Chapter 6
Brackish Water Shrimp Farming and the Growth of Aquatic Monocultures in Coastal Bangladesh

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Abstract One of the most significant changes in marine and coastal environments since the mid–twentieth century has been the growth of coastal shrimp aquaculture in many tropical and sub–tropical regions of the world. This chapter, which draws on the author's own archival and field research and the published works of other students of the global shrimp market, examines the growth of brackish water shrimp production from the 1970s to the present in Bangladesh's coastal belt and its social and ecological impacts. It shows that for most of this period shrimp production was encouraged by the Bangladesh Government to expand in a fragmented and uncoordinated way with varying environmental, economic and social consequences. These included higher levels of soil salinity, increased risk of flooding, loss of agricultural land, a decline in biodiversity, contraction of various traditional occupational activities, growth in new non-agricultural work, a shift to diversified employment strategies among households, higher incomes for shrimp farmers and land renters and economic and social dislocation for others. Government, business and international aid agencies supported the expansion of mono–cultural forms of shrimp production integrated into global trading networks at the expense of local resource extraction activities such as artisanal fishing and forestry.

Keywords Aquaculture · Bangladesh history · Shrimp farming · Shrimp production · Ecological impacts

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with varying environmental, economic and social consequences. These included higher levels of soil salinity, increased risk of flooding, loss of agricultural land, a decline in biodiversity, contraction of various traditional occupational activities, growth in new non-agricultural work, a shift to diversified employment strategies among households, higher incomes for shrimp farmers and land renters and economic and social dislocation and displacement for others. Government, business and international aid agencies supported the expansion of mono–cultural forms of shrimp production integrated into global trading networks at the expense of local resource extraction activities such as artisanal fishing and forestry.[1]

Shrimp Culture in Bangladesh History

For many centuries the people of Bangladesh (formerly part of Bengal in pre-partition India and of East Pakistan from 1947 to 1971) have engaged in the open water capture of inland and marine finfish and the cultivation in perennial and seasonal tanks, bhunds (special tanks designed to mimic riverine conditions) and ponds of fin fish and of various species of freshwater and brackish water shrimp (Das 1931, 1932; Hora 1948; Bagchi and Jha 2011). Since ancient times, fish has been a central component of the Bengali diet for all classes and castes of people, although there were some restrictions on types of fish and crustacea eaten by Brahmanical castes and Muslims (Ray 1994). Over 200 different species of fish were caught, traded and consumed. Open water fishing was dominated by caste Hindu fishers with some Muslim participation (Pokrant et al.1997, 2001). Traditionally, shrimp grew alongside finfish in a polycultural system integrated into the seasonal social and ecological rhythms of village life and characterized by family and community ownership of ponds and tanks, integration of production with food cropping and livestock activities, risk-averse strategies of spreading food risks across different food sources, provision of off-season work for farmers, and production largely for local consumption. There were also extensive methods of more commercialised closed culture brackish and salt water fish production (*bhasabadha* and *bheri* in Bengali), which used few additional inputs other than the fry or fingerlings obtained from natural sources. Shrimp were also caught wild in rivers by fishers and farmers and in the Bay of Bengal by Hindu professional fishers.

Like open water capture fishing, closed culture fishing involved both natural and artificial stocking. Unlike open water capture fisheries, which until recent times were dominated by Hindu fishers (Pokrant et al. 1997), there was a limited development of professional closed culture fishers, with most of the labour being supplied by local villagers fishing their own ponds, working for wealthier landholders or drawing on common pool resources. Such culturing involved a wide variety of fish and, to a lesser extent, crustacea in both freshwater and brackish water

[1] Shrimp monoculture in this chapter refers to the practice of cultivating a single or limited number of shrimp species in a systematic way over several seasons.

environments. While there was trade in fish, it was largely for domestic consumption at the local and regional levels.

Many villages contained private and community water tanks some of which were used to raise fish (Gupta 1984). Formerly, tanks had been a main form of irrigation but by the end of the eighteenth century many had silted up and been abandoned. Under the British (1793–1947), while there were some attempts to promote pond culture and breed carp in captivity, the colonial state paid relatively little attention to culture fisheries as they were considered to be under the control of the *zamindars* (mainly Hindu landlords), their subordinates or in the hands of village communities. The main production was of finfish rather than shrimp, which were produced as a by-product of pond and tank culture or were taken wild from rivers, estuaries and the sea for domestic human consumption, manure, and as a regional trade item (Pokrant et al. 1997; Reeves 1995).

At the beginning of the twentieth century, fish culturing was done by the wealthy in ponds largely for their own domestic use rather than any commercial purpose. There was some leasing of tanks and many poorer people worked as fry collectors for tank owners and lessees. In addition, many of the rural poor had access to various common pool resources which included community ponds and tanks as well as seasonal *beels,* ditches, canals and pits (Gupta 1908; Webster 1911; Jack 1916; O'Malley 1925). There was a strong trade in fish fry and spawn for tanks. During the twentieth century, the most commercialised culture fisheries were the *bheris* in the Salt Lake area of what is now Kolkata in India's West Bengal (formerly known as Calcutta). Bheris were sewage-fed saltwater ponds that were controlled by the municipality and were let to lessees who sub-contracted to others. The bheris were flooded at the height of the rainy season and small fish and fry were brought in through sluices. These ponds were also nurseries for fish and prawns. Leases were annual so by February all fish had been caught, limiting any longer term expansion of the industry.

From the early twentieth century to the 1950s attempts were made to breed carp in ponds and enclosed spaces. By 1940 The Government of Bengal had made recommendations to improve closed culture fisheries, including shrimp, and there was a regional trade in open capture shrimp (*sutki chingdi/chingri*) from coastal estuaries with Burma and East Bengal. Shrimp were boiled and crushed to make into manure for sale to foreign and local companies. By 1945 fry and spawn were reared by local government authorities for sale (Rahman 1945). In 1949 a number of fish nursery units were established and fry and fingerlings were sold to private fish farmers. In addition, 25 demonstration fish farms were either under operation or being established by 1950. However, none of these were specifically devoted to shrimp.

During Pakistani times (1947–1971), there was little processing of either cultured or wild-caught fish apart from salting, drying and the production of shrimp paste, although there was extensive trade in fish fry between Chittagong and Kolkata. For example, the 1951 FAO-funded report (Kesteven and Ling 1951) on the fisheries of East Pakistan, prepared for the Pakistan Government by G L Kesteven, FAO Regional Fisheries Officer for Asia and the Pacific, and Assistant Regional Fisheries Officer S W Ling, refers to 'brackish water trapping pond operations' (bheries) in the Khulna area in which mullet, *bhetki* (ocean perch), *chanda* (pomfret)

and shrimp were the main catch. Some 9,000 fishermen using seine and cast nets operated on the ponds alone or as part of paddy cultivation. Kesteven and Ling discuss freshwater tank culture, noting that tanks were supplied with wild spawn and fry, which supplemented the capture of fingerlings from inland water depressions (beels). Over 20,000 people carried some 15,000 containers of spawn and fry by train from Rajshahi and Chittagong in East Bengal/Pakistan to other parts of the province for local stocking. The report points out that tank cultivation for commercial reasons were limited and '…in the majority cultivation is for subsistence and pleasure; consequently the operations are not carried out with any efficiency and in fact many of the tanks are neglected and even derelict' (Kesteven and Ling 1951).

Yet apart from a small regional trade in fish and shrimp, most fish and crustaceans were consumed domestically. These early forms of culture fisheries are best described as 'proto-aquacultural' or a form of stock enhancement with limited intervention in faunal life cycles (Beveridge and Little 2002). As Bagchi and Jha (2011) put it in their survey of fisheries and pisciculture in India's history:

> Prior to India's independence in 1947, fish culture primarily consisted of purchasing some spawn from the market, putting them in the pond, and reaping a harvest at the end of the year.

The Pakistan Government paid limited attention to shrimp production during the 1950s but the beginnings of a more specialised export-oriented shrimp industry can be traced to that period when two factories were established in 1954 to export frozen and canned shrimp to the USA and Western Europe and in 1959 the first shrimp and fish processing and freezing plant was established in Chittagong to export headless, shell-on freshwater shrimp to Europe and the USA. In 1960/1961, fish canning plants were set up in Khulna District in East Pakistan (Pakistan 1961) and from that time Khulna and its environs became the main centre of wild shrimp processing. By 1970, there were five fish canning plants in Chittagong engaged in the freezing of prawn and frog legs (Rizvi 1970). By the mid-1960s, wild shrimp (of which there are 22 species) were being sold for the domestic market both fresh and in preserved and cured form by means of sun-drying, boiling and sun-drying and smoking (Ahmed 1967). Sources of shrimp for local consumption continued to be river estuaries, canals, *beels*, rivers, tanks, paddy fields and ponds. Both freshwater and brackish water shrimp species were consumed locally but the latter came mainly from open water river, estuarine and marine fisheries rather than shrimp farms.

The Bangladesh Shrimp-Export Sector and the International Seafood Industry Since 1971

The modern Bangladesh shrimp export sector is a product of the post-1950 growth of an international seafood industry. Traditionally, the industry was dominated by open capture fisheries but as wild fish stocks declined or levelled off, aquaculture has increasingly filled the global gap in the supply of fish, crustacean and molluscs.

Aquaculture accounted for almost 50 % of world fish food supply in 2008 (Bostock et al. 2010; FAO 2010) of which freshwater fish was the major contributor. As a result of the growth of the international industry, many marine artisanal fishers and coastal agricultural communities with traditional livelihoods rooted in local systems of fishing and crop cultivation have been incorporated into global networks of commodity flows which increasingly dictate standard and type of product, price, and other conditions of production, marketing and sale (Humphrey 2006). Seafood production and consumption has become increasingly freed from seasonal fluctuations and distance constraints as people living in widely separated localities have been linked electronically, organisationally and psychologically through international networks of commodity exchange, extensive air and sea transportation services and the gaze of private and public governance agencies. The agencies setting product and process standards are the governments of major importing countries, global governance agencies such as the WTO and the FAO, and a growing number of private third party certification agencies such as GLOBALG.A.P, the Global Aquaculture Alliance's Best Aquaculture Practices (BAP), and the Aquaculture Stewardship Council (ASC). These regulatory agencies put pressure on the seafood industry to respond quickly to biosecurity concerns of consumers in the richer countries and to middle class consumers in Asia and Latin America. These changes apply to both open capture and closed culture fisheries but reach their most developed form in the latter, a shift that represents a closing of the fishing frontier equivalent to the domestication of wild plants and animals and the emergence of terrestrial agriculture 11,000 years ago (Duarte et al. 2007).

Wild-caught and cultured shrimp is one of the highest valued commodities in the international seafood industry and while capture fisheries continue to supply the bulk of shrimp products traded internationally, a growing proportion of the volume and value supply comes from cold and warm water aquaculture with Penaeid shrimp, particularly Pacific White Shrimp (*Penaeus vannemai*) and Black Tiger Prawn (*Penaeus monodon*, dominating tropical brackish water aquaculture. Today, Asia is the main region of warm water shrimp production with the industry providing foreign exchange and direct and indirect employment to the main producer countries such as China, India, Bangladesh, Vietnam and Thailand. Bangladesh ranked eighth among world shrimp producing nations in 2008 (FAO 2010) and by 2010 export production reached 109,000 t compared with 19,224 t in 1993 (BBS 2011). Shrimp exporting countries have followed several accumulation strategies in an effort to meet market demands and increase financial returns. These include increased intensification of cultivation, expansion of the land and aquatic areas under cultivation, improved transport and storage, shortened supply chains, species switching in favour of fast-growing varieties, shift to value-added products, use of chemicals and antibiotics, government support (such as tax breaks and technical assistance) and an extension of the shrimp growing season. The most developed form of shrimp production today is that of the super-intensive raceway and 'bio floc' shrimp rearing systems found in the US, although they remain limited in extent and experimental. In most shrimp-exporting countries in the tropics, the dominant forms of shrimp cultivation continue to range from modified extensive to intensive.

The extension of export-oriented production into rural areas has resulted in many changes to agrarian societies and ecologies in the tropical world. There has been the spread of commodified relations of production and exchange, land and water use changes and attendant conflicts, the growth of new sources of local wealth with a concomitant expansion of demand for products and services, shifting political alliances as shrimp-based economic capital is translated into political capital, the physical alteration of land and waterscapes, reduced agro- and bio-diversity, and a shift away from traditional forms of village production and cultivation such as rice farming (Fig. 6.1).

Shrimp Farming and the Bangladesh Shrimp Sector

The Bangladesh shrimp farming sector lies at the lower end of a domestic and international commercial and governance network extending from the collection of broodstock from the Bay of Bengal to the restaurants and supermarkets of the developed world (75% of export value comes from the EU) and increasingly to market segments in the rapidly growing developing economies such as China and India. Farms are relatively undeveloped by international standards with most extensive or improved extensive in function with low stocking densities, limited or no artificial feed use, and poor water quality management. The two main types of shrimp cultivated for export are brackish water shrimp (*Bagda chingri* or Black Tiger Prawn) and freshwater prawn (*Golda chingri* or the Giant Freshwater Prawn). Approximately 95% of these two culture species are exported with brackish water shrimp accounting for the greater part of exports but exports of freshwater prawn have been growing steadily in recent years. Also, processors and exporters have pressed for greater production of Pacific White Shrimp as they grow quicker and considered more competitive internationally. There are over 120,000 shrimp farms covering over 217,000 ha concentrated mainly in the Southwest and Southeast of the country (GoB 2010; DoF 2010. See Table 6.1). Some 80% (170,000 ha) of shrimp farm land is under brackish water shrimp and consists of some 37,397 shrimp farms run by 40,000 farmers with an average farm size of 4.5 ha, of which over 50% are less than one hectare. In the southwest, the most common shrimp regime consists of shrimp-rice rotation compared with the southeast where shrimp-salt rotation and shrimp only production are most common. Employment is largely seasonal drawing on both local and migrant and predominantly Bangladeshi labour. Shrimp farmers buy shrimp fry from wild and hatchery fry traders who in turn rely on several hundred thousand wild shrimp fry collectors operating along the coast, estuaries and rivers and 48 shrimp hatcheries mainly located in Cox's Bazar. The farms sell to thousands of traders who supply over 10,000 shrimp depot owners. The depots sell on to independent traders and commission agents who supply the 148 processing plants (75 of which are EU approved) located mainly in Khulna and Chittagong. There are several feed companies but most farmers provide their own feed (Uddin 2008). The Bangladesh Government has constructed 21 modern shrimp landing and

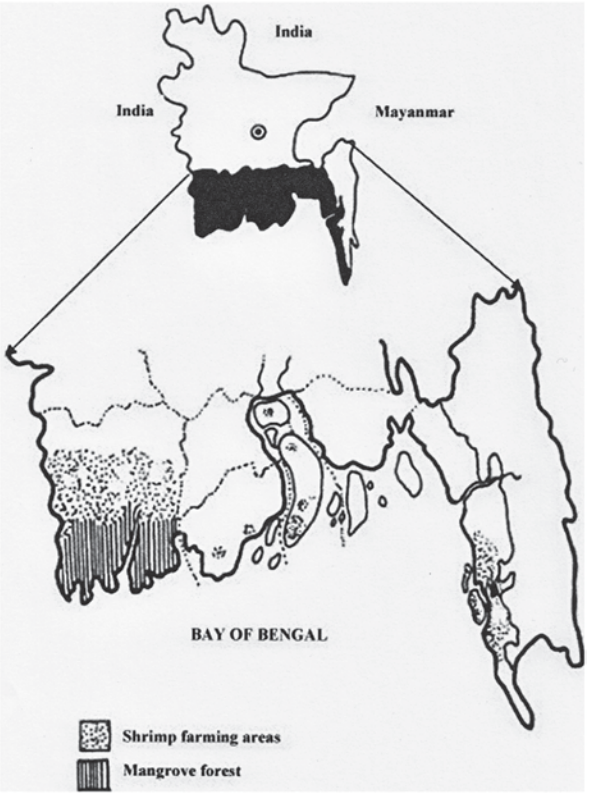

Fig. 6.1 Shrimp Farming Areas in Bangladesh. Source: Md Shahidul Islam (2003) Perspectives of the coastal and marine fisheries of the Bay of Bengal, Bangladesh. Ocean & Coastal Management, 46 (8): 763-796. http://dx.doi.org/10.1016/S0964-5691(03)00064-4.

service centers at a cost of 100 million taka (US$ 1.2 m.) to improve post-harvest quality and safety of shrimp raw materials. Production levels are low at less than 200 to 300 kg/ha compared with countries such as Thailand where yields can reach up to 5,000 kg/ha.

From its inception in the 1970s, shrimp farming expanded in a fragmented and uncoordinated way with varying environmental, economic and social consequences (Rahman et al. 2006). This expansion took place during a period of domestic economic and political turmoil and instability. In 1970 the country experienced one of the most devastating cyclones in its history, which resulted in major destruction to the country's limited physical, economic and social infrastructure and the death of up to 500,000 people, and in 1971 the country became independent from Pakistan after a bloody liberation struggle. Between 1971 and 1975 Bangladesh took an authoritarian and quasi-socialist direction under liberation hero, Sheik Mujib Rahman, which in combination with near famine conditions in 1974 resulted in a decline in national living standards. During the Mujib era, the government sought

Table 6.1 Year-wise shrimp/prawn farm area statistics of Bangladesh (area in hectares). (Source: Statistical Yearbook of Bangladesh, 2008–2009. Vol 26, no. 1)

									Rate of increase (%)			
Division	1984–1985	1985–1996	1987–1988	1988–1989	1993–1994 Up to 1996–1997	1997–1998 Up to 2002–2003	2003–2004	2004–2005 Upto 2008–2009	Compare to 2002–2003 and 1996–1997	Compare to 2003–2004 and 1996–1997	Compare to 2002–2003 and 2003–2004	Compare to 2002–2003 and 2004–2005 to 2008–2009
Chittagong	23,437	24,781	24,781	25,514	29,792	29,792	29,792	34,704	0.00	0.00	0.00	16.49
Khulna	39,976	62,448	69,053	80,418	104,624	107,962	163,848	171,506	3.19	56.61	51.76	58.86
Barisal	833	71	176	348	3,341	3,357	9,189	11,425	0.48	175.04	173.73	240.33
Dhaka	–	–	–	–	239	242	242	242	1.26	1.26	0.00	0.00
Total	*64,246*	*87,300*	*94,010*	*108,280*	*137,996*	*141,353*	*203,071*	*217,877*	*2.43*	*47.16*	*43.66*	*54.14*

to distribute public lands to the landless and marginal farmers with limited success (Adnan 1993). In 1975 the government was deposed by the army and the new military government led by Ziaur Rahman adopted a more liberal and export-oriented economic policy continued by his successors to this day (van Schendel 2009). From the late 1970s there was a growth of private investment in brackish water shrimp farming and in the Bangladesh Second Five Year Plan (1980–1985), the Government supported many initiatives to improve cultured shrimp production technologies through agencies such as the Food and Agricultural Organisation/Swedish International Development Agency (FAO/SIDA) Bay of Bengal Programme, the First Aquaculture Development Project (Asian Development Bank/ADB), the Shrimp Culture Project (International Development Agency), the second Aquaculture Development Project (ADB), the Third Fisheries Project (World Bank) and from 1999, the Fourth Fisheries Project (World Bank). The main emphasis in these projects was technical development of nurseries for post-larvae, screening of pond sluices, selective stocking with brackish-water shrimp, water quality, and maintenance of appropriate water levels in shrimp farms (Karim and Aftabuzzaman 1995).

Military rule persisted until 1991 when the country returned to civilian rule and democratic politics. Despite the shift to democratic politics, attempts at democratic consolidation have generally failed. What we see instead is a circulation of the political elites each of which when in power took on the characteristics of patrimonial rule in which access to positions of authority and influence was shaped by political loyalty rather than political, technical or administrative competence (Islam 2008). The close relationship between government, business and the military during both periods was reinforced by World Bank Structural Adjustment finance amounting to US$ 1.76 billion aimed at creating an export-oriented and market driven economy. This close relationship extended to the shrimp sector, including shrimp farming.

During the early development of the shrimp export sector when international prices for shrimp were high, some members of the business community used their economic power and political connections to pressure rice farmers, particularly in the country's southwest, to lease out their lands for shrimp farming and to convert public (*khas*) lands to shrimp farming. The World Bank and Asian Development Bank promoted shrimp farming as an important new source of foreign exchange earnings and Bangladesh experienced a rapid growth in shrimp farms, shrimp depots, processing plants and a labour force engaged in wild shrimp fry collection. The shrimp export sector was declared a thrust industry in 1991 and shrimp farmers and hatchery operators were given, among other things, a tax holiday and reduced rates of bank interest on loans. A year later, the Bangladesh Government introduced the Shrimp Mohal Management Policy (Habib n.d.), which supported the turning over of suitable public land to shrimp farming, which went against existing legislation protecting land against salinity (Afroz and Alam 2012). The sector grew rapidly to become Bangladesh's second largest official earner of foreign exchange. However, it accounts for only 5% of export earnings compared with garment manufacture, which accounts for over 80% of total gross export earnings. Almost 90% of the US$ 527 million foreign exchange earnings from the country's seafood sector come from farmed shrimp exports (2006/2007). The Bangladesh government, business and international aid

agencies continue to support the expansion of export-oriented shrimp production and several million people rely directly or indirectly upon it for work and income.

Debates About Shrimp Farming in Bangladesh

The changes brought about by shrimp farming have been the subject of increasing scholarly and policy debate and analysis. The debate and analysis have generated a considerable body of literature of variable theoretical sophistication, methodological clarity and empirical rigour. It consists of a mix of official, academic and grey literature such as official Bangladesh government and national and international NGO reports, academic synchronic studies usually of single village or shrimp farming sites, consultancy reports for government or private business and newspaper reports on particular events and developments in shrimp farming areas. Many published sources include shrimp farming as one component of a wider study of the industry as a whole often with a focus on the technical aspects of shrimp farming rather than wider social and environmental concerns. Few studies have taken a longitudinal, cross-village and cross-regional, controlled comparative approach to gauge the particular impact over time of specific drivers on the social and ecological fabric of rural communities (Pokrant 2006). Most studies have been done in the southwest of the country where some 80 % of all shrimp farms are found and the bulk of these deals with brackish water shrimp farming, although increasing scholarly attention has been given to freshwater prawn farming (Ahmed et al. 2010; Ahmed and Garrett 2011).

Much of the literature on shrimp farming is descriptive and often technical, focusing on farm preparation, yields per hectare and costs of production. However, there is a growing body of academic and policy literature, which focuses on the social, economic and ecological aspects of shrimp farming. In this literature, two main approaches can be identified (Béné 2005; Pokrant 2006).

The first is the Radical or Political Ecology approach taken by some sectors of the national and international NGO movement and several academic commentators. Political Ecology focuses on the unequal distribution of political and economic power within and across countries, which is considered to determine access to land, technical inputs, and capacity to meet international product and process standards set by the major shrimp importing countries. This approach regards what is often referred to as industrial shrimp farming as unsustainable and proposes national and local changes in policy direction favouring small farmers and more ecologically sound farming practices, a reform of international trading regimes and a change in rich country consumption habits. Some proponents of this approach have a radical political agenda that seeks to replace or constrain neo-liberal capitalism with alternative forms of political and economic organisation or to drastically restrict the power of international corporations and global governance agencies and to shift the centre of political gravity to local communities or to networks of local communities within bio-regional contexts. This approach is found among a number of small

advocacy-based national NGOs such as the Bangladesh Environmental Lawyers' Association, *Nijera Kori, Unnayan Bikalper Nitinirdharoni Gobeshona* (UBINIG 'The Policy Research for Development Alternatives'), and *Uttaran* supported by overseas NGOs such as the Environmental Justice Foundation (2003, 2004) and the Swedish Society for Nature Conservancy (2011).

The second approach is the Mainstream or Ecological Modernisation approach, which starts from the premise that environmental sustainability is attainable through the application of scientific, technological and organisational processes within existing political and economic frameworks. It is this view of sustainable development that is supported by the Bangladesh Government, national and international business, some service-oriented national and international NGOs such as the Bangladesh Shrimp and Fish Foundation and Caritas, and several key global governance agencies such as the World Bank and the Asian Development Bank. Supporters of this approach consider that the negative social and ecological effects of shrimp farming are the result of poor management and bad planning, which can be rectified by improved farmer education, better farm management and more efficient supply chains at the level of the shrimp farm. The greater financial resources, political and intellectual capital available to those who work within the Ecological Modernisation paradigm means that much of the literature on shrimp farming falls within this category. Drawing on sources from both approaches, including the author's own field work over 15 years, the following general observations can be made about the social, economic and ecological changes brought about by shrimp farming.

Social-Ecological Systems and the Impact of Shrimp Farming

The distinction made between socio-economic and agro-ecological changes should be regarded as an analytical or heuristic device rather than independently existing or isolated phenomena. Humans are part of nature and human life is entangled with a world of things, including natural things (Hodder 2012). As such, rural communities in general and shrimp farming in particular are embedded within ecological systems and the interaction between them is one of dependence and mutual constitution (Berkes et al. 2003). Modern shrimp farming was introduced into a society, which historically was (and remains) highly inegalitarian in terms of land ownership, distribution of political power, and gender and ethno-religious relations (Bose 1993). Before modern shrimp farming, Bangladesh had already undergone substantial environmental change over many centuries (Eaton 1990; Iqbal 2010; Richards and Flint 1990). Huge tracts of Bengal were cleared of forest to make way for rice farming and other uses so that by the 1970s forest land, other kinds of land cover and water bodies had been altered to accommodate new agricultural and urban populations (Mukerjee 1938). By the early 2000s, forest cover had been reduced to less than 10% of the country's land area (Choudhury and Hossain 2011). The clearing of land also led to the decline and extinction of many terrestrial and aquatic floral

and faunal species. This has given the remaining forest cover and water bodies great political, economic and ecological significance in contemporary debates regarding the impacts of shrimp farming.

Since the 1970s, shrimp farming has acted singly and in combination with other historical and contemporary drivers of change to affect rural people's livelihoods. These drivers include national government policies aimed at promoting rice production through conversion of land and water bodies, consumer country regulation and control of shrimp imports, the building of embankments and polders and the introduction of High Yield Varieties (HYV) of rice, local, national and international water control and diversions ranging from the Farakka Barrage in India to filling in of water depressions (*beels*) and ponds across the country; climatic and human-induced changes to water and soil quality, increased coastal populations, land fragmentation, and the growing competition for inland and marine fish and forest products.

Shrimp farming is one part of a global network of seafood processing activities and its introduction to rural communities has made those communities increasingly subject to the actions of rich country governments, international trading and processing companies, and global governance agencies. Shrimp farmers are dependent on global demand for shrimp and shrimp products, which in good years has meant high incomes for some but in poor years resulted in heightened indebtedness and even loss of land and livelihoods. The power of global and regional regulatory agencies is particularly apparent as they can (and do) shut down the industry overnight if contaminated shrimp are found in export consignments. For example, since the early 1990s, the EU has warned the Bangladesh Government that the shrimp sector needed to improved its health and safety regime. This came to a head in 1997 when an EU Inspection team inspected conditions in several Bangladesh processing plants, which led to a 1998 ban on exports to the EU resulting in substantial financial losses throughout the sector (Cato and Lima dos Santos 1998; Alam and Pokrant 2009; Alam 2010). At this time, the main cost of restructuring was borne by processing plants but subsequent inspection visits by the EU Commission resulted in growing surveillance of operations at shrimp farm and hatchery levels.

In some areas and over time smallholders have benefited economically from expanded shrimp production but often at the expense of consumption crops such as rice and a growing inequality in landholdings, forcing marginal landowners out of production (Ali 2006; Islam 2009; Karim 2000). Many farmers switched to shrimp as returns were higher compared with either rice farming or salt farming or rice farming alone, with shrimp-salt rotation being the most profitable (Islam et al. 2003). A key problem for the sector has been disease, which increased local farmers' perceptions of risk, causing many to seek other kinds of work as a hedge against disease epidemics and other risks such as uncertain foreign markets, irregular supply of shrimp fry and dependence on informal credit arrangements in long domestic supply chains (Ahsan 2011). These domestic supply chains consist of many intermediaries such as fry traders, hatcheries, shrimp traders, money lenders, and shrimp depot owners who supply essential inputs to farmers and sell their products. Such dependencies shape farmer perceptions of the viability of shrimp farming.

Government investment and assistance to the shrimp sector has been greatest in the processing and hatchery sectors, which are dominated by wealthy Bangladeshis who exert most economic influence on the supply chain. For 20 years processing plant owners and some hatchery operators have pressed for farming land to be turned over to them to allow them to engage in more controlled contract farming and to shift towards more intensive forms of production. At present, processing plants have considerable over-capacity as a result of poorly planned expansion. Governments have resisted meeting their demands as they fear rural unrest from smallholders losing markets and resistance from those poor and landless parts of rural society dependent on public lands and common pool resources. While some shrimp farms are unable to meet processor demand, which gives them some advantage in bargaining over price, this is limited by long supply chains with many intermediaries and a lack of powerful national shrimp associations to act as bargaining agents. Some smallholders have sought to enhance their economic security through cooperation in water sharing.

Several studies point to a decline in land area devoted to rice farming, traditional forms of livelihood and employment opportunities as a result of shrimp farming. There has been conversion of common pool resources to private use, a reduction of sharecropping opportunities in rice farming, reduced access to grazing land, and lower labour requirements of shrimp farms compared with those of paddy production (Rahman et al. 1997; Rahman et al. 2006). However, the shrimp sector as a whole has generated new jobs and income opportunities in shrimp processing, trading and distribution as well as the multiplier effects of increased incomes on local communities.

In areas of mixed rice and shrimp farming found mainly in the southwest and south central coastal zones, opportunities for sharecropping have declined as rice farmers switched to the more lucrative shrimp farming, which requires lower labour inputs per land area and where workers are paid daily or short-term contractual wage rates rather than a share of shrimp harvests (Datta 2006; Tutu 2006). Maniruzzaman (1998) notes in his study of three villages in one union in Khulna District the decline of pre-shrimp forms of labour. These included *bebaira* (engagement of guest labour) when friends and relatives of the farmer were given food in return for work; *badla* or labour exchange under which arrangement workers worked on each other's land and no cash wages (*kamla*) or food payments were given; sharecroppers who worked for a landlord as cultivators but were expected to provide labour services to the household such as catching fish, house repair etc. This *begar khata* or work without payment was a means by which landlords could retain labour for the next season's sharecropping. Similar changes have occurred in the country's southeast but there mixed salt and shrimp or shrimp only production is more common and workers alternate between shrimp farm and salt pan work. Recruitment of labour took place through local market places, direct recruitment and the use of labour contractors. Shrimp farmers also enter into harvesting arrangements with local fishers and others to allow harvesting of fin fish in shrimp ghers (Pokrant and Reeves 2003).

Shrimp farming has contributed to growing pressures on marginal farmers and the landless to migrate from rural areas to the cities or overseas. There is also evidence of in-migration in shrimp farming communities as people seek to take advantage of perceived work and investment opportunities (Maniruzzaman 1998). There have been multiplier effects of rising incomes from shrimp farming. For example, Ito (2002) reports from the freshwater prawn farming areas of Southwest Bangladesh that landless workers have secured jobs as farm guards, shrimp harvesters, shrimp farm building workers, mud snail shell breakers and traders, van drivers and transporters of prawns, fry, ice and shrimp feed. He argues that the availability of such work has strengthened the bargaining power of workers employed on traditional annual labour contracts by richer farmers. Pokrant and Reeves (2003) report from brackish water shrimp farming areas of Southeast Bangladesh that many landless labourers and marginal farmers worked as shrimp farm labour, shrimp fry collectors, fishers, salt workers, petty traders, short distance transporters, rice farm labourers and sharecroppers, rickshaw pullers, snail de-shellers, wood collectors and other small-scale artisanal and petty commodity activities. Their survey of 958 shrimp farms in Chakoria Sub-district in Southeast Bangladesh revealed that total employment on these farms was approximately 5,394 with over 80% employing six or fewer workers, some of whom were able to negotiate long-term contracts of a year or more. The sub-district is noted for its salt production and some workers alternated between shrimp and salt work, the latter being more remunerative.

Women have been affected in different ways by the growth of shrimp farming. The majority of women who physically work in shrimp farming and related activities such as fry collecting come from lower socio-economic groups. For these women, their work and income opportunities are gendered such that they are confined to particular types of shrimp farm and related tasks. On shrimp farms, adult women and female children are restricted to pond preparation and repair, some harvesting and snail collecting, although this varies across the country. Poorer women from functionally landless households are more likely than other women to be found collecting shrimp fry from the ocean, rivers and estuaries.

Physical work on shrimp farms and in fry collecting is considered by the more well-off members of both Hindu and Muslim local communities to be of low status as it is poorly paid, often carried out in unhygienic and dangerous conditions, socially demeaning and morally suspect for women who are forced to work in public spaces (Delap and Lugg 1999; Gain 2005; Pokrant and Reeves 2003). The wealthier and politically influential village elites and middle class consider fry collecting to be a threat to the moral order as women move about freely uncontrolled by men (Jalais 2010). However, female fry collectors often reject such negative views and assert their right and need to work, pointing out that it provides a degree of autonomy and a capacity to work with other family members, something unavailable in the now banned shrimp de-heading sheds where they were often monitored by employers (Delap and Lugg 1999). Women have also benefited financially from work in shrimp processing plants located in the large urban centres, although the benefits remain gendered with male processing workers earning more, on average, than female ones. Some landless people have taken

up crab collection as an alternative livelihood strategy. These are usually among the poorest and possess limited bargaining power in the supply chain dominated by intermediaries and buyers in regional and national urban centres (Zafar and Ahsan 2006). Those with greater assets are able to invest in crab fattening and enjoy higher returns.

There is evidence that shrimp (and prawn) fry collection for shrimp farms has threatened coastal ecosystems with declines in black tiger prawn fry, freshwater prawn fry and other aquatic species (Ahmed and Troell 2010; Hoq 2007; Islam and Wahab 2005) as it takes large quantities of bycatch which affects aquatic species diversity. The Government ban in 2000 on fry collection was motivated, in part, by environmental considerations but was also a response to pressures from shrimp hatchery owners who saw wild fry collectors as competitors (this is discussed further below).

One of the most dramatic impacts of shrimp farming on local social and ecological environments is the destruction and clearing of the Chakoria Sundarban mangrove forest in Southeast Bangladesh during the 1980s and 1990s (Pokrant 2009). Up until the early 1980's, the forest was in public ownership under the control of the forestry department, which had recommended a resting of the land for 10 years to recover from what it saw as poor land use in the past. It was turned over to private investors, many outsiders to the area, who rapidly replaced the forest with shrimp farms and who then sub-leased the farms illegally to local lessees. Other public lands intended for use by the landless as common pool resources were appropriated by politicians, their supporters and urban business interests who sought to profit from a growing global demand for tropical shrimp.

Social and environmental impacts have been felt across much of the coastal belt as shrimp farms have encroached upon private rice farming land and public lands, often used as common pool resources by local farmers, fishers and the landless. The modified extensive nature of shrimp farming has meant that increased production has been brought about by conversion of rice fields and other lands to shrimp farms and the decline of several traditional non-shrimp livelihood practices and associated land and water uses. These include cattle grazing lands, fishing sites, and vegetable growing areas, and the decline or disappearance of local timber and plant varieties (Giasuddin et al. 2003).

A significant by-product of the shift to shrimp farming has been the massive growth in the number of wild shrimp fry collectors drawn largely from the poorer, landless sections of the rural population. Whether landless prior to shrimp farming or made so by the removal of paddy land from production in favour of shrimp cultivation, at their peak in the 1990s, fry collectors numbered over 400,000 (Azad et al. 2007; USAID 2006), spread across the coastal region of the country. Working in family teams often financed by small-scale fry traders, fry collectors came into conflict with fishers, some environmental and social NGOs and shrimp hatchery owners for a variety of reasons. For fishers, the indiscriminate collection of shrimp fry reduced aquatic biodiversity, including fish stocks. For some environmental NGOs, fry collectors undermined biodiversity and the capacity of local ecosystems to sustain themselves. For social NGOs, fry collecting meant the exploitation of

minors required to work long hours waist deep in water. For the hatchery owners, fry collectors were a source of competition as they sought to establish themselves as the main source of shrimp fry for farmers. They lobbied government to restrict collectors' activities on the grounds of their threat to biodiversity and some local livelihoods and their use of child labour. The result was a ban on fry collecting in 2000 (SRO No. 289/Act/2000) but the ban has been poorly implemented and fry collection continues. Government commitments to providing alternative employment have not been realised. The decision to ban fry collecting met with opposition from fry collectors themselves, fry traders who stood to lose business and shrimp farmers who preferred wild fry to that of hatchery fry. It was also criticised by some NGOs and donor agencies on the grounds that it made fry collectors scapegoats for a much wider problem of environmental destruction caused by such factors as deforestation, overfishing, and inefficient shrimp trawling in the Bay of Bengal. Also, it was argued that any ban should be directed at traders and shrimp farmers themselves who dominate the local supply chains (Azad et al. 2007; Frankenberger 2002).

Agro-Ecological Impacts

There has been an increase in levels of soil and water salinity through changes in groundwater quality and deliberate flooding of rice fields, which has affected rice farming in contiguous areas. Shrimp investors and farmers have legally and illegally appropriated common pool resources, which have displaced fishers, landless labourers and marginal farmers. The conversion of land to a single use has resulted in threats to biodiversity and the spread of shrimp diseases (particularly White Spot SyndromeVirus) into shrimp farming areas (Shahid and Islam 2003). Shrimp disease was introduced early into shrimp farming as a result of the import of diseased shrimp fry from Thailand. It is now endemic across practically all brackish water shrimp farming areas.

The spread of shrimp disease illustrates that shrimp farmers themselves are highly vulnerable to human-induced hazards and also natural hazards. The latter is vividly demonstrated by the impacts of two cyclones on Southwest Bangladesh in 2007 and 2009. In the 2007 cyclone (Sidr) it was reported that over 90 % of shrimp farms were destroyed in some sub-districts of Bagerhat District in the country's southwest (The Fish Site 2007). In the 2009 cyclone (Aila) it was estimated that over 40 % of shrimp farms were affected or destroyed and the livelihoods of thousands compromised and undermined (Kumar et al. 2010). The capacity of shrimp farmers to respond to this cyclone depended on their income and assets, familial and other social networks, and links to government officials. Some small shrimp farmers heavily dependent on small loans obtained at high interest rates were least resilient and for many their futures became uncertain (Kartiki 2011). As a result of the cyclone, there is some evidence of both a backlash against shrimp farming and a more positive view that shrimp farming could provide an alternative livelihood

on land that had become so saline it could not support rice farming (Daily Star 1 May 2011a; 26 May 26 2011b). The cyclone also forced some families to take up shrimp fry collection.

Shrimp farming has reduced soil quality, increased social and water salinity levels, increased acidity of soils, reduced the area under rice cultivation, reduced rice yields and reduced fodder supply for livestock (Ali 2006; FAO 2009; Haque Munira et al. 2010). Swapan and Gavin (2011) report changing land use, village organisation, increased susceptibility to cyclone and other hazards, shifts to salt tolerant rice strains and reduced fish availability. Food habits have changed as local people are less able to grow or afford fruits, vegetables, duck and beef as a result in part of increased soil salinity caused by shrimp farming (Rahman et al. 2011).

Ali's work in Southwest Bangladesh sums up well some of the consequences:

> Shrimp farming has affected the village rice ecosystem in several ways. It has brought major changes in soil properties and caused soil degradation that affects rice yields. Transformation of rice fields into shrimp ponds has reduced the total area under rice and fodder production and has created food shortage for both human and livestock population. Toxic chemicals and effluents in shrimp ponds have disrupted the habitat for fresh water fish and aquatic species inherent in rice ecosystem (Ali 2006)

Local Resistance to Shrimp Farming

The changes described above have met with various kinds of resistance largely directed at the appropriation of public lands, decline in sharecropping opportunities, and the coercive treatment of rice farmers unwilling to rent out land for shrimp. The early years of shrimp farming from the 1980s to the 1990s were marked by a spurt of investment by urban and rurally-based business people in response to rising world prices for shrimp and government incentives. They leased out land from local rice farmers or were able to acquire public lands often at the expense of local landless people and marginal farmers (Guimaraes 1989; Adnan 1993). During this period, referred to as an 'era of resistance' by Islam (2009), there was considerable controversy and public debate over the spread of shrimp farming and the newspapers of the time are full of reports about land appropriation, strong-arming of rice farmers to lease out land for shrimp, flooding of paddy fields with salt water, and looting of shrimp farms. There are numerous examples of local resistance to shrimp farming in Khulna and Satkhira districts. One of the most well-known was the Horinkhola movement in Paikgacha in Khulna District in 1990 when a local business man sought to establish a shrimp farm on land owned by absentee landlords. Fearing dispossession and destruction of their livelihoods, the landless organised a protest led by a widow named Korunamoyee Sarder who was a member of Nijera Kori Mohila Bhumiheen Samity (Nijera Kori Women's Landless Society) and who was killed by supporters of the farm owner. After this killing, a big protest meeting was held in Horinkhola with the participation of Nijera Kori leader, Khushi Kabir, and members of the Communist Party and the main national opposition party, the

Awami League.[2] A memorial was built to her and a memorial service is observed every year.

Other movements include the Jaliakhali Movement in Dacope sub-district of Khulna, which was formed in 1987 when a group of shrimp farmers tried to start a shrimp farm on 70 ha of land. Local people under the leadership of the Communist Party started a movement against them, which resulted in the farmers leaving the farm. The farmers attempted to stop the local protest by using a hired gang called 'Hunda-Gunda Bahini' to get control of the farm but were unsuccessful. The Bhaina Beel movement was formed in 1988 in Dumuria sub-district of Khulna to oppose the establishment of a shrimp farm on local land. The Tala movement operated during the period from 1996 to 1998 in Tala sub-district of Satkhira when a group of local influential people established shrimp farms on several thousand acres of land in seven publicly owned canals (*khas khals*).

The newspapers of the time are full of stories about land-grabbing and conflicts over land use, particularly in the south west of the country where most shrimp farms are located close to rice farming lands. For example, the National Daily, Dainik Ajker Kagoj, reported in March 1994 that: 'Law and order situation [has] deteriorated due to shrimp farming in Southern Khulna'. The Dainik Ittefaq reported in May 1994 a 'Clash between two groups for capturing shrimp project land in Chakaria [southeast Bangladesh]: one murdered and 6 injured'. Manik Saha, a fearless local journalist, wrote a report entitled: 'struggle against gher [shrimp farm or enclosure] owners and terrorism by the gher owners in South Khulna & socio-economic and environmental impacts of shrimp culture in Khulna region' in which he described the many conflicts over control of land and water in the region. His report, based on observations from 1990 to 1995, describes lootings, killings and rape, which he summarised in Table 6.2. He also reported on the killing of a local landless leader against land appropriation by wealthy local business people in November 1990 (Saha 2000; n.d.a; n.d.b) (Table 6.2).

Saha was murdered on a public street in January 2004 although his killers have yet to be brought to justice and it is unclear if his death was retaliation against his reports of the activities of 'shrimp mafia' or part of a wider attack on journalists for reporting various cases of extortion and other rackets in rural Bangladesh.

Similar English-language and Bengali-language newspaper reports from the Cox's Bazar region appeared in the National and local press from the early 1990s to the mid-2000s. For example, the *Daily Star* of August 9, 2002 ran a headline: 'Shrimp lords destroy coastal mangrove: Local BNP [Bangladesh National Party] MP's men fell trees, exposes Sonadia island to tidal wave'. This long article outlines some of the changes brought about by land grabbing in the area, summarised in the opening paragraph:

> The ecologically critical Sonadia Island under Moheshkhali Police Station fast loses thousands of acres of state-owned natural mangroves. Hundreds of workers engaged by the local BNP MP Alamgir Mohammad Mahfuzullah Farid are chopping down the mangroves

[2] See http://www.nijerakori.org/documents/The_harin_khola_movement.pdf.

Table 6.2 Saha report on violence and displacement in Southwest Bangladesh, 1990–1995

Total news reports published on attacks/clashes	50
Total murdered (in 30 incidents)	40
Total injured	525
Total raped	8
Total untraced/lost	10
Total families compelled to leave the locality	50

> to convert the area into shrimp cultivation compartments. The massive deforestation of 15-kilometre-radius Sonadia Island on the Bay of Bengal, where about 100 families live, has exposed the adjacent Moheshkhali to tidal waves, cyclones and other natural calamities (Daily Star, Vol. 3 No.1038, Friday August 09, 2002).

In Cox's Bazar, from the early 1990s to 2004, local organised resistance to shrimp farming was arranged through local movements and organisations such as the *Bargachasi Samity* or Sharecroppers' Society against 'outsider' control of public (khas) land for shrimp farming, the manipulation of shrimp fry prices by traders, and opposition to loss of common property resources. Attempts were made by the landless to gain access to public shrimp farming land via the *Kudal Bahini* (Spade Soldiers) organisation, and opposition to the use of 'outside' labour on shrimp farms (Gregow 1997). By 2004, the Sharecroppers' Society and the Spade Soldiers had ceased to operate and while there is still local resentment at the power of khas land leaseholders, the leader of the Sharecroppers' Society told the author he had gone back to sub-leasing several shrimp plots from a first-hand lease owner. Kudal Bahini was formed by landless labourers in Badarkhali to secure khas shrimp land. At its height in the mid-1990s it had more than 500 members. Most were also members of the Badarkhali Cooperative Society and part of their grievance was that the Forest Department had allocated public khas land to six members of the Society. Khas landholders in the region were well organised and well-connected politically, and were able to stop the movement.

In addition to the more vocal and organised protests against shrimp farming, there is some evidence of what James Scott refers to as everyday forms of resistance (Scott 1985). According to Scott, these include: 'foot-dragging, dissimulations, false compliance, feigned ignorance, desertion, pilfering, smuggling, poaching, arson, slander, sabotage, surreptitious assault and murder, [and] anonymous threats' (Scott 1989) The author's own field work in Chakoria, Southeast Bangladesh revealed some evidence of poaching and pilfering. One large shrimp farm owner told me of poaching taking place on his farm which required him to hire guards to protect shrimp stocks. Employees working on some of the larger shrimp farms were also searched as it was believed that shrimp were hidden in the men's *lungis* (tube-shaped and skirt-like wraps worn by men and boys) when they finished work. Guimaraes (1989) reports from Southwest Bangladesh that poaching was a common problem as shrimp attracted high prices on the 'black market' and was difficult to police. However, it is important to note that several of these tactics have

been employed by the more powerful shrimp investors against opponents of shrimp farming, as noted earlier.

Conclusion

The emergence and growth of the Bangladesh shrimp export sector since the 1970s illustrates one aspect of the growing dominance of a global seafood industry aimed at producing high quality fish and fish products for a global market centred on the rich countries of the world and, more recently, growing middle class markets in Asia. It also illustrates Bangladesh's attempt to shift towards a more export-oriented development policy aimed at earning foreign exchange, generating employment and raising the living standards of the population through a shift domestically to a more market-based exchange and production system.

The incorporation of large areas of coastal Bangladesh into international circuits of shrimp production, distribution, exchange and consumption has brought many changes to communities and ecologies in shrimp farming areas of the country. From an initial private investor-led and government-backed yet poorly regulated expansion of shrimp farming into what had been traditional rice growing communities, shrimp farming has become firmly established as an important agro-industrial activity in which the economic and social benefits have spread unevenly across the rural populations. Shrimp farming is increasingly regarded, if not completely accepted, by local communities as a fact of rural life and financial benefits have extended beyond an initial core of urban-based investors to many medium- and small-scale farmers. However, it has also meant the physical and social displacement of many landless labourers and marginal farmers who lost access to public lands and work opportunities under the earlier rice-based rural regime. Particularly during the early years of the development of the sector, there was some organised opposition to shrimp farming and several landless labourers and marginal farmers were killed as they sought to protect their livelihoods from shrimp farm expansion. Ecological impacts have ranged from a destruction of some mangrove areas to increasing salinization of ground water and soil, which have affected, *inter alia*, rice production, grazing opportunities and availability of potable water. These impacts have, in turn, affected the capacity of many rural peoples to maintain their livelihoods, which has forced some of the poorest populations to exploit the fragile ecological systems such as the Sundarban mangrove forest in the country's southwest in order to survive.

More recently, there have been signs that the Bangladesh State along with NGOs and global governance agencies, is attempting to regulate the sector to protect Bangladesh's fragile coastal zone and its inhabitants from unregulated shrimp farming. One such initiative is the creation of zones for shrimp production to reduce competition with rice farming and to protect particular ecological environments. For example, in February 2012, the Bangladesh High Court ruled as illegal the use of salt water on forest and agricultural land (Daily Star 2012). The aim of this ruling is

to protect such lands from forcible conversion to shrimp farming. Another initiative is the development of integrated shrimp farming approaches (Bostock et al. 2010). This includes mixed shrimp-fish-rice, prawn production systems, which seek to reduce the incidence of disease, to spread economic risks by diversifying production options and to enhance the compatibility of shrimp farming with the prevailing agro-ecological conditions (Ahmed et al.2010). One 'pro-poor' shrimp initiative is the Danish Danida-funded Greater Noakhali Aquaculture Extension Project, which from 2002 was designed to assist poor women to nurse freshwater prawn fry for sale to grow-out farmers who export the mature shrimp (Danida 2008). SIPPO (Swiss Import Promotion Program) began a pilot project in 2004 in South West Bangladesh to see if shrimp could be produced using traditional methods free of artificial compound feed, chemicals and fertilizers and recent evidence suggests improved environmental and economic outcomes for organice farmers (Paul and Vogl 2012, 2013). Shrimp farmers have moved towards obtaining shrimp fry from hatcheries in order to ensure a steady supply and reduce reliance on wild-caught fry, although some hatcheries have suffered from viral and other diseases, which can threaten the quality of shrimp as well as farmer livelihoods. The government ban on wild fry collection in 2000 has not stopped the practice and there is little evidence of government initiatives to assist fry collectors to shift to other work. Indeed, the criminalisation of such activity has exposed some of the poorest to official and unofficial intimidation. The FAO (FAO 2012) has initiated a program to organise selected shrimp farmers into cluster organisations to adopt best management practices in disease control, quality assurance standards, improved supply chains and cooperation among shrimp farmers. The idea is that these organisations will act as leaders in their field, setting an example for other shrimp farmers.

These initiatives indicate a growing awareness of the need for longer term strategies based around ecohydrological or ecosystem management systems which seek to control effluents, disease and salinity through more environmentally sensitive and polycultural techniques and mangrove and wetland restoration to absorb salt and other contaminants (Sohel and Ullah 2012). There have also been calls to integrated shrimp farming into Bangladesh's Integrated Coastal Zone Management Strategy (ICZMS), which has been under development since the late 1990s (Afroz and Alam 2012). However, the schemes mentioned focus largely on shrimp farms as economic and environmental units and only partially address wider community issues such as landlessness and poor governance.

In addition, concerns have been expressed that such initiatives are aimed predominantly at meeting certification and other standards set by richer countries and global agencies and do not engage local peoples sufficiently in setting such standards (Islam 2009; Vandergeest and Unno 2012). Shrimp farmers themselves play little if any role in the setting of such standards and remain dependent on distant market players and cross-governmental bodies who determine the buying price of shrimp and who continue to set global production and process standards. For example, globally there exists human rights and environmental group opposition to the new certification standards being developed by the World Wildlife Fund (WWF) for the ASC with support from some NGOs in Bangladesh linked to the more radical

approach outlined earlier. However, it is unclear if shrimp farmers in Bangladesh are aware of these certification changes, which suggests the need for more research on the domestic political economy of Bangladesh to examine the degree to which domestic NGO opposition reflects the views of local shrimp farmers and other rural inhabitants.

The urgency of taking a more integrated approach to the place of shrimp farming in Bangladesh is highlighted by the growing threat of climate change to coastal dwellers in Bangladesh. The Government of Bangladesh has been at the forefront of global climate change governance and has embarked on an ambitious climate change adaptation strategy for the country supported by the World Bank, the British Government and several international and national NGOs and action research centres (Ministry of Environment and Forests 2009; GoB Climate Change Strategy and Action Plan 2009). Shrimp farming is included in new climate change adaptation programmes and it remains to be seen what changes will be required in the shrimp sector to assist in sustainable adaptation to the hazards of climate change.

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