



Growth and Development Potential of Livestock and Fisheries in Bangladesh

*Zahurul Karim, Khan Shahidul Huque, Md. Golam Hussain, Zulfiqar Ali,
and Mosharraf Hossain*

Bangladesh Food Security Investment Forum, 26–27 May 2010, Dhaka

GROWTH AND DEVELOPMENT POTENTIAL OF LIVESTOCK AND FISHERIES IN BANGLADESH

Zahurul Karim, Former Secretary, Ministry of Fisheries and Livestock
Khan Shahidul Huque, Bangladesh Livestock Research Institute
Md. Golam Hussain, Bangladesh Fisheries Research Institute
Zulfiqar Ali, Bangladesh Institute of Development Studies
Mosharraf Hossain, Ministry of Fisheries and Livestock

**Prepared for the
Bangladesh Food Security Investment Forum
May 2010**

CONTENTS

EXECUTIVE SUMMARY.....	5
INTRODUCTION	6
SECTORAL POLICY AND GROWTH.....	6
Policies	6
Growth of livestock	7
Growth of fisheries.....	7
SUPPLY AND DEMAND OF LIVESTOCK PRODUCTS AND FISHERIES.....	8
EMPIRICAL EVIDENCE ON SOME SECTORAL SUCCESS.....	9
Livestock.....	9
Smallholder poultry.....	10
Fisheries	10
CHALLENGES FACING THE SECTORS	11
Policy barriers.....	11
Additional barriers	12
PRIORITY INVESTMENT AREAS	14
Investment opportunities.....	14
Livestock.....	16
Fisheries	17
CONCLUSION	18
REFERENCES	18

EXECUTIVE SUMMARY

The vibrant fisheries sector in Bangladesh accounts for roughly 20 percent of the agricultural GDP while the growing livestock sector comprises around 12 percent. More than 10 million Bangladeshis directly depend on these sectors for their livelihoods. A large proportion of these people are smallholders whose production of milk, meat, and eggs increased significantly between 2002 and 2008 primarily because of improved breed, feed, and fodder; available veterinary health services; and investments led by the private sector. The growth rate in the fisheries sector has also improved—from 2.33 percent in 2002–03 to 4.11 percent in 2007–08. This growth is largely from intensive technological management practices in agriculture. Pond aquaculture has also been improving and now produces about 866,049 metric tons (mt) per year, representing 41.92 percent of total inland fish production (2,839 kilograms/hectare).

Some technological interventions with improved breed, feed, housing, and management systems have greatly improved meat and egg production in Bangladesh. Milk production is also on the rise due to increased use of crossbred cows. Small-scale dairy farming has increased due to introduction of modern milk processing and packaging techniques. Daily milk yields per cow were recently measured at 8.0 liters for crossbred cows (CBC) and 4.1 liters for local breed cows (LBC). Thus, CBC farms generate more cash income and employment than LBC farms. Overall, dairy generates more regular cash income, and dairy production, processing, and marketing generate more employment per unit value added when compared with crops. Profit margins of small scale dairy and poultry farming are higher than those of crop and fish farming. For example, an average broiler farm earns a profit of about 23,000 *taka* (TK) per year, and the substantial profits (TK 187,000) of layer farms had an annual rate of return of about 107 percent on their investment. Cattle fattening has also been a profitable venture. Even smallholder poultry rearing can increase the annual income of rural families, specifically under the credit support program of the Palli Karma Shahyok Foundation (PKSF).

A wide gap still exists, however, between the current production of and demand for milk, meat, and eggs. A comparison of projected supply and demand shows that there will be a shortfall of about 1 million metric tons (mt) of fish in 2015 under a high-demand growth scenario. There will also be shortfalls, although somewhat smaller, under low and medium growth scenarios. Local milk production is also in jeopardy because, at present, the government is imposing only a 32.8 percent tariff on powdered milk imports but much higher tariffs on milk packaging materials (53.5 percent) and cattle feed. To protect local milk production, the powdered milk duty should be increased to about 40 percent, and there should be no duty on milk packaging material or cattle feed.

Overall, challenges facing the livestock and fisheries sectors are wide yield gaps; a shortage of feed and fodder; inadequate supply of veterinary services; the need for institutional reforms of the Department of Livestock Services (DLS); problems of quality control in livestock products, drugs, vaccines, feeds, and breeding materials; a lacking organized market; inadequate coverage of animal health services; inadequate supply of sustainable breed development; poor management of public water bodies; low productivity of fisheries and brackish water shrimp; genetic degradation of carp; climate change effects; and the marginalization of women in the labor sector.

Policy barriers contribute to a number of these challenges, as evidenced in a recent study of the dairy value chain conducted by CARE (2010). The imperfect dairy market in Bangladesh has allowed milk importers to transfer any increase in price or cost due to rising global prices or taxes/tariffs to consumers immediately without transferring the benefits of such price increases to producers, thereby dissolving any incentives to increase productivity. The opposite situation occurs when global prices or taxes/tariffs fall; the benefit of such a decline has been transferred to consumers very slowly. Thus, the imperfect dairy market has rendered tax and tariff policies ineffective for dairy sector growth in Bangladesh.

Most of Bangladesh's pond production, on the other hand, has been found to be profitable. Under an improved polyculture system, production was found to have doubled. Intensively managed ponds using quality fingerlings, commercial feed, and solid pond management practices produce up to 10,000 kilograms per hectare (kg/ha) each year of two crops. Community-based management should be an effective option for increased *baor* fish production while also empowering individual regions. Bangladesh's Department of Fisheries (DOF) and various nongovernmental organizations (NGOs) have taken initiatives to maximize fish production. Developing successful community-based co-management arrangements that ensure sustainable wetlands and productive fisheries is a challenge, however. Thus, future wetland resource management policies should be based on community participation and address wider watershed issues

*Note: All references to taka (TK), the currency of Bangladesh, are based on the official exchange rate as of May 20, 2010: TK 69.35 per US\$1.

by ensuring that lessons and best practices from previous experiences are widely adopted.

Smallholder poultry and dairy farmers and community-based fishers remain vulnerable, but safety nets such as the nationwide incentive credit program and provision of insurance have helped. The government may consider establishing specialized financial institutions for rendering these services of credit and insurance. It may require that the government creates an endowment fund that donors may favor. The priority investment areas identified are promoting smallholder poultry and dairy development; improving diagnostic capacity and veterinary clinical services; developing public-private partnership for diversified vaccine production and marketing; sustainable management of animal genetic resources; preparing for highly pathogenic avian influenza; creating community-based sanctuaries with co-management practices; reversing genetic degradation in carp stock through improved hatchery management; improving productivity of brackish water shrimp; promoting hygiene in animal food production; adding value to livestock and fishery diversity and processing; and value chain management.

The DLS and DOF lack the capacity to meet the current challenges and to diversify extension programs; these agencies need to be reformed to account for changes caused by globalization, trade liberalization and World Trade Organization (WTO) regulations. Private sector involvement will be essential. In addition, the wetland leasing policies are to be revised for community-based co-management toward a solution of wetland degradation in Bangladesh. Long-term leasing with more involvement of the DOF should be ensured.

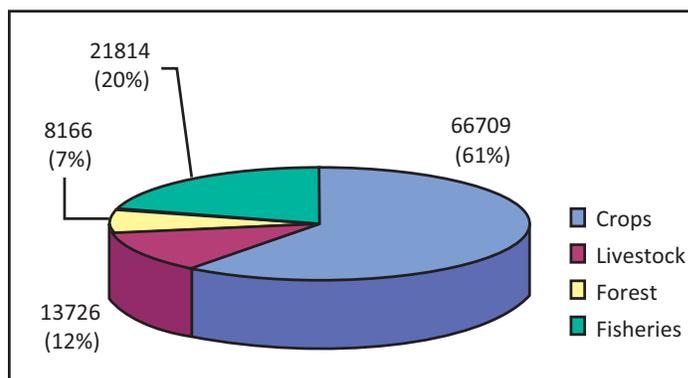
Finally, research and development in noncrop sectors is lagging in Bangladesh. As a result, technology flow from livestock and fisheries institutes is minimal. Compared to the contribution of this sector, there is inadequate support to both human resource development (HRD) and infrastructure. Thus, priority investment is also required in research and development. More public-private partnership programs should be developed for vaccine production and production of quality breeds, broods, and chicks. There should be much more support for establishing quality hatcheries, marketplaces, and value chain activities. Training and capacity building are also needed on a continuous basis, and the use of information and communication technologies (ICT) should be promoted to move things along swiftly.

INTRODUCTION

The fisheries and livestock sectors are two major pillars of Bangladesh's economy, and more than 10 million people directly depend on these sectors for their livelihoods. These sectors are also important for food, nutrition, income, export earning, draft power, biofertilizer, and transport. The fisheries

sector is vibrant, contributing to about 20 percent of the agricultural GDP, while the livestock sector contribution is around 12 percent (see Figure 1). These two sectors provide the major dietary protein. During 1994–2005 the food from animal origin increased from 76 to 113 gm per capita per day. About 63 percent of animal protein supply in the diet of the people of Bangladesh is obtained from fish.

Figure 1—Sectoral share of agricultural GDP in Bangladesh



Source: Prepared by authors.

Bangladesh is fortunate enough to have extensive water resources scattered all over the country in the form of small ponds, beels, lakes, canals, rivers, and estuaries covering about 4.57 million ha and employing about 1.4 million people. The country has a coastal area of 2.3 million ha and a coastline of 714 km along the Bay of Bengal, which offers a great potential for marine fisheries production. About 296 fresh and brackish water fish species (including freshwater prawns) and 511 marine species (including marine shrimp) are available in Bangladesh waters.

The livestock sector contributes largely to rural poor through income and employment generation. It offers sustained employment opportunities particularly for the rural poor. Small-scale livestock farming during 1993–2002 provided self employment to approximately 3 million poor women (DANIDA 2002).

SECTORAL POLICY AND GROWTH

Policies

In 2006, the government drew up a National Fisheries Strategy. This reflects a shift from the way the subsector had been managed under the 1998 fisheries policy, when the government controlled the sector through its agents, mostly the Department of Fisheries. Their activities largely included the management and control with direct involvement in supplying some of the inputs such as fingerling. The more recent strategy stipulates that government activities place greater emphasis on fostering

participation with local communities, the private sector, and nongovernmental organizations (NGOs); providing advice; and establishing a regulatory framework in which the subsector can function properly. This strategy emphasizes collaboration linkages and partnerships throughout the sector. The strategy also reflects current government concern for poverty alleviation through more targeted activities by all.

A National Livestock Development Policy was prepared in 2007 to address the key challenges and opportunities for the comprehensive and sustainable development of the livestock sector. It promotes sustainable improvement in productivity of milk, meat, eggs, etc.; promotes activities to improve income, nutrition, and employment for landless and small farmers, and invites greater participation and investment of the private sector. This policy also provides opportunities and reduces vulnerability and risk in an effort to harness the full potential of the livestock subsector, thereby accelerating economic growth for reduction of rural poverty.

The elements in the 2006 National Fisheries Strategy and 2007 Livestock Development Policy are comprehensive, but have yet to be implemented.

Growth of livestock

The livestock subsector experienced a growth rate of 5.9 percent in 2006–07. The contribution of the livestock subsector to agricultural gross domestic product (GDP) is 12 percent and to the country’s GDP is 2.9 percent. There is increasing trend in the production of milk, meat, and eggs during 2002–08 (see Figures 2 and 3) (Bangladesh Economic Review 2007 and NMTPF 2010). The main growth drivers are supply of improved breed, feed, and fodder; veterinary health services; smallholder farmers; and private sector-led investments.

Figure 2—Trends in production of milk and meat in Bangladesh

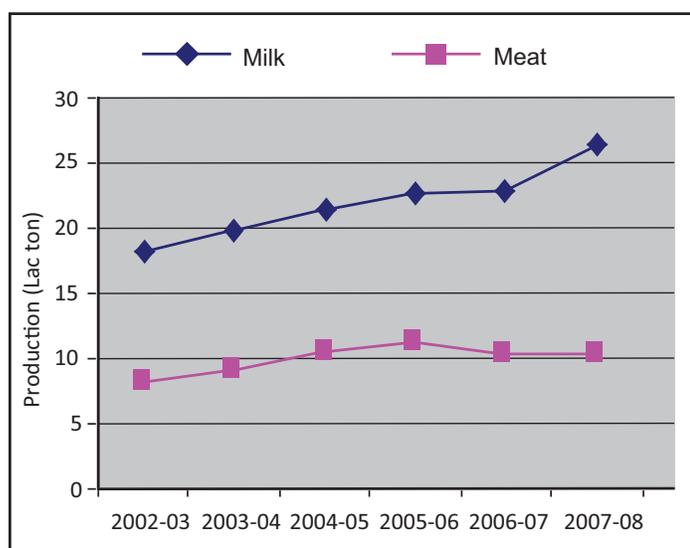
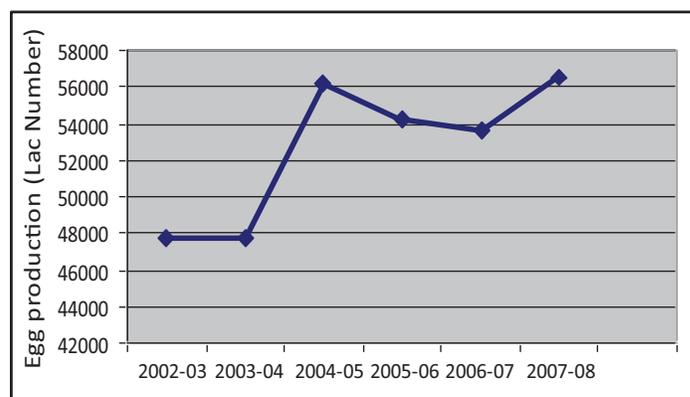


Figure 3—Trends in egg production in Bangladesh



Source: NMTPF 2010.

A large number of smallholders are operating in this sector and the numbers are growing (see Table 1). The rapid expansion of the livestock subsector has tremendous scope for increasing food production, employment, incomes, and improving the livelihoods of millions of people in Bangladesh.

Table 1—Growth of livestock farms in private sector, 1990–91 and 2001–02

Type of farm	Number of farms		Annual growth rate (%)	
	1990–91	2001–02	Simple	Compound
Dairy farm	7,369	47,319	45.18	15.49
Goat farm	2,904	52,872	143.91	24.21
Sheep farm	50	28,886	400.00	32.42
Poultry farm	39,613	106,134	14.57	8.42

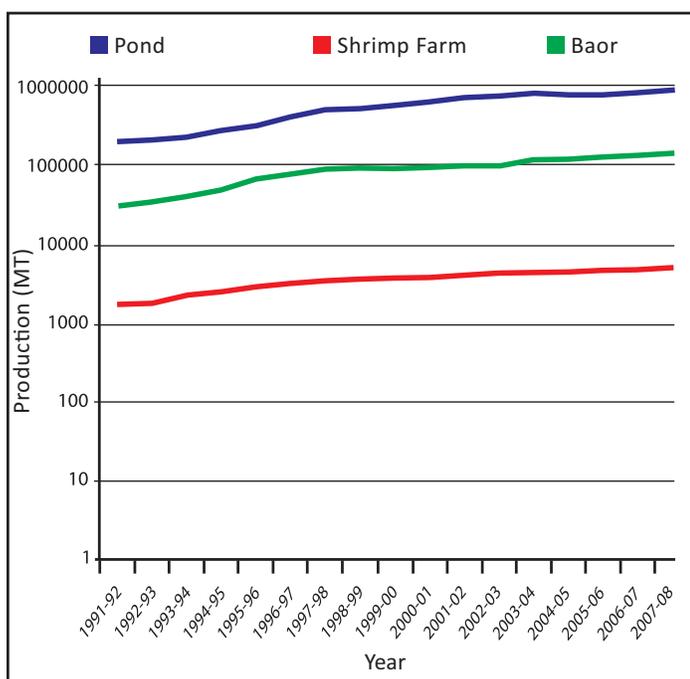
Source: Division of Livestock Services and authors’ calculations.

Growth of fisheries

The fisheries sector contributes about 5 percent to the GDP and 5 percent to the country’s export earnings. The growth rate in the fisheries sector has increased from 2.33 percent in 2002–03 to 4.11 percent in 2007–08. The growth can be attributed largely to pond fisheries, while growth in open water fisheries is continuously declining, though open water resources still contribute more than 40 percent of total fish production. The main driving forces for growth of aquaculture are high intensive technological management and improved fish breeds.

Bangladesh’s total pond area—now 305,025 ha, or 6.67 percent of total inland water—has increased by about 25 percent from 1999–2000. Pond aquaculture contributes about 866,049 mt, representing 41.92 percent of total inland fish production (2,839 kg/ha). The trend of total fish production over time has been continuously increasing (see Figure 4).

Figure 4—Source wise aquaculture production trends



Source: NMTPF 2010

SUPPLY AND DEMAND OF LIVESTOCK PRODUCTS AND FISHERIES

A recent background study of the Planning Commission's sixth Five Year Plan (2011–2015) projected demand and supply of livestock and fisheries using linear approximation of an almost ideal demand system (LA/AIDS) model. The projection, which considered population growth, urbanization, and growth in real income, shows that there would be a deficit of 0.33 million liters of milk, 0.76 million tons of meat, and 485 million eggs in 2010 (see Table 2). The deficit would further increase at the end of Sixth Five Year Plan period (2015).

Projected demand for fish is expected to reach 3.45, 3.47, and 3.49 million mt in 2011; and 4.53, 4.65, and 4.79 million mt in 2015 under low, medium and high growth scenarios respectively (see Table 3). Projected demand for 2015 is about one and half times higher than that of the 2010 base-year demand. Projected supply shows that total fish production will reach 3.03 million mt in 2011 and 3.79 million mt in 2015, from the base year figure of 2.87. Production in 2015 is projected to be 32 percent higher than the base year production in 2010. A comparison of projected supply and demand for fish for 2011 through 2015

Table 2—Projection of demand for and supply of livestock and poultry products during Sixth Five Year Plan Period

Products	Growth	Benchmark (base year)	2011	2012	2013	2014	2015	Total
			Projected Demand					
Meat (million tons)	Low	1.87	2.17	2.51	2.93	3.43	4.05	16.96
	Medium	1.87	2.19	2.58	3.06	3.64	4.37	17.71
	High	1.87	2.22	2.65	3.19	3.86	4.72	18.51
Eggs (million numbers)	Low	6,575	7,110	7,687	8,311	8,984	9,711	48378
	Medium	6,575	7,156	7,788	8,474	9,220	10,030	49243
	High	6,575	7,202	7,888	8,639	9,460	10,357	50121
Milk(million tons)	Low	3.31	3.77	4.29	4.90	5.61	6.42	28.3
	Medium	3.31	3.81	4.40	5.09	5.90	6.84	29.35
	High	3.31	3.86	4.51	5.28	6.20	7.28	30.44
			Projected Supply					
Meat (million tons)		1.11	1.16	1.22	1.28	1.34	1.41	7.52
Eggs (million numbers)		6,090	6,383	6,689	7,011	7,348	7,702	41223
Milk(million tons)		2.98	3.15	3.32	3.50	3.70	3.91	20.56
			Projected Supply-Demand Gap					
Meat (million tons)	Low	-0.76	-1.01	-1.29	-1.65	-2.09	-2.64	-9.44
	Medium	-0.76	-1.03	-1.36	-1.78	-2.3	-2.96	-10.19
	High	-0.76	-1.06	-1.43	-1.91	-2.52	-3.31	-10.99
Eggs (million numbers)	Low	-485	-727	-998	-1,300	-1,636	-2,009	-7155
	Medium	-485	-773	-1,099	-1,463	-1,872	-2,328	-8020
	High	-485	-819	-1,199	-1,628	-2,112	-2,655	-8898
Milk(million tons)	Low	-0.33	-0.62	-0.97	-1.4	-1.91	-2.51	-7.74
	Medium	-0.33	-0.66	-1.08	-1.59	-2.2	-2.93	-8.79
	High	-0.33	-0.71	-1.19	-1.78	-2.5	-3.37	-9.88

Source: Planning Commission/BIDS 2009.

Table 3—Projection of demand for and supply of fish, in millions of metric tons

All Fisheries/ Subsectors	Alternative Growth Scenarios	Projected Demand					
		2010 (base year)	2011	2012	2013	2014	2015
All Fisheries	Low (6%)	3.23	3.45	3.69	3.95	4.23	4.53
	Medium (6.5%)	3.23	3.47	3.74	4.02	4.33	4.65
	High (7%)	3.23	3.49	3.78	4.09	4.42	4.79
		Projected Supply					
		2010 (base year)	2011	2012	2013	2014	2015
Capture Fisheries		1.18	1.25	1.32	1.39	1.47	1.55
Culture Fisheries		1.13	1.20	1.27	1.35	1.43	1.52
Marine Fisheries		0.55	0.58	0.61	0.65	0.68	0.72
All Fisheries		2.87	3.03	3.20	3.39	3.58	3.79
		Projected Supply-Demand Gap					
		2010 (base year)	2011	2012	2013	2014	2015
All Fisheries	Low (6%)	-0.36	-0.42	-0.49	-0.56	-0.65	-0.74
	Medium (6.5%)	-0.36	-0.44	-0.54	-0.63	-0.75	-0.86
	High (7%)	-0.36	-0.46	-0.58	-0.7	-0.84	-1.00

Source: Planning Commission/BIDS, 2009

shows that there will be a shortfall of about 1 million metric ton of fish in 2015 under the high growth scenario. There will also be shortfalls, though somewhat smaller, under low and medium growth scenarios in 2015. Thus, in order to meet the projected demand for livestock and fish in the coming years, the government would need to invest more resources in this *subsector* in order to achieve higher growth of livestock and fish production.

EMPIRICAL EVIDENCE ON SOME SECTORAL SUCCESS

Livestock

Some technological interventions with improved breed, feed, housing, and management systems have greatly improved meat and egg production. A new poultry hybrid called “Sonali” has been developed locally by DLS and is being widely used in some areas by smallholder poultry farmers.

Milk production has also increased due to increased use of cross bred cows. Use of deep frozen semen for artificial insemination has significantly improved the cattle breeding program. Small scale dairy farming has increased due to introduction of modern milk processing and packaging techniques. It was found that daily milk yields per cow were 8.0 liters for cross-breed cows (CBC) and 4.1 for local breed cows (LBC) (Jabbar et al. 2005). CBC farms generate more cash income and employment than LBC farms.

Gross margin from CBC farms is impressive (TK 40,000 per annum) with an annual rate of return of 58 percent. An average CBC farm spends TK 69,000 per annum, with feed accounting for 61 percent of expenses. Dairy generates more regular cash income, and dairy production, processing, and marketing generate more employment per unit value added compared to crops (Asadduzzaman 2000; Omore et al. 2002). Profit margins for small scale dairy and poultry farming are higher than for crop and fish farming.

The average number and range of cattle per farm or animals fattened in a year is shown in Table 4. The smallholders keep 1.9 animals per farm and it ranges from 1 to 8 heads. Seasonal producers keep 2.3 animals per farm and vary from 2 to 22 heads. Profitability of cattle fattening varies based on different factors, such as regions, seasons, animal sizes, and feeding and management, and ranges from TK 4,400 to TK 24,400.

Table 4—Average profitability of cattle fattening in different areas (thousand TK)

Item	Chittagong	Khulna	Dhaka	Rajshahi
Animal procurement price	15.5	15.0	16.6	6.2
Total cost	29.7	21.4	22.5	9.4
Animal sale price	54.2	32.0	33.6	13.8
Profit	24.4	10.5	11.1	4.4

Source: BLRI 2010.

Smallholder poultry

Poultry farming is reported to be profitable (Younus, Ahmed, and Chowdhury 2008). Total revenues from sale of day old chicks (DOCs) were TK 12.32 million per farm. The owners earn around TK 0.87 million per month, with an annual rate of return of 91.8 percent on their investment. An average broiler farm sold grown up broilers worth about TK 203,000 per month and earned a profit of about TK 23,000, yielding an annual rate of return of around 152.4 percent on their investment. The major costs of broiler farms were feed (62 percent) and DOCS (23 percent). Layer farms made substantial profits (TK 187,000), with an annual rate of return of about 107 percent on their investment.

Rearing smallholder poultry increased annual income of rural families under the credit support program of Palli Karma Shahyok Foundation (PKSF). Keeping only 16 family chickens, a woman can add about TK 5,085 to her family income of TK 74,003 in a year, or 6.87 percent. Broiler rearing at the rate of 196 birds per batch contributes about 25.3 percent of the total annual income of TK 112,096. A family may easily raise at least two to three batches of broiler birds, and may earn the money required to support his family of 4.30 heads. However, these producers are required to work under a contract growing system (see Table 5).

Table 5—Poultry rearing as a tool for increasing household income (financial figures in taka)

Items	Family chicken	Broiler rearing
Family size	5.30	4.30
Number of birds	16	196/batch
Poultry farming	5,085	28,350
Crops and Others	68,918	83,746
Total annual income	74,003	112,096
Poultry share to total income (%)	6.87%	25.30%

Source: BLRI 2010.

Similarly, a flock of 250 layers may support an average family through an annual earning of TK 88,000, and continuous rearing under any value chain system may improve the food security of millions of people and raise them out of poverty.

Fisheries

Productivity enhancement

Some of the technologies generated by the Bangladesh Fisheries Research Institute have been transferred to producers. In fact, most of the pond production involves polyculture and has been found to be profitable, using mixed species that can make optimum use of the varied feeds and ecological niches that exist in a pond system. Under monoculture of certain species (catfish, tilapia, perch), average production reaches up to 3,500–4,000

kg/ha/year. Under the improved polyculture system, production was found to have doubled as is evident from the experience of several recently implemented donor assisted projects (IFAD 2006; DANIDA 1996). Intensively managed ponds using quality fingerlings, commercial feed and good pond management practices produce up to 10,000 kg/ha/year through two crops annually (WB 2009). There are records of producing more than 40 tons of pangas per ha/year (Rahman 2006) under intensive farming with improved supplemental feeds. In 2007, tilapia production in Bangladesh was about 66,767 mt (DOF 2009). Tilapia farming made great progress from 1999 to 2007, with an increase in production from 2,140 to 66,767 mt in 2007. Due to the rapid expansion of hatcheries producing mono-sex all male tilapia seed and of farms within a span of two years (2005–2007), tilapia production increased more than threefold (Hussain 2009).

Bangladesh is endowed with 600 *baors*, covering an area of 5,500 ha situated in the southwest part of the country. To date, 39 *baors* with a water area of 2,471 ha are managed under different development projects and have been stocked with fingerlings. Among these, DOF is managing six *baors* covering an area of 1,137 ha, and fish production has increased from 80 kg to 871 kg/ha (DOF 2008), while the private sector is managing 594 *baors*, and fish production has increased to 941 kg/ha/year. The fish production trend of *baors* over the period from 1991–92 to 2007–08 showed almost an insignificant increase. A recently completed Aquaculture Development Project funded by IFAD produced an average of 1145 kg/ha/year and a maximum of 2500 kg/ha/year. Grameen Bank helped support a *baor* production increase from 697 kg/ha per year to 3,250 kg/ha per year through gradual improvement to traditional management and introducing a more intensive management system.

Bangladesh is blessed with 2.8 million ha of flood plain, providing good potential to expand aquaculture. Currently 92 projects under community based flood plain aquaculture covering about 5000 ha is being implemented in Comilla district following the Daudkandi model of community based flood plain aquaculture. Six of these have been established in collaboration with SHISHUK and the rest have been implemented by joint venture entrepreneurs and land owners of the area. Average fish production of the flood plain area is about 1,850 kg/ha per year (SHISHUK 2008), and the program is expanding very rapidly throughout the country.

Economic value of wetland

Thompson and Colavito (2007) calculated the value of wetlands in Bangladesh. They made a detailed assessment of the economic value of Hail Haor by developing a simple bioeconomic model using data from 1999–2000. The results indicate that the annual value of wetland products in Hail Haor in 2000 was about TK 37,000, or US\$650 per hectare (see Table 6).

Table 6—Estimated value of Hail Haor economic outputs in 1999–2000

Type of good or service	Total returns (TK)	Value per area (TK/ha)*	Percent
Commercial fisheries	56,272,200	4,580	12
Subsistence fisheries	83,651,100	6,800	18
Non-fish aquatic products**	127,973,300	10,410	28
Boro rice value	63,857,500	5,190	14
Project/biodiversity funds	43,650,600	3,550	10
Pasture value	40,292,800	3,280	9
Flood control	23,443,200	1,910	5
Recreation	7,025,600	570	2
Transportation	8,758,300	710	2
Total (TK)	454,924,600	37,000	100.0
Total (US\$)	7,981,100	650	

Water quality, aquifer recharge benefits and existence value were not valued.

* Total output value divided by maximum water area (12,300 ha in 1999).

** Includes aquatic plants used by local residents and by tea estates.

Exchange rate at that time US\$1 =TK 56.9

This compares with a net return from the alternative of single cropped boro paddy land of TK 18,250 per ha. The main contributors to this value were fish and other non-fish aquatic products (such as plants, grazing values, etc.). Most of these products are collected by and provide income or food for the poor. The annual return from Hail Haor in its condition at that time was estimated to be just under US\$8 million. Restoration of fish catches alone in Hail Haor has raised this to about US\$10.9 million in 2005-06. These studies clearly demonstrate that wetland protection and restoration make good economic sense for Bangladesh. The value of resources and services generated by wetlands even when degraded is more than alternative agricultural uses, so further changes in use or drainage of wetlands should be avoided.

There are some community based fisheries management (CBFM) projects describing good success. In CBFM-2 project areas, fish production increased in 2003 and 2004 by 41 percent and 89 percent, respectively. Biodiversity has improved by 28.3 percent. In Management of Aquatic Ecosystem through Community Husbandry (MACH) project sites, fish catch increased by 2 to 5 times over baseline catch before intervention, from 58–171 kg/ha to 315–390 kg/ha between 2004–2005 (WorldFish 2006).

CHALLENGES FACING THE SECTORS

Policy barriers

The government at present is imposing a 32.8 percent tariff on the import of powdered milk. Milk packaging materials have a much higher tariff (53.5 percent), while the tariff for cattle feed is 32.8 percent.

Studies on the value chain development of dairy by CARE (2010) find many important policy barriers on dairy development of Bangladesh. The imperfect dairy market in Bangladesh has allowed milk importers to transfer any rise in price or cost due to increases in global prices or tax/tariffs to consumers immediately without transferring the benefits of such price hikes to producers or providing incentives to increase productivity and production. The opposite occurs when global prices or tax/tariff fall, with the benefit of such declines transferring to consumers very slowly. Thus the imperfect dairy market rendered tax and tariff policies ineffective for dairy sector growth in Bangladesh.

The formal processing sector also did not play any significant role in the long term growth of the dairy factor partly because of its small size and partly because of its lack of interest in providing incentives and services to producers to increase productivity and efficiency.

Genetic improvement through cross breeding with exotic semen contributed long term growth of the dairy sector. But the livestock policy has the provision to promote limited array of breeds while experts and farmers opinions indicate that breed choices should be made out of a larger array of breeds based on a number of selection criteria rather than just milk yield.

The poultry industries in Bangladesh have suffered considerable setbacks due to avian influenza and high feed costs. The private sector is not allowed to have diagnostic kits while public-sector institutions also lack capacity and cannot promptly deal with avian flu epidemics, often resulting in devastating losses in the poultry industries. Although the importation of chicks is not normally allowed, the government often allows some parties to import chicks and eggs when there are shortages. It has been reported that even countries with incidences of avian influenza have not been excluded from the importation lists. This sometimes bought epidemic in the domestic industry. No established safety net measures are operative in Bangladesh, leaving smallholders' poultry—and the livelihoods they realize through farming—vulnerable.

Since June 2009, a number of anomalies and barriers have become apparent in the official Gazette on leasing policy by the Ministry of Land.

Although the policy is aimed at productivity enhancement and conservation of aquatic biodiversity, the provision and procedure described throughout the document is more revenue oriented than conservation or production oriented.

Only a short term provision for a three-year lease is made and there is an incremental contract fee to renew the contract. This is contradictory to fisheries productivity enhancement, favoring revenue income. This is not the goal of wetland management and conservation.

The land leasing applies to government owned water bodies (Khas Jalmahal), excluding areas surrounding the Khas Jalmahal that are privately owned or may be owned by GOB agencies other than the Ministry of Land, NGOs, etc. Furthermore, open water bodies (without physical boundaries) are not subject to

management under this policy. Conflicts arise between stakeholders (for example, between leaseholders of public water bodies and owners/users of surrounding areas) and constrain productivity enhancement and sustainable operation of open water fisheries resources.

The basic structure of the fisheries sector in Bangladesh has changed drastically over the past 40 years. In the past, open-water capture fishery was the main contributor to the sector, whereas now aquaculture is the main contributor. Hence, the policy should include both fisheries and fish farmers as main stakeholders.

The implementation mechanism relies more on bureaucracy and the involvement of politicians while overlooking fishers and fish farmers. This will not bring desired reforms.

The stated policy might be conflicting with National Fisheries Policy and relevant strategies formulated by the ministry of fisheries and livestock duly approved by the GOB.

The stated policy involves other ministries and agencies but only in a supplementary role. The Department of Fisheries deserves larger role in the district and upazila level Jalmahal Management Committees, where they should act as Member Secretaries.

Additional barriers

Genetic degradation in carp and other farmed fish species

Today the biggest obstacle to increasing the aquaculture production trend in Bangladesh is the genetic deterioration and inbreeding depression in hatchery-produced seeds of various farmed fish species (such as carp, catfish, tilapia, and perch). In fact, most of the hatcheries in the country function in genetic and reproductive isolation (no introduction of or replenishment with new stocks) to maximize the fixed target of seed production, but without considering the genetic quality of hatchery population (or brood stock). As a result, deterioration of the quality of hatchery produced seed has become a normal phenomenon, increasingly limiting the potential scope of aquaculture production. Many fish breeding experts suggest that brood stock replacement and selective breeding are the simplest, most promising and useful methods to improve desirable traits in a founder stock with high genetic variability. In this way, genetically superior individuals can be developed per generation, heritability and genetic variability of all traits can be increased to a maximum level, and inbreeding depression can be kept to a minimum in carp and other farmed fish species (Hussain and Mazid 2001).

Restriction of breeds and livestock breeding program

The latest provisional livestock policy document approved in 2008 adopted a strategy to promote principally Friesian crosses and Red Chittagong for breed improvement, with marginal emphasis on improvement of local breeds. The paper presents results of

a survey of 128 teaching, research, and development experts and 200 market oriented farmers to highlight their perspectives on breed development strategy options and criteria to be used in choosing breeds for adaptation or for using crossbreeding to improve local cattle. The findings suggest that the implementation of the new livestock policy, especially its breeding strategy, focused on Friesian and Red Chittagong, which will lead to a cattle population with different breeds but will not promote long term breed development in the country. Indiscriminate breeding with choices limited to two specific breeds without proper progeny records may also lead to eradication of locally adapted best performing genetic resources from the country.

Lack of organized market and low value addition

Lack of an organized market for selling farm produce is an important problem for Bangladesh. The salient features of agricultural product markets are poor infrastructure, with lack of storage and processing facilities, poor roads and communication systems, unfair practices of middlemen, etc. The marginal and small farmers often face problems marketing their product and are not getting fair prices due to trade syndicates. Government initiatives and supports will be required to develop marketplaces and market outlets. Credit facilities would be required to promote private initiatives for small and medium-scale agribusinesses in processing and packaging.

Climate change

A primary impact of climate change is water scarcity, particularly during the dry season, when fresh surface water bodies have limited capacity to handle the expanding demand for fisheries and livestock. Minimum acceptable surface water levels in many rivers and streams are also compromised by enhanced hydrological drought due to climate change which threatens the existing aquatic ecosystem, fisheries, and livestock. The Intergovernmental Panel on Climate Change has reported that climate change and its impacts can result in the outbreak of many new disease and pests that will affect these subsectors.

Women's involvement

Women's involvement in income generating activity is crucial for the nation's economic development. In the past, women were not allowed to work outside of the home. In cases where this is still in practice, women can be involved in fisheries' and livestock's more labor and capital intensive activity that can be undertaken within the homestead area. If women can be heavily involved in this sector, then total production and income generation will be greatly enhanced.

Availability of feeds and fodder for livestock

The acute shortage and low quality of feeds and fodder is one of the single most important obstacles to livestock development

in Bangladesh. Livestock farmers rely on a combination of both local and imported concentrates and other inputs, a trend that is expected to intensify. Land is a scarce resource in Bangladesh. It is rarely available for cultivation of green fodder. Feed and its high price offer a major challenge for livestock development. Feed resources for livestock are primarily derived from crop residues and by-products such as straw, grass, and tree leaves. Supplementary and concentrate feed are provided rarely and inadequately. This has resulted in stunted growth, reproduction, and reduced productivity.

Most of the dairy and poultry farmers are facing the problem of adulterated and inferior quality of commercial feeds and feed ingredients. Feed labelling and control is inadequate. Most feed millers do not disclose important information on packaging with regards to feed composition, ingredients, date of manufacturing, date of expiry, storage guidelines, energy levels, and protein and vitamin contents. Further, poor packaging causes quicker spoilage and deteriorated quality, threatening both animal and human health. High prices of feeds and fodder are also a problem for the smallholder livestock farmers.

Inadequate coverage of animal health service

The ratio of veterinary surgeons to farm animals and poultry is as low as one-to-one lac for livestock and one to two million for poultry. The problem is aggravated by a poor transportation network that effectively shuts out 80 percent of farmers from veterinary service. Only about 15–20 percent of farm animals are occasionally vaccinated. Private sector investment in the animal health sector remains low and is unlikely to expand in the future, unless provided with adequate policy support and extension services. While the quality and quantity of vaccine, medicine, and veterinary service delivered by the DLS is inadequate, the private sector is stepping up to alleviate these problems. There is no independent authority to check the quality of domestically produced or imported vaccine, medicine, feed, vaccine, and other inputs, and there are no provisions for control of movement and quarantine during disease outbreak or epidemics.

Disease diagnostic facilities are limited. The DVH (District Veterinary Hospitals), Regional Field Diseases Investigation Laboratories (RFDIL) and the Central Disease Investigation Laboratory (CDIL) of DLS are responsible for providing diagnostic services. However, due to shortage of skilled manpower and funds, they cannot provide desired services. Few local veterinarians are trained in clinical pathology to diagnose diseases properly. The Veterinary Public Health Unit in the DLS has the mandate to perform diagnosis, surveillance, and control of zoonotic diseases, ensure food safety of animal origin, and liaise with the Health Department. The Unit is, however, suffering from serious shortages of human capital, funding and laboratory facilities.

Finally, most drugs traders and shop keepers have no formal training on drug handling, transportation, storing, and dispensing, and readily sell drugs such as antibiotics, hormones, and sedatives without prescription.

Decline in the growth of land open water fisheries

Bangladesh is rich in terms of inland water resources. Inland waters comprise numerous rivers, canals, *haors*, *beels*, lakes and a vast area of flood plains amounting to about 4.4 million ha (88.45 percent of total inland) and produced 1.6 million MT which was about 41.4 percent of total fish production. Historically, inland open water was the major source of fish production in the country. During the 1960s the inland open water resources contributed about 90 percent of the country's fish production, but due to manmade causes such as overfishing, implementation of Flood Control Drainage and Irrigation Projects, and environmental degradation, the fish production in the inland open water, particularly in the rivers and flood plains, has declined significantly during the last three decades and its production during 2007–08 was found to be only 41.36 percent of the total fish production. The downward trend in the late 1970s showed a 20–25 percent decrease in contribution to production from inland open water sources. This decline has been comparatively high in the case of important and valued fish like carp, which had contributed about 30 percent of the total fish production but now has dropped to 5–6 percent (Tsai and Ali 1987). Carp hatchling catch from natural ground reduced from 19,000 kg in 1985 (DOF 1986) to 1,872 kg in 2008 (DOF 2008 and NMPF 2010).

Depletion of resources and degradation of public water bodies and habitat

Inland open water fisheries are inhabited by 260 fish species, 24 shrimp species, and 12 exotic fish species. During the early 1970s, inland open water capture fisheries contributed about 90 percent of total fish production, whereas in 2007–08 it contributed only up to 41 percent, a marked decline due to environmental degradation and species depletion. Among the 260 fin fish species, about 143 are termed as small indigenous species which was abundantly available in the past. Because of habitat destruction/reduction and overexploitation, most of those species are not available in the market. Meanwhile, 21 fish species have become extinct in Bangladesh, and 54 have been listed as critically endangered and vulnerable in the red book of IUCN (2000). To increase overall fish production in the country, the trend in stock depletion must be reversed by effective conservation measures. Since 1994 BFRI has been conducting research on the conservation of fish biodiversity and has successfully developed a number of technology packages for artificial breeding and seed production of some of important threatened freshwater fish species using *in vitro* fertilization.

A major consideration with the open water fisheries is that they are a common property resource managed by many agencies other than fisheries. As a result, these water resources are not being used as a primary source of fish production, but rather for revenue generation, irrigation, and other secondary purposes. Utilization of such resources for secondary purposes leads to the development infrastructure that reduces, alters, and degrades

natural habitats through retardation of reproduction potential and growth. To increase fisheries production, these encroachments on habitats need to be halted and refocused toward fisheries production. The existing leasing system of freshwater bodies to individuals is also problematic because individuals have limited incentives for conserving the biodiversity of the resource base.

In 2001 BARC has reported in its Red Data Book that more than 100 species of vascular plants are either extinct or endangered. There are no data on agro-biodiversity losses in different regions of the country.

Low productivity of aquaculture fisheries

The productivity of freshwater aquaculture for fish under traditional, low input management is much smaller than its potential. Several extension projects, including the Mymensingh Aquaculture Extension project (MAEP), for example, raised production, easily achieving 3,000 kg/ha per year. Greater productivity can be attained by adopting improved management practices. Pond and pen culture techniques can be used to expand carp polyculture to new areas. A significant area comprising many small water bodies, ditches, and abandoned ponds could still be brought into production under communal ownership. Community management may be the most useful approach for developing fish farming in such unused ponds and ditches.

Low productivity of brackish water shrimp

Since many of the farms produce several crops of shrimp each year, productivity per ha is very low compared to the several thousand kilograms per ha per year obtained in major shrimp farming countries such as Thailand, China, and Vietnam. Improved productivity can be achieved through improved technology. The industry should also move to the use of disease free seed from brood stock produced in a land-based captive breeding program and halt the capture of mother shrimp so that wild stock may be protected. This would also be a key step to effective disease management in shrimp farming.

Incidence of shrimp disease has caused some damage to the shrimp industry, but no appreciable preventive or curative intervention measures appear to have been taken to address the issue. Research efforts need to be enhanced for immediate prevention of outbreaks.

Inadequate financial resources

The fisheries and livestock sector contribute more than 10 percent of the GDP, but its allocation share is only 0.63 percent of the national budget. The sector also receives very little out of the government's huge subsidy bills; similarly, the sector gets little allocation of agricultural credit from various credit institutions.

PRIORITY INVESTMENT AREAS

Reducing poverty through employment creation in the rural economy is the utmost priority. The government is committed to reduce the number of unemployed people in the country from 28 to 24 million by 2013 and will further still to 15 million by 2021. The livestock and fisheries sectors offer the greatest potential for new employment opportunities. These sectors are pro poor and important for investment, as huge numbers of smallholder are engaged. Tables 7, 8, and 9 present major interventions and investment opportunities for promoting growth and employment in these two sectors.

Dissemination of good practices in the fisheries and livestock sectors will generate significant employment and will help reduce yield gaps, which often exceed 40 percent of the farmer's achievable yields, even in favorable agri-ecological regions. Reduction of such yield gaps requires expanding capacity of farmers and extension systems along with appropriate technology development and dissemination. Research programs to bridge these yield gaps also have enormous potential to reduce food insecurity. Meeting this challenge may be possible through on-farm research with direct participation of the farmers.

Investment opportunities

Offer interest-free loans and insurance

It is unfortunate that the investment in the livestock and fisheries sectors is only 0.63 percent of the national budget, and that this investment has been declining since 2005. Increased investment in these sectors, coupled with removal of policy barriers, can lead to the employment of an additional 40 million people in next five years. No financial institutions are providing credit or any other financial incentive to the smallholder farmers. To address this gap, the government should launch a nationwide interest free loan for all sorts of dairy and poultry smallholders and different entrepreneurs working for value chain management. Community-based fishers should also receive interest free loans in order to sustain productivity and support livelihoods. Since the livestock sector is very vulnerable to diseases, climate change threats, and other external stress, it is imperative that smallholder livestock and fishers have risk coverage. An insurance program should be launched to provide coverage, potentially through the government, which create new financial institutions to render this service. This may require the government's creation of an endowment fund along with donor investment.

Provide safety nets for vulnerable smallholders and community-based fishers

Producers often suffer severe losses threatening their livelihood due to factors such as an unpredictable climate, outbreak of diseases, and market failure. To mitigate risk, the government

Table 7—Enhanced fish productivity through intervention and additional employment during 2009–10 to 2013–14

Types of fisheries	Area	Present production (2007–08)	Major intervention	Increased productivity (%)	Additional employment (million)
Aquaculture					
Ponds	305	866	• Suitable culture technologies	34.64	6.36
Baor	5.5	48	• Desirable improved varieties	100	
Shrimp farm	217.9	135	• Quality feeds • Good management practices (GMP)	40	3.2
Inland open water					
River & estuary	103.2	137	• Establishment of sanctuaries	19.71	3.8
Floodplains	283.3	819	• Fishing bans and alternate livelihood opportunities	69.60	
Beel	114.2	78	• Cage culture practices	30.36	
Kaptai lake	68.8	8.2	• Leasing	25.63	
Sundarbans	189.2	18.2	• Integrated coastal management	15.99	
Marine					
Trawl fishing	-	34	• Management measures (i.e MCS)	5.88	3.0
Artisanal	-	463	• Regional cooperation (IOTC membership) • Industrialization	12.74	
Total		2563			16.4

Source: Authors.

Table 8—Present and future attainable fish yield from aquaculture using most suitable technologies

Technologies	Present Yield (Kg/ha) 2007-08	Attainable Yield (Kg/ha) 2013-14	Increased Productivity (%)
Carp polyculture in perennial ponds	4,000	5,500	37.5
Culture of Thai pangus	24,000	32,000	33.3
Culture of Thai Climbing perch (Koi)	10,000	16,000	60
Monosex tilapia culture	22,500	30,000	34
Culture of native catfish, Shing	8,000	12,000	50

Source: BFRI.

should restrict fishing for particular periods during the breeding season in some areas. During such bans, fishers should be provided with livelihood supports via a government safety net program.

Provide subsidies to support feed and forage production

The price of feed and imported raw materials is continuously increasing, reducing the competitiveness of livestock and fish production and making the industries unsustainable. The government should consider subsidizing the livestock and fisheries sectors similarly to its subsidization of crop agriculture. Based on the experiences of many neighboring countries, the production of feed and forage requires a financial incentive package for revamping growth.

Adjust taxes and tariffs

The government currently imposes a 32.8 percent tariff on powdered milk imports. Milk packaging materials have a much higher tariff (53.5 percent), while the tariff in cattle feed is 32.8 percent. The duty on imported powdered milk should be further increased to protect local milk production. Conversely, the duty on packing materials, feeds, and other agro-processing materials should be removed to benefit local production and employment generation.

Remove policy barriers and work toward institutional reform

The DLS and DOF are neither strong enough nor sufficiently organized to meet current challenges and diversify extension

Table 9—Major interventions, additional employment generation, and growth in livestock sector during 2010–14

Types production system	Major interventions	Growth (%)	Additional employment generation in 5 years time (Millions)
Smallholder dairy production	Market support and value addition through public–private partnership (PPP)	9.3	4.13
Commercial chicken egg production	Regional self-sufficiency policy approach for breeder farming & input support through PPP, market support, and value addition	7.3	0.86
Broiler production	Regional self-sufficiency policy approach for breeder farming & input support through PPP, market support, and value addition	7.5	0.12
Smallholder native chicken and duck egg & meat production	Community native chicken and duck production, market support and PPP	5.1	0.22
Smallholder meat production (cattle & buffalo fattening, goat & lamb production)	Market support and value addition through PPP	8.2	10.8 8.0
Total		7.5	24.1

Calculated on gross output of Taka from additional milk, meat or egg production in 5 years and direct labor coefficient of livestock (85.0) or Poultry (67.3) as suggested by Planning Commission (1998)

programs. These agencies need to be reformed, keeping in mind the changes caused by globalization, trade liberalization, and WTO regulations. Major involvement of the private sector will be essential. The wetland leasing policies are to be revised for community-based co-management toward a solution of wetland degradation in Bangladesh. Long term pro-production leasing with more involvement of the Department of Fisheries should be ensured. Also, research and development in Bangladesh in non-crop sectors is lagging, resulting in minimal technology flow from livestock and fisheries institutes. Compared to the contribution of this sector, support to both human resource development and infrastructure is inadequate. Thus, priority investment is also required in R & D.

Promote hygiene in animal food production and processing

Hygiene measures should be promoted in production, processing, and marketing of livestock and fish products in order to minimize risk of food borne disease, with greater emphasis on prevention and control. Application of HACCP principles and SPS conditions are essential elements. In this regard, increased investment would be required for capacity and infrastructure development.

Meat has traditionally been viewed as a vehicle for a significant proportion of human food-borne diseases. Such disease could be minimized by changing the production and processing system. A contemporary risk-based approach to meet basic hygiene standards requires application of measures at points in the food-chain where they will be of great value in reducing food-borne risks to consumers. For example, measures to mitigate risk in slaughter houses are very important in Bangladesh.

Livestock and fishery products are perishable and need processing. Processing of milk, meat, and fish can generate employment and income and can add value. Increased supports

for milk, meat, and fish processing in different locations of the country can enhance productivity and ensure fair product prices and minimize post harvest losses.

Add value to livestock and fishery diversity

Local breeds, species lack recognition for the value of their products. Yet local species should be supported through government policies and institutions because they can produce unique products that can generate significant level of demand and income while rescuing different threaded species. Capturing opportunities for niche marketing of local breeds/species requires investment.

Livestock

Promote smallholder poultry and dairy development

Promoting smallholder poultry and dairy development is important for agricultural diversification, poverty reduction, food security and employment generation. In particular, the sector needs supports for (i) quality feed and chicks at an affordable price, (ii) promoting fodder production, (iii) supply chain development through group marketing, (iv) processing and value addition, and (v) a community-based vaccination program.

Improve diagnostic capacity and veterinary clinical services

The DLS' disease diagnostic capacity is limited. The District Veterinary Hospitals (DVH), Regional Field Diseases Investigation Laboratories (R FDIL), and the Central Disease Investigation Laboratory (CDIL) of DLS are responsible for providing diagnostic services to the farmers. However, due to shortage of skilled

manpower and shortage of funds, they cannot provide needed services. There is no provision for residue analysis of drugs, heavy metals, hormones, pesticides, and toxins in foods of animal origin. There are only few local veterinarians trained in clinical pathology to diagnose diseases properly. Therefore, it is important to support diagnostic capacity and veterinary clinical services of DLS.

Develop public–private partnerships in diversified vaccine production and marketing

Only a small amount of vaccine is produced in the country by the public sector. A large investment is needed to improve the vaccine production and marketing system, potentially through a public–private partnership.

Promote sustainable management of animal genetic resources (AnGR)

A strategic approach to sustainable livestock development is required. To appropriately address the use of available AnGR and the role of genetic improvement in sustainable development, policies, plans, and programs for the livestock sector must be based on soundly established and agreed upon livestock development objectives (LDO) and well integrated and realistic livestock development strategies to achieve the LDO. Increased investment in the development of poultry and duck, cattle, buffalo, goats, and sheep would be required.

Development of appropriate breeding policies and scaling up of artificial insemination practices should be prioritized. The government AI program is inadequate to meet the country's growing needs. The private sector should be entrusted with the AI program, while the government program should focus on quality control of breeding materials. The latter could be ensured by upgrading all districts with modern laboratory facilities.

Prepare for highly pathogenic avian influenza

Recently highly pathogenic avian influenza has seriously affected poultry farmers and the poultry industry whenever and wherever it has appeared in Bangladesh. The virus has been present in Bangladesh since 2007. Everyone has a stake in minimizing the spread of this virus. This requires increased investment to improve preparedness for highly pathogenic avian influenza and its detection.

Fisheries

Community-based co-management: A solution to wetland degradation in Bangladesh

As reported earlier (Flood Hazard Research Centre (FHRC), World Fish Centre and USAID/IPAC), there are some successes

in community-based fisheries management (CBFM) and MACH (Management of Aquatic Ecosystem through community Husbandry). Studies on these efforts clearly demonstrate that wetland protection and restoration make good economic sense for Bangladesh.

Developing successful community-based co-management arrangements that ensure sustainable wetlands and productive fisheries and meet the needs of resource users and other stakeholders is a challenge. Policy makers, donors, and other external actors have a vital role to play in meeting this challenge. Future wetland resources management policies should be based on community participation and address wider watershed issues by ensuring that lessons and best practices from previous experiences are widely adopted.

Use genetics and biotechnology to enhance aquaculture productivity

Globally, production in the fisheries sector is growing faster than any other sector, and this sector is expected to make better contributions in terms of value addition and income generation. Bangladesh can leverage this opportunity through the use of biotechnology in fisheries and aquaculture production. Both classic and modern biotechnological techniques have wider implications for increasing overall productivity of fisheries and aquaculture through improvement of breeds and nutrition, protection of health, and conservation and management of genetic resources of fish and fish-like animals. Like other developing countries, Bangladesh needs to build up its biotechnological capability following the “National Guidelines for Fish and Animal Biotechnology,” in compliance with the National Biotechnological Policy and National Bio-safety Guidelines.

Application of simple genetic tools in the hatchery, such as brood stock replacement and selective breeding technique(s), can minimize the inbreeding depression in hatchery stocks and ensure quality seed production of carps and other commercially important fish species of aquaculture. Proper implementation of the National Breeding Plan (NBP), as already designed by DOF and BFRI, and the carp/shrimp hatchery law (recently approved by the government) will ensure the quality seed production through genetic management of brood stock in the hatcheries and equitable dissemination of improved breeds to the target groups (farmers and entrepreneurs) for sustainable enhancement of aquaculture production in Bangladesh.

Improve productivity of brackish water shrimp

Since many of the farms produce several crops of shrimp each year, productivity per ha is very low compared to major shrimp farming countries such as Thailand, China, and Vietnam. Improved productivity can be achieved through improved technology and better scientific management. The industry should also move to the use of disease free seed from brood stock produced in a land-based captive breeding program and halt the capture of mother

shrimp to protect wild stock. This would also be a key step to effective disease management in shrimp farming.

Assess marine fisheries resources

For the marine fisheries, it is vitally important to assess the resources in the artisanal and deep sea levels. Allocation of fishing rights should be contingent upon this assessment to ensure optimal fishing at both artisanal and deep sea levels. Introducing modern techniques of fishing in the coast as well as in the sea and providing modern fishing equipment are also required to augment production from the marine fishery.

Prospects of tuna fisheries in Bangladesh

At the moment, marine fisheries resources in the shallower regions are painfully overexploited, socio-economic conditions of fishers are poor, and coastal environments are becoming gradually degraded. At the same time, valuable deep sea pelagic resources are unacceptably underexploited, keeping the proper utilization strategy far behind the acceptable limits. Among the valuable pelagic resources, tuna and tuna-like fish, especially the yellowfin tuna (*Thunnus albacares*) and swordfish (*Xiphias gladius*) are the most in need of proper utilization. A recent survey conducted by the BIMSTEC (Bay of Bengal Initiatives for Multi-Sectoral Technical and Economic Cooperation) member countries (Bangladesh, India, Myanmar, Sri Lanka, Nepal and Thailand) from October to December 2007 also suggested using those resources. The survey suggested that among three areas of the Bay of Bengal surveyed, the area closest to Bangladesh's exclusive economic zone is the richest in one of the most important commercial species, the Yellowfin tuna. The species is so important that India is exporting the raw fish by chartered air cargo to Japan at 20,000–30,000 rupees per fish. Other commercially important pelagic species are swordfish, black marlin (*Makaira indica*), and different species of sharks. Entrepreneurs should be encouraged to harvest and export those valuable pelagic resources. Membership of the Indian Ocean Tuna Commission (IOTC) is essential to generate information to ensure proper utilization of the tuna and tuna-like fishes in the export market.

CONCLUSION

The potential of the fisheries and livestock sectors are not fully realized. There are considerable opportunities to increase productivity through scientific application of technologies and appropriate management practices. The wetlands of Bangladesh have very high value resources. It requires community management, and a Jalmahal lease must incorporate such management based on a long-term contract involving stakeholders living in the area. Leasing of wetland should be made truly productive and should provide an enabling environment for real fishers. Leasing

tenure should not be less than 10 years a shorter duration will prohibit investment by the lessee for fish culture.

The tax and tariff imposed by the government in this sector needs to be reviewed and revised to support the growth of the livestock and fisheries sectors. To protect local milk production, the duty on powdered milk should be increased about 40 percent, while there should be no duty on milk packaging material and cattle feed. The electricity rate for the sector needs to be reduced and the rate should be per crop sector. There could be some other financial incentives like low cost credit, endowment funds, and insurance coverage to improve productivity among all stakeholders. These sectors should receive priority allocation, especially considering their share to GDP and employment opportunities.

Investments also require for development programs for both public and private research and development agencies. More public-private programs should be developed for vaccine production and production of quality breeds, broods, and chicks. There should be much more support for establishing quality hatcheries, marketplace, and value chain activities. Smallholder poultry producers are valuable, yet they face a large number of threats. To protect them, the government should establish and operate an effective safety net program. Training and capacity building should be a continuous goal. Use of ICT could be promoted for faster dissemination of technology.

REFERENCES

- Asadduzzaman, M. 2000. Livestock sector, economic development and poverty alleviation in Bangladesh. In *Changing rural economy of Bangladesh*. ed., M. A. S. Mondal. Bangladesh Economic Association, Dhaka.
- DANIDA (Danish International Development Agency). 2002. *Impact study of the Bangladesh semi-scavenging poultry model*. Ministry of Fisheries and Livestock, Government of Bangladesh. Dhaka, Bangladesh.
- Mymensingh Aquaculture Extension Project Phase II. 1996. Evaluation Report.
- DOF (Department of Fisheries). 2008. Fisheries Statistical Yearbook of Bangladesh. Dhaka, Bangladesh: Ministry of Fisheries and Livestock.
- _____. 2009. Fisheries Statistical Yearbook of Bangladesh, Department of Fisheries, Ministry of Fisheries and Livestock, Government of Bangladesh.
- Government of Bangladesh. Government Jalmahal Management Policy, Bangladesh Gazette, June 25, 2009.
- Hussain, M.G. 2010. Freshwater fishes of Bangladesh: Fisheries, biodiversity and habitat. *Aquatic Ecosystem Health and Management* 13 (1): 85-93.

- Hussain, M.G., and Mazid, M.A. 2001. *Genetic improvement and conservation of carp species in Bangladesh*. Bangladesh Fisheries Research Institute and International Center for Living Aquatic Resources Management.
- IFAD (International Fund for Agricultural Development). 2006. Project completion report of Aquaculture Development Project, Report No. 1812. Rome.
- IPAC. Proceeding of the dissemination of good practices in fisheries sector, integrated protected area co-management/USAID.
- Jabbar, M.A. 2010. *Policy barriers for dairy value chain development in Bangladesh with a focus on the Northwest Region*. Dhaka, Bangladesh: CARE Bangladesh.
- Jabbar, M.A., S.M. Fakhru Islam, C. Delgado, S. Ehui, M.A.I. Akanda, M.I Khan, and M. Kamruzzaman. 2005. *Policy and scale factors influencing efficiency in dairy and poultry production in Bangladesh*. Nairobi, Kenya: International Livestock Research Institute.
- Ministry of Finance, Government of Bangladesh. 2007. *Bangladesh Economic Review*. Annual Report. Dhaka.
- Mymensingh Aquaculture Extension Project Phase II. 1996. Evaluation Report.
- NMTPF (National Medium-Term Program Frameworks). 2010. *Towards a food secure Bangladesh: National medium term priority framework of Bangladesh (2010–2015)*. Dhaka, Bangladesh and Rome: Bangladesh Ministry of Agriculture, and Food and Agriculture Organization of the United Nations.
- Omoro, A., Mulindo, J.C., Islam, S.M.F., Nurah, G., Khan, M.I., Staal, S.J., and Dugdill, B.T. 2002. *Employment generation through small-scale dairy marketing and processing: Experiences from Kenya, Bangladesh and Ghana*. Rome: Food and Agriculture Organization of the United Nations.
- Planning Commission. 2009. *Background Studies for the Sixth Five Year Plan (2011-2015)*. Dhaka, Bangladesh: Ministry of Planning, Government of the People's Republic of Bangladesh.
- Rahman, A.K.A. 2006. National Agricultural Technology Project, Preparation Phase, Final Report. Dhaka, Bangladesh: Bangladesh Agricultural Research Council.
- Thompson, P. and L. Colavito, 2007. *Economic value of Bangladesh wetlands*. MACH Technical Paper 6.
- Tsai, C.F, and L. Ali 1987. The changes in fish community and major carp population in Beels in the Sylhet-Mymensingh Basin, Bangladesh. *Indian J. fish.* 34(1), 78–88.
- USAID/WINROCK. *Community-based co-management*. 2005. Policy brief 1. Washington, D.C.
- World Bank. 2009. *Mission report of the livestock and fisheries subsector review*. Washington, D.C.
- Younus, M., N. Ahmed, and E.H. Chowdhury. 2008. *Supply chain analysis of poultry in Bangladesh*. Report prepared for Academy for Educational Development, Washington D.C.
-



This paper has been commissioned by the Government of the People's Republic of Bangladesh for the Bangladesh Food Security Investment Forum, 26–27 May 2010. The Forum is organized by the Ministry of Food and Disaster Management with technical support from the International Food Policy Research Institute (IFPRI), the Bangladesh Institute of Development Studies (BIDS), and the Food and Agriculture Organization of the United Nations (UN-FAO). Financial support has been extended by the United States Agency for International Development (USAID), the United Kingdom Department for International Development (DFID), and the European Commission (EC). The views and opinions contained in this paper are those of the authors.