

# Socio-economic and environmental impacts of shrimp farming in the south-western coastal region of Bangladesh

Sebak Kumar Saha<sup>1,2</sup>

<sup>1</sup>School of Culture, History and Language, College of Asia and the Pacific, The Australian National University, Canberra, Australia

<sup>2</sup>Department of Sociology, School of Social Sciences, Shahjalal University of Science and Technology, Sylhet, Bangladesh

E-mail: [sebak.kumar@gmail.com](mailto:sebak.kumar@gmail.com); [sebakumar.saha@anu.edu.au](mailto:sebakumar.saha@anu.edu.au)

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## ABSTRACT

Despite contributing to the export earnings, saline-water bagda shrimp farming has created serious socio-economic and environmental problems in the south-western coastal region of Bangladesh. Bagda shrimp farming has adversely affected the livelihoods of small and marginal farmers and landless people. It has also destroyed the mangroves and increased salinity problems and thus has negatively affected soil, water, agriculture, fishery, the ecosystem, and the livelihoods of communities in the south-western coastal region of Bangladesh. Although bagda shrimp farming under the present situation benefits a small group of people, the benefit to society is minimal, or even negative, as a small group of people appropriate the profits at a cost to the livelihoods of the majority and to the environment. Thus, any economic analysis of bagda shrimp farming needs to take into account its negative impacts on the livelihoods of small and marginal farmers and landless people, and on the environment. The long-term benefits of bagda shrimp farming can only be achieved through the development of environmentally sustainable shrimp farming. Promoting bagda shrimp farming as a strategy for poverty alleviation and economic development necessitates fundamental changes in its management, and regulation to address serious adverse socio-economic and environmental impacts associated with it. This will only be possible when the issues of social equity and environmental sustainability become central to the management of bagda shrimp farming. Otherwise, bagda shrimp farming does not have a future role to play in poverty alleviation or the economic development of Bangladesh.

**Key words:** saline-water bagda shrimp, shrimp farming, socio-economic impact, environmental impact, Bangladesh

## Introduction

Black Tiger Shrimp (*Penaeus monodon*), locally called bagda, is one of the most important export commodities in Bangladesh (Department of Fisheries [DOF] 2014a). Saline-water bagda shrimp is usually known as shrimp, while the Giant Freshwater Prawn (*Macrobrachium rosenbergii*), locally called golda, is usually known as prawn in Bangladesh (DOF

2014a).<sup>12</sup> In addition to bagda and golda, other saline-water shrimp and freshwater prawns are also produced in Bangladesh (DOF 2014b). Fish and fish products contributed 2.01 percent of the total export earnings of Bangladesh in 2012–2013 (DOF 2014b). The shrimp and prawn sector (which includes bagda, golda and other shrimp and prawn species) contributed to about 81 percent of the total export earnings from the fisheries sector in 2012–2013, with bagda and golda making up about 74 percent of the

### Highlights

- Shrimp farming has adversely affected the livelihoods of communities and environment;
- Any economic analysis of shrimp farming must consider its negative impacts on livelihoods and the environment;
- Fundamental changes in the management and regulation of the shrimp industry are necessary to make it a socially and ecologically viable option for poverty alleviation and economic development in Bangladesh.

<sup>1</sup> Bagda thrives in saline or brackish water while Golda, which is cultivated in freshwater ponds and found in most inland freshwater and estuarine areas, needs saline or brackish water only during the early stages of the life-cycle (Environmental Justice Foundation [EJF] 2004).

<sup>2</sup> The term 'shrimp farming' in this paper means saline-water bagda shrimp farming.

total export earnings from the fisheries sector in this period (DOF 2014b). Bangladesh earned about US\$396 million from bagda and golda exports in 2012–2013, of which about US\$304 million (over 76 percent) came from bagda exports (DOF 2014b). In addition to contributing to the export earnings, the shrimp and prawn sector has created employment for a large number of people. Recent figures suggest that about 15 million people in Bangladesh are directly or indirectly dependent on the shrimp and prawn farming and its associated activities for their livelihoods (Ministry of Fisheries and Livestock [MFL] 2014).

The geographic area used for saline-water bagda shrimp and freshwater golda prawn production in Bangladesh has expanded rapidly in an uncontrolled and unregulated manner (DOF 2014a, 2014b; MFL 2014; Environmental Justice Foundation [EJF] 2004) (see Table 1). The total bagda and golda production area in Bangladesh was nearly 52,000 hectares (ha) in 1983–1984 and nearly 140,000 ha and 200,000 ha in 1995 and 2002 respectively (EJF 2004). Out of 200,000 ha in 2002, nearly 170,000 ha (over 37,000 farms) were under bagda production and about 30,000 ha (approximately 105,000 farms) were under golda production (EJF 2004). The total bagda and golda production area in Bangladesh in 2012–2013 was nearly 275,274 ha, of which nearly 210,053 ha were under bagda production and nearly 65,221 ha were under golda production (DOF 2014b). The environmental and ecological impacts of bagda farming are high compared to golda farming (Ahamed et al. 2014). In addition to the majority of environmental and ecological impacts (e.g. soil degradation, salinisation of freshwater supplies, decline in freshwater fish species, and decrease in vegetation coverage and trees), the majority of socio-economic problems (e.g. agricultural production, land-use patterns, land conflicts, and negative impacts on people's health and livestock) are also linked to bagda production (EJF 2004).

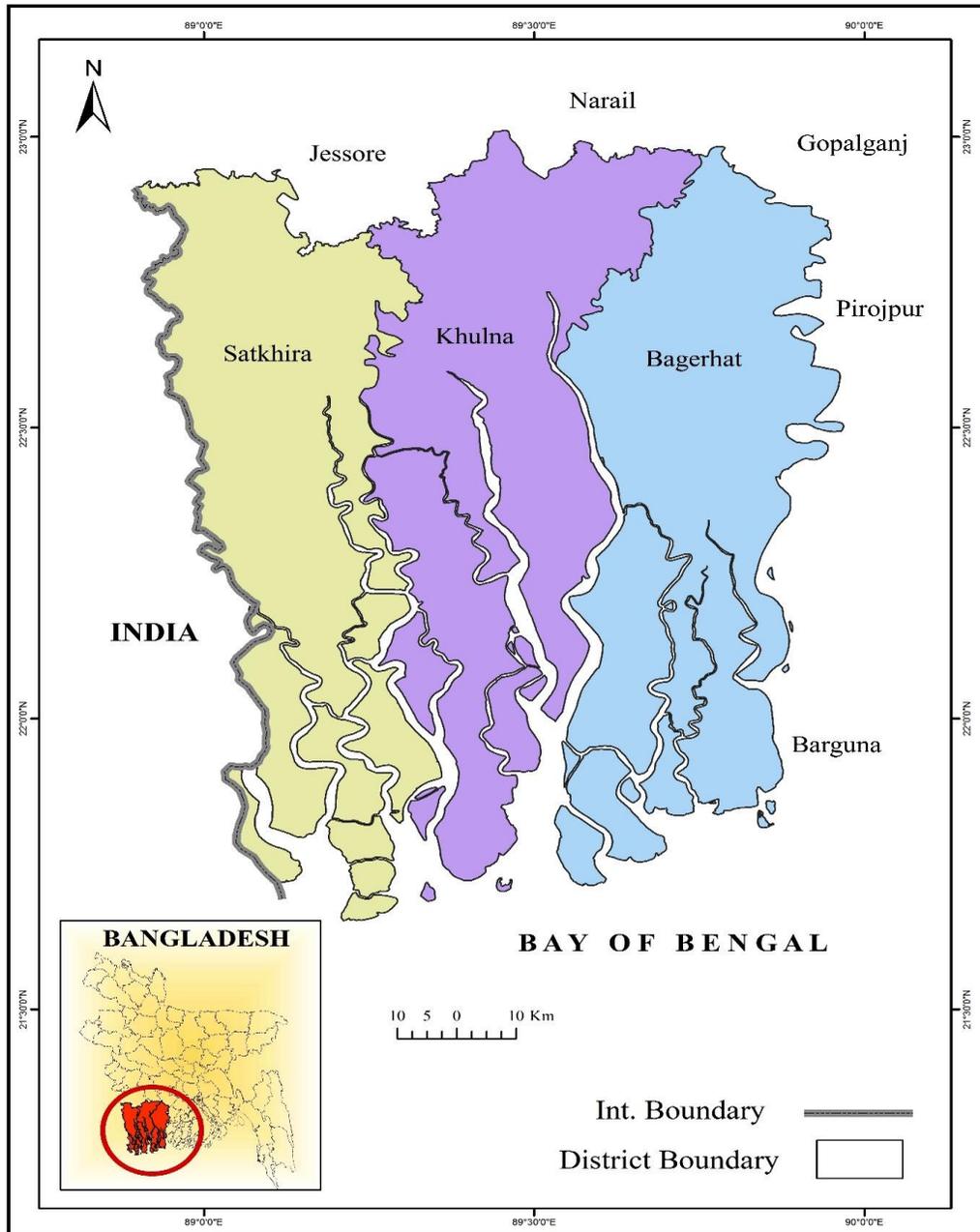
Bagda and golda production is concentrated in the Bagerhat, Khulna, and Satkhira districts of the south-western coastal region of Bangladesh (DOF 2014b) (Figure 1). These three districts include about 72 percent of the total area under bagda and golda cultivation of Bangladesh. These three districts include 74 percent of the total area under bagda production in Bangladesh (155,603 ha out of 210,053 ha) and contribute 76 percent of the country's total bagda production (DOF 2014b). These three districts also include about 66 percent of the total area under golda production in the country (42,688 ha out of 65,221 ha) (DOF 2014b). The areas under bagda cultivation in Bagerhat, Khulna, and Satkhira are 51,799 ha, 37,035 ha and 66,769 ha respectively (DOF 2014b). The other coastal districts of Bangladesh that have a considerable area under bagda production are Cox's Bazar (43,377 ha), Patuakhali (7,009 ha), Chittagong (2,805 ha) and Jessore (922 ha). These seven districts (Bagerhat, Khulna, Satkhira, Cox's Bazar, Patuakhali, Chittagong and Jessore) represent about 99.80 percent of the total area under bagda production in Bangladesh (DOF 2014b).

This paper, based on secondary published literature, explores the socio-economic and environmental impacts of saline-water bagda shrimp farming in three districts of the south-western coastal region of Bangladesh, namely Bagerhat, Khulna, and Satkhira. The paper is divided into three sections. The first section briefly presents the emergence of commercial saline-water bagda shrimp farming in Bangladesh; the second explores the socio-economic and environmental impacts of saline-water bagda shrimp farming in Bagerhat, Khulna, and Satkhira districts; and the third concludes with some possible solutions to address the adverse socio-economic and environmental impacts of saline-water bagda shrimp farming.

**Table 1:** Farmed area and production of bagda shrimp and golda prawn in Bangladesh.

Year	Bagda (Shrimp)		Golda (Prawn)	
	Area farmed (ha)	Production (MT)	Area farmed (ha)	Production (MT)
2007–2008	172,817	42,593	45,060	24,296
2008–2009	172,817	49,710	45,060	27,412
2009–2010	186,145	43,154	60,052	30,636
2010–2011	213,617	56,569	62,874	30,868
2011–2012	209,456	57,784	65,777	45,162
2012–2013	210,053	68,948	65,221	43,713

Source: DOF 2014a



**Figure 1.** Location map of Bagerhat, Khulna and Satkhira (Source: Author)

**The emergence of commercial saline-water bagda shrimp farming in Bangladesh**

Local people have practiced a limited-scale traditional coastal aquaculture, known as *bheri culture*, for centuries (Swapan and Gavin 2011). They used to practice *bheri culture* in their paddy fields from January/February to June/July (without fry harvesting, stocking, artificial feeding, liming, fertilisation, or aeration), in addition to rice production during the monsoon season (Ahmed et al. 2002; Habiba et al. 2013; EJV 2004). However, the

Coastal Embankment Project (CEP) – a government project to create a green revolution in agriculture that began in the 1960s – has left no options for rice production as it created permanent saltwater logging in cultivable lands (Swapan and Gavin 2011).

The government implemented the CEP to increase agricultural production by converting coastal tidal plains into freshwater areas in the south-western coastal region (Islam 2006; Swapan and Gavin 2011). As a part of the project, many polders (areas surrounded by dykes or embankments and hydrologi-

cally separated from the main river) were built (Swapan and Gavin 2011; Islam 2006). Although polders contributed to the increased agricultural production by saving crops from flooding and salinity in the initial phase, the successes from the polderisation soon disappeared (Islam 2006). As the polders prevented the inflow of silts to the plains, heavy siltation occurred outside the polders and saline-water flowed over the high embankments and submerged the low-lying agricultural lands within the polders (Swapan and Gavin 2011). However, as sluice gates became blocked with silt, draining out the water through the sluice gates was not possible. Thus, polderisation has created permanent saltwater logging within the polders (Swapan and Gavin 2011).

A few farmers started small-scale shrimp farming in their saltwater-logged agricultural lands with no agricultural alternative. As the practice gradually spread, surrounding areas became affected by the increased salinity and the region became the victim of a 'Green Revolution' due to government policy failures (Swapan and Gavin 2011). This man-made hazard brought an end to the limited-scale traditional shrimp culture and forced local farmers to be engaged in small-scale shrimp farming. This man-made hazard also created a favourable environment for large-scale commercial shrimp farming in the south-western coastal region of Bangladesh by making rice cultivation a financially less-viable option as agricultural lands lost fertility due to salinity (Swapan and Gavin 2011).

In addition to the lack of financial viability of rice cultivation, the increased international demand and high prices for shrimp products attracted outside investors and turned the small-scale shrimp farming into large-scale commercial shrimp farming. The high market demand, cheap land, available labour, and available wild shrimp fry provided a unique opportunity to outside investors and local large landholders to be involved in large-scale commercial shrimp farming. This rapid expansion of the commercial shrimp farming converted agricultural land and mangroves, often forcibly, to shrimp farming areas (Islam 2006; Swapan and Gavin 2011).

Favourable government policies, tempted by the international export markets and the prospects of huge profits that these would bring, also contributed to the rapid development of commercial shrimp farming in Bangladesh (Masum 2008; Swapan and Gavin 2011). The government of Bangladesh considered shrimp farming as an industry in its *Second Five-Year Plan 1980–85* and took various measures to increase shrimp

production (Swapan and Gavin 2011). Shifting the development strategy of the country towards export-oriented activities also created policies favourable for the industry. Reforms performed under the World Bank and IMF structural adjustment programmes (1980–1990s) to liberalise trade provided policy initiatives and fiscal and financial incentives that supported the shrimp sector to become an export-oriented industry (EJF 2004).

Government facilities that helped the industry include fiscal incentives for exports, preferential loan rates, subsidised credit, a nine-year tax holiday, income tax rebates, leasing of government *Khas* land on favourable terms, an indirect subsidy equivalent to US\$5.8 million to bagda production per year, and institutional support for processing industries (EJF 2004). In addition, various projects undertaken with support from donor agencies, including the World Bank and UNDP, also accelerated the commercialisation of the shrimp sector (Swapan and Gavin 2011; EJF 2004). For instance, the Shrimp Culture Project (1986–1993) that was implemented in the Khulna and Cox's Bazar districts with the support from the World Bank (IDA) and UNDP intensified the production of saline-water bagda shrimp and increased the quantity of exports through infrastructure and technology support (World Bank [WB] 1994). Thus, the international market demands and high prices paid for shrimp products, and favourable government policies, in addition to the permanent saltwater logging in cultivable lands that resulted from the failure of a government project have led to the commercialisation of saline-water bagda shrimp farming in Bangladesh.

### **Impacts of saline-water bagda shrimp farming on people and the environment**

Shrimp farming has significantly reduced the area available for rice production by converting paddy fields into shrimp farms (Ali 2006).<sup>3</sup> A study in two unions under Koyra Upazilla of Khulna District reveals that almost 90 percent of the land previously used for rice and vegetable production has been converted into shrimp ponds (Swapan and Gavin 2011). Furthermore, shrimp farming has significantly reduced the

<sup>3</sup> The expansion of saline-water shrimp farming occurred based on the expansion of area under shrimp farming instead of intensification of the shrimp production (Karim 2006). Shrimp farming in Bangladesh is mainly based on traditional extensive or improved extensive methods although some large-scale commercial shrimp farms practice semi-intensive or intensive farming methods (DOF 2014a; Swapan and Gavin 2011; Karim 2006; Ali 2006).

productivity of lands. Shrimp farming causes soil degradation by increasing soil salinity and acidity, and by depleting soil nutrients, and thus lowers rice production significantly (Ali 2006). Shrimp farming also increases the salinity levels of the ground and surface water as saline water from shrimp farms seeps into ground and surface water (Abedin et al. 2012; Habiba et al. 2013; EJF 2004). Ali (2006) found that rice production in a village in the Satkhira District declined 62 percent between 1985 and 2003 due to shrimp farming, although the population in the village increased from 888 to 1324 people over the same period. Thus, shrimp farming – by contributing to the drastic reduction in rice production – has increased food insecurity among the small and marginal farmers of the study village (Ali 2006). As the economy of Bagerhat, Khulna and Satkhira districts is predominantly agricultural, the decline in the rice production area and the productivity of lands due to shrimp farming has negatively affected the livelihoods of those people in these three districts who are dependent on agriculture.

It is worth noting that the coastal region of Bangladesh has been experiencing severe soil and water salinity in recent years (Ministry of Environment and Forests [MoEF] 2005; Habiba et al. 2013) and the problem of soil salinity is much higher compared to water salinity (Habiba et al. 2013)<sup>4</sup>. Out of 2.85 million ha of the arable coastal land in Bangladesh, about 1.2 million ha suffer from various levels of salinity (MoEF 2005) and almost 20 million people in the coastal region have been affected by salinity in drinking water collected from natural sources (Habiba et al. 2013).

Salinity has greatly reduced agricultural production in the coastal region through a lack of freshwater for irrigation and soil degradation (Abedin et al. 2012). It has significantly reduced rice production – the most important agricultural crop in the coastal region and the source of food for most Bangladeshis (Pender 2010; Abedin et al. 2012; Habiba et al. 2013). Key causes of the increased salinity in the coastal region of Bangladesh include a rise in the sea level, reduced flow in the Gorai River during the dry season, high tidal flooding, withdrawal of water at Farakka Barrage in India, excessive use of groundwater, faulty management of coastal polders, and the rapid

expansion of shrimp farming (Habiba et al. 2013; MoEF 2005). Sea level rise due to climate change has worsened the salinity problem and is predicted to worsen (MoEF 2005). Though the problem of salinity intrusion exists across the coastal region, high salinity levels are particularly concentrated in the three districts of Bagerhat, Khulna, and Satkhira in the south-western coastal region of Bangladesh (Pender 2010) and thus, the negative effects are also severely experienced in these districts (Habiba et al. 2013).

Although the salinity intrusion is not uniquely linked to shrimp farming, the expansion of saline-water bagda shrimp farming has intensified the salinity problem over time in the south-western coastal region, particularly in the districts of Bagerhat, Khulna and Satkhira (Habiba et al. 2013; Abedin et al. 2012; EJF 2004; Dev 1998), as almost three-quarters of the total area under bagda shrimp production in the country is in these districts (DOF 2014b). Saline-water bagda shrimp farming has exacerbated the salinity problem in these districts as soil salinity levels in the shrimp farming areas can be up to 500 percent higher compared to the non-shrimp farming areas (Habiba et al. 2013; EJF 2004), and because shrimp farming increases the salinity levels of the adjacent freshwater sources through seepage (Habiba et al. 2013).

Higher salinity levels in water sources due to shrimp farming have severe negative impacts on people's health and well-being (Habiba et al. 2013). Salinisation of freshwater supplies due to shrimp farming causes scarcity of drinking water, as well as water needed for other daily activities such as bathing and cooking (Abedin et al. 2012; EJF 2004). Salinisation of freshwater supplies increases hardships for women, particularly pregnant and lactating women, and adolescent girls since they are primarily responsible for collecting drinking water from distant sources (Abedin et al. 2012; Ahmed 2008). In some areas, women and girls need to walk three to four hours a day to collect drinking water from distant sources as all nearby water sources are affected by high salinity, and thus, they lack enough time or energy to manage other household activities and to concentrate on their physical and mental health (Ahmed 2008; Abedin et al. 2012). In addition, drinking saline water due to the unavailability of freshwater causes various waterborne diseases, such as diarrhoea and cholera, and other diseases, such as kidney stones and rheumatism (Habiba et al. 2013). Moreover, high levels of salinity in drinking water might cause hypertension in pregnancy, resulting in various adverse maternal and fetal outcomes in coastal Bangladesh (Khan et al. 2011).

<sup>4</sup> Soil and water salinity in Bangladesh is high during the dry season (January–July). Saltwater intrusion occurs during March–May and the salinity concentration in the rivers and canals is the highest in May. Saline water reaches to 40 percent area of the country in the dry season while it reaches to 10 percent area of the country in the rainy season (Habiba et al. 2013).

Shrimp farming has also caused the gradual decline in other agricultural and homestead crops, various fruit and woody trees, and homestead vegetables (EJF 2004). Shrimp farming, by increasing salinity, has caused the gradual disappearance of the salt-sensitive species, such as jackfruit, mango, guava, sapota, black plum, palm tree, and hog-plum (EJF 2004). A study in the Shyamnagar Upazilla of Satkhira District shows that shrimp farming is linked to a reduction of tree coverage by 68 percent in the study area during the period 1985–2000 (EJF 2004).

Shrimp farming has also reduced fodder sources and increased mortality rates of livestock (EJF 2004). The reduction in grazing lands due to the conversion of grazing lands into shrimp ponds, and the reduction in rice production areas and resulting decline in rice crops, have reduced animal fodder such as paddy straw (Ali 2006; EJF 2004). The reduction of animal fodder, as well as pollution and salinisation of water supplies due to shrimp farming, has caused an increase in livestock mortality in shrimp farming areas (EJF 2004). A study in a village in the Satkhira District shows that shrimp farming caused a marked decline in the livestock population in the village between 1985 and 2003, during which time the livestock population declined from 630 to 168 (Ali 2006). Sometimes, farmers are forced to sell their livestock due to reduction in grazing lands (EJF 2004).

The decline in livestock, agricultural crops and tree coverage also reduces traditional fuel sources, such as cattle dung, paddy straw and tree branches (EJF 2004). Thus, villagers are increasingly buying fuel wood from markets (EJF 2004). The reduction in traditional fuel sources is also partly responsible for the exploitation of the Sundarbans<sup>5</sup> (the largest mangrove forest

in the world), by fuel collectors in the south-western coastal region, particularly in Bagerhat, Khulna and Satkhira districts (EJF 2004).

Shrimp farming is also causing the decline in freshwater fish species (Ali 2006; Habiba et al. 2013). Increased salinity is causing the gradual disappearance of some of the native freshwater fish species, such as *boal*, *katla*, *koi*, and *ruhi* (Habiba et al. 2013). Shrimp ponds restrict traditional users' access to common lands and coastal and wetland resources, and negatively affect the livelihoods of communities, especially landless people since they are dependent on access to common resources and *Khas* (government-owned) land for maintaining their livelihoods (EJF 2004). It is worth mentioning that large shrimp farmers sometimes become the owners of the common property resources, such as grazing lands and open water bodies, through illegal occupation (Masum 2008).

Unplanned and unregulated saline-water bagda shrimp farming through the conversion of mangrove forests into shrimp farms has considerably reduced the mangrove forests (Masum 2008; Dev 1998; EJF 2004; Habiba et al. 2013). The conversion of the mangrove forests into shrimp farms has destroyed the breeding habitat of many fishes and increased the erosion of the shorelines (Masum 2008). This conversion also has serious adverse impacts on the traditional livelihood practices of the local communities in the Bagerhat, Khulna and Satkhira districts, as a considerable number of people from local communities are directly or indirectly dependent on various forest resources (Masum 2008; Swapan and Gavin 2011).

Although substantial economic benefit is the major reason for the increased commercial saline-water bagda shrimp farming, it is the outside leaseholders and local large shrimp farmers that mainly receive economic benefits. In most cases, small landowners convert land into shrimp ponds or lease their lands to the owners of the shrimp farms (large landholders of the village or the outsiders, and often alliances between two parties) since they are trapped by surrounding shrimp ponds (Swapan and Gavin 2011). In some cases, socially and politically influential and wealthy shrimp farmers purposefully inundate large areas of agricultural land with saline water when they fail to take lease of agricultural land from small and marginal farmers. Thus, small and marginal farmers feel compelled to lease their paddy fields to socially and politically influential and wealthy shrimp farmers as they fear the loss of their rice production due to the increased salinity intrusion in their paddy fields

<sup>5</sup>The Sundarbans, most of which is in Bangladesh, with the remaining part in India, is well known for its wide variety of flora, fauna, and aquatic life. Over 270 species of birds, 35 species of reptiles, 42 species of mammals (including Royal Bengal tiger), and 400 species of fish are found in the Sundarbans (Government of Bangladesh [GOB] 2008). The Sundarbans serves as a protective barrier for the millions of people in the south-western coastal region against cyclones by reducing the intensity of both the cyclonic wind and the storm surge (Saha and James 2017; GOB 2008). Increased salinity has already adversely affected the ecosystem of the Sundarbans (Habiba et al. 2013), and is considered to be one of the main reasons for the death of Sundari trees – the most dominant tree species in the Sundarbans (Habiba et al. 2013; Abedin et al. 2012) – and for slowing down the plant growth and reducing the productivity of the forest (Habiba et al. 2013).

following the inundation of the paddy fields with saline water. However, as these farmers no longer have the option to cultivate rice and so need to lease their paddy fields to powerful and wealthy shrimp farmers, the lease conditions are set by the powerful and wealthy shrimp farmers (Dev 1998). It is often reported that small and marginal farmers do not prefer shrimp farming since they lack sufficient land and capital to start commercial shrimp farming, and as they adopt extensive cultivation instead of intensive systems when they use land for shrimp farming, they receive less profit (Swapan and Gavin 2011). Therefore, high profits and salinity of land by surrounding shrimp ponds are major reasons for the accelerated shrimp farming, although the former is mainly related to large landowners and outsiders, whereas the latter is related to small landowners.

Although shrimp farming has created employment, landless farmers and agricultural labourers are the most affected groups since the same amount of land used for shrimp farming requires fewer people to be employed compared to agriculture (Swapan and Gavin 2011; Karim 2006). A study in Koyra Upazilla in the Khulna District reports that shrimp farms absorbed less than 10 percent of the villagers who had lost jobs due to the conversion of agricultural lands to shrimp ponds (Swapan and Gavin 2011). Another study, in Rampal Upazilla in the Bagerhat District, shows that the introduction of shrimp farming increased unemployment from zero percent to 19 percent among males, and from 46 percent to 55 percent among females during the period 1975–1999 (Karim 2006). The same study also revealed that agricultural employment over the same period declined from 75 percent to 38 percent among males, and from 37 percent to zero percent among females.

It is worth noting that about 50 percent of total employed people in the shrimp and prawn sector in Bangladesh are fry collectors who are from the poor sections of the coastal communities (Masum 2008).<sup>6</sup> Among all fry collectors, about 40 percent are male, about 30 percent are female, and about 30 percent are boys and girls (United States Agency for International Development [USAID] 2006). However, all fry collectors – who make up 50 percent of the total number of employed people – receive only 6 percent of the profits generated by the shrimp and prawn sector (Masum 2008). It is also reported that, during the lean season,

the majority of fry collectors take loans from the local small-scale buyers of fries and sell the fries to the lenders at a price determined by the lenders (Masum 2008; USAID 2006).

The conflicts of interest between large local farmers and outsiders, and small-scale farmers and landless people, have caused severe land conflicts in this region. A study reports that 150 incidents of land conflicts occurred in some of the villages of Koyra Upazilla of the Khulna District between shrimp farm owners and villagers in the year preceding the study (Swapan and Gavin 2011). These violent conflicts often resulted in deaths (EJF 2004). Wealthy and powerful shrimp farmers often file false cases against people who oppose shrimp farming to harass and intimidate them, and it is reported that people who oppose shrimp farming often find themselves wrongly imprisoned due to these false allegations (EJF 2004). These incidents reveal who benefits and who loses from shrimp farming: apart from a few exceptions, only large local landholders and outside investors who take control of land through capital and alliances with local large landholders, gain from the conversion of agricultural land to shrimp ponds. Economic benefits received by the communities are either minimum or negative because of the outflow and polarisation of profits (Swapan and Gavin 2011).

### Conclusion and recommendations

Despite some positive aspects, saline-water bagda shrimp farming has created serious socio-economic and environmental problems in the Bagerhat, Khulna and Satkhira districts of the south-western coastal region of Bangladesh (Karim 2006; Islam 2006; Swapan and Gavin 2011). It has adversely affected the livelihoods of small and marginal farmers and landless people (Karim 2006; Swapan and Gavin 2011). Unplanned and unregulated expansion of bagda shrimp farming has not only destroyed the mangroves, but has caused an increase in the salinity problems and has thus adversely affected soil, water, agriculture, fishery, the ecosystem, and the livelihoods of communities in these districts (Habiba et al. 2013). Although there is no doubt that bagda shrimp farming under present circumstances is beneficial for a small group of people, the benefits to society are minimal, or even negative, because a small group of people appropriate the profit at the cost of the livelihoods of the majority and damage to the environment. Any economic analysis of bagda shrimp farming should consider the cost of environmental problems and the negative social and economic impacts (Karim 2006). The long-term benefits of bagda shrimp farming can

<sup>6</sup>About 425,935 individuals in Bangladesh worked as bagda and golda fry collectors during the peak season in 2005 and most of them were landless (USAID 2006).

only be achieved through the development of environmentally sustainable shrimp farming. This will address the socio-economic and environmental problems generated by shrimp farming, and ensure the survival of shrimp farming. If not managed according to environmental sustainability practices, the apparent success from the bagda shrimp farming cannot continue.

Some of the earlier important government policy documents such as the National Fisheries Policy (Ministry of Fisheries and Livestock [MFL] 1998) and the Coastal Zone Policy (Ministry of Water Resources [MWR] 2005) contain guidelines in relation to shrimp farming. However, these guidelines, particularly guidelines regarding shrimp farming in the National Fisheries Policy (MFL 1998), were not adequate to address the negative socio-economic and environmental impacts of shrimp farming. Nevertheless, the National Fisheries Policy emphasises environmentally friendly shrimp farming and supports an integrated cultivation of shrimp and rice in rotational or concurrent system (MFL 1998). Likewise, the Coastal Zone Policy (MWR 2005), which does not directly address the negative impacts of shrimp farming, also emphasises an environmental friendly and socially acceptable shrimp farming industry, and the introduction of internationally accepted quality control measures in the shrimp sector. Although the National Adaptation Programme of Action (NAPA) (MoEF 2005) mentions that the salinity intrusion due to climate change will have serious adverse effects on agriculture and the availability of freshwater in the coastal area of Bangladesh, and identifies that inundation of the land with saline water for shrimp farming as one of the key reasons for salinisation of the coastal land, it does not suggest any measures to address the adverse effects of salinity induced by shrimp farming.

However, the National Shrimp Policy (MFL 2014) contains some restrictive policies, such as banning the expansion of shrimp farming in the mangrove forest; restricting the size of bagda shrimp farms to 30 acres; requiring prior approval from the concerned authority for the use of suitable coastal agricultural lands only for shrimp farming; requiring permission from landowners to introduce saline water in their lands for shrimp farming; and stopping seepage of saltwater from shrimp ponds into the adjacent agricultural lands. These restrictive policies, if enacted, can play an important role in addressing many of the negative socio-economic and environmental impacts of shrimp farming. It is worth mentioning that although the

National Fisheries Policy (MFL 1998:7) also contains a policy regarding banning the expansion of shrimp farming in mangrove forests, or the destruction of mangrove forests due to shrimp farming, the policy was never successfully translated into action.

To address the negative impacts of saline-water bagda shrimp farming, both economic and regulatory policy options need to be applied. The following policies should be applied immediately to address the problems:

- The government should consider negative externalities as a cost and should take measures to ensure that the indirect costs to society, such as water and soil salinity, destruction of mangroves and livelihoods resulting from saline-water bagda shrimp farming, are borne by shrimp farmers themselves. Government needs to devise economic policy options to impose costs of negative externalities on shrimp farmers (Ascher 1999).
- The government should remove or reduce subsidies, tax holidays and other financial incentives that exacerbate shrimp farming induced socio-economic and environmental problems through exploitation, and distort traditional land use of the region.
- A code of practice that ensures the responsible use of chemicals and drugs in shrimp farming should be developed and implemented. Strong monitoring is required for chemical use, and social and ecological impacts. Better coordination among various government agencies is required. NGOs can also be given the responsibility for monitoring. Economic incentives and disincentives should be provided for compliance and non-compliance with the code of practice.
- Land zoning is necessary to manage diverse uses of limited land (MFL 1998, 2014; Ministry of Land [ML] 2001; MWR 2005). Land zoning will minimise the unplanned expansion of shrimp farming by identifying agricultural zones, shrimp zones and integrated zones where both agriculture and shrimp farming can be practiced. Besides, areas that should be protected to maintain ecological balance and areas that are needed for grazing of livestock and common access should also be clearly classified through land zoning. Shrimp farming outside the demarcated area should be strictly prohibited.
- Immediate steps should be taken to protect the expansion of shrimp farming in the mangrove areas to ensure ecological balance (MFL 1998).

- Tree plantations should be encouraged in shrimp farming areas to ensure ecological balance.
- Government-owned (*Khas*) land should be distributed among the landless coastal people instead of being leased to shrimp farmers (MWR 2005). Appropriate measures should also be taken to return lands that have been illegally occupied by shrimp farmers to local communities.
- Appropriate measures should be taken to ensure that shrimp farms do not lead to salinisation and pollution of freshwater supplies and adjacent agricultural land.
- Shrimp farmers should be provided with appropriate training to improve existing farm management practices.
- Alternative livelihood opportunities need to be developed for people who lost their livelihood or experienced reduced livelihood options due to shrimp farming.
- Provisions should be introduced to ensure that the shrimp farms employ workers from the local community (to the extent possible) and that the employers conform to the labour rights and standards set by the national laws and International Labour Organisation (ILO).
- The establishment of a fund, with contributions from fees and taxes on earnings from the shrimp sector, to compensate people whose livelihoods were damaged by shrimp farming, and to restore and protect mangrove forests, wetland habitats and agricultural lands.
- Undesired breaching of polders by shrimp farm owners should be prohibited and, where necessary, should be done in an appropriate way. Co-management of polders is necessary to stop undesired breaching of polders by shrimp farm owners.
- An independent body should be established to investigate human rights abuses and land conflicts associated with the shrimp industry.
- Consultation with and participation of all stakeholders should be prioritised in the development and monitoring of the shrimp industry.

Finally, saline-water bagda shrimp farming may have a future role to play in poverty alleviation and the economic development of Bangladesh. However, promoting bagda shrimp farming as a strategy for poverty alleviation and economic development requires fundamental changes in the management and regulation of this industry to address adverse socio-economic and environmental impacts associated with

bagda shrimp farming; this will only be possible when the issues of social equity and environmental sustainability are placed at the centre of the management of the bagda shrimp farming. If this industry continues in its current form, it has no role to play in poverty alleviation and the long-term economic development of Bangladesh.

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