CLIMATE CHANGE AND FISHERIES & LIVESTOCK IN BANGLADESH

INFORMATION BRIEF

Photo: IUCN / Abdul Quayyum

KEY POINTS

- The fisheries and livestock sector is second to agriculture in the economy of Bangladesh.
- The important effects of climate change in fisheries sector are – loss of habitat, change in habitat conditions, disease outbreak, obstacle in migration routes, obstacle in reproduction and reduced production. The same for livestock sector are – reduced grazing area, fodder crisis, less growth and stresses and decrease in production of milk, egg and meat. All these will lead to loss in rural household income, unemployment and supply of dietary nutrition.
- The policy and actions needs to address climate change effects on different types of fishes and livestock and subsequent adaptation strategies and techniques on protection against pond flooding, improved crafts and gears, alternative aquaculture technique, climate-resilient fodder crops and livestock breeds.

INTRODUCTION

Fisheries

The fisheries of Bangladesh are attributed by the nature of the waterbodies of the country. In terms of the nature of fish habitat, Bangladesh fisheries can be broadly divided into inland water, estuarine or coastal water and marine water areas. The inland aquatic habitat is dominated by freshwater rivers, extensive floodplains during rainy season and its territorial canals (*Khal*) led to enclosed water bodies (*Beel*). Dead rivers also created oxbow lakes (*Baor*) in the south west region of the country. There is also deep depression in Northeast Bangladesh known as *Haor*. A large artificial lake called Kaptai Lake was also formed from the hydroelectric dam in the Chittagong hill tracts. The inland water bodies have 1,288,222 manmade ponds and reservoirs which provide a total area of 305,025 hectors. Bangladesh is bounded by the Bay of Bengal on its southern boundary. The coast line of the country is approximately 710 km in length and the area of the sea Exclusive Economic Zone (EEZ) is estimated to cover 70,000 sq. Km. In 2009- 2010 fiscal year a total of 2.89 million metric ton of fish were produced in the country. Of them 17.85% of fish was produced from the sea, while 46.62% from the inland culture sector and 35.53% from the inland capture fisheries sector.

The fisheries sector is a source of employment and income for a large sector of the population, particularly in rural areas. According to the fisheries statistical year book published by FRSS, DoF this sub-sector of agriculture contributes ±5% in GDP. Fish is the source of 60% animal dietary protein of the country population demand.

Livestock

The Bangladesh Economic Review[1] shows the highest growth rate of livestock sub-sector in GDP at constant prices (base year 1995-96) in the years 2004-05, 7.23% and 2005-06, 6.15% compared to crops and vegetables (4.02%) and fisheries (4.16%). A lower rate of growth in subsequent years 2006 – 07, 5.49% and 2007-08, 2.44% was observed which might be due to the incidence of Avian Influenza causing a serious loss of poultry birds. Livestock in Bangladesh in 2007-08 comprised of cattle 23 million, buffalo 1.3 million, goat 21.6 million, sheep 2.8 million, chicken 212.5 million and duck 39.8 million. The per capita number of cattle was o.16, goat 0.15, sheep 0.01, chicken 1.47 and duck 0.27.

Livestock is thus an integral component of agricultural economy of Bangladesh performing multifarious functions such as provisions of food, nutrition, income, savings, foreign currency earning (by exporting hides & skin, bone and other products), draft power, manure, fuel, transport, social and cultural functions.

IMPACTS OF CLIMATE CHANGE ON FISHERIES AND LIVESTOCK

A primary impact of climate change will be frequent cyclonic events, inland and coastal flooding, low flows of water and droughts, salinity intrusion, changes of the river bed level due to sedimentation and changes in morphological processes. Consequently, minimum acceptable surface water levels in many rivers and streams are compromised which threatens the existing aquatic ecosystem, fisheries, and livestock.

The IPCC[2] has reported that climate change and its impacts can result in the outbreak of new diseases and pests that will affect these subsectors. Degradation of productive land including quality and physical loss are key concerns for agriculture, fisheries and livestock production.

There has been considerable interest in gaining an understanding how domestic livestock respond to climatic stressors. Some studies have been undertaken in developed countries, less so in Africa, Asia and South America and there is uncertainty on how climate changes will impact animal production on a global scale.[3]

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[1] Bangladesh Department of Finance. (2009). *Bangladesh Economic Review 2009*. Bangladesh Bureau of Statistics.

[2] IPCC. (2001). *Climate Change 2001: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.

[3] Gaughan, J.B., Lacetera, N., Valtorta, S.E., Khalifa, H.H., Hahn, G.L. and Mader, T.L. (2009). 'Adaptive responses of domestic (farm animals) to climate challenges'. In: G.R. McGregor, R. de Dear, K.L. Ebi, D. Scott, S. Sheridan and M.D. Schwartz (eds.), *Biometeorology for Adaptation to Climate Variability and Change*, 1 ed., pp. 131-170. Germany: Springer.

SPECIFIC IMPACTS

Fisheries

- ***Effects on reproduction and growth of fish:*** Erratic and irregular rainfall as well as temperature change will affect the readiness, maturity and gonad development of fishes in breeding season. Higher water temperature may bring changes in physiology and sex ratios of fished species, altered timing of spawning, migrations, and/or peak abundance, changes in timing and levels of productivity across marine and freshwater systems, increased invasive species, diseases and algal blooms. These will lead to changes in timing and levels of productivity across marine and freshwater systems and reduced production of target species in marine and fresh water systems.
- ***Effects on species composition, abundance and distribution:*** Increased salinity and change in water quality can instigate a change in species composition and distribution especially in coastal areas. There will be clear change in seasonal abundance of individual fish. This would in turn encounter a change in fish culture practices in the affected areas.
- ***Effects on aquaculture:*** Change in temperature will effect on aquaculture by increasing risk of disease outbreak may cause economical losses in coastal areas. Suitable areas for major culture species will be reduced.

Box 1: Impact of CC on the biology of major carp

Growth and reproductive biology of Major carps (Rui, Catla, Mrigal etc.) has relations with seasons of Bangladesh. They breed in rainy day with higher dissolved oxygen contents in water with moderate current. Higher temperature and erratic rainfall could change the reproductive performance of Major carps. In 2009- 2010 extreme weather causes late maturity of hatchery fishes in Mymensingh region. The Impact in carp natural fishing ground at Halda river not known.

Events	J	F	M	A	M	J	J	A	S	O	N	D	Remarks
Fish maturity				■	■	■							1
Fish Reproduction						■	■	■					2
Good Growth		■	■	■	■	■	■	■	■	■			3
Poor Growth	■										■	■	4
Ambient Temperature		▥	▥	▥	▥	▥	▥	▥	▥	▥			5
Rainfall					▤	▤	▤	▤	▤				6

1. Ambient temperature and good growth helps in maturity
2. Rainfall is related to spawning
3. Ambient temperature is necessary
4. Cold weather restrict body metabolism, food intake and so the growth of fish
5. Water temperature between 24-28°C is necessary for good growth, reproductive maturity, hatching success of eggs and larval survival in water
6. Thunder storm, cloudiness and water current are creating environment for carp mating behavior in river system. Rainfall also increase dissolved oxygen in water.

Organic culture area will be reduced due to reduction in natural productivity of water, hence increase supplementary feeding practice would ultimately causes diseases and degraded habitat. Increase of disaster events will damage culture firms more frequently.

- ***Effects on habitat quality and migration routes:*** Increased flooding and erosion can result in natural habitats being destroyed. Change in habitat quality will destroy breeding sites. There will be changes in water levels of wetland and in dry water flows in rivers leading to reduced productivity resultant change in migration pattern.

Livestock

As compared to other sectors, there are very few economic analyses done on the climatic effects on livestock sector worldwide. Livestock in developed countries appear less vulnerable to climate changes because they live in protected environments (sheds, barns etc.) and have supplemental feed (e.g., hay and corn). In Bangladesh, by contrast, the bulk of livestock have no protective structures and they graze off the land area.

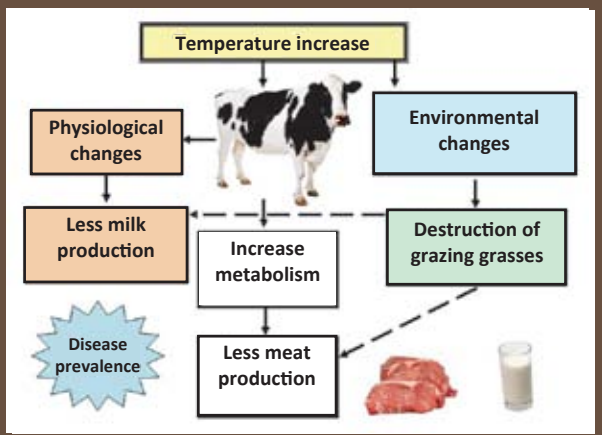
- ***Grass land changes:*** Dry weather and salinity-increase constricts grazing area for livestock. This result in reduction of weight gain in animals and less milk production.
- ***Temperature and growth:*** A high temperature will increase body metabolism which will cause less growth in livestock.
- ***Rainfall and humidity:*** Increased flooding poses significant risks to animal mortality especially in low lying areas. This reduces the productivity of poultry.
- ***Extreme hot weather:*** Creates stress in livestock and poultry. This leads to less meat, milk and egg production.

RESULTANT IMPACTS AND ECONOMIC LOSSES

The role of fisheries and livestock sub-sector is very crucial for the economic development of agriculture-based Bangladesh. Fish and livestock provide daily protein and milk dietary requirements of the population, thus playing an important role in providing nutrition and health. Any reduction in production in this sector will result in a loss in rural household income, and an increase in unemployment in the rural areas. In vulnerability study of 132 national economies to potential climate change impacts on their capture fisheries using an indicator-based approach found Bangladesh and three others in the most vulnerable category among the tropical Asian countries.[4] The research found that this vulnerability was due to the combined effect of predicted warming, the relative importance of fisheries to national

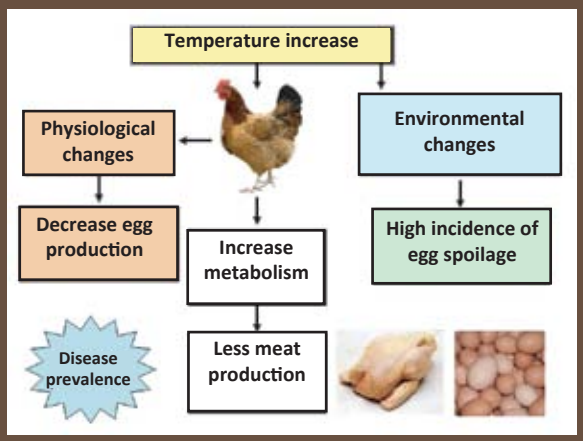
Box 2: Impact of CC on livestock

Increase in temperature can cause physiological changes in livestock. This will result in less milk and meat production. Besides disease prevalence may occur.



Box 3: Impact of CC on poultry

Temperature can cause physiological changes in poultry. This will result in less egg and meat production. Besides disease prevalence may occur.



[4] Edward H. Allison, Allison L. Perry, Marie-Caroline Badjeck, W. Neil Adger, Katrina Brown, Declan Conway, Ashley S. Halls, Graham M. Pilling, John D. Reynolds, Neil L. Andrew & Nicholas K. Dulvy. (2009). 'Vulnerability of national economies to the impacts of climate change on fisheries'. *Fish and Fisheries*, 10:173–196.

economies and diets, and limited societal capacity to adapt to potential impacts and opportunities.

- ***Coastal population:*** The salinity intrusion shall have impact on the meat and milk production in the coastal area. This will be due to the destruction of pasture lands in the area. Due to increased salinity, availability of water for livestock will be less leading to decrease in livestock resources. Increase in shrimp culture may hamper as more saline led disease will appear and destroy the corps in future.
- ***Barind population:*** The dryness of Barind area will have severe consequences to its economy through production hamper and habitat destruction. Production of inland capture is likely to decline due to 10% loss of area.
- ***Hill population:*** Due to the loss of biodiversity of hill area, tribal people, those who depend upon wild animals for food will cause more harm to the biodiversity of the area.
- ***Change in migratory routes of important species:*** Migratory routes of species may change like Tuna and Catadromous Hilsha and Bagda chingri. Increased production of pelagic fish due to upwelling which may results in negative change in food chain. Change in the location of the fishing grounds will also occur.
- ***Inland fishing operations and livelihoods:*** Due to change in precipitation, more droughts or floods, and less predictable wet/dry seasons, there will be reduced opportunities for farming, fishing and aquaculture as part of rural livelihood systems, damage to productive assets (fish ponds, rice fields, etc.) and homes; and reduced ability to plan seasonal livelihood activities.
- ***Coastal infrastructure and fishing operations:*** Due to sea level rise and increased frequency of storms, there will be changes in coastal profile, loss of harbours and homes. Livelihood will be greatly affected for coastal fisher communities due to fewer days at sea and increased risk of accidents as well as damages to aquaculture installations (shrimp hatchery). Costs of adaptation will increase and may make fishing less profitable.
- ***Water logging and drainage congestion:*** Due to sea level rise and increased rainfall water logged areas will be expanded specially in the coastal polders. This will reduce shrimp culture area resultant in loss of production and income of farmers.
- ***Cyclone Damage:*** Cyclone SIDR caused significant damages to fisheries and livestock production. The preliminary damage and loss assessment, for the crops, livestock, and fisheries, is reported by Government of Bangladesh as around USD 6.71 million. Because the agriculture sector consists primarily of private farmers and fishers, with few exceptions, almost all the damage and loss occurred in the private sector.

Table 1: Damage to the Fisheries Infrastructure due to SIDR (GoB, 2008)[5]

Item	Million (USD)
Public Sector	0.11
Private Sector	6.60
Washed Fish	2.56
Washed Shrimp	2.02
Washed Fingerlings	0.13
Boats and Nets	1.89
Total	6.71

[5] GoB (Government of Bangladesh). (2008). *Damage Report for Cyclone SIDR.*

MANAGING CLIMATIC HAZARDS

Existing Adaptation Mechanisms

The people of Bangladesh have adapted over generations to the risk of floods, droughts and cyclones. However, impacts of climate change means the present approaches and traditional methods of adapting to climatic changes need to be reassessed. Salt-tolerant fish species need to be identified for aquaculture in water-logged areas and ponds. Mechanized fishing technologies need to be introduced. Other possible adaptation options include protection against pond floating, mechanization of boats and fishing technology, development of pond aquaculture, provision of alternative livelihood for vulnerable fishermen folk, and introduction of climate-resilient fodder crops and climate-resilient poultry and livestock breeds. Some specific measures are:

- The zones appropriate for growing shrimp on the coastal belt need to be delineated and monitored.
- Mechanism to build water reservoir using existing canals and dry rivers for water retention from flush flood in the Barind areas could help in restoring fish habitats.
- Shallow pump could supply water to restore grass land in char lands where major livestock are raised.
- Fish sanctuaries and associated practices already being executed should be made to preserve indigenous fishes from extinction.
- Women can be involved in fisheries and livestock creating more labour and capital intensive activities that can be undertaken within the homestead areas. If women can be heavily involved in this sector, then total production and income generation will be greatly enhanced.
- In the recent years, cage aquaculture has emerged as a strategy for fish culture in the southwest coastal zone especially in the open water bodies such as small-river, canal or wetlands. In this technique, fish are cultured in cages until they grow into a size for harvesting, while allowing them to grow in their natural environment. There is a positive social impact as it establishes rights of local people to access common water bodies, allows productive use of water logged areas and can protect local beneficiaries from individualization of resources.[6]
- It is important to assess the vulnerability of economically important breeds. For example, Black Bengal goat is considered as short term animal crop in Bangladesh. It is famous for its breed characteristics such as quality of meat and skin, highly prolific and disease resistance. This breed is also considered as poverty reduction tool in Bangladesh. Consequently, it can be considered as flagship species too. According to the Bangladesh Economic Review[1] (2009) there are 22.4 million goats in Bangladesh, and the production trend has been increasing with the growth rate of 2.4%.

Technology and Research

Studies and research on fisheries and livestock is limited. This is even more evident in the livestock sector. Literature on climate change impacts and adaptation options need to be enhanced. The government should allow grants for research and incentives for development of technology and knowledge on the following:

- Establishment of small scale cage and pen aquaculture in flood and open water areas;
- Development of technology of salt tolerant fish species culture;
- Conservation of fish sites through establishing sanctuary to retain indigenous fish biodiversity;
- Introduction of climate resilient fodder crops and poultry and livestock breeds;
- Development of low cost weather controlled housing for livestock;
- Strengthening animal disease surveillance facilities.

[6] Karim, F. and N. Mimura. (2010). *Sea level rise in the Bay of Bengal: its Impacts and Adaptations in Bangladesh*. Center for Water Environment Studies, Ibaraki University, Hitachi, Ibaraki 316-8511, Japan.

FINANCING ADAPTATION IN FISHERIES AND LIVESTOCK

The government of Bangladesh has recently established a National Climate Change Fund, with an initial capitalization of 45 million USD later raised to 100 million USD, which will focus on adaptation. Fisheries and livestock have been included in the first pillar of the Bangladesh Climate change Strategy and Action Plan[7] and it is expected part of this fund should go into adaptation against impacts of climate change on fisheries and livestock. However, these types of funds need to be administered properly with sound disbursement modalities, an appropriate governance structure and careful resource management.

No adaptation measure can entirely eradicate the adverse impacts of climate change and climatic variability. To strengthen the capacity to withstand losses from climate change, insurance mechanisms need to be strengthened to the future needs. Areas for such insurance schemes may include commercial livestock farms and fisheries schemes.[8] Constraints in assessing financial flows in the sector should be considered. Good research could identify the area and could further help in developing models to assess the values chain in the sector.

POLICY AND INSTITUTIONAL ARRANGEMENT

Fisheries & Livestock Policy

The National Fisheries Policy of 1998 has the objectives of enhancing fisheries production, creating self-employment and improvement of socio-economic conditions of the fishers for poverty alleviation, fulfilling the demand for protein, earning of foreign currency by exporting fish and fisheries products to achieve economic growth, maintaining ecological balance, conserving biodiversity, ensuring recreational facilities.

It provide policy directions for procurement, preservation and management of fisheries resources of the open water bodies, for fish culture and management in closed freshwater bodies, for culture of shrimps in coastal regions, for exploitation, conservation and management of marine fisheries resources. The policy also provides guidance on establishment of hygienic fish landing centers, transportation, marketing, processing, quality control, and export of fish, on fisheries education, extension, and research, and organizational facilities for fisheries sector, on fisheries environment, fisheries credit and on fisheries co-operatives.

The policy needs to shed light on how impacts from climate change hazards such as sea level rise, temperature rise, variation in precipitation, salinity intrusion have effects on different types of important fish species, their breeding and subsequent adaptation strategies. The monitoring of impacts of climate change, response measures, institutional strengthening and coordination and disaster risk reduction issues need to be address further.

The National Shrimp Policy of 2008 put focus on the conservation of nature, environment and the ecological balance. The policy has room to include issues related to the potential climate change impacts like destruction of shrimp hatcheries, diseases, availability of fry and DRR.

Although reduction of risk and vulnerability for harnessing full potential of the livestock sub-sector is the general objective of the national Livestock Development Policy of 2007, climate change and DRR issues are not explicitly referred to in the document. It is emphasized that due consideration would be given to conservation / restoration of nature during the implementation of this policy.

Institutional Arrangement

Water Resources Planning Organization (WARPO) is the major institution involved in water resource management. WARPO was established as the secretariat to the National Water Resources Council (NWRC). NWRC is the water sector apex body chaired by the Prime Minister that has the authority for formulating water policy and ensuring inter-agency coordination. WARPO's mandate is supported by the National Water Policy, 1999 and National Water Management Plan (NWMP). WARPO is responsible for national water planning; monitoring; formulation of water legislation and regulations; inter-sectoral coordination of water plans and maintaining central data system.

The Department of Fisheries (DoF) is the primary institute engaged in managing fisheries resources. DoF was created with strong focus on enhancing the

[7] MoEF. (2009). *Bangladesh Climate Change Strategy and Action Plan (BCCSAP'09)*. Ministry of Environment and Forests with technical support from IUCN Bangladesh Country Office.

[8] MoEF. (2006). *National Adaptation Programme of Action (NAPA), Final Report*. Ministry of Environment and Forest, Government of the People's Republic of Bangladesh.

production. DoF has been steadily fulfilling its mandate mostly through aquaculture extension. The Department of Livestock Services (DLS) deals with livestock and poultry production at the national and farm level, solve problems through multi and inter-disciplinary and inter-institutional research and develop technologies to help food and nutrition security of the country in view of the increasing population, poverty alleviation, employment opportunities, income generation and control of environmental pollution. Both departments are under administrative control of the Ministry of Fisheries and Livestock and there is administrative set-up at national, division, district and Upazila levels.

CONCLUSION AND RECOMENDATIONS

The role of fisheries and livestock sub-sector is very crucial for the economic development of agriculture based Bangladesh. Fish and livestock provide daily dietary protein and milk requirements of the people thus playing an important role in the nutrition and overall health of the population. Any reduction in production in this sector will result in a loss in rural household income, and an increase in unemployment in the rural areas.

Climate change is seen as a major threat to the survival of many species, ecosystems and the financial sustainability of fisheries livestock production systems. Because of stormy weather, cyclones, and tidal surge, fishing time will shrink causing loss of livelihood of fishermen disrupting fish trading. Like human beings, livestock and poultry may suffer due to natural disasters, higher temperatures, salinity intrusions and floods. In changing climate scenarios, fodder production may decrease and disease and mortality rates may rise, which may threaten the viability of the livestock production in future.

New fishing technologies need to be invented and introduced. Other adaptation options include protection against pond flooding, mechanization of boats and fishing technology, development of alternative fish species aquaculture technique, provision of alternative livelihood for vulnerable fishermen and introduction of climate-resilient fodder crops and climate-resilient poultry and livestock breeds. The government also needs to focus on research and development of new technologies to reduce the impacts of climate change on fisheries and livestock sector.

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