weight: 60.0 kg	-	Meat, poverty reduction and income generation
	Female adult weight: 45.0 Kg	-	
	-	-	
	-	-	
	Av. daily milk yield: 1.50Kg	-	
Sheep	Male adult weight: 25.0kg	Age at puberty: 180.0 days	Meat, fiber poverty reduction and income generation
	Female adult weight: 17.0Kg	Kidding interval: 180.0days	
	-	Fecundity: 1-4	
	-	Birth weight: 0.85 Kg	
	-	Kid mortality: 3.0%	

Table 2.1 shows that about 73.20% of the total goat is reared under low input system and the rest (26.80%) are supported by the medium inputs. About 6.20%, 8.10% and 12.50% of goats supported by medium inputs are reared in the subsistence, smallholder and small-scale-commercial operations, respectively. But the recent initiative of the Govt. for the development of goats may have some positive effects on the input support for goat production in the country.

Table 2.5: Type of livestock farm by production system for Goat (%)

Type of Operation	Production systems			
	Low input	Medium input	High input	Total
Subsistence	15.00	6.20	-	21.20
Smallholder	58.20	8.10	-	66.30
Small-scale-commercial	-	12.50	-	12.50
Large-scale-commercial	-	-	-	-

Estimated data

Table 2.2 shows that the low input production system is gradually decreasing but the production systems supported with medium inputs have been increasing in the last 20 years. The importance of goat to rural peoples and marketing facilities of its produces facilitate entrepreneurs and some non-government organizations to undertake program on goat raising with a better input supports. Table 2.5 shows that about 15.0% and 58.20% of the total goat under subsistence and smallholder production system, respectively is supported with low input and 6.20% and 8.10%, respectively of the total goat of subsistence an smallholder production systems is supported by medium inputs. However, there is

about 12.50% of the total goat is reared with medium input support under small-scale-commercial production system.

2.5 Sheep Production

A total of 0.67 million sheep (BBS, 2001) are avialbale in the country. Small and landless farmers rear about 37.5%, medium farmers 40.0% and large farmers 22.3%. Sheep in Bangladesh are mostly indigenous type and is called **Bangla sheep**. They are small with an average adult weight of 25.0 kg for ram and 17.0 kg for ewe. Bangla sheep are sparsely distributed throughout the country but a higher concentration of sheep is found in the coastal region of Noakhali and Cox's Bazar, and in the enlarged many charlands. However, the river basins of the greater Rajshahi and Tangail districts have also a higher concentrations of sheep, where farmers maintain larger commercial (meat) flocks. In both the regions sheep are reared in extensive system without any input supports. Most of the sheep under extensive system is belong to large farmers. However, farmers of other areas of the country use to keep a few sheep with their cattle herd.

Observation on husbandry practices and biological adaptability of sheep suggests that less problems are associated with sheep management, nutrition and health than that with goats (Faylon, 1990). Private sector and NGOs are reluctant to accept sheep as an economic animal as sheep meat is not Most of the sheep (84.80% of the total) is reared under low input system and the rest 15.20% is found under medium input system (Table 2.1). However, the input support to sheep is not changing very much due to the absence of awareness of farmers on the economic importance of sheep rearing or of consumers on the nutrition of sheep meat (Table 2.2).

Table 2.6: Type of livestock farm by production system for sheep (%)

Type of Operation	Production systems			
	Low input	Medium input	High input	Total
Subsistence	25.20	5.20	-	30.40
Smallholder	44.40	10.00	-	54.40
Small-scale -commercial	15.20	-	-	15.20
Large-scale -commercial	-	-	-	-

Estimated data

Table 2.6 shows that about 25.20%, 44.40% and 15.20% of the total sheep under subsistence, smallholder and small-scale-commercial production system, respectively are supported with low input and 5.20% and 10.10%, respectively of the total sheep of subsistence and smallholder production systems is supported by medium inputs.

Similar to goat, sheep rearing, especially, in the coastal and in some selected areas of the country may be an economical production system of lamb, if smallholder producers are supported with training,

inputs and marketing facilities. The public sector should play primary role to demonstrate profitable production of sheep by smallholder and help to link-up its marketing through organizing entrepreneurs. Moreover, development of slaughtering system and quality control of meat are important area to address by the public sector.

2.6 Chicken production

Commercial chicken production in the country in the last two decades developed at a faster rate than that of other poultry species but the production system of native chicken did not changed very much. Most of the native chicken is still raised under low input system and their productivity still remains low. However, they are good sources of organic chicken produces that could fetch much profit for the farmers. The chicken production system of the country may be described as follows.

Rural chicken production: About 89% of the rural households keep poultry with an average of 6.8 birds per holding. A good number of women are involved in poultry rearing in the rural areas with or without landholdings.

Semi-scavenging chicken production: This system is developed in collaboration with the Department of Livestock Services and NGOs, and considered to be a viable income-generating system for the distressed and poor women and unemployed youth in the rural areas. The exotic pure breeds and their crosses are used in the system supporting with supplementary feeding, rearing techniques and health care. It contributes in poverty alleviation, employment opportunity and income generation in rural Bangladesh.

Commercial chicken production: Commercial farming system is developed in the private sector and completely based on imported germplasm. Commercial hatcheries are developed mostly on imported parent stocks and commercial broiler and layer day-old hybrid chicks are produced and marketed to a range from small to large farmers. The commercial farming system has got comparatively higher annual growth than scavenging system. The local hatcheries produce about 11.80 million layer and 61.0 million broiler day-old chicks in 1999-2000 and reported to meet only half of the market demand. About 70000 farms of different sizes are established in the country. Of them 20% has been rearing 1000 to 50000 birds and the rests are very small with 100 to 1000 birds.

Most of the large poultry entrepreneurs are interested to invest in building linkage industries like hatchery, feed mill etc. but their all out supports to small farms is the basis for sustained development of commercial layer and broiler farm industries.

Contract farming system is an important system for rapid growth of poultry industry. Contract poultry farming may be of two types for broiler production: a) contract to buy at a guaranteed price and b) contract to raise for the company on either per head or per kilo basis. But for layers hatcheries may have contract pullet raisers or there could be agents to raise layer chicks up to 16-18 weeks until they are delivered to egg producers. Contract raisers may have land, house, raising equipment and labour and the contracting companies may be responsible for supply of chicks, balanced feed, medicines and management advices including health control. Loan may also be given initially to facilitate contact raisers. This system has yet to be developed properly in Bangladesh. The proper introduction of contract growing system would be one of the best systems for poultry development in the country.

The native chicken germplasm used for conservation and further improvement are described below.

Native chicken germplasm used for conservation and further improvement

Chicken	Performance		*Contribution to food & agriculture and rural development*
Non-descript deshi	Age at sexual maturity (d)	145	Used for meat and egg production and also contributes to food and agriculture and rural development, rural family economy and nutrition and tasty meat.
	Weight at sexual maturity (g)	1100	
	Adult body weight (kg)	1.5	
	Egg number per year	50-60	
	Egg weight (g)	35-40	
	Fertility (%)	94	
	Feed intake (g/d)	83	
	Carcass weight (%)	55	
	Length of laying (d)	10-16	
	No. of eggs/clutch	10-16	
	No. of clutch/year	3-4	
	No. of eggs/set/clutch	10-15	
	Brooding age (d)	49	
	Hatchability of eggs (%)	84-87	
Naked Neck	Age at sexual maturity (m)	6.5±1.5	Used for meat and egg production and also contributes to rural family economy and nutrition and tasty meat. Efficient producer of high quality and high priced meat.
	Weight at sexual maturity (g)	1149.0	
	Adult body weight (kg)	1.50	
	Egg number per year	90-120	
	Egg weight (g)	37.0-40.0	
	Fertility (%)	88.0	
	Feed intake (g/d)	84.0	
Hilly	Age at sexual maturity (d)	150.0	Used for meat and egg production and also contributes to rural family economy and nutrition and tasty meat. Efficient producer of high quality and high priced meat.
	Weight at sexual maturity (g)	1326.0	
	Adult body weight (kg)	1.90	
	Egg number per year	80.0-100.0	
	Egg weight (g)	40.0-42.0	
	Fertility (%)	88.0	
	Feed intake (g/d)	85.0	
Aseel	Age at sexual maturity (d)	223.0	Used for meat and egg production and also efficient producer of high quality and high priced meat.
	Weight at sexual maturity (g)	1700.0	
	Adult body weight (kg)	3.20	
	Egg number per year	49.0	
	Egg weight (g)	43.0	
	Fertility (%)	90.0	
	Feed intake (g/d)	95.0	
Jungle Fowl	Age at sexual maturity (m)	5.9±0.42	Used for meat and egg production and also contributes to rural family economy and nutrition and tasty meat.
	Weight at sexual maturity (g)	961±150	
	Egg production (%)	14.07	
	Egg number per year	34.2±2.15	
Native Dwarf	Age at sexual maturity (m)	6.5	Used for meat and egg production and also contributes to rural family economy and nutrition and tasty meat.
	Adult body weight (kg)	1.2-1.6	
	Egg number per year	121	
	Egg weight (g)	39	
	Feed intake (g/d)	80	

Table2.1 shows that about 61.70% of the total chicken is still remained under low input system, 22.20% under medium input and the rest 16.46% receives high input support. The chicken under medium and high input system may be considered as commercial poultry. The input support to chicken production has increased rapidly during the last 20 years (Table2.2).

Table 2.7: Type of livestock farm by production system for chicken (%)

Type of Operation	Production systems			
	Low input	Medium input	High input	Total
Subsistence	24.40	10.40	-	34.80
Smallholder	36.94	11.80	-	48.74
Small-scale-commercial	-	-	12.50	12.50
Large-scale-commercial	-	-	3.96	3.96

Estimated data

Table 2.7 shows that 24.40% and 36.94% of the total chicken under subsistence and smallholder production systems receive low input support and 10.40% and 11.80%, respectively receive medium input support. Out of the rest 16.46% of the total chicken under small-scale-commercial and large scale-commercial operations belong to high input production system.

2.7 Duck production

Ducks are mainly raised by the rural peoples and are not operated under good management system. Rural and smallholder duck production systems are mostly popular in the country. Duck-cum- fish production system is newly demonstrated in different regions of the country. The production system may be described as follows.

Rural duck production: Ducks are mainly reared with chicken in scavenging system allowing their access to ponds, confined water areas, canals, beels (big water reservoir) and rivers. Duck eggs are mainly hatched and day old ducklings are brooded by broody chicken, but growing ducklings are managed by farmers, especially, by women and children.

Smallholder duck production:

The smallholder duck production is a unique system that is developed based on natural feed resources available in low lying water bodies of the country. About 85-88% of the total 29.12 million ducks is reared in the scavenging and about 58% of the small and landless farmers are engaged in scavenging duck production in the typical Sylhet basin of the country. The average range of duck numbers kept by different farmers was found as 50-600 per farm and average annual egg production per duck was recorded as 204. However, the productivity of eggs found low in dry period. The duck farmers raised

the problems of non-availability of ducklings, training, capital and easy marketing systems that were the hindrances for increasing duck production using the water bodies available in the country. To support the smallholder duck production, the Govt established hatcheries with intensive duck management system to distribute ducklings to farmers.

Duck cum fish production

Duck cum fish production system is newly introduced by the Bangladesh Fisheries Research Institute and still remains at field demonstration level in certain parts of the country. Bangladesh Livestock Research Institute has also demonstrated the integrated system in its demonstration sites and some NGOs have also taken initiative to disseminate the technology at field level.

Most of the ducks (65.03% of the total, Table2.1) are reared under low input system and the rest are in the medium input system. Smallholder duck production under scavenging share the medium input supports. The low input duck production system remains more or less constant in the last 20 years but the smallholder production system in the scavenging conditions are gradually increasing (Table 2.2) due mainly to extension programs undertaken by the Govt. and Non-government organizations.

Table 2.8: Type of livestock farm by production system for duck (%)

Type of Operation	Production systems			
	Low input	Medium input	High input	Total
Subsistence	24.73	6.40	-	31.13
Smallholder	40.30	19.54	-	59.84
Small-scale -commercial		9.03	-	9.03
Large-scale -commercial	-	-	-	-

Estimated data

Subsistence and smallholder operations of duck rearing encompasses 24.73% and 40.30%, respectively and are supported by low inputs. The medium input supported production systems under subsistence, smallholder and small-scale-commercial operations are reported to be 6.40%, 19.54% and 9.03%, respectively.

2.8 Pig production

Pigs are distributed throughout the country. Higher concentration is noticed in the districts of Rangamati, Comilla, Sylhet, Mymensingh, Gazipur, Tangail, Feni and Noakhali. However, nomadic flocks of pig are seen to move in most of the districts of the country. Pig production systems in Bangladesh are mainly of two types i) semi-intensive- mainly kept by tribal peoples and who rear at their homestead areas and ii) extensive- nomadic peoples who rear pigs in flocks through continuous shifting of their scavenging areas.

2.9 Rabbit production

Rabbits in Bangladesh are scattered and distributed all over the country. However, the rabbits are found in a great number in the region of Muktagacha, Haluaghat, Modhupur, Tangail and in some parts of Dhaka. In commercial form most of the rabbits are found in various research organization, laboratories, and educational institutions.

Commercial farming of rabbit in Bangladesh is still very limited although there is a demand of this animal. In most cases the research institute is rearing rabbit for research purposes under confinements. In the rural areas, where the people rear it in large or medium scale, follow semi-intensive system, some times intensive system as well. But the system is rear to observe.

2.10 Dog production

Dogs are available everywhere in Bangladesh. Due to religious and ethical reasons dog meat is not important as a food item in Bangladesh. Most of the dog in the village play an important role as watch dogs as they guard against thieves, jackals and other beasts. Dogs are rarely used for hunting purpose by the hill tribes. In the urban areas, especially, in the down towns, there are many apparently ownerless dogs. In the cities like Dhaka and Chittagong the elite persons keep dogs as a matter of hobby and also for safeguarding their houses. Other than the role of safeguarding, dog has no economic significance in the context of Bangladesh.

Dogs are mainly of two types: (i) dogs that are reared in captive as a matter of hobby and/or for the sake of safeguard and (ii) the ownerless dogs that wonder around freely and seem to live as scavenger fundamentally. Basically, the population size of the latter types is higher (nearly 99 %). However, the population size of captive dogs are increasing while the ownerless scavenging type dogs are decreasing day by day due to the lack of feed availability, incidence of diseases and parasites and natural calamities. As dogs carry the virus responsible for rabies, people sometimes indiscriminately kill them to reduce the incidence of rabies.

2.11 Horse production

Equine population in Bangladesh is very limited and it does not appear in national livestock statistic of Bangladesh. It is said that native horses have been raised in this country since old times and that they have been influenced genetically by Arabian and Persian horses which have been immigrated through India from the west.

Horse has a little contribution to the food and agriculture, although before increasing the advancement of farm power and machineries horse was used largely as sources of traction power in agriculture and

rural transportation. The use of horse in agriculture or rural transportation is almost absent except its sporadic use in some areas. Some exotic horses are used in military and police services.

2.12 Deer production

Deer is mostly available in the forest area of the country and they are wild types. However, Chitra deer are sometimes reared at household level for meat purpose. A few private initiatives may be available on rearing deer commercially in a small herd.

Chapter 3: THE STATE OF GENETIC DIVERSITY

Manipulation of farm AnGR in the country is being continued from the beginning of the last century. Cattle and chicken are the two major species of farm animals and poultry and are being manipulated genetically either through inclusion of exotic blood and/or import of live animals and birds. Ducks and buffaloes are also being crossed with exotic germplasm. Live animals and birds are imported and allowed to cross with the native germplasms. The genetic diversity of farm animals and poultry is described below.

Cattle germplasm consists of both local and exotic gene pool in the country and they are considered as a preferred animal in the subsistence agriculture of Bangladesh. They are kept both for milk and meat, and draught power .

3.1: Cattle genetics

The native cattle are not described yet but some of them are considered potential in some locality and are identified by its local name, such as Pabna cattle and 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 has already been added to the herd of different parts of the country. Thus, cattle population of the country consists of i) Native cattle, ii) Pabna cattle, iii) Red Chittagong cattle, iv) Crossbred cattle and v) Exotic breeds (Holestein and Frisean, Shahiwal, Sindhi and Jersey).

Table 3.1 shows that there are about four (4) local varities and four (4) exotic breeds of cattle are reared in the country. All the local varities (Pabna, Red Chittagong, North Bengal Grey, Munshiganj) are at the risk of extinction due to indiscreminate use of cross breeding programmes throughout the country. Farmers interest for more milk, absence of initiatives for conservation of local variety and absence of organized pograms for idnetification and characterization of their production and reproduction performances in the past or even in the present lead to the local cattle germplasm at risk. All the cattle germplasm reached at the risk of extiction were used widely. During the last 50 years the country already lost potential local cattle germplasm and Jersey exotic breed. A comprehensive baseline survey of none of the cattle is done yet but the individual perforamance recording has been continuing for Pabna and Red Chittagong cattle (Table 3.2) in BLRI under conservation *ex situ in vivo* condition.

Red Chittagong cattle

The origin of Red Chittagong Cattle (RCC) is not clear but the history of human habitation in the Chittagong area indicates that about 2300 years ago RCC was introduced from the western India and its source of genetics may have originated either from Shahiwal or Sindhi. Their habitats, in addition to Chittagong, are extended to the plain land of Feni, Cox's Bazar and Rangamati districts (Fig.1). However, their exact number of population and their distributions are yet to be estimated.

Red Chittagong cattle are red in colour except the horns, muzzle and hooves which are use to be dun or pink. The animals are small in size, the wither height of adult females is about 125.0 cm and that of male is about 150.0 cm. The average birth weight is about 17.0 kg. Adult male weight is about 350.0kg but the adult female weight is about 150.0 kg. Blood protein polymorphism study done on the cattle of Bangladesh indicates that there may be genotypic difference between RCC and indigenous cattle of Bangladesh. Blood samples from RCC of Bangladesh Agricultural University (BAU) dairy farm are analyzed for blood protein polymorphisms and mtDNA but the work is not completed yet. The data available from the *ex-sito* conservation program of the research farms of BAU and Bangladesh Livestock Research Institute (BLRI) indicate that average lactation yield of RCC cow is 800.0 litres in a lactation period of 250 days. Average daily milk yield under farm condition is about 3.0 litres but the superior cows of the original breeding tract produce 5.0 liter milk daily. The reproductive efficiency is satisfactory and high under farm condition. Semen quality analyzed in the Artificial Insemination laboratory of BAU indicates that good quality semen can be obtained from a bull up to 7 years of age. The animals have high adaptation efficiency without much health problems under low input system.

Pabna cattle

Pabna cattle are one of the improved types of indigenous cattle in the country and their habitats are shown in Fig1. The northern low lying basins around the meeting point of the river Padma and the Jamuna (Shahzadpur, Bera and Sathia upozilla of the greater Pabna district) are their habitats. Gradually the cattle germplasm is being diluted with the introduction of exotic blood. A small herd of Pabna cattle (250) is maintained at BLRI and is considered to be a good source of genetic make-up of Pabna cattle in Bangladesh.

The native cattle of the Pabna area was crossed with the introduction of *Bos indicus* bulls such as Sahiwal and Hariana before the second world war and an intensive selection during the last 50 years for increased milk yield supported by higher input system as compared to other areas resulted in a variety of improved type of cattle known as Pabna. Its colour is red, gray or a mixture of both. The average body weight for adult female and male cattle is about 250.0 kg and 500.0 kg, respectively. The daily milk yield is 4.5 liter per day though the best cow yielded 20.0 liter per day. However, the

germplasm began to be diluted from 1975 with the introduction of Friesian and Jersey bulls for artificial insemination (AI) programme in the area. The concentration of Pabna cattle has been declined alarmingly due to the widespread use of A.I. services with exotic bulls and the germplasm will be extinct in near future.

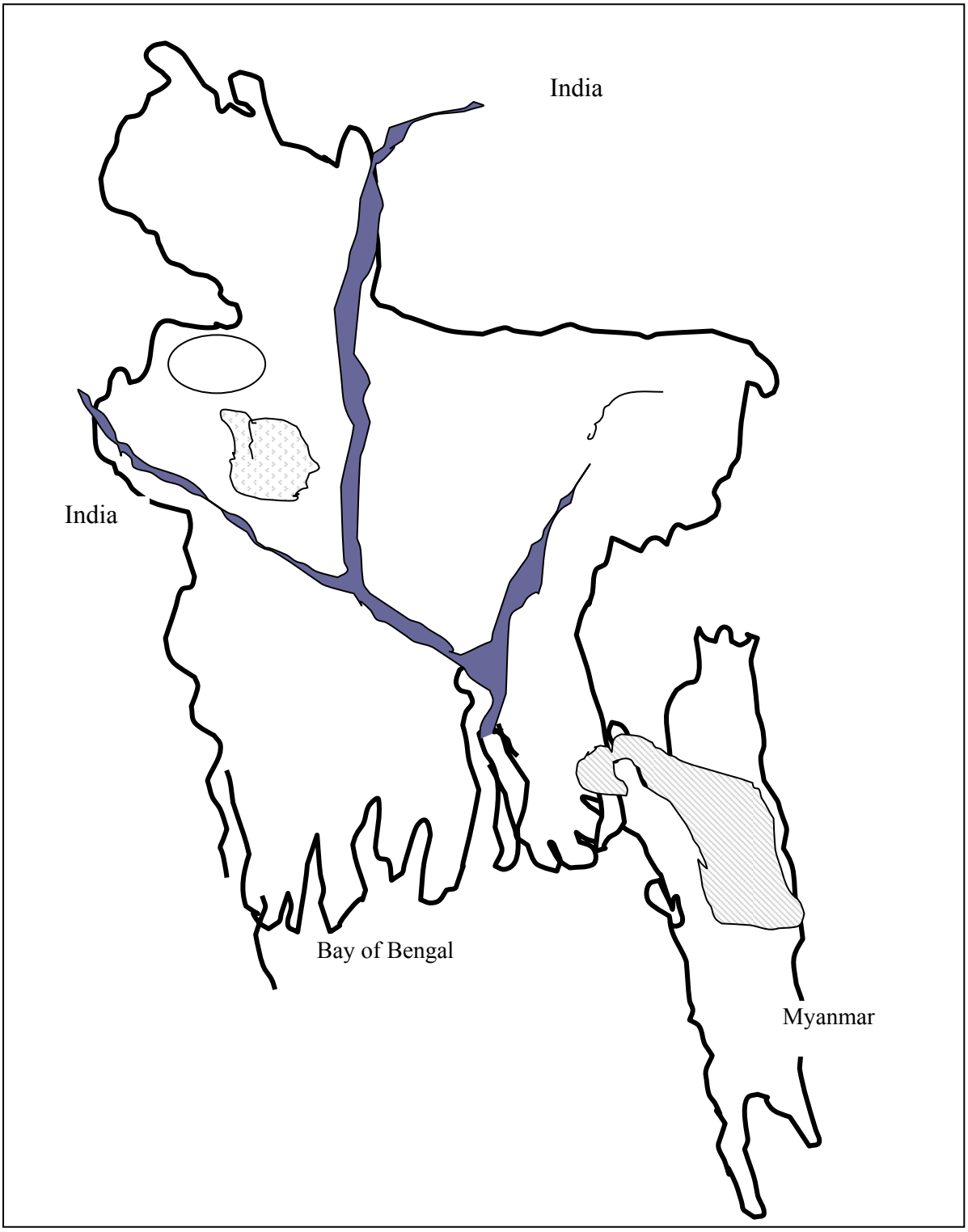

Fig.1: Map of Bangladesh showing the habitats of Red Chittagong cattle by red circle ( ) and of Pabna cattle by green circle( ).

Native cattle

Native cattle are the mixture of different animals with a variety of colours (red, gray, white or black) found in different regions of the country. Their average wither height of adult animals varies from 120.0 cm to 140.0 cm. Adult females weigh about 120.0 kg and males about 180.0 kg. The average daily milk yield is about 1.0 liter and lactation period ranges from 180 to 240 days. They can, however, survive on low level of nutrition and can withstand hot humid climate. Their draught efficiency is higher than any other existing cattle genotypes of the country.

Crossbred and exotic cattle

The crossbred cattle are being produced through A.I. programme using frozen semen of exotic breeds mostly Sahiwal and Friesian. It is estimated that the country now possesses about 2.3 million crossbred cattle heads. The crossbred cows being improved with high genetic material, yield better than the natives under medium to high input level of management but perform poor under low input system of production. The average daily milk yield is as high as 20.0 liters in F_1 generation but the yield is declined with subsequent problems of infertility and sterility with the advancement of generations.

Genetics

Two Japanese teams in collaboration with the Department of Animal Breeding & Genetics, Bangladesh Agricultural University (BAU) made genetic studies on the breed differentiation of the native domestic animals in Bangladesh in 1984 & 1987. The species covered were cattle, buffalo, goat, sheep, horse, chicken, pig and dog. Their studies included areas of morphological characters, blood protein polymorphisms, coat colour variations & karyotypes. Those studies gave some insight as to the genetic composition, gene frequencies of native species and the genetic distances of Bangladeshi native AnGR with that of other Asian countries. Work with further molecular base such as DNA microsatellite has yet to be addressed with Bangladeshi AnGR.

Namikawa *et al.* (1984, 1987) reported the blood groups, blood protein polymorphism and karyotypes of the native cattle. They reported the blood protein polymorphism for 6 loci. These are haemoglobin, albumin, transferrin, carbonic anhydrase, amulase-I and diaphorase-II. The most frequently occurred genes were Hbb^A, Alb^B, TfD^2, *Am-IB*, CA^S and $Dia\text{-}II^C$. They detected 9 blood group systems. These were A, B, C, F, L, J, S, Z and R′ . They found 60 chromosomes in diploid cells of native cattle, 58 autosomal chromosomes were acrocentric, X and Y chromosome (sex chromosome) were submetacentric and acrocentric, respectively.

The availability of different genetic resources in the country is shown below.

Animal genetic resources of cattle and buffalo available in Bangladesh

Animals	Purpose	Production systems
Indigenous type	Both milk and meat	Crop residues, mainly straw diets supplemented with a little amount of grain by-products and sometimes with green grass
Pabna cattle	Both milk and meat	Winter fodder (Nov to May) Stall fed (June to Oct) mainly on with straw diets with concentrates
Munshiganj Cattle	Both milk and meat	Winter fodder (Nov to Feb) + Stall fed/Roadside grazing & stall fed mainly with straw diets
Red Chittagong cattle	Both milk and meat	Roadside grazing & stall fed mainly with straw diets
HF (100% exotic)	Both milk and meat	Stall fed with concentrate, straw and green grass
HFXL (50x50)	Both milk and meat	Stall fed, straw and green grass with concentrate
HF x L (50x50)	Both milk and meat	Stall fed, straw and roadside green grass with supplementary concentrates
HF x SL (50x50)	Both milk and meat	Stall fed, green grass, straw with supplementation of concentrates
HF x SL (unknown)	Both milk and meat	Stall fed, green grass, straw with supplementary concentrates
J x L (unknown)	Both milk and meat	Stall fed, road side grass, mainly straw with supplementary concentrates
JxSL	Both milk and meat	Stall fed, road side grass, mainly straw with supplementary concentrates
SL (100%)	Both milk and meat	Stall fed, green grass, straw with concentrates supplementation
SL x L	Both milk and meat	Stall fed, crop residue, road side green grass, straw with little supplementation of concentrates
Buffalo- River type -Swamp types	Milk Meat	Located in a higher concentration in some selected areas (coastal and river valleys) of Bangladesh. Except flood period they use to graze on the river bank and bathans
Nili Ravi	Milk	Reared *ex situ in vivo* under stall feeding condition

3.2 Buffalo genetics

No clear information is available about the origin of water buffaloes of Bangladesh. It may be grouped into five populations on the basis of their history of domestication, distribution and morphology. These are (i) Native buffaloes in the eastern part, (ii) Native buffaloes in the western part, (iii) Native buffaloes in the central part, (iv) Native buffaloes in the southern part and (v) Nili-Ravi breed in the Buffalo Breeding Farm at Khulna. Water buffalo distribution have been presented in Fig.2.

As described above there are about four types of native buffaloes in the country and all of them are used widely in different regions. Nili-Ravi is the only imported exotic buffalo germplasm used widely for crossing with the local cows and the Nili-Ravi is at risk at present (Table3.1). Baseline survey is already conducted for the above buffalo germplasms and their characterization in terms of genetic distance and molecular studies are completed (Table3.2). Individual performance recording for the native buffaloes of the central part of the country is being continued in BLRI.

Native buffaloes in the eastern part

The native buffaloes found in the eastern part eg. in the greater Sylhet and Chittagong districts are considered to be the most primitive one of the country. They are well adapted to the swamp soil of coastal and marshy land of this area. They represent about 39% of the total buffalo population of the country (BBS 1986, 1999; Faruque *et al*. 1990). Their coat color is usually gray and have crescent horns. Most of the buffaloes have chevrons and white stocking. Some water buffaloes have white flecks on each side of the face. Few albinoid buffaloes are found. However, their actual distribution is yet to be determined. They are the smallest in size among Bangladeshi buffaloes. Height at wither ranges from 121.0 to 126.0 cm for adult buffaloes. Their milk yield is very low and produce only 272.0 to 300.0 kg milk in a lactation period of 240 to 270 days. These animals are usually used for draught purpose. Management system is mostly extensive.

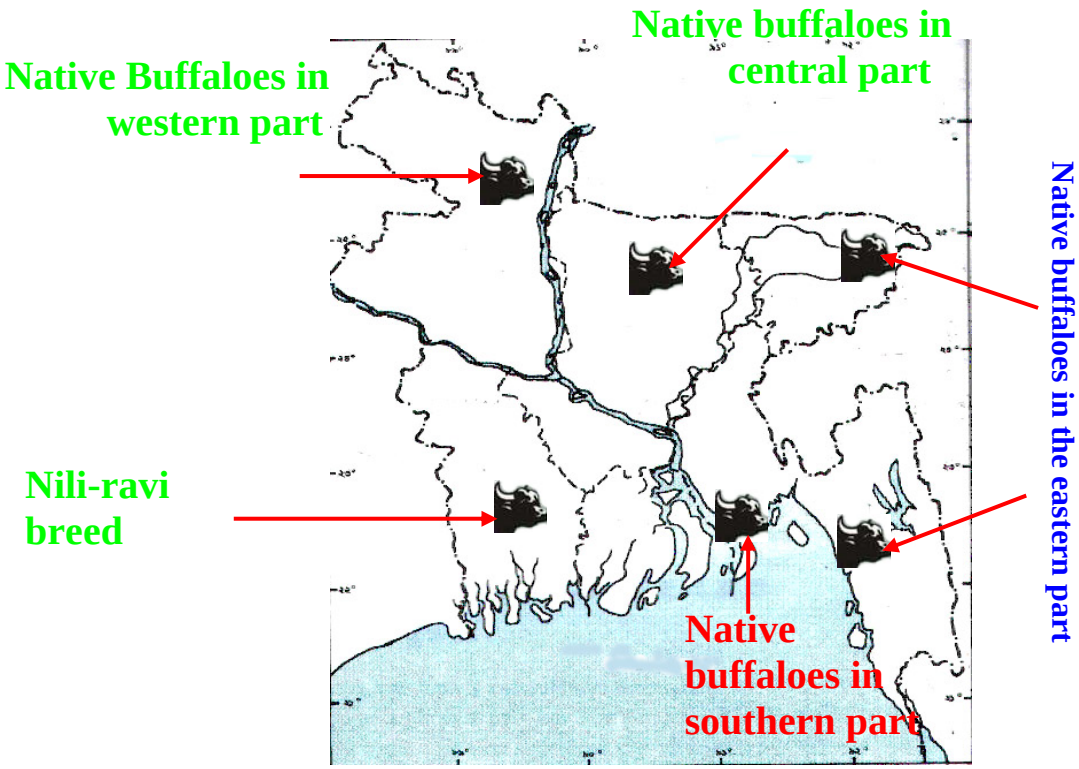

Fig2: Water buffalo types and distribution in the country

Native buffaloes in the western part

These buffaloes are the largest group and constitute about 41% of the total buffalo population. They are found in the western part of the country and are used mainly for cultivation of land, transportation and crushing of sugarcane. Their coat color is usually black and horns are curly. But some animals

have brown coat color with spot in the tail switch. White stockings are also observed in some animals that have brown coat color. Hanging horns are also observed in some animals. They are the largest buffaloes in the country. Height at wither ranges from 133.0 to 148.0 cm. The male buffaloes are used for draught purpose and females for dairy purpose. Average milk yield is about 620.0 kg in a lactation period of 270 days. Their management system is semi intensive.

Native buffaloes in the central part

These animals are found in the sandy islands of the River Brahmaputra and the Jamuna of the central part of the country. Their population size is rather small and reported to be approximately 4500.0 to 5000.0. Two small buffalo herds are kept by the BLRI and BAU. Their morphological characteristics are almost similar to those of the western part. Their coat color is also black and horns are curly. Few Albinoid buffaloes are found, but their frequency is very low. The utility and management are the main differences between these buffaloes with those of the western part of the country. They are kept absolutely for dairy purpose. Moreover, they are managed under semi intensive system but in dry period, they are kept under extensive system in bathan (a common natural pasture). Average lactation milk yield is about 900.0 kg in a lactation period of 274 days.

Native buffaloes in the southern part

The native buffaloes in the coastal area of southern part are mainly crossbred type. Crossbreeding of the native buffaloes in the southern part started in 1960 with Nili-Ravi imported from Pakistan and subsequently produced in the Govt. Buffalo Breeding Farm at Khulna. This program is still going on. A good number of crossbred buffaloes are, therefore, observed nowadays in the coastal area of the southern part of the country. Faruque (2000) estimated that it constitutes about 15% of the total buffalo population of the coastal area. They are larger in size than the native buffaloes of that area. Their milk yield is two to three times higher than the natives and adaptability is quite satisfactory. However, their reproductive efficiency is yet to be assessed. They are managed extensively and used for dairy purpose.

Nili- Ravi breed

Nili- Ravi buffaloes were first imported from Pakistan in 1960 to supply Nili-Ravi bulls to the farmers in the coastal area of southern part for cross breeding purpose. Initially, the breeding males and females were maintained in the Central Cattle Breeding Farm in Dhaka. Buffalo Breeding Farm was established in Khulna in 1985, and a fresh batch of Nili-Ravi males and females were again imported from Pakistan. So far, about 200 pure Nili Ravi bulls have been distributed in the coastal area for

crossbreeding purpose. There are 197 animals at present in Buffalo Breeding Farm.

Genotypes

Blood protein polymorphism studied by Amano *et al.* (1987) indicates the existence of 7 polymorphic loci in buffalo populations of Bangladesh. These are albumin, transferrin, haemoglobin- α, haemoglobin- β, carbonic anhydrase, alkaline phosphatase and peptidase-B. Alb^X, gene of typical swamp buffalo was found only in the populations of the eastern and southern part. Tf^A, gene of typical swamp buffalo was detected only in the population of the eastern part. Amano *et al.* (1987) determined the karyotypes of water buffaloes of Bangladesh. They reported 50 chromosomes for the water buffaloes of the central part and 48 chromosomes for those of the eastern part (Sylhet district). The mtDNA *cytochrome b* gene sequence of different populations of water buffaloes of Bangladesh also reveals the existence of swamp buffaloes in the Sylhet district. The genotypes determined indicate that water buffaloes of the western and the central part are river type. The water buffaloes of the north-eastern part are swamp type and those of the south eastern part are river type. The water buffaloes of the southern part are swamp type or crossbreds (Swamp X Nili-Ravi).

3.3 Gayal genetics

The Gayal has age dependent coat colours. The coat colour of calves is red and changes to brown at yearling and turn permanently to black in adult. The height of male and female individual is 135.0 and 126.0 cm, respectively. The weight of adult male and female is 530.0 and 430.0 kg, respectively. The karyotypes reveal the existence of 58 chromosomes in diploid chromosome. Of the 58 chromosomes, first two autosomal chromosomes are submetacentric, the rest autosomal chromosomes are acrocentric and the sex chromosome is submetacentric. The blood protein polymorphism studied indicates the existence of polymorphism for haemoglobin, albumin, transferrin, carbonic anhydrase, amylase-1 and diaphorase-1.

The performance studies made under confinement reveals that the birth weight of calves is 24.0 and 20.0 kg for male and female, respectively. The growth rate is 405.0, 307.0, 315.0 and 312.0 g/day for calves up to 3 months, 3-6 months, 6-9 months and 9-12 months, respectively. Age and weight at first estrus is 16.7 months and 247.0 kg, age at first calving and calving interval is 28.3 months and 16.7 months, estrus cycle and gestation period is 24.5 days and 283 days, respectively.

However, natural species hybridization between Gayal X local cattle (*Bos indicus*) happens frequently. This crossbred is locally known as **'Tomru'** and has been reported to be fertile. The crossing of gayal with Holstein Friesian indicates that the crossbred calves have higher birth weight and growth rate than the pure gayal claves. The fertility and fitness of crossbred calves are yet to be determined.

A single type of Gayal germplasm is available in the country but due to mating with local cattle, deforestation of the area, absence of any program for its conservation led the animals at the risk of extinction (Table3.1). Data on individual performances are being recorded in BLRI Gayal research farm established in the hilly areas of the country (Table3.2).

3.4 Goat genetics

It is estimated that more than 90 percent of total goat population in Bangladesh is comprised of Black Bengal (Table 3.1) and the remainder being Jamnapari and their crosses (Husain *et al*. 1998). Black Bengal goat has some reputed features: early sexual maturity, high prolificacy, adaptability to hot and humid environment and yields superior quality skin and meat (Husain *et al.,* 1996; Amin *et al.*, 200, Chowdhury *et al.,* 2002 and Devendra and Burns, 1983). However, some authors reported that their growth rate is slow; milk production low and and it use to be affected by higher kid mortality (Husain et al., 1996, 1998; Amin et al., 2000, 2001 and Chowdhury et al., 2002). The coat color of Black Bengal goat is not only black but black & white, brown, brown and white & white are also common in the population.

The range of body length of adult (12-24 months) Black Bengal goats is 46.0 to 56.0 cm. Heart girth of male and female goats at> 24 months of Generation 1 is 72.3±1.35 and 69.8±1.16 cm, respectively. The average adult (>24 months age) body weight of male and female goat is 29.9±1.08 and 25.9±1.08 kg, respectively. Chowdhury and Faruque (2001) reported that wither height of adult (>12 months) male goats is higher (58.6±0.88 cm) than female goats (54.4±0.70 cm). Average neck length of adult (>6 months) female goats was higher (15.08 cm) than male goats (14.71 cm) and neck breath was higher in male goats (30.65 cm) than female goats (25.33 cm).

Black Bengal goat is more or less evenly distributed throughout the country. But concentration is relatively higher in the north-western areas of Bangladesh and it belongs to the *high gangas river floodplain* agro-ecological zone. Moreover, they are also found throughout the eastern and north eastern India from Bihar through northern Orissa to entire West Bengal, Assam, Monipur, Tripura and Meghalay province.

Jamnapari, an Indian bigger size goat breed is popularly known as **Ram Chhagal**. They are found in a limited scale in urban and peri-urban areas of Bangladesh in the form of pure or Jamnapari x Black Bengal cross with varying degrees of inheritance. They are reared both in intensive and semi intensive management system. However, the population size of Jamnapari is not so large (about 6-7 %) in the country (Table 3.1).

In addition, some Missionary's have few small flocks of goat in the country and they maintain exotic breeds such as Beetal and Jamnapari in a limited scale aiming at producing bucks for distribution among the landless and marginal farmers as a part of their poverty alleviation programme in Bangladesh. Their target is to produce crossbred kids with improved production potentials

(particularly, milk) to meet the demands of landless and marginal farmers. However, the Govt. restricted crossbreeding programme of Black Bengal goats at present.

There are few data on the production system of Black Bengal goats in the country but complete baseline survey is not done yet. Characterization of Black Bengal goats in terms of its genetic distance and genetic and molecular evaluations are important but could not be started due mainly to the lack of availability of inputs including trained human resources in the country (Table3.2).

3.5 Sheep genetics

Sheep in Bangladesh are mostly indigenous non-descript type and it is sparsely distributed throughout the country (Table3.1). A few steps are so far been undertaken for characterization of indigenous sheep at population or individual level (Table 3.2). BLRI collected different native sheep germplasm from different regions of the country and it has taken step for evaluation of production and reproduction performances. In collaboration with International Livestock Research Institute (ILRI), Kenya the Dept. of Animal Breeding and Genetics of Bangladesh Agricultural University, Mymensingh has started the process for genetic characterization of native sheep of Bangladesh.

As of today, only a total of 19 rams were imported in 1965, 1976 and 1984 from Pakistan (Lohi), New Zealand and Australia (Romney Marsh, Suffolk and Parendale). However, the impact of imported sheep samples on the national sheep population is negligible. Garole sheep are found in Sundarban area in the southern part of Bangladesh. It is reported to exist in the coastal region of the country. They are reputed for multiple births and reported to have contributed to the Boorola Merino stain of Australia (Sharma et al. 1999).

3.6 Chicken genetics

The genetics of chicken is not known very much except the work done by Okada et al, 1988; Zaman et al, 1991 through a collaborative works between Japan & Bangladesh Agricultural University. The gene constitution at the morphological and blood group loci of Deshi chicken in Bangladesh was done. The studies on the relationship between the jungle and the domestic fowl was conducted from ecological, morphological, biochemical and chromosomal viewpoints. Since 1971, a Japanese research group has been doing research activities in Southeast Asia including Bangladesh with the objective of defining the evolution and domestication of jungle fowls.

From identifications of gene frequencies at 4 blood groups and 8 plasma polymorphic proteins (The AKP, AKP-2, ES-1, Amy-1, Amy-3, Alb, Pas, and Tf loci) Okada *et al.*(1988) suggested that the average genetic distances between the domestic fowl and jungle fowl were small for the Red Jungle fowl, intermediate for the Grey Jungle fowl, and very large for the Ceylonese and the Green Jungle fowls.

The gene frequencies at 9 morphological loci were also used to compare chickens of different districts (geographical areas of the country). The morphological characteristics analyzed were the comb shape (the P,R and Cr loci), earlobe color, feather color (the B,E I and S loci) and shank color (the Id locus). Concerning the gene frequency at each locus, some variations were observed in different districts. A good variation in the frequencies of the E and I alleles controlling feather color was noticed. Genetic distances were calculated from the gene frequencies at 4 blood groups and 8 plasma protein loci. Genetic distances between each pair of local populations in Bangladesh were small, but the distance between Deshi & Aseel was relatively large which corresponded almost to the differences between the breeds. These studies further revealed that no systematic selection had been carried out on those morphological characteristics of indigenous chickens of Bangladesh. Japanese research group also found that Laos native fowl was genetically close to Bangladesh native fowl, and the genetic distance between them was estimated as 0.01 and these populations and Nepal native fowl were clustered in one group. In collaboration with International Livestock Research Institute (ILRI), Kenya the Dept. of Animal Breeding and Genetics of Bangladesh Agricultural University, Mymensingh has started the process for genetic characterization of native chicken of Bangladesh.

The chicken germplasms of native and exotic types available in Bangladesh, their habitats, rearing systems and importance are described below.

Chicken germplasm available in the country

Types of chicken	Habitat	Rearing system	Importance
(a) Native			
i) Non-descript deshi	All over Bangladesh	Scavenging	Long adapted, low input, low productivity, tasty meat and egg
ii) Naked Neck	All over Bangladesh	Scavenging	Long adapted with special genetic merit for production
iii) Hilly	Chittagong Hill tract	Scavenging	May have gene of special merit
iv) Aseel	Brahmanbaria, Chittagong	Scavenging	Fighter, meat
v) Native dwarf type	Sporadically available in Bangladesh	Scavenging	Long adapted with special genetic merit of low input requirement
vi) Yasine	Sporadically available in Bangladesh	Scavenging	Long adapted and meat type
viii) Crossbred	Demonstration areas	Semi-intensive	Meat and egg
(b) Introduced exotic breeds			
i) White leghorn ii) Rhode Island Red iii) White rock iv) Barred Plymouth Rock ***v) Fayoumi***	Mostly in Govt. farms	Intensive	Used mainly for crossing
(c) Continually imported			
(a)Commercial broiler strains i) Starbro, ii) Vancobb, iii) Hubbard Classic, iv) Ross, v) Arbor Acres and others	All over Bangladesh	Intensive & cage system	Commercial meat production
(b) Commercial layer strains i) B.V.300, ii) Isha brown, iii) Lohmann brown, iv) Starcross – 579, v) Hi-sex brown, Hy-line and others	All over Bangladesh	Intensive & cage system	Commercial egg production

There are about six native chicken germplasms (Non descript deshi, Naked Neck, Hilly, Aseel, Native dwarf type and Yasine) in the country, out of which three (Non-descript deshi type, Necked Neck and Hilly) are found to be used widely and the other three (Aseel, Yasine, and Native darf type) are at the risks of extinction (Table3.1). About 15 exotic chicken germplasms are available of which five are pure breed and the rest are commercial strains of layer and broiler chicken. Out of them 10 commercial strains are used widely in the country (Table 3.1). None of the native germpalsms of chicken is characterized in detail so far except performance evaluation at individual level (Table 3.2).

3.7 Duck genetics

Similar to chicken, Bangladesh has also got different types of duck germplasms and they are reared in different systems in different regions of the country. The following duck germplasm list shows that Nondescript indigenous type, Deshi White, Deshi Black and Muscovey are the four native duck germplasms found in the country. The former three native ducks are used widely at farm levels (Tabel 3.1). Individual performance evaluation of Deshi white, Deshi Black and Muscovey ducks are being continued but their characterization at population or individual level are not done yet (Table 3.2). Khaki campbell, Indian Runner and Jending are the three exotic ducks used widely at farm level and the White Pekin is limited to some duck farms in the public sector (Table 3.2).

Duck germplasm available in the country

Types of ducks	Habitat	Rearing system	Importance
(a) Native			
i) Nondescript indigenous type	Kishoregonj, Netrokona, Sylhet, All over Bangladesh	Scavenging & semi-intensive	Well adapted to scavenging system & disease resistant
ii) Desi White	All over Bangladesh	Scavenging and semi-intensive	Well adapted to scavenging system & disease resistant
iii) Desi Black (Nageshawri)	All over Bangladesh	Scavenging and semi-intensive	Well adapted to scavenging system & disease resistant
iv) Muscovy	Limited to duck farms in the public sector	Intensive	Meat
v) Cross ducks	All over Bangladesh	Scavenging and semi-intensive	Meat and eggs
(b) Introduced exotic types			
i) Khaki Campbell	All over Bangladesh	Scavenging and semi-intensive	Egg
ii) Indian Runner	All over Bangladesh	Scavenging and semi-intensive	Egg
iii) Jending	Duck farms and selective places of the country	Scavenging, semi-intensive& intensive	Egg
iv) White Pekin	Limited to duck farms in the public sector	Intensive	Meat

3.8 Special fowl genetics

The types of special fowls found in Bangladesh are Geese, Quail, Pigeon and Guinea fowl. Their available types, habitats, production systems and importance are described below. There are two types of native Goose (Grey and White Goose) are used widely at farmers level, and are not characterized both at population or at individual level (Tabel 3.1 and 3.2).

Types of Special fowls		Habitat	Rearing system	Importance
(a)Geese				
Native	i)Grey goose ii)White goose	South & South West Bangladesh	Scavenging	Meat
(b) Quail				
Native	i)Indigenous ii) Jungle Quail	Semi-urban Hilly forest	Intensive Free flying	Egg and meat
Exotic	i)Japanese ii)Brown iii)Dhakai	Semi-urban	Intensive and semi-intensive	Egg and meat
(c) Pigeon				
Native	Indigenous types (Jalali)	All over Bangladesh	Free flying	Squab production
Exotic	i)King, ii)Homer, iii)Siraji, iv)Fantail, v)Pouters, vi)Tumblers	All over Bangladesh	Intensive and semi-intensive	Squab production
(d) Guinea fowl				
Native	i) Non-descript indigenous type	All over Bangladesh	Scavenging	Egg and meat

Both native and exotic types of Quail are available in the country. Jungle quails are mostly found in the forest area under free flying conditions but indigenous type is reared in semi-urban area under intensive condition. Japanese, Brown and Dhakai are the three exotic types of Quail are reared in the semi-intensive or intensive systems. The exotic Japanese Quail is widely used and indigenous type is at the risk of extinction (Table 3.1). The birds are not characterized yet except their individual performance evaluation (Table 3.2).

There is a single native type of pigeon but about six (6) exotic types of pigeon are found in the country (Table 3.1). Indigenous "Jalali" pigeon is widely used by peoples. Most of them are reared on free flying system i,e the farmers provide only shelter for their squab production. They used to collect their feed from different sources. No work is carried out for their characterization in the country (Table 3.2).

Native Guinea fowl of indigenous type is reared by the farmers and found to be popular in some regions of the country. However, no survey works on their habitats or production system or any initiative for characterization of the germplasm is done except some individual evaluation at farm level (Table 3.1 and 3.2).

Table 3.1: Breed Diversity (Number of Breeds)

Species	Number of breeds									
	Current Total		At risk		Widely used		Others		Lost (Last 50 yr)	
	L	E	L	E	L	E	L	E	L	E
Cattle	4	4	4	-	4	1	1	-	1	1
Buffalo	4	1	-	1	4	1	-	-	-	1
Goyal	1	-	1	-	-		-	-	-	-
Goat	1	1	-	-	1	-	-	-	-	-
Sheep	1	-	-	-	1	-	-	-	-	3
Chicken	6	15	3	-	3	10	-	-	-	-
Duck	3	4	-	-	3	3	-	-	-	-
Geese	2	-	-	-	2	-	-	-	-	-
Quail	2	3	1	-	-	1	-	-	-	-
Guinea fowl	1	-	-	-	1	-	-	-	-	-
Pigeon	1	6	-	-	1	-	-	-	-	-
Pigs	1	-	-	-	1	-	-	-	-	-
Dogs	2	3	1	-	1	3	-	-	-	-
Rabbits	-	-	-	-	-	-	-	-	-	-
Horse	-	-	-	-	-	-	-	-	-	-

(1=none, 2=little, 3=regular, 4= more and 5= high)

3.9 Dog genetics

There are mainly three types of dogs available in Bangladesh. (i) Exotic breeds – imported by the elites and consists mainly of German Shephard, Elsesian etc, (ii) Native dogs – indigenous non-descript in nature and seen everywhere in Bangladesh and (iii) Sarail dogs – this is found mainly in Sarail upazilla of Brahmanbaria district of the country. Most of indigenous dogs in Bangladesh are very uniform in their appearance. Sarail dogs are at the risk of extinction at present (Table 3.1).

Table 3.2: Number of breeds for which characterization has been carried out (Number of breeds)

Species	At population level				At individual level		
	Base line survey	Genetic distance	Breeds & crosses evaluation	Valuation	Performance recording	Genetic evaluation	Molecular evaluation
Cattle	-	-	-	-	2	-	-
Buffalo	5	5	-	-	1	-	5
Goyal	-	-	-	-	1	-	-
Goat	-	-	-	-	1	-	-
Sheep	-	-	-	-	1	-	-
Chicken	-	-	-	-	7	-	-
Duck	-	-	-	-	3	-	-
Geese	-	-	-	-	2	-	-
Quail	-	-	-	-	2	-	-
Guinea fowl	-	-	-	-	1	-	-
Pigeon	-	-	-	-	-	-	-
Pigs	-	-	-	-	-	-	-
Dogs	-	-	-	-	-	-	-
Rabbits	-	-	-	-	-	-	-
Horse	-	-	-	-	-	-	-

(1=none, 2=little, 3=regular, 4= more and 5= high)

3.10 Pigs

Nearly all pigs in Bangladesh are indigenous type. There is only one government pig farm in the Rangamati district of the country and the average litter size of native pigs is 4-8 pups. It is commonly known as **Ghori** (Table 3.1). It has also got some local names in different localities such as Dome, Pigmy, Sukar etc. Pig has little potential role in the rural development of Bangladesh specially for the hilly areas where tribal peoples use to rear pigs for their meat consumption. Wild relatives of indigenous pigs are reported to be seen in the forest areas of the country (Rangamati and Hill Tracts). No work is been done on the characterization of native pigs in Bangladesh.

3.11 Rabbit genetics

Most of the rabbits in Bangladesh are of indigenous type and a few of them originated from the breed of New Zealand White and from wild type of rabbits in Bangladesh. They vary their production performance, body/coat colour and as well as in sizes. The types of rabbit of Bangladesh are not identified yet or the characterization could not be done.

3.12 Horse genetics

The horses of Bangladesh cannot be defined under any specific breed. Native horses in Bangladesh have a body size similar to those of Southeast Asian ponies. Constitution of gene controlling coat colour variation and blood protein polymorphisms in Bangladeshi horse are observed to be close to those of the Thai native horse which are direct descendants of the Chinese South Western mountain ponies. Thus, it can be said that the Bangladesh native horses are belonged to the lineage of the South East Asian ponies rather than that of the Arabian and Persian horses.

Chapter 4. THE STATE OF UTILIZATION OF AnGR (Use and Development)

The general framework for development of a sustainable AnGR programme includes implications of agricultural policies, infrastructure and farmer involvement, markets and some aspects on the choice of populations available. A breeding programme needs to be integrated and its success is determined by the scope of farmer participation**.**

4.1 Relative importance of livestock products and services with in species

The estimated values for relative importance of livestock products and services within species are shown in Table4.1. Cattle and buffalo are the two livestock species, to some extent, are equally important for milk and draught power exceeding the importance of meat production from the two animals. The relative importance of cattle for milk and also for meat is higher than that of the buffaloes. Farmers are increasingly becoming interested for milk and also for beef production from cattle diverting their attention for draught power from the animal. The animal draught power use is gradually replacing by fossil fuel use. Both the types of animals share the importance for production of hides, manure and also bear the importance for risk management of the farmers. The major importance of the Gayal is for meat production.

The primary products from goat are meat and shown a relative importance of 52.0% followed by skin (40.0%) and risk management (8.0%). The importance of meat is the highest (80.0%) for sheep production followed by its fiber (10.0%) and risk management (3.0%). The relative importance of chicken for meat and eggs is 50.0% and 40.0% followed by its importance for risk management (7.0%). Guinea fowl and quail are reared in a limited scale. However, their relative importance for meat and eggs is shared equally. Goose and pigeon are reared mainly for meat production but their share to total production is minimum.

Continuous import of exotic germplasm of poultry and to some extent of cattle plays an important role for food and agriculture of the country. The recent development of egg and chicken meat production is completely based on continuous import of exotic germplasm of commercial strains. The share of egg and meat production of the native chicken to the total yield is gradually decreasing despite the increase of their population during the last decades. The relative importance of duck meat and eggs is 43.0% and 50.0%, respectively and for risk management is 5.0%. Duck meat is less popular than chicken meat.

Table 4.1: Relative importance of livestock products and services within species (%)

Species	Milk	Meat	Eggs	Skin	Fiber	Risk Management	Fertilizer Manure	Draught	Culture	Recreation	Fuel	Feather	Environmental Management	Total
Cattle	30.0	16.0	-	7.0	-	5.0	5.0	30.0	10.0	1.0	2.0		4.0	100
Buffalo	25.0	13.0	-	5.0	-	2.0	3.0	45.0	1.0	2.0	3.0	-	1.0	100
Goyal	-	70.0	-	2.0	-	-	-	-	20.0	5.0	-	-	3.0	100
Goat	5.0	52.0	-	40.0	-	8.0	2.0	-	-	-	-	-	-	100
Sheep	-	80.0	-	6.0	10.0	3.0	1.0	-	-	-	-	-	-	100
Chicken	-	50.0	40.0	-	-	7.0	2.0	-	-	-	-	1.0	-	100
Duck	-	43.0	50.0	-	-	5.0	-	-	-	-	-	1.0	-	100
Guinea fowl	-	48.0	50.0	-	-	2.0	-	-	-	-	-	-	-	100
Geese	-	100	-	-	-	-	-	-	-	-	-	-	-	100
Quail	-	50.0	50.0	-	-	-	-	-	-	-	-	-	-	100
Pigeon	-	90.0	-	-	-	-	-	-	-	10.0	-	-	-	100
Pigs	-	95.0	-	-	-	5.0	-	-	-	-	-	-	-	100
Horse	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Estimated data

Similar to duck, the relative importance of eggs and meat of guinea fowl is more or less similar although the bird is available in certain selected areas of the country and their total contribution to poultry meat and egg production is minimum. The quail are reared in urban and semi-urban area under intensive system and is not very much popular in the country. However, the relative importance of its egg and meat is shared at equal rates (50.0% and 50.0%). Goose rearing is popular in some localities and is reared only for meat. Except some recreation purpose pigeon is reared for squab production and the relative importance for its meat is about 90.0%.

4.2 Relative importance of different species of livestock within livestock products and services

The estimated relative importance of different species of livestock within livestock products and services is shown in Table 4.2. Milk and meat are the two most popular products in the country and cattle score the highest (98.0%) relative importance followed by buffaloes. However, buffalo could contribute more in milk production if their production system may be supported by inputs at least at medium levels. However, there is a small niche market for goat milk. The calculated relative importance of livestock and poultry species for meat production in the country shows that cattle ranked the highest (60.0%), followed by chicken (25.0%), goat (8.27%), duck (3.0%), buffalo (2.81%) and sheep (0.92%). However, a very small niche market is available in the country for pigeon, rabbit and pigs. But, their relative importance to meat production could not be calculated due to unavailability of data. Chicken (61.3%) and ducks (38.7%) share the relative importance for egg

production in the country. Guinea fowl and quail share a very minimum importance for egg production.

The relative importance for skin production as calculated from available data showed that cattle ranked the highest (60.0%) followed by buffalo (32.0%), goat (8.0%) and sheep (0.67%). Fiber is not important in the country but the coarse wool produced by sheep shares the total relative importance for fiber production in the country. The major fraction of livestock and poultry species is kept by the landless and small farmers. They used them for their risk management and the relative importance in the risk management by different livestock and poultry species is the highest for goat (30.0%) followed by cattle (20.0%). The relative importance in risk management by chicken (20.0%) is similar to that of cattle. Buffalo, duck and sheep share equally to help farmer in management of their risk. The relative importance for addition of manure to soil, as calculated, is found as 93.2% for cattle, 4.3% for buffalo and 25.0% for chicken and duck. Both cattle (70.0%) and buffalo (30.0%) share the relative importance for draught power production in the country. The relative importance of livestock species for production of other products is not assessed.

Table 4.2: Relative importance of species within livestock products and services (%)

Species	Milk	Meat *	Eggs *	Skin *	Fiber	Risk Management	Fertilizer Manure	Draught	Culture	Recreation	Fuel	Feather	Environmental Management
Cattle	98.0	60.0	-	60.0	-	20.0	93.2	70.0	-	-	NA	-	NA
Goyal	-	-	-	-	-	-	-	30.0	-	-	NA	-	NA
Buffalo	2.0	2.81	-	32.0	-	10.0	4.3	-	-	-	NA	-	NA
Goat	-	8.27	-	8.0	-	30.0	2.5	-	-	-	Na	-	NA
Sheep	-	0.92	-	0.67	100	10.0		-	-	-		-	NA
Chicken	-	25.0	61.3	-	-	20.0	-	-	-	-		NA	NA
Duck	-	3.00	38.7	-	-	10.0	-	-	-	-		NA	NA
Guinea fowl	-	NA	NA	-	-	-	-	-	-	-		NA	NA
Geese	-	NA	-	-	-	-	-	-	-	-		NA	NA
Quail	-	NA	NA	-	-	-	-	-	-	-		-	NA
Pigeon	-	NA	-	-	-	-	-	-	-	-		-	NA
Pigs	-	NA	-	NA	-	-	-	-	-	-		-	NA
Horse	-	NA	-	-	-	-	-	NA	-	-		-	NA
Total	100	100	100	100	100	100	100	100	-	-		-	NA

Estimated on the basis of data available in BBS (2000) and others are estimated data; NA=Not Assessed

Table4.4 shows the number of widely used breeds of livestock and poultry in Bangladesh. Most of the native cattle found in different regions of the country are under crossbreeding system. The potential types of animal, such as, Red Chittagong and Pabna cattle are also extensively used for crossing. In most of the cases Friesian and Shahiwal exotic breeds are used for crossbred animal production. Thus,

five (5) different types of cattle breed are used under cattle breeding program. Pabna and Red Chittagong cattle are recently introduced institutionally for pure breeding program with a goal to develop the germplasm. But, the programs need to be organized more effectively with the participation of stakeholders. Nili-Ravi exotic breed is used for crossing with native four types of buffaloes in Bangladesh found in different regions of the country (Table 4.3). A single type of Goyal is available in Bangladesh and it is being crossed with native cattle of hilly areas. An initiative for crossing Goyal with Friesian bull was taken institutionally, later it was stopped. However, *ex situ* conservation and pure breeding programme is being continued with a very minimum number of animals. Black Bengal Goats, a single breed of the country, are not used for crossbreeding with exotic goat except cross breeding happens to occur at farmers level with Jamnapuri goat, available in some regions at a very low concentration. Attempts were made in the past to upgrade native sheep of the country crossing with exotic types but it was not sustained. No organized purebreeding programme has yet been initiated for improving the native sheep.

Including commercial strains and exotic breed there are about 13 different types of chicken (Table 4.3) used in the country. Three types of native chicken (Native, Necked Neck and Hilly) are being used for purebreed selection programme at a very limited scale institutionally by BLRI (Table4.4) and it needs to be organized in a planned way using the available infrastructural facility in the public sector. Department of Livestock Services has been conducting crossbreeding program with White Leghorn or Rhode Island Red with Fayoumi and producing **Sonali** or **Rupali** crossbred chicken to distribute to the farmers (Table 4.3).

Table 4.3: Number of widely used breeds with breeding strategies (No. of Breeds)

Species	Breeding strategies			
	Total number of breeds	Purebred selection	Crossbreeding	Both
Cattle	5	2	3	0
Buffalo	5	0	1	0
Goyal	1	1	1	1
Goat	2	1	1	0
Sheep	1	0	0	0
Chicken	13	3	3	0
Duck	6	2	5	0
Geese	2	0	0	0
Quail	1	0	0	0
Guinea fowl	1	0	0	0
Pigs	1	0	0	0
Pigeon	1	0		
Horse	-	-	-	-

Khaki Campbell, Indian Runner, Jending, Deshi White and Deshi Black and Indigenous type of ducks are widely used in the country. Among them Deshi White and Deshi Black ducks are used for purebreeding (Table4.4) and the other ducks are crossed indiscriminately at field level.

4.3: State of art of technologies/methodologies

Cattle

Breed development of any livestock and poultry species may be considered as one of the strategies for enhancing food and agriculture production. Most of the breeding programs for cattle development so far undertaken in the public sector and by different stakeholders (Milk Vita, BRAC) are crossbreeding of native germplasm with the exotic bull.

The most critical part of any breeding programme is to define the breeding goal. The breeding goal should state i) the purpose of production (milk, meat or dual purpose), ii) the foundation stock/stocks to be used in proposed breeding programme, their production potentiality for the traits to be modified and production system under which those traits have been evaluated, iii) the production potentiality of target population (breed/ population that will be produced through execution of proposed breeding programme) at the end of breeding operation in a particular production system and iv) time frame or time to be taken to achieve the target .

The choice of straight breeding or crossbreeding is dictated by (i) the time required to achieve the goal and (ii) availability of the breeds/genotypes. The straight breeding allows the utilization of one breed/genotype. So, one can practice this mating system with any locally available breed/genotype (Locally available breeds are usually adopted to the local environment). It takes longer time as the rate of genetic progress is slow. Crossbreeding allows the use of two or more breeds and utilizes the heterosis effect. It takes less time than straight breeding to achieve genetic progress. However, crossbred progenies should be used for one generation and breeds used in crossbreeding must be selected through “Breed test” programme. Breed test programme allows testing a number of breeds along with their crossbred progenies, simultaneously, in a particular environment for particular purpose.

Straight breeding is yet to be practiced in Bangladesh. The recently introduced “Breed up gradation through progeny testing” programme may allow practicing straight breeding if local cattle are taken into consideration.

The breeding policy adopted in 1982 states “Cattle of urban, semi-urban and milk potential areas will be upgraded by using bulls produced out of crossing native cattle with pure Friesian bulls and pure Sahiwal cows (Table4.4). The bulls having 50% Friesian blood and 50% local blood will be put into the operation for upgrading cattle of the rural areas”. However, the policy was revised in 1997 and it

states that (i) for intensive dairy production system (urban, semi-urban and milk potential areas) pure exotic blood of Friesian and Shahiwal breed would be used for crossing with native (Table4.4) for production of crossbreds with native and exotic blood of 50:50 and a long-term Open Nucleus Crossbreeding System (ONCS) would be followed to have high yielding animals, and for (2) extensive system (traditional) improved Deshi cattle would be used to develop genetic potentiality of local animals through using Open Nucleus Breeding System (ONBS). However, no purpose of production and production potentiality of the foundation stock or target population were defined or no specific time for running the programme is mentioned. These are affecting the genetic progress of cattle in Bangladesh. Moreover, the crossbreeding program conducted during the last three decades had no specific recording system, especially, at field level. Thus, it has yielded about 2.5 million crossbred cattle without any progress on breed development of cattle.

The recorded history of crossbreeding programme in cattle started in 1915 with the importation of Sahiwal bull privately in Pabna district. The official crossbreeding programme in cattle started in 1935 with the introduction of Hariana bulls in selective districts of Bangladesh. Since then, a number of breeds, e.g., Sindhi, Sahiwal, Hariana, Friesian, Jersey, Australian Friesian Sahiwal have been introduced and used for crossbreeding. Sahiwal is the only breed that has been used continuously. The next widely used breed is Friesian. It was first introduced in 1973 from Australia and is being used continuously. Sindhi was introduced in 1960 from Pakistan and discarded from crossbreeding programme after 1972. Jersey was introduced in 1973 from Australia and discarded from crossbreeding programme after 1982. However, Bangladesh Milk Producers' Cooperative Union Limited has introduced this breed for cross breeding purpose in their areas in 2000 and is using this breed. Australian Friesian Sahiwal was also introduced in 1991 and discarded few years later. Frozen semen of Sahiwal and Friesian imported from Pakistan, Australia, New Zealand and Germany and still contonued to be imported. The problems in implemented crossbreeding programme are that no breed has been introduced through "Breed test" programme. So, the performances of crossbred progenies are unsatisfactory in many situations/environments. However, the farmer has no alternate choice due to their dependence upon bulls used in A.I. service. Directorate of Livestock services, Bangladesh Milk Producers' Cooperative Union Limited, BRAC (an NGO) and Khulna Genetics (a private enterprise in Khulna) are involved in cross breeding programme. A breed test programme should be introduced in future to select appropriate breeds/genotypes to be used in crossbreeding programme for particular environment and purpose.

Selective objectives, selection criteria and methods

The selective objectives in the on going breeding programme are not well defined. Usually, selection is done for increasing milk yield. The other economic traits like fat%, protein% in milk and feed efficiency do not get appropriate weight and in most cases are not considered. Milk composition; an

important trait, especially, for milk marketing and feed consumption & feed efficiency, other important traits for cattle production in Bangladesh; have not been considered in many situations. Selection criteria are not based on selection Index- the most efficient method. Breeding values and for genetic parameter for dairy traits have been attempted to estimate at the BAU since 1990. Information for selection is obtained directly from the individuals and their pedigrees. In most of the cases selection method is either mass selection or combination of mass selection & pedigree selection. Progeny testing, the most widely accepted and efficient selection method for dairy animals has just been introduced. This programme will follow ONBS. Marker assisted selection (Microsatellites, QTL etc) is totally absent in the country (Table4.5).

Table 4.4: Number of breeds with current breeding strategies and tools being used (No. of breeds)

Species	Breeding goals	Designed	Designed and implemented	Individual identification	Recording	AI	ET	Genetic evaluation
Cattle	3	3	3	0	0		0	0
Buffalo	1	1	0	0	0	0	0	0
Goyal	0	0	0	0	0	0	0	0
Goat	0	0	0	0	0	0	-	0
Sheep	0	0	0	0	0	0	-	0
Chicken	3	3	0	0	0	0	-	0
Duck	2	2	0	0	0	0	-	-
Geese	0	0	0	0	0	-	-	-
Quail	0	0	0	0	0	-	-	-
Guinea fowl	0	0	0	0	0	-	-	-
Pigs	-	-	-	-	-	-	-	-
Pigeon	-	-	-	-	-	-	-	-
Horse	-	-	-	-	-	-	-	-

(1=none, 2=little, 3= regular, 4= more and 5= high)

Buffalo

The Government of Bangladesh is distributing Nili- Ravi bulls in the southern part for cross breeding of indigenous buffaloes. This programme was started in 1960 and is still going on (Table4.4). However, there was no follow up programme to monitor the performances of crossbred animals from the onset of the activity. In other parts of the country, there is no government approved breeding programme. So, farmers depend upon their own method that is selecting bulls on the basis of mass selection. Sometimes, they use the bulls produced in the same herd and inbreeding depressing effects occur frequently. The female buffaloes are selected on the basis of mass selection. There is neither record keeping system nor artificial insemination system for water buffaloes throughout the country. Progeny tested bulls are not available. There are no breed societies for water buffaloes in the country. In the absence of any organized breeding programme, the productivity of water buffaloes is deceasing

day by day.

Gayal

It has already been described that Gayal is honoured by the tribal people as sacrifice animals. This custom is prevailing yet now. At the same time the traders collect adult Gayal from the tribal people and sell them for getting beef in Chittagong, a city in the south-eastern part of the country. Beef obtained from Gayal is sold at a higher price than beef of cattle and buffalo. Moreover, Gayal is a zoo animal.

There is demand of Gayal and Gayal meat no doubt. But there is no policy to protect the natural habitat of Gayal. Due to deforestation and indiscriminate use of Gayals from their habitats, the population size has been decreasing; but there is no scientific observation about the rate of extinction of the animal.

Artificial Insemination, Embryo transfer, Genetic engineering etc. are the techniques applied in animal breeding. In cattle breeding, artificial insemination introduced in 1950s and it is extending rapidly throughout the country. Both liquid semen and frozen semen are used. At present, Directorate of Livestock Services, Bangladesh Milk Producers' Cooperative Union Limited, Bangladesh Agricultural University and BRAC (an NGO) are involved in production of semen and artificial insemination operation. Directorate of Livestock Services has 22 A.I. centers and about 1100 A.I. sub centers and points. Bangladesh Milk Producers' Cooperative Union Limited has 775 societies throughout country and A.I. is done in all the societies. BRAC has 320 A.I. points. All the organizations have their own bull station, semen collection, evaluation and processing laboratories. Every organization has its own policy for A.I. programme. All the efforts on AI now cover approximately 25% of total cattle population for A.I. Except the societies of Bangladesh Milk Producers' Cooperative Union Limited and milk collection centers of BRAC, farmers have to pay for A.I. Semen is sold from Tk. 50/= to Tk.100/= and subsidy is provided in each case. Embryo culture and transfer laboratory has been set in Directorate of Livestock Services and Bangladesh Agricultural University. These are in experimental stage to date. Genetic engineering technology for animal breeding is not available at this moment in the country.

Table 4.5 shows the position of using technologies and methodologies used in breeding strategies in the country. None of the technology/methodology listed in the Table is used so far at research institutions or by breeders' associations. Moreover, there is no animal identification and animal recording system at farmers level and institutional farm level per see. In the absence of any recording system at farmer level, it is impossible to get data on production traits and to estimate genetic parameters (Heritability, breeding values etc.). These are practiced at institutional herds even with small degree of accuracy. Even ICAR (International Committee for Animal Recording) approved

methods are not also followed at institutional herds. Moreover, records are not maintained systematically and are often difficult to estimate genetic parameters from the available data.

Table 4.5: State of the art of technologies/methodologies used in breeding strategies

Technology or Methodology	Used for	
	Research	Breeders
Multi-trait selection index construction	0	0
Optimization tools for breeding plans	0	0
Electronic data base related to recording schemes	0	0
Genetic evaluation software for: Phenotypic selection breeding values	0	0
Reproductive technologies	0	0
Microsatellite linkage maps for QTL identification for marker Assisted	0	0
Other technologies	0	0

Department of Livestock Services (DLS) being a public institution has a regular responsibility for artificial insemination program (Table 4.6). However, it has to play a high leading role in coordination with the research institute (BLRI) in the implementation of tools for the development of AnGR. The BAU with its laboratory facilities and trained manpower may help to train the human resources and at the same time participate in the implementation procedures. Other NGOs have taken little step in using the AI (Table4.5). Other stakeholders at the moment are sharing role for implementation of AI tools only for the development of AnGR in the country. This indicates that the utilization and development activity of AnGR in the country is very poor. In the context of the country, the main responsibility for AnGR development must be born by the concerned stakeholders. The local government system in the country in its present form does not bear the responsibilities related to AnGR development (Table4.6).

Table 4.6: Role of stakeholders in the implementation of tools for the development of AnGR

Stakeholders	Breeding goal	Individual identification	Recording	Artificial Insemination	Genetic evaluation
Federal Government	2	1	1	3	1
Local government	1	1	1	1	1
Breeder's Associations	1	1	1	1	1
Private companies	1	1	1	1	
Research	2	1	1	1	1
NGOs	1	1	1	2	1

(1=none, 2=little, 3= regular, 4= more and 5= high)

The federal Government and research institute have high involvement in the development of AnGR in terms of formulation of legislation, carrying out the breeding works and development of infrastructure, human resource and farmer's association (Table4.7). But none of the responsibility is done up to the level of requirement to develop AnGR in the country.

Table 4.7: Involvement of stakeholders in activities related to the development of AnGR

Stakeholders	Legislation	Breeding	Infrastructure	Human	Farmer's
Federal Government	5	4	4	2	4
Local government	1	1	1	1	1
Breeder's Associations	1	1	1		1
Private companies	1	1	1	1	1
Research	5	5	2	2	1
NGOs	1	1	1	1	1

(1=none, 2=little, 3= regular, 4= more and 5= high)

Table 4.8 shows that the Govt. in association with the research institute prefer more to develop locally adapted breed and the breed available within the region as compared to the exotic type. But, farmers are highly interested to cross their animals with exotic breed to have more milk out of a cow. Similar to farmers, NGOs preference is higher for the exotic breeds.

Table 4.8: Stakeholders preference for animal genetic resources

Stakeholders	Locally adapted breeds	Imported within region	Imported exotic breeds
Federal Government	4	4	3
Local government	1	1	1
Breeder's Associations	1	3	5
Private companies	1	1	1
Research	4	3	3
NGOs	2	2	4

(1=none, 2=little, 3= regular, 4= more and 5= high)

Table 4.9 shows the priority needs for utilization of technologies for the development of AnGR. The technologies listed in the Table are important to use in the country but knowledge gaps and training problems are the major considerations for facilitating their use in the country. Financial resource allocation and organization of Breeder's Association are also important and need to consider in association with the fulfillment of other needs.

Table 4.9: Priority of needs for utilization of technologies for the development of AnGR

Technology	Knowledge	Training	Financial resources	Breeder's organization
Recording	5	5	4	5
Genetic evaluation	5	5	4	4
AI/ET	3	3	4	5
Molecular techniques	5	5	4	4
Breed organization techniques	5	5	4	5

(1=none, 2=little, 3= regular, 4= more and 5= high)

No organized breeding programme has yet been undertaken on goat and sheep development. Artificial Insemination technique use in goat is still in laboratory and need to be tested at field level. However, the economics of using the technology is important as multiple birth characteristic of goat is very important for the farmers.

Conservation *ex situ in vivo* and purebreeding programme has been conducted by BLRI using a very limited number of does. The programme need to be integrated with other facilities in the public sector as well as with farmers initiatives.

Some of the native poultry are brought under conservation and breeding program in a limited scale is being continued but the progress is very minimum and the programs are not organized well. A short description of the programs is given below.

Conservation *ex situ in vivo* and breeding program on native poultry

Type of Poultry	Breeding practices	Status
Chicken	(i) Purebreeding	On-going
	(ii) Crossbreeding	On-going
Duck	(i) Purebreeding	On-going
	(ii) Crossbreeding	On-going
Geese	Purebreeding	On-going
Quail	Purebreeding	On-going
Pigeon	Purebreeding	On-going
Guinea Fowl	Purebreeding	On-going

Chapter 5: THE STATE OF CONSERVATION OF AnGR

Livestock production has been intensified for food production and income generation activities with the increase of human population. In most cases locally adapted farm animal genetic resources are disregarded. Conservation and development of these farm animals are required to achieve sustainable production systems and meet the demands of food. A coordinated program on AnGR is needed based on proper assessment of endangerment and diversity and the program need to be integrated with FAO program for the management. However, a regional programme has been initiated through UNEP-GEF-Bangladesh collaboration.

5.1 Cattle conservation

The following are the changes in the production system and utilities of cattle have taken place in the country.

i) The demand of draught power requirement from animal source has reduced due to mechanization of cultivation and transportation system. This has facilitated farmers to use their inputs for rearing more dairy animals instead of the draught.

ii) Farmers get benefits from keeping high yielding cows and are interested to have more crossbred cattle, specially, Friesian crosses. In the late 90s, there were hardly 0.5 million crossbred cattle and increased to about 2.3 million at present.

iii) The present breeding policy is enhancing the production of crossbred cattle. Since the farmers depend heavily on A.I. programme, they have to choose the breeds/genotypes of bulls used by the A.I. programme. So gene pool is changing from indigenous cattle to crossbred cattle. However, performance of crossbred cattle is not satisfactory in many situations where the environment support is poor.

iv) Disappearance of natural pasture compelling farmers to keep their animals under stall fed conditions. Even the fallow land in the hilly area is being used for vegetable and fruit cultivation. The cropping pattern is also changing. The land for pulse cultivation has also been reduced affecting the availability of pulse by-products or legume forages that are good quality roughage for the ruminant animals

v) The cattle population of most of the HYV rice cultivated areas remains under nourished and long time suffering from nutrition gradually resulted in degeneration of the genetic potentiality of the farm AnGR of that particular areas.

In conclusion, it may be stated that i) present breeding policy, ii) trend in utility of cattle and iii) availability of cattle feeds have been affecting the existing gene pool of indigenous cattle in Bangladesh.

However, the indigenous cattle are valuable animal genetic resources of our country. They have been playing vital role to meet the demand for milk, meat, draught power, fertilizer, fuel, hide, foreign exchange earning, employment and poverty alleviation. They are well adapted to local environment. Indiscriminate crossbreeding with exotic breeds and severe feed crisis are threatening the existence of this species in many areas of the country. This is happening due to lack of knowledge of stakeholders about the management of farm AnGR. At the same time, there is no government policy on AnGR management. In this context characterization of indigenous cattle and their preservation is being done independently by different institutes like BAU, BLRI or DLS. Information gathered by each institute or scientists is neither shared among them nor it has reached to farmers and other beneficiaries. The followings are some examples of AnGR activities on cattle in Bangladesh.

i. First work on characterization of cattle was done by Department of Animal Breeding & Genetics, BAU, Mymensingh in 1984 and 1987.
ii. The *ex situ* conservation of Pabna cattle and Red Chittagong cattle are being done by DLS, BLRI and BAU for about a decade.
iii. DAD–Domestic Animal Diversity (a programme like AnGR run by FAO) is being represented by Bangladesh also for about 10 years (FAO, 1990).
iv. A long term research project funded by USDA on the characterization of Red Chittagong Cattle has been initiated recently based on ONBS theory.

The limitations of the above activities were:

i. There is no coordination among the institutes engaged in the similar type of works.
ii. The country representatives of DAD at present and also in the past did not disseminate the concept of AnGR to stakeholders.

The breeding policy adopted in 1982 did not consider the conservation and management of the indigenous cattle of the country and no program was undertaken for straight breeding of native cattle despite the availability of infrastructure in the public sector. The on going “Breed up gradation programme through progeny testing” may assist in achieving this goal if the animal identification and recording system are put in place and native cattle are considered as a genotype. However, a strong coordination should be built among the stakeholders both in public and private sectors.

5.2 Buffalo conservation

The domestic buffaloes are valuable genetic resources of our country. There is demand for buffalo milk, meat and draught energy. However, this species is always neglected in our country. There is no policy for AnGR management of water buffaloes at present in the country. The information on characterization work carried out independently in different institutes like BAU, BLRI or DLS who neither shared among them nor reach to the farmers and other beneficiaries. The infrastructure for buffalo breeding is quite inadequate and need to be reorganized and strengthened. The only Buffalo Breeding Farm in the public sector is neither well equipped nor provided with skilled manpower. There is no A.I system for water buffaloes in Bangladesh. Breed societies/associations for water buffaloes that may provide better service to farmers is also absent in the country. All these problems should be solved through planned breeding policy and conservation programme.

5.3 Gayal conservation

As Goyals are in risk, urgent steps should be taken to save the animals. There are three places where goyal is being preserved *ex situ.* These are Dhaka zoo having 7 Goyal, Dulahazaria safari park having few Goyal and BLRI regional farm at Naikhongchari of Bandarban district having about 27 Goyals. The animals are maintained *ex situ in vivo* condition. However, there are management problems due to insufficient and inconsistent support. The following programs amy be undertaken to meet the immediate needs for Goyal development.

1. A survey programme should be taken immediately to find out the actual number of goyal in the country.
2. A well planned conservation progamme should be taken involving experts from BLRI, BAU and the Department of forestry

***In situ* conservation:**

1. The natural habitat of goyal should be preserved by prevention of deforestation and stopping human settlement there. This can only be done by motivation of local people who are involved in the process of deforestation. Simultaneously, the department of forestry should be pursued to take such programme.
2. The goyal should be declared endangered species and any further catching and hunting of goyal should be stopped.

***Ex situ* conservation:**

1. The present goyal farm of BLRI should be well managed, proper record keeping and appropriate breeding strategy (both straight and cross breeding) should be taken under the supervision of a breeder.
2. There should be a bull exchange programme among BLRI, Dhaka zoo and Dulahazaria safari park

5.4 Goat and Sheep conservation

There is no crossbreeding program on goat and sheep in the country at present, The native animals are preferred by the farmers and they are use to produce and reproduce under low input system at farmer levels. However, availability of breeding buck and ram is scarce and has been affecting the production and reproduction performances of the animals. Moreover, buck rearing is not usually acceptable practice in the society and often the buck rearers has little or no social respect. The poor peoples usually kept bucks without any good management in terms of their nutrition, feeding and maintenance of breeding values for servicing the local does and use to affect the genetic performance of local animals. This is considered as the most important factor for degeneration of performance of goat at farm level.

There are about six goat farms in the public sector to conserve and improve Black Bengal goats and to distribute improved bucks and does to the farmer. No purebreeding program has yet been undertaken either in public sector using all these facilities for improving the production and reproduction performances of Black Bengal goat in the country except the initiative of BLRI for individual evaluation and conservation *ex-situ in vivo* programme which is confined within its research farm of about 450 goats of all ages or in private sector. It has not yet taken any visible program on goat development in the country.

Conservation *ex situ in vivo* and improvement program of cattle, buffalo, goat and sheep is shown below.

Conservation *ex situ in vivo* of native AnGR

Species	Conservation		Characterization	
	In situ	*Ex situ*	Phenotypic	Genetic/Molecular
Cattle	-	Pabna, Red Chittagong, Shahiwal, Friesian and Indigenous Deshi, Sahiwal	Done	Not done
Buffalo	-	Water buffalo	Done	Partially done
Goat	-	Black Bengal Goat	Done	Not done
Sheep	-	Native Sheep	Done	On-going

Most of the conservation *ex situ in vivo* programmes is limited to collection of some live animals and rearing them under confinement. This has facilitated the evaluation of individual performances but purebreeding programme based on these herds or flocks encounters numbers of problems. On the other hand, absence of coordination among the stakeholders and any conservation *in situ* programme has been allowing the native potential AnGR to be affected.

No conservation and development program has been undertaken for Bangla sheep in the public or private sector except some initiative undertaken in the past for crossing the native sheep with the exotic germplasm. All the sheep germplasm are remained at farm level and used to be affected genetically due to the unavailability of good quality Rams to the farmers. Both the public and private sector has no programme at the moment on conservation and development of sheep germplasm except the initiative of BLRI for conservation *ex situ* of the native sheep of about 140 animals of all ages from different regions of the country. The institute has been using these animals for individual performance evaluation.

5.5 Conservation of Poultry

Except Aseel, Yasine and Native Dwarf other native chicken germplasms are not threatened to be endangered due to the ongoing activities in the country. Conservation and improvement programme of native chicken may be undertaken *in situ* both for increasing food production and poverty alleviation in rural Bangladesh. Both eggs and meat to be produced from this type of production system would harvest a good price as organic products, if processed and marketed ensuring their quality.

Bangladesh Livestock Research Institute so far has conserved *ex-situ in vivo* some of the potential poultry germplasms as described below. The institute in its live poultry germplasms has 3 chicken breeds, 3 Quail breeds, Pigeon, Geese, Duck and Guinea fowls. The size of each of the flock vary from 100 to 400 birds.

Breed covered under conservation *ex situ in vivo*

Species	Conservation		Characterization	
	In situ	***Ex situ***	**Phenotypic**	**Genetic/Molecular**
Chicken	-	Naked Neck, Hilly, Non-descript Deshi	Done	On-going
Duck	-	Deshi white, Deshi Black, Non–descript deshi, Muscovy	Done	Not done
Quail	-	Japanese, Brown, Dhakai	Done	Not done
Geese	-	Deshi white, Deshi grey	Done	Not done
Guinea fowl	-	Indigenous	Done	Not done

Table 5.1 shows that out of locally adapted four cattle germplasm (Padna, Red Chittagong, Munshiganj and Indigenous types) two are managed (Pabna and Red Chittagong) *ex situ in vivo.* The Goyal germplasm are similarly conserved *ex situ in vivo* by the public sector but are not managed well due to various problems. The locally adapted chicken germplasm (Naked Neck, Hilly, Non-descript deshi) as stated above are managed *ex situ in vivo* in the public sector.

Table 5.1: Current number of breeds in managed conservation programmes

Species	Number of locally adapted breeds at risk			
	Total	Managed *in situ*	Managed *ex situ*	Both(*in* & *ex situ*)
Cattle	4	0	2	0
Buffalo	0	0	0	0
Goyal	1	0	1	0
Goat	0	0	0	0
Sheep	0	0	0	0
Chicken	3	0	3	0
Duck	0	0	0	0
Geese	0	0	0	0
Quail	0	0	0	0
Guinea fowl	0	0	0	0
Pigs	0	0	0	0
Pigeon	0	0	0	0
Dogs	1	0	0	0
Horse	0	0	0	0

(1=none, 2=little, 3= regular, 4= more and 5= high)

Table 5.2: Current number of breeds receiving incentives and for which various tools for management of *ex situ* conservation programmes are used

Species	Incentive			Tools				
	Govt.	NGO	Market	Semen storage	Embryo Storage	DNA/Tissue storage	*In Vivo*	Monitoring system
Cattle	0	0	0	0	0	0	0	0
Buffalo	0	0	0	0	0	0	0	0
Goyal	0	0	0	0	0	0	0	0
Goat	0	0	0	0	0	0	0	0
Sheep	0	0	0	0	0	0	0	0
Chicken	0	0	0	0	0	0	0	0
Duck	0	0	0	0	0	0	0	0
Geese	0	0	0	0	0	0	0	0
Quail	0	0	0	0	0	0	0	0
Guinea fowl	0	0	0	0	0	0	0	0
Pigs	0	0	0	0	0	0	0	0
Pigeon	0	0	0	0	0	0	0	0
Horse	0	0	0	0	0	0	0	0
Dogs	0	0	0	0	0	0	0	0

(1=none, 2=little, 3= regular, 4= more and 5= high)

Incentives in whatever the forms for in situ or ex situ conservation of germplasm are mainly provided by the public sector not by any private companies or organizations (Table 5.2). However, no incentives so far been given for in situ conservation from the public sector except the recent program on local bull collection and distribution of their semen for crossing under the extensive system. The incentives from the public sector for conservation ex situ in vivo is limited and considered to be irregular to support the programme. It includes the cost of rearing of animals in different farms in the public sector. Limited incentives for conservation ex situ in vitro in the form of facilities development have also been given for semen and embryo. However, the program is not very much planned integrating the facilities/inputs available in different stakeholders of the sector (Table5.2 and Table 5.3).

Table 5.3: Current number of breeds receiving incentives and for which tools for *in situ* conservation programmes are used

Species	Incentive				Technical tools			
	Gov.	NGO	Market	Private	Recording	AI	ET	Others
Cattle	0	0	0	0	0	0	0	0
Buffalo	0	0	0	0	0	0	0	0
Goyal	0	0	0	0	0	0	0	0
Goat	0	0	0	0	0	0	0	0
Sheep	0	0	0	0	0	0	0	0
Chicken	0	0	0	0	0	0	0	0
Duck	0	0	0	0	0	0	0	0
Geese	0	0	0	0	0	0	0	0
Quail	0	0	0	0	0	0	0	0
Guinea fowl	0	0	0	0	0	0	0	0
Pigs	0	0	0	0	0	0	0	0
Pigeon	0	0	0	0	0	0	0	0
Horse	0	0	0	0	0	0	0	0

(1=none, 2=little, 3= regular, 4= more and 5= high)

Table 5.4 shows that the involvement of Breeder`s Association, Private companies and NGOs is absent in the management of conservation in situ or ex situ. However, the Government and Research institutes/Universities have little involvement in the management of AnGR. Table 5.5 shows that in addition to financial scarcity, the absence of required number of skilled human resources, programme for continuous training facilities in the country or in abroad, unavailability of technologies are the major factors affecting planned and managed conservation of animal germplasm in the country. However, the most important factor that has been affecting the conservation and development of the AnGR is the absence of coordination system among the stakeholders both in public and private

sectors of the country. Trained manpower for planning, implementation, regulating and monitoring the programme for achieving the target in certain durations is also lacking.

Table 5.4: Stakeholders involvement in the management of conservation programs

Stakeholders	***In situ* Conservation**	***Ex situ* Conservation**
Government	1	2
Breeder's Association	1	1
Private Companies	1	1
Research Institutions/Universities	1	2
NGOs	1	1

(1=none, 2=little, 3= regular, 4= more and 5= high)

Table 5.5: Priority of needs for utilization of technologies for *in situ* conservation programmes

Technology	**Knowledge**	*Training*	**Financial resources**	**Technology**
Recording	5	5	5	5
Genetic evaluation	5	5	5	5
AI/ET	3	3	3	3
Molecular technique	5	5	5	5
Breeder improvement techniques	5	5	5	5

(1=none, 2=little, 3= regular, 4= more and 5= high)

Chapter 6. THE STATE OF POLICY DEVELOPMENT AND INSTITUTIONAL ARRANGEMENTS FOR AnGR

6.1: State of National Capacities

Department of livestock services (DLS) and Bangladesh Livestock Research institute (BLRI) are the two public sector organizations under the Ministry of Fisheries and Livestock (MOFL) is responsible for management and conservation of AnGR. Bangladesh Agricultural University, Mymensingh, a public university has got a dairy farm with native and exotic cattle germplasm. Bangladesh Milk Producers' Cooperative Union Ltd. (Milk Vita) and a number of NGOs also use different native and exotic cattle AnGR to produce and distribute semen to their member farmers. Both the organization have their own bull stations to support their mating plan.

Department of Livestock Services

Facilities for conservation *ex situ*

The Department of Livestock Services at present has an approved mating plan of cattle which is described in Chapter 4 (page 43). To support the breeding program and objectives for evolving improved quality synthetic cattle breed suited to local conditions, the "Central Cattle Breeding and Dairy Farm, Savar, Dhaka was established in 1960-61. In 1974, 125 heads of Friesian and Jersey cows and bulls were imported as 'Grant' and thus started intensive cross breeding to produce half-bred and 2/3 bred cross-bred cattle of Local x Friesian and Shahiwal x Friesian. Later, in the last two decades a good number of Friesian and Shahiwal cattle and Frozen semen were imported for further strengthening of the ongoing cross breeding program. Thus, the "Central Cattle Breeding Station & Dairy Farm, Savar, Dhaka became the "Nucleus Breeding Station" for genetic improvement of cattle throughout the country. About 1718 cattle heads at present are available at the farm. The main activity of the farm is the production of quality bulls.

The core breeding activity of the farm is done using the Central Artificial Insemination Laboratory established along with the farm. Breeding bulls are reared, tested and produced through individual selection and culling method following the national cattle breeding principles and guidelines and some of the bulls are distributed to 22 district AI centres of the country. At present, a comprehensive AI network consisting of 22 district AI centres and 1059 AI sub-centres and AI points established in regions of the country has been operating to improve the genetic quality and production potentials of the native cattle using both liquid and frozen semen of quality breeding bulls.

In addition to production of breeding bulls, production, storage and distribution of frozen semen in 22 district AI centres is also carried out by the AI laboratory. The Central Artificial Insemination Laboratory at the moment has 289 bulls of which 65 considered an active, 137 trial bulls, 84 young bull calves and the rest considered as other types.

Six (6) more Dairy and Cattle Breeding Farms including one buffalo breeding and development farm are being operated in different location of the country. In the meantime, the Govt. Dairy Farm, Tejgaon, Dhaka is merged with the Central Cattle Breeding & Dairy Farm, Savar, Dhaka.

Different cattle farms were established in different locations of the country with the objectives of conservation and development of native resources. However, the breeding programs followed in those farms during the periods were not found always responsive to the objectives formulated during the establishment of the farms. The buffalo breeding & development farm in Bagerhat was established to conserve the buffalo genetic resources and to develop suitable draft and milk types buffalo for distribution among the farmers.

Five goat farms were established in different locations of the country with objectives for conservation and improvement of Black Bengal Goats, distribution of goat to the poor at a reduced cost and for demonstration of goat farming to farmers. The five goat farms together have got about 41,135.00 sqft areas of animal shed for a maximum capacity of 4000 goats of different ages. With some limitations the farms are operated with only 42.2% of their total capacity.

Establishment of poultry farms in the public sector started from the British regime when four poultry farms were established in Tejgoan, Dhaka, Narayongonj, Jamalgonj and Sylhet to produce eggs and meat. After partition, seven more poultry farms were established and gradually the total number of poultry farms in the public sector reached at 33 excluding two duck farms. In addition to that there are six (6) poultry and two (2) duck hatcheries are operated in the public sector.

Facilities for conservation *ex situ in vitro*

It is now accepted that conservation of AnGR is essential but economic compulsions have over riding influence and often jeopardize the attempts to preserve them. Apart from *in situ* conservation modern biotechnological approaches can supplement the conservation of animal genetic resources in the form of sperms, embryos, oocytes, cell lines, isolated chromosomes, genomic DNA libraries and isolated genes. Some of these technologies are still in the experimental stage but hold promise for the protracted preservation of animal germplasm and eventual resurrection of breed. Other major benefits include the ability to collect and cryoconserved semen to ensure against the death of genetically valuable individuals or to maintain a flock genetic diversity without retaining live males. A very little attempt was made to adopt these technologies in the country.

The Central Artificial Insemination Laboratory, Savar, Dhaka was established to support the country-wide AI activities of the country. Initial use of liquid semen in the laboratory was gradually replaced

by liquid nitrogen frozen semen and helped to establish cryo-conservation facilities for bull semen. The cryo-conservation of AnGR in other forms is still need to be upgraded.

Bangladesh Livestock Research Institute

The institute started conservation program of native cattle in the beginning of 1990s when a native AnGR from Pabna bathan area was collected, and conserved and multiplied in the research farm of the institute. The germplasm, in the mean time, is already been diluted at farmer levels with the exotic blood during the whole period of time. During the mid 1990s, the institute collected different types of native chicken and duck germplasm and continued to collect other germplasm of specialized fowl like, geese, guinea fowl, quail, pigeon up to the end of the decade. The germplasm of Black Bengal goat was collected in 1998-1999 and that of other native large ruminants such as Red Chittagong Cattle, buffalo was collected in 2001and 2002. The Bangla Sheep germplasm was collected from different regions of the country in 2002.

BLRI collected all those germplasm with an objective to conserve *ex-situ in vivo* and characterize different native germplasm of both large and small ruminants, chicken and ducks and other specialized fowl. But limitations in sufficient number of different types of AnGR conserved *ex-sito in vivo* and the absence of a good coordination system with other stakeholders, especially, with the DLS resulted in fragmented approaches on AnGR conservation and their economic exploitation for food and agriculture. The facilities for both conservation *ex-situ in vivo* and *ex-situ in vitro* should be increased in BLRI. The institute has got a very few trained manpower as compared to that is required to support the national program of AnGR and the number of trained scientist in the field is essential to increase to respond to the national priorities.

BLRI has developed unique facility for laboratory both in terms of building space and sophisticated equipment like PCR, electrophoresis, DNA sequencer and related supports. Moreover, research facilities in terms of the availability of animal and poultry sheds for the individual species and land area are the major advantages for further development opportunity of BLRI. Utilization of these facilities need further support in terms of finance and human resource development.

A long term bilateral programme with an international organization having excellent expertise in the related field based on AnGR development programme may make the BLRI as a centre of excellence in the related field.

Bangladesh Agricultural University, Mymensingh

Bangladesh Agricultural University, Mymensingh, has a dairy farm, a poultry farm, AI centre, sheep. goat and horse farm with native and exotic AnGR. It has laboratory facilities to support to some extent the works on animal genetics and reproduction but facilities for supporting breeding services is

good. Under the Faculty of Animal Husbandry, the Department of Animal Breeding and Genetics has got qualified manpower on animal genetics, breeding and reproduction who, in addition to their major responsibility for teaching, may well support national priority programs on AnGR development.

Some recent activities of the BAU are as follows.

i) An USDA funded project entitled "Characterization, conservation and improvement of Red Chittagong Cattle of Bangladesh" using ONBS is in operation since January, 2004.
ii) A UNEP-GEF-ILRI-Bangladesh collaborative program entitled "Development and Application of Decision support tools to conserve and sustainably used Genetic Diversity in Indigenous Livestock and Wild Relatives" is in operation since October, 2003.
iii) Quality Black Bengal buck production through contract breeding program at Fulpur, ADP, World Vision since 2003.

Milk Vita

Bangladesh Milk Producers' Cooperative Union Ltd. (Milk Vita) use different exotic cattle AnGR to produce and distribute semen to their member farmers. It has its own bull stations to support their mating plan approved for 65,000.0 members of 775 societies throughout the country up to 2004. At present Milk Vita is using semen of pure Sahiwal, Holstein and Friesian and Jersey bulls. However, in the past their major emphasis was on Sahiwalazition.

Entrepreneurs and Non-government Organizations

Both entrepreneurs and other non-government organizations have established layer and broiler parent and grand parent stock farms of different exotic germplasm, such as, Shaver, Arbor Acres, Hubard, Nera etc. BRAC being involved in livestock development programs established six poultry farms and hatcheries in different regions of the country and a bull station with the capacity of 50,000 dosages semen/month. It produces semen of Friesian and Sahiwal bulls.

6.2: Legislation and regulations

Bangladesh is a signatory of Convention on Biological Diversity (CBD). To fulfill the commitment of the CBD, and for sustainable management of nation's biodiversity, Ministry of Environment and Forest, the Govt. of the People's Republic of Bangladesh has taken an initiative to develop a National Biodiversity Strategy and Action Plan. The following objectives would be fulfilled after developing the National Biodiversity Strategic Action Plan (NBSAP).

- To identify the current status of pressure on, and options and priority actions for, the conservation and sustainable use of national biodiversity by stakeholders.

- To raise community awareness on the sustainable use of biodiversity thus creating a greater understanding and responsibility by the grass roots with the hope that any further activities required to safeguard the biodiversity rests within the local communities.

The followings would be achieved from NBSA

- A combined and unified policy for biodiversity conservation and management would be gained.
- It would ensure the people's ownership and clear objectives, strategy, planning, and sustainable use of biodiversity conservation.
- Government's implementation will be increased actively in biodiversity conservation and management.
- It will ensure the traditional rules and regulations on biodiversity and also would give directives to develop a clear rules and resolutions and would create awareness among community people of the country.

The legislation required for farm AnGR conservation and development require the interference of the government. Laws and regulations functions to regulate import, export and quarantine; prevent the spread of disease, safeguard animal welfare, promote conservation of livestock; control animal slaughter; control and license poultry farming, especially, hatcheries; govern animal breeding, control licensing of sires and castration of non-licensed males and pollution of animal origins are required to formulate and enacted by the Department of Livestock Services. Policies or legal instruments for utilization of AnGR either in urban/peri-urban or rural system are not enacted considerably at filed level (Table6.1). There are development programmes on cattle, chicken and duck in the public sector and may help urban, semi-urban and rural production systems. Slaughter and animal quarantine acts covering protection of young animals from slaughtering and disease prevention measures are under the process of revision and approval by the Government.

For food security and well being of the nation **National Policy on Domestic Animal Diversity (NPDAD)** need to be formulated and enacted to control conservation and sustainable utilization of farm AnGR (Table 6.3). The objective of formulation of NPDAD would be i) optimization of economic benefits from sustainable utilization of different farm AnGR, ii) ensure long term food security of the nation, iii) increase economic production of animal protein, maintain and conserve animal genetic resources for the present and future generations, iv) enhance scientific and technological knowledge, v) educational and socio-cultural values of domestic animal diversity and vi) emphasize biosafety considerations in the development and application of animal biotechnology in line with ethical and religious needs. A survey on the identification of domestic animal diversity and their habitats is very essential to develop **Farm Animal Genetic Resource Management Plan** in the

country (Table 6.3). This will also help policy development process for sustainable utilization of farm AnGR to meet the increasing demand of food and agriculture matching with the resources available in the country.

Table 6.1: Effects of existing policies and legal instruments on the utilization (use and development) of AnGR

Species	Urban/Peri-urban systems		Rural production	
	Industrial systems	Smallholder systems	Industrial systems	Smallholder systems
Cattle	2	3	1	2
Buffalo	1	1	1	1
Goyal	1	1	1	1
Goat	1	1	1	1
Sheep	1	1	1	1
Chicken	2	3	2	3
Duck	1	1	1	2
Goose	1	1	1	1
Quail	1	1	1	1
Guinea fowl	1	1	1	1
Pigs	1	1	1	1
Pigeon	1	1	1	1
Dogs	1	1	1	1
Horse	1	1	1	1

(1=none, 2=little, 3= regular, 4= more and 5= high)

6.3: Sanitary and Phytosanitary Aspects

Livestock and poultry farming interact with the environment through changing its biotic and abiotic compositions and it may result in products not loyal to human health if the sanitary and phytosanitary aspects are not taken into consideration. Therefore, the programs pertaining to health control of the host animal must include the aspects of the management waste of different types. Legislation governing the sanitary aspects of AnGR include proper disposal of dead carcasses, disinfection of premises and vehicles and proper measures to underatke during disease outbreaks. Some of these aspects are already in place through slaughter house act which is under the process of approval of the government.

6.4: Biosafety issues

The Ministry of Science and Information & Communication Technology (MOIST) has developed Biosafety Guidelines which will regulate the use of genetically modified organisms and legislation

would be enacted for controlling environment. There are five committees on Biosafety regulations related with different disciplines. Biosafety Act is under the process of approval by the government.

6.5: Intellectual Property Right

Intellectual Property related to animal genetic resources would include intellectual/technological creations and biotechnological inventions. The purpose of formation of law on Intellectual Property Right (IPR) is to provide protection for intellectual property to local and foreign parties in accordance with International Standards and to promote creativity and innovation. The law governs IPR in the form of patents, trade marks, copyrights and industrial designs, would also be applied to agriculture but still it requires time to put in to action. However, animal genetic resources, unlike plant varieties, are excluded from patent protection under TRIPS (Agreement on Trade Related Aspects of Intellectual Property Rights). The Govt. approved Farmers Breeders Act and other related Act in the country for protection plant germplasm. There is no international law for protection of animal breeds.

The activities and policies of the public sector are supporting to some extent sustainable use of exotic or locally adopted breeds or responding to organizations of breeders or farmers` associations, or helping identification of training, research and extension activities needs especially, for cattle, goat, chicken and duck (Table 6.2). BLRI, however, has got programs for conservation and purebreeding of native germplasm but it is very limited in scale to the requirement of conducting sound breeding programs.

Establishment of national conservation and improvement program for each of the economic germplasm, such as, for dairy and beef cattle development, black bengal goat and sheep development, chicken and duck development should be established using the facilities available to different stakeholders. BLRI, as a research institute must have strong coordination with other stakeholders to achieve the goal, especially, for the development of economic animal for supporting increasing demand of meat, milk and eggs in the context of changed global situation.

The laboratory facilities for characterization of AnGR are still not developed in BLRI. It has procured some essential laboratory equipment but further support in terms of trained manpower and financial assistance is very much essential. To address the future demand the laboratory facilities in the country should be developed through establishment of strong coordination among the stakeholders such as BLRI, BAU and DLS and other public universities got facilities to support the AnGR programmes.

Table 6.2: The focus of current policies on activities related to the utilization (use and development) of AnGR

Species	Activities			
	Use of Exotic Breeds	Use of Locally adapted Breeds	Training Research & Extension	Organizations of Breeders and Farmers
Cattle	2	2	2	2
Buffalo	1	1	1	1
Goyal	1	1	1	1
Goat	2	2	3	2
Sheep	1	1	1	1
Chicken	3	2	3	3
Duck	2	2	2	2
Goose	1	1	1	1
Quail	2	1	1	1
Guinea fowl	1	1	1	1
Pigs	1	1	1	1
Pigeon	1	2	1	1
Horse	1	1	1	1

(1=none, 2=little, 3= regular, 4= more and 5= high)

Table 6.3: Prioritising the needs to enable the development of AnGR policies

Needs	Required		
	Immediately	Medium term	Long term
National Policy on Domestic Animal Diversity and Development of Farm Animal Genetic Resource Management Plan	√		
Technical assistance of international organization	√	√	√
Human resource development	√	√	√
Institutional mechanisms	√	√	√
Conservation of farm AnGR	√	√	√

The acute shortage of skilled manpower in the field of Animal Breeding, Genetics and Reproduction and technicians in the respective field may be prioritized them for their development at different periods (Table 6.3). The support of the public sector is considered important for building the facilities in this field of research.

6.6: Coordination among the stakeholders

Coordination among the stakeholders (Table 6.3) is the main concern for directing all out supports of different organizations and institutions for the development of farming community. A coordinating body in the form council or commission or even a team under the direct supervision of the Ministry of Fisheries and Livestock may be established to perform the coordination activity among the

stakeholders in planning, implementation, monitoring and evaluation of projects or programs. Whatever the form of the coordinating body would be, the responsibility for leading service oriented, pro-business and client-friendly livestock development programs would be the main purpose of its establishment.

Otherwise, after having approved sound programs on AnGR development, any specific organization in the public sector may be given the responsibility for coordinating a program that would be implemented at field level through participation of all related stakeholders in the public and private sectors including village farmers. The responsible organization would be designated as the focal point for that particular program.

The priority of future needs in policy development for AnGR conservation and utilization is shown in Table 6.4 and Table 6.5, respectively. Table 6.4 shows that the human resources is the high priority needs both for conservation and utilization of different AnGR resources of the country followed by the need of technology and financial resources. All these needs should have to be supported with more organizational structures and regular development of infrastructures.

Table 6.4: The priority of future needs in policy development for AnGR conservation programmes

Species	Policy development related to				
	Technology	Infrastructure	Human resources	Financial resources	Organizational structures
Cattle	4	3	5	4	4
Buffalo	4	3	5	4	3
Goyal	3	2	4	3	2
Goat	4	3	5	4	4
Sheep	4	3	5	4	4
Chicken	4	3	5	4	4
Duck	4	3	5	4	4
Pigs	3	3	3	3	3
Geese	3	3	3	3	3
Quail	3	3	3	3	3
Guinea fowl	3	3	3	3	3
Pigeon	3	3	3	3	3
Rabbits	3	3	3	3	3
Dogs	3	3	3	3	3
Horse	3	3	3	3	3

(1=none, 2=little, 3= regular, 4= more and 5= high)

Table 6.5: The priority of future needs in policy development for the utilization (use and development) of AnGR

Species	Policy development related to				
	Technology	Infrastructure	Human resources	Financial resources	Organizational structures
Cattle	4	4	5	4	4
Buffalo	4	4	5	4	4
Goyal	3	3	4	3	3
Goat	4	4	5	4	4
Sheep	4	4	5	4	4
Chicken	4	4	5	4	4
Duck	4	4	5	4	4
Pigs	4	4	4	4	4
Geese	3	3	3	3	3
Quail	3	3	3	3	3
Guinea fowl	3	3	3	3	3
Pigeon	3	3	3	3	3
Rabbits	3	3	3	3	3
Dogs	3	3	3	3	3
Horse	3	3	3	3	3

Assigning score: 1=none, 2=little, 3=regular, 4=more and 5=high

6.7: Education and Human resource development

The priority consideration for AnGR conservation and management is to develop expertise in the country, especially, in the field of molecular genetics, quantitative genetics, animal breeding, reproductive biotechnology, nutrition and animal biodiversity management and conservation. The BAU offers courses on Animal Breeding and Genetics and AnGR conservation at under graduate and post-graduate levels. It also offers post graduate courses of M.Sc (AH) in Animal Breeding, M.S. in Animal Breeding and Genetics and PhD in Animal Breeding and Genetics and intensive training courses on AI and reproductive management since 1990. Besides, four Government Veterinary Colleges also offer courses on Animal Breeding and Genetics for ungraduate students. BLRI offers training courses for upazila and district livestock officers of the DLS and other non-government organizations.

All these efforts are helpful but insufficient to respond to the present requirement for developing necessary expertise to manage AnGR, their characterization, conservation and development. A few expertise developed are heavily engaged in teaching and research works in their own discipline in the university. The BLRI, the extension department (DLS) and Veterinary Colleges have got a huge shortage of expertise, especially, in this particular field.

Nevertheless, human resources are the key factor for exploration of any resource. Availability of quality human resources depends on execution of long term training program based on field problems. Besides, bilateral training and degree based programs with reputed international organizations may help to achieve the goal.

Long term (PostDoc, PhD, MS) training in the discipline of Livestock Breeding and Conservation, Animal Breeding, Animal Genetics, Genetic Engineering, Reproductive Biotechnology, Animal Nutrition and Reproduction and short term training on AnGR conservation and farm animal recording and identification are important to undertake immediately. Some of the long term programmes may be undertaken through bilateral cooperation with the university of developed countries. Except the academic and laboratory supports the research programme of a bilateral long term training should base the local problems on AnGR development.

The country at the moment has been facing a serious constraint on the availability of qualified trainers on AnGR planning, development, management, characterization and conservation at the BLRI and DLS and it is an urgent need to employ expatriate expertise adequately qualified in the respective field for long term basis. Development partners and donor agencies may extend their help in this particular aspects.

6.8: Capacity development

Equipment and research facility available in the research institute and university should be brought under full utilization. This needs building up a coordination mechanism among the laboratory and minimum but continuous financial support both from national and international organizations.

Information system and policy development

A central information system on different AnGR, their production systems, phenotypic and genetic, productive and reproductive characteristics should be established. The DAD-IS is still has not taken an active role in the country. The data and information available on different AnGRs should be included to make DAD-IS updated.

6.9: AnGR Development priorities and programmes

The general framework for development of a sustainable AnGR programme include implications of agricultural policies, infrastructure and farmer involvement, markets and some aspects on the choice of populations available. A breeding programme needs to be integrated and its success is determined by the scope of ***farmer participation*.**

The scope of any AnGR development must be set in relation to the resources available, and the stage of development in the region concerned. It must be kept simple and reliable, at least initially, rather than sophisticated and vulnerable to a number of pre-requisites that cannot be guaranteed. The design may, therefore, vary considerably depending on the available AnGR, production system and other circumstances.

Based on experiences of different research programs conducted in different parts of the world combination of both *ex-situ* and *in-situ* approaches is the best option for conservation of different animal germplasm. But implementation of sustainable exploration program for food and agriculture depends on socio-economic and agro-eccological factors that dictate livestock production system of a region. The main aim of livestock development in Bangladesh is to assist farmers to produce and sustain livestock of high economic potential. Research strategic plan should aim at improvement of quality of animals & birds through genetic means.

The following management and development policies may, therefore, be suggested for sustainable exploration of livestock germplasm in the country.

(a) National policies should immediately be formulated for conservation and improvement of potential AnGR of large and small ruminants and poultry and their wild relatives.

(b) The breeding goals in the existing cattle breeding programme should be corrected and implemented accordingly.

(c) Characterization, conservation and documentation of potential AnGR and development of national data base on distribution of AnGR and their phenotypic, genetic, productive and reproductive characteristics.

(d) Coordinated national program on characterization, conservation and improvement of AnGR should be undertaken integrating different stakeholders (DLS, BLRI, BAU, NGOs, farmers and the public university having manpower and infrastructure for supporting the works).

(e) Animal identification and recording system should be introduced. The animal identification and animal recording system of ICAR may be adopted at all institutional herds and progeny testing programme.

(f) Research and development program on exploration of AnGR strengthening laboratory facilities & human resources and adoption of frontier animal biotechnology should be given priority at least with minimum supports.

(g) Improvement of different dairy/beef type indigenous cattle through selective breeding.

(h) Evaluation of performance of exotic breeds of cattle & their crosses with that of native breeds.

(i) Development of a simple method for genetic ranking of animals to be used in the national AI services.

(j) Development of HYV livestock in the local environmental conditions.

(k) Long term linkages with international and regional organization should be established to upgrade national capacities for managing and economic exploration of AnGR.

As mentioned before only a small proportion of cattle & poultry industry of the country are under commercial conditions, the rest AnGR predominantly are indigenous and are under traditional subsistence mixed farming where specialized exotic breeds may not match. Moreover, potential indigenous AnGR population of Bangladesh are under threat. Therefore, future efforts should be focused on the *in situ* development & conservation of potential AnGR of Bangladesh. In this regard, the most successful way could be genetic screening & open nucleus breeding strategies (ONBS) for the improvement of most promising indigenous AnGR. The programmes may operate through both selection & distribution of males to participating & non-participating village farmers for agreed upon breeding goal. Another way may be operation of sire selection & multiplication for distribution scheme. The said approaches will not only improve the indigenous genetic material but will conserve them *in situ* for the benefit of the livestock keepers. The success of said *in situ* animal genetic resource development & conservation strategies would largely be due to the fact that the strategies will be based on the indigenous animal populations in their adaptive environments.

AnGR development programmes

Keeping national perspective and high relevance for developing Bangladeshi AnGR, the following potential programmes (all species) may be included.

i. Characterization and documentation of existing breeds/types of indigenous AnGRs of Bangladesh.

ii. Characterization, conservation & improvement of dairy type indigenous Red Chittagong cattle.

iii. Characterization, conservation & improvement of dairy/beef type indigenous Pabna cattle.

iv. Characterization, conservation & improvement of dairy/beef type indigenous non-descript cattle.

v. *In-situ* conservation and improvement of indigenous chicken genetic resources through community breeding program

vi. Coordinated Black Bengal goat breeding and improvement programme community development programme(CDP).

vii. Coordinated indigenous sheep breeding and improvement programme through CDP.

viii. Coordinated buffalo breeding and improvement programme including farmer cooperatives.

ix. Conservation and improvement of indigenous duck genetic resources through community development programme.

x. Efforts for commodity development and identification of markets should also be strengthened.

xi. Establishment of a National Centre for Genetic Evaluation of Farm Animals.

xii. Establishment of Breed Improvement Association and Animal Seed Certification Board.

The initial programme may involve surveying to know the current population size, average herd / flock size, the distribution, the rate of decline, morphological characters, production and reproduction profile, biological efficiency and socio-economic aspect of indigenous AnGR. The other programmes may involve establishment of Open Nucleus Breeding herds or flocks (On-station or On-farm) with selected (screened) males & females from different areas of the country. The selection criteria for cattle would be 100 days milk yield, for goat & sheep 6 month body weight and fixing litter size up to 2 kids/lambs & for fowl 6 month body weight and higher egg production. The nuclei herds or flocks may be used for development & dissemination of superior germplasm, either through bull/ram/buck/cock distribution or AI programs at the villages. This will require further improvement of research and development facilities for each species.

The public sector should take a leading to execute the plans integrating the efforts both in public and private sectors to face challenges of food security, employment generation and poverty alleviation in a rapidly changing situations of market economy throughout the globe.

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Appendix 1

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Appendix 3

List of Acronyms

Sl. No.	Acronyms	Words
1.	AnGR	Animal Genetic Resources
2.	AI	Artificial Insemination
3.	BAU	Bangladesh Agricultural University
4.	BARC	Bangladesh Agricultural Research Council
5.	BBS	Bangladesh Bureau of Statistics
6.	BC	Before Christ
7.	BDT	Bangladesh Taka
8.	BLRI	Bangladesh Livestock Research Institute
9.	BRAC	Bangladesh Rural Advancement Committee
10.	C	Centigrade
11.	CBD	Convention of Biological Diversity
12.	DAD-IS	Domestic Animal Diversity Information System
13.	DNA	Deoxyribonucleic Acid
14.	DLS	Department of Livestock Services
15.	E	Exotic
16.	FAO	Food and Agriculture Organization
17.	GDP	Gross Domestic Product
18.	HF	Holstein Friesian
19.	HYV	High Yielding Variety
20.	ICAR	International Committee for Animal Recording
21.	ILRI	International Livestock Research Institute
22.	IPR	Intellectual Property Right
23.	J	Jersey
24.	L	Local
25.	MOFL	Ministry Of Fisheries and Livestock
26.	MOIST	Ministry of Science and Information & Communication Technology
27.	MT	Metric Tons
28.	NCC	National Consultative Committee
29.	NPDAD	National Policy on Domestic Animal Diversity
30.	NBSAP	National Biodiversity Strategic Action Plan
31.	NGO	Non Government Organization
32.	ONCS	Open Nucleus Crossbreeding System
33.	ONBS	Open Nucleus Breeding System
34.	PCR	Polymerise Chain Reaction
35.	PRSP	Poverty Reduction Strategic Plan
36.	RCC	Red Chittagong Cattle
37.	SL	Sahiwal
38.	SPS	Sanitary and Phyto-sanitary System
39.	TRIPS	Agreement on Trade Related Aspects of Intellectual Property Rights
40.	US	United States
41.	USDA	United States Development Agency