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## Research Article

# Sustainability Challenges to Giant Freshwater Prawn (GFP) Firming Sector in Bangladesh: Lesson to Ensure Sustainable Economic Growth

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## Abstract

**Background:** Vibration of economy of many agriculture-based countries likewise Bangladesh sometime greatly relies on foreign remittance gained through exporting the Giant Freshwater Prawn (GFP). **Methodology:** Manifold constraints restrict the furthering and sustainable growth of this sector. The main constraints that contribute slowing the progress include: Lack of upgraded production technology, absence of well-timed international marketing policy and strategy, increased production cost developed through manual operations of different production and distribution circles. **Results:** This study advocates that with an assurance of implementation of a realistic pattern, the sustainably viable sector would be able to contribute in fostering the sustainable economic growth. In order to map the gaps, sustainability challenge is framed by looking at the possible enhancement and the existing position compared to what the state provided in the last two-three decades to the prawn farming. **Conclusion:** This study also provides a legislative direction to boost the marketing strategy, process for production, quality assurance, traceability and other relevant requirements that policy-maker of the sector may consider as a whole.

**Key words:** Prawn, export potentiality, constraints, sustainability, business challenges, policy

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**Data Availability:** All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Bangladesh is considered as the most suitable places for giant freshwater prawn (*Macrobrachium rosenbergii*) farming in the regions because of its agro-climatic conditions and favorable resources. A huge and abandon water bodies and sub-tropical climate offer a good prospect prawn farming and culture opportunity. There are 10 species of *Macrobrachium* in the catalogue of *Macrobrachium* family currently available in Bangladesh<sup>a</sup>. However, within the total of 24 species of freshwater prawns of *Macrobrachium* family, *Macrobrachium rosenbergii* commonly known as Giant Freshwater Prawn (GFP) is cultured commercially in Bangladesh because of its substantial aquaculture and production potential<sup>1-6</sup>. *Macrobrachium rosenbergii* farming is considered as one of the most significant sectors in Bangladesh during the last two decades and earned a good

amount of foreign currencies. The prawn and shrimp<sup>b</sup> industry is the second largest industry in Bangladesh in terms of export earnings, followed by readymade garments earning US\$348 million per annum with a 5.6% of the total exports<sup>2,7</sup>.

There are 1.2 million households are involved directly in shrimp and prawn farming and 4.8 million households are indirectly linked with the shrimp and prawn farming activities. In addition, further 30,000 households are directly and indirectly associated with marketing<sup>c</sup> which offers diverse livelihood<sup>1,7,8</sup> opportunities<sup>d</sup>. The shrimp and prawn farming are linked with several activities until the production such as by feeding, facets, fertilization, farming (locally known as gher), breeding, dike cropping, harvesting, management and supervision<sup>5,9</sup>. The shrimp and prawn farming are about 75% located in southwest districts mainly in Khulna, Bagerhat and Satkhira regions and the rests are located in Southeast districts mainly in Noakhali and Cox's Bazar regions (Fig. 1).

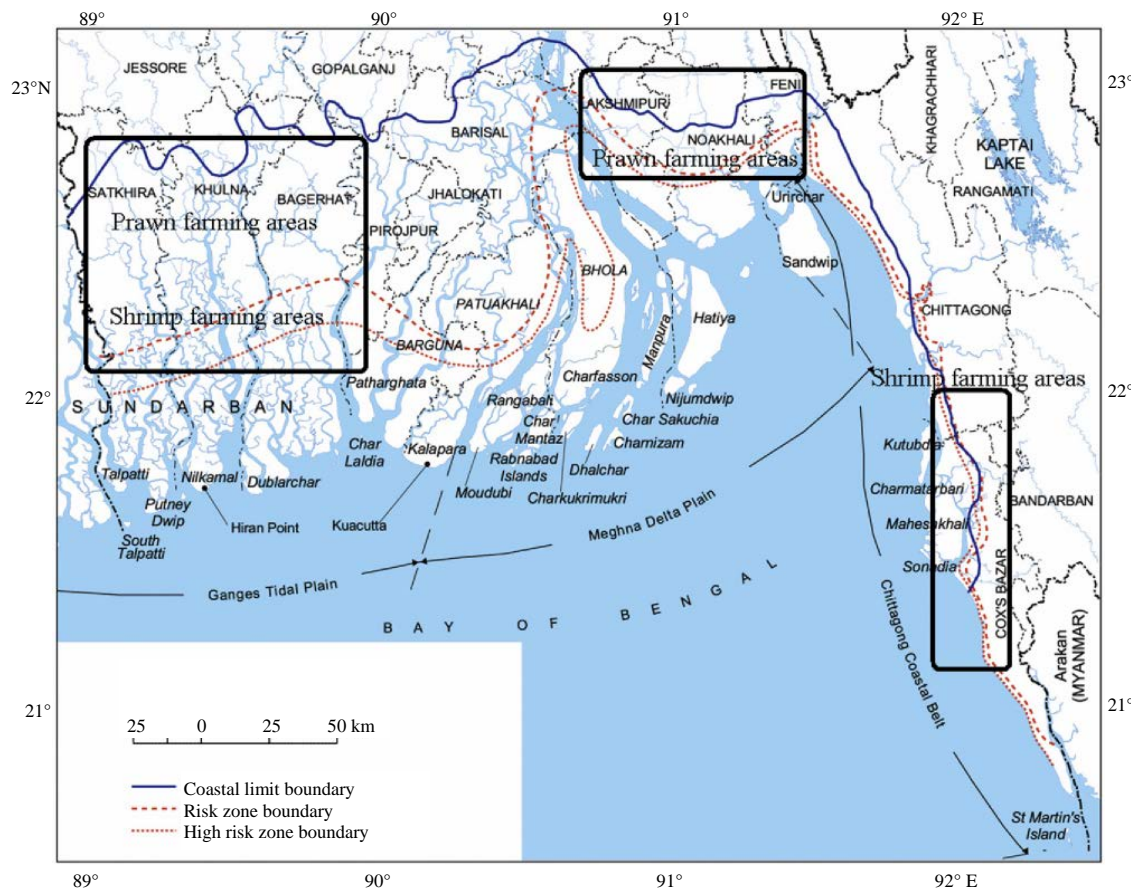


Fig. 1: Prawn and shrimp farming zones in the coastal districts of Bangladesh

<sup>a</sup>The 10 species are 1: *Macrobrachium rosenbergii*, 2: *Macrobrachium malcolmsonii*, 3: *Macrobrachium nipponense*, 4: *Macrobrachium villosimanus*, 5: *Macrobrachium mirabilis*, 6: *Macrobrachium birmanicus*, 7: *Macrobrachium rude*, 8: *Macrobrachium dayanus*, 9: *Macrobrachium lamarei* and 10: *Macrobrachium dolichodactylus*<sup>6</sup>

<sup>b</sup>Known as *Penaeus monodone*

<sup>c</sup>A large number of households are involved in day laborers such as fry traders and wild postlarvae collectors for prawn farming<sup>6</sup>

<sup>d</sup>Particularly, there are about 300,000 households are involved directly in prawn production and 400,000 households are directly and indirectly associated with total prawn farming, postlarvae fishing and marketing related activities<sup>1</sup>

Table 1: Prawn and shrimp farming figures of Bangladesh's 2010-11

Facts	Prawn	Shrimp	National figures
Species information	24	36	60
Scientific information	<i>Macrobrachium rosenbergii</i>	<i>Penaeus monodone</i>	-
Farming areas (ha)	62,875	213,617	276,492
Farming area (%)	23	77	100
Typical farm size (ha)	0.2-0.5	2.5-4	-
Production (t year <sup>-1</sup> )	39,867	84,781	124,648
Production (%)	32	68	100
Productivity (kg ha <sup>-1</sup> year <sup>-1</sup> )	634	397	-
Farmer's numbers	315,000	835,000	1,150,000
Farmer's numbers (%)	27	73	100

Source: Ahmed<sup>1</sup>

The total shrimp and prawn cultivation areas has been increased from 3,500-276,492 ha since mid-1980s to 2010 and out of the total 62,875 ha is under prawn farming alone<sup>2</sup>. The total shrimp and prawn production was 124,648 t in 2010-11 and of which prawn production<sup>2</sup> is 39,867 t. The figures of farming area, farm size and production of both prawn and shrimp are shown in Table 1.

The giant freshwater prawn (*Macrobrachium rosenbergii*) farming is introduced first in the early 1970s, Southwest districts of Bangladesh<sup>10</sup>. Hormuz Ali a local farmer who introduced the wild prawn fry collection technique and spread the technique to the local people to catch prawn fry from the river Ichamati<sup>11</sup> in 1971<sup>e</sup>. Following the techniques, a few local farmers experimented stocking prawn postlarvae in the carp ponds and structured the design, stocking, feeding with other techniques at Fakirhat zone of Bagerhat district (Fig. 1)<sup>12</sup>. During that time the prawn cultivation and farming practice cultivated in the low-lying rice<sup>6</sup> fields<sup>f</sup>. This prawn farming system widely practices after knowing the success of the neighboring farmers with rice and carps fishing until late 1980s<sup>13,14</sup>. The pace for adoption of new technology increased intensely and spread to other zones of Bagerhat and Satkhira districts in 90s. The middle and large scale farmers (including small and marginal) farmers increased prawn farming during that time<sup>14,15</sup>.

Particularly, the expansion of prawn farming and cultivation practice accelerated in the Khulna regions primarily after the adoption of new techniques<sup>15</sup>. However, the increased international market demand attracted more farmers in the other zones of Bangladesh such as southern parts at Noakhali and Patuakhali districts and north-central zones Mymensingh district. Since then the prawn farming initiated fully by cultured commercially<sup>16</sup>. The international donor-funded projects had shown interest in promoting prawn culture in Bangladesh in late 90s and particularly,

the WorldFish Center, CARE by Greater Options for Local Development through Aquaculture (GOLDA), Technology Development Project (ATDP), Winrock International and Greater Noakhali Aquaculture Extension Project (GNAEP) involved in commercial prawn farming<sup>7</sup>. The period until late 90s was considered as the golden time of prawn farming adoption in Bangladesh.

In the early 1990s, prawns exported with an estimated of 5% Cox's Bazaar zone, 35% Noakhali and Comilla zones and 60% from the Bagerhat and Khulna zones<sup>17</sup>. In the 90s Bangladesh widely developed export market demand of prawn and shrimp farming marketing and therefore exported farm outputs in United States, Europe and Japan<sup>18</sup>. The Asian market demand such as in Malaysia, Singapore, Hong Kong and Thailand increased, although the demand declined recently in Japanese market. The prawn's demand increased in European and US and markets since 90s, particularly Netherlands, Belgium, Germany, Denmark and United Kingdom, have huge market<sup>8</sup>. Over the last two decades there has been an increase in the export demand and value of prawn (including shrimp) in the world market<sup>1</sup>. The trends of prawn (including shrimp) production, domestic consumption and export are shown since 1990-2011 in Table 2. The prices of prawn were stagnated largely in the major markets in late 90s to 2003 due to complexities arose to fulfill international 'Standardization Certificate'<sup>8,19</sup>. In 2010-2011, the export value from prawn and shrimp was US\$446 million and exports were 54,891 t, of which the contribution of prawns farming<sup>2</sup> was 30%.

## MATERIALS AND METHODS

### Prawn farming system

**Prawn farming, culture area and farm size:** Bangladesh identified as the promising zone because of the climatic conditions, favorable resources and availability of wild

<sup>e</sup>It is a border at Debhata in the Satkhira district between India and Bangladesh

<sup>f</sup>Keramat Ali regarded as recognise the 'Father of freshwater prawn farming' in Fakirhat zone of Bagerhat district<sup>14</sup>

Table 2: Trends of prawn (including shrimp) production, domestic consumption and export (1990-2011)

Fiscal year	Prawn and shrimp production (t)	Export (t)	Domestic consumption (t)
1990-1991	80,384	17,684 (22%)	48,231 (60%)
1995-1996	116,655	25,225 (22%)	70,791 (60%)
2000-2001	140,350	29,713 (21%)	86,326 (62%)
2005-2006	211,010	49,317 (23%)	121,343 (58%)
2010-2011	239,460	54,891 (23%)	139,658 (58%)

Difference between domestic consumption and export is processed waste, sources: Ahmed<sup>1</sup>, DOF<sup>7</sup>

postlarvae. However, the Southeast and Southwest parts such as Khulna, Noakhali and Patuakhali regions are the most promising zones for prawn culture. There are about 75,000 out of a total of 105,000 prawn farms are located in these zones<sup>20</sup>. Three-quarters of prawn farming are cultured here. Particularly, the climatic conditions and resources such as cheap labor, low lying land and availability of ponds are easily accessible<sup>15,21</sup>. The prawn culture area has increased currently estimated over 50,000 ha which was about 30,000 ha in the early 2000s and 3,500 ha in the mid-1980s<sup>1,20,22,23,g</sup>. This figure is likely to rise with an increasing expansion of prawn farming into new zone and the expansion rate is an average 10-20% per annum since 90s<sup>1,7,22,24</sup>. Even though regions to regions the prawn farm size varies but the average prawn farm size is about 0.28 ha, which is much lower than shrimp farm, is average about 4.0 ha. Particularly, the prawn farm size on an average is 0.23 ha in the Bagerhat zone which is lower than average in Bangladesh<sup>1,9</sup>. In contrast, the prawn farm size is 0.17 ha an average in the Noakhali zone where 29% farmers are involved in pond farming and 71% farmers are involved in gher farming<sup>20,25</sup>. However, the prawn farm size an average is 0.08 ha in Mymensingh zone which is the lowest than any other zones in Bangladesh<sup>9</sup>. Therefore, prawn farms are typically economical than shrimp farms in terms of land and gher uses<sup>1,6</sup>.

**Feeds and feeding of prawns:** To have an effective outcomes feeding schedules of prawns are followed by three feeding periods in Bangladesh: (1) Starter period: It is the first 4 weeks with a rate of 6% of the bodyweight, (2) Grower period: It is the second 12 weeks with a rate of 4% of the bodyweight and (3) Finisher period: It is the last 8-12 weeks with a rate of 3% of bodyweight<sup>6,9</sup>. Generally, a variety of feeds in including supplementary feeds are used in the prawn farming but the preferred feed is *pila globosa* and freshwater snail<sup>15</sup>. Generally, the snails are use during the month of June to October and snail meat is given in the morning and in the evening twice daily. Pelleted feed is also preferred if the feed supply is reduced in snail meat coats. Snail meat was widely used before but recently the

unavailability of snail meat push farmers to use locally made supplementary feed such as rice bran, fish meal, oil cake, cooked rice. However, sometimes pelleted feed also use but that depends on the needs<sup>6,9</sup>.

**Fertilization:** The prawn farming practice is still based on traditional (10,000-18,000 postlarvae ha<sup>-1</sup> year<sup>-1</sup>), semi-intensive (18,000-30,000 postlarvae ha<sup>-1</sup> year<sup>-1</sup>) and extensive techniques (over 18,000-30,000 postlarvae ha<sup>-1</sup> year<sup>-1</sup>) in Bangladesh. There are about 80% of farms practice traditional methods where as only 20% practice and prawns cultivate by intensive and semi-intensive (improved methods) in nature<sup>26</sup>. Traditional methods use mainly zooplankton, phytoplankton and benthos in pond for natural productivity and inorganic or organic fertilizers are irregularly used based on the needs. Semi-intensive methods use pelleted feeds with inorganic and organic fertilizers and intensive methods use supplementary diets with ingredient feeds such as fish meal, wheat bran, oil cake and rice bran. There are two types of fertilizer are used in the prawn farming: (a) Organic fertilizer is mainly cow dung and (b) Inorganic fertilizer is mainly from Triple Super Phosphate (TSP) and inorganic urea. Farmers generally apply cow-dung in the gher farming, as it is relatively available and cheap. On the other hand, farmers also use inorganic fertilizer in the gher system is to generate good quality feed naturally to increase farm production. The annual fertilizer uses rate in the prawn farming system per hectare is 403 kg of urea, 217 kg of TSP and 1,467 kg of cow-dung. Lime is also used to maintain a productive and healthy environment in the farms and the rate is 247 kg ha<sup>-1</sup>.

**Harvesting of prawns:** The peak season of prawn harvesting of gher system in Bangladesh from May-January and farmers harvest prawns several times in a 'Few weeks' intervals. The seine nets and cast nets are usually used in the large and small gher, respectively. However, the seine nets are used in commercial harvesters and cast nets is used by a single farmer or small farmer. The harvesting is operated by such a way that smaller prawns are allowed to grow for the next harvesting in a few weeks intervals. The harvested prawns

<sup>9</sup>The prawn cultivation areas are 62,875 ha in year 2010-2011

are preserved in plastic or aluminium containers until sold to sellers, traders, dealers, buyers, agents, merchants or vendors. Usually, the of production of grade-20 is about 50%, grade-10 and grade-5 is about 10% and grade-30 and grade-50 is remaining 30% of the total production in a gher system. A smaller size of prawns such as less than grade-50 restores in the gher rather than harvest<sup>20</sup>. In contrast, the peak season of prawn harvesting of ponds system in Bangladesh from October-December and farmers continue up to next year of May to June after generally 6-8 months of stocking. The average size of prawn is about 60-150 g but the larger prawn is found in the Noakhali and Mymensingh zones which is about 175-200 and 400 g, respectively<sup>16,26</sup>.

**Marketing of broodstock:** The demand of broodstock is substantial in prawn farming system. A number of household such as fishermen, suppliers, agents, vendors, traders and transporters are involved in the broodstock marketing chain and system. However, it is less competitive and the market of broodstock such as volume, value and employment level is relatively small. The fishermen are the primary producers of broodstock (i.e., wild) and sell it to the suppliers by local agents and sometime directly supply to hatchery. Mostly, agents are involved to supply the broodstock to hatchery. Agents carry typically 25-30 broodstock weekly from fishermen supplier's depot. The broodstock mortality rate is about 10% and it arises because of poor handling, unmonitored water temperature and sometime long duration of transportation. Additional, 5% broodstock is being wastage during catching and stocking in hatcheries. Hatcheries are connected to suppliers and generally act as fry traders in the chain. Broodstock marketing is usually controlled by agents and suppliers (i.e., intermediaries) who collect broodstock from fishermen. Even though broodstock marketing is seasonal in Bangladesh but agents and suppliers are engaged in trading around the year.

**Production technology:** The average stocking density in Bangladesh is 20,680 ha<sup>-1</sup> of postlarvae but this range may vary from<sup>15,20,26,27</sup> 10,000-30,000 ha<sup>-1</sup>. The production postlarva in the hatchery until recently has been limited as farmers reported hatchery's postlarvae to be inferior in quality. Moreover, the survival rate of wild postlarvae has been found higher than that of hatchery. There are about 87 prawn hatcheries and 38 out of total are currently operational in Bangladesh with a capacity of 10 million postlarvae production of a year. Around 400,000 people are associated with prawn production technology<sup>7,8,28</sup>. Recently, farmers use

Table 3: Prawn farming productivity growth in the regions

Country	Production (kg ha <sup>-1</sup> year <sup>-1</sup> )	References
Thailand	2,338	Vicki <sup>32</sup>
Taiwan	1,500	New <sup>33</sup>
Vietnam	1,000-1,500	Ridmontri <sup>34</sup>
India	600-1,000	Raizada <i>et al.</i> <sup>35</sup>
China	1,500	Weimin and Xianping <sup>36</sup>
Bangladesh	634	Ahmed <sup>1</sup>

Table 4: Prawn farming production and growth rate in Bangladesh

Year	Production (t year <sup>-1</sup> )	Growth rate per year
1995-96	38,327	+33.02
1999-00	59,414	+1.88
2000-01	59,156	-0.43
2001-02	58,241	-0.55
2004-05	82,661	+9.97
2010-11	139,658	+3.13

Sources: Ahmed<sup>1</sup>, DOF<sup>7,30</sup>, USAID<sup>8</sup>

net cages and separate small ponds to improve survival rate of postlarvae. Singh and Vijiarungam<sup>29</sup> also reported similar techniques to improve survival rate of postlarvae in their earlier studies. Generally, farmers nurture postlarvae for 4-6 weeks by a stocking rate from<sup>15,26</sup> 50-100 m<sup>2</sup>. This stocking density is practicing for prawn farming regardless the coastal zone together or other regions in Bangladesh.

**Prawn productivity:** The average yield of prawn was 168 kg ha<sup>-1</sup> year<sup>-1</sup> in yearly 90s and yield was increased a bit to 200-250 kg ha<sup>-1</sup> year<sup>-1</sup> in the late 90s, however, the level of outcome was still low due to practice of the traditional and non-intensive farming process in the prawn farming system<sup>30,31</sup>. The average annual prawn productivity is currently 634 kg ha<sup>-1</sup> year<sup>-1</sup> in Bangladesh. Even though the production has increased over the decade but still the figures is behind to Thailand, Vietnam, China and Taiwan<sup>1,h</sup>. Therefore, it is a fundamental issue to Bangladesh for prawn market sustainability in the international market. Thailand, Vietnam, China and Taiwan use intensive techniques and larger exporters as well than Bangladesh. These countries have also significantly higher yields compared to Bangladesh (Table 3 and 4). The total production of shrimp and prawn was 82,661 t in the year 2004-2005 and of which about 30% was from prawn farming<sup>30</sup>. Since 1995 the total production of shrimp and prawn has been increasing and decreasing in Bangladesh is an irregular pace (Table 4). However, the total production is increasing over decades due to more engagement of farming but the productivity growth is too low compared to other developing nations in the regions. Over the last decade (i.e., year 1995-2005), the annual growth of prawn production was 11.56% in an average and the recent productivity just over 3% which is very low compared to the three decades (1995-1996) earlier (Table 4).

<sup>h</sup>According to Hoq *et al.*<sup>37</sup> the prawn productivity together with fish culture was 162-428 kg ha<sup>-1</sup> year<sup>-1</sup> during 70s

Table 5: Commercial value of prawn in international markets

Grade	Prawn quantity (lb)	Price (US\$/lb)
U-5	Less than 5	7.0
5/7	5-7	6.5
8/12	8-12	6.0
13/15	13-15	5.5
16/20	16-20	5.0
21/25	21-25	4.5
26/30	26-30	4.0
31/50	31-50	3.5

Sources: DOF<sup>7,30</sup>

**Production costs and finance of prawn farming:** The annual production costs of prawn in Bangladesh is about US\$1,343 ha where fixed cost is US\$351 ha<sup>-1</sup> year<sup>-1</sup> and variable cost is US\$992 ha<sup>-1</sup> year<sup>-1</sup> <sup>9,15,28</sup>. The fixed cost includes as land, operating capital, water pump, feed machine and net including interest and depreciation on capital and land. On the other hand, the variable cost considers as labor, fertilizer, feed, seed, harvesting farming, marketing and miscellaneous related issues for the prawn culture system. According to Ahmed<sup>38</sup>, the fixed and variable cost in the prawn farming is an average 39 and 33% of the total cost, respectively. Muir<sup>20</sup> reports that the total cost of prawn production comprise of 4% of labor, 21% of feed and 28% of seed. The money required in the prawn farming is quite substantial for the marginal and small scale farmers. The cost of production of prawn farming recently increased notably due to high cost of labor, price of feed and seed. The financial help from the financial institution is limited in Bangladesh and therefore, about 68% farmers invest own money for farming and culture<sup>9,15,28</sup>. The financial support received by a farmer from the financial institution is about US\$228 year<sup>-1</sup>. National banks provide credit to farmers against collateral land with an interest rate of 15% and most of the small and marginal farmers are unable to take credit. Therefore, a substantial amount of finance is comes from informal and personal sources. Sometimes, farmers finance for farming by disposing of household and personal assets since the beginning of the prawn farming in Bangladesh<sup>12</sup>.

**Prawn marketing:** The production of prawn and its business viability in Bangladesh depends on international market conditions and demands. The international market and demand of prawns was quite strong in the early 1990s with dampen in the year 2000s but the markets have grown since 2005 until to date. The commercial value of prawn in international markets is shown in Table 5. The peak marketing season of prawn is from November to January but the marketing involved around the year. The marketing of prawn in Bangladesh is a linked-value chain of prawn production

from farmers to processing plants for export facilities to international (i.e., including local) markets. The suppliers purchase prawns directly from farmers to the prawn traders. Prawn traders supply prawns directly to the processing plants or sometime via agents within 1-2 days of purchase. The time period of flow of prawns in the processing plants from the gher is about 24-48 h<sup>20</sup>. Consignments generally send for daily trade once adequate amounts of prawn obtain to the processing plants. There are a number of constraints faced by the prawn farming and industry prawn marketing such as poor transport facilities, inadequate supply of ice, power cuts, lacking of storage depots and labor and political unrest<sup>9,20</sup>. The prawn marketing is controlled, financed and managed by powerful intermediaries such as agents, traders and processing plants<sup>9</sup>.

**Processing:** There are 124 shrimp and prawn processing plants for the local and international business in Bangladesh. Currently, 38 processing plants in Chittagong, 35 processing plants in Khulna which are active or operational and 51 have mostly shut-down for shortage of prawn supply and approval procedure of a quality inspection. The total capacity of all processing plants is 165,000 t daily but the operational volume is about 825 t. There are about 45% processed wastage causes in the prawn processing plants during removal of the legs and shell. There are about 600 contract labors are involved in a prawn processing plant in the peak season<sup>7</sup>. Men work more closely with machinery such as block freezing and packaging section and women work more closely with beheading and cleaning of prawns<sup>8</sup>. Processing plants together with shipping agent make shipment prawns to Chittagong or Mongla ports for export marketing in the international markets. The general export capacity of a usual processing plant is about 4.5 t daily in the peak season<sup>7</sup>.

## RESULTS AND DISCUSSION

### Major constraints of prawn farming

**Infrastructure and marketing:** Commercial culture of prawn farming in Bangladesh faces a number of limitations including inadequate supply of postlarvae, mortality, high production costs, high transformation costs, low quality feed, disease, water pollution and flooding<sup>5,15</sup>. However, the literature suggests that Bangladesh is a suitable place for freshwater prawn (*Macrobrachium rosenbergii*) farming in the regions and a huge and abandons water bodies and sub-tropical climate should offer substantial freshwater prawn farming with a good employment opportunity.

Therefore, it is a fundamental question to find an applicable solution of major constraints of prawn farming. Literature suggests that a developed service market has not yet emerged in Bangladesh because of poor market involvement<sup>20</sup>. This is because of the lacking in the dynamics of market infrastructures. Moreover, export oriented prawn farming should be highly interlinked with international markets such as price, demand, supply and quality issues to have a strong interaction with economic, social and sustainability of prawn market, prices, costs and profits of marketing<sup>39,40</sup>.

Remote rural areas are still facing effective accessibility which leads to high transport costs and low profit margins. Farmers are in a weak position in the prawn marketing as they have limited bargaining power on price due to strong position of intermediaries in the marketing syndicate. Farmers are unable to communicate directly with marketing, as market communication is controlled by agents as intermediaries. Sometimes traders are even failing to get a decent profit margin as due to low selling price over the controlling power by agents<sup>5,9</sup>. Local agents are involved in buying prawns from the farmers to the wholesalers and typically in the marketing system they can earn 1-5% commission for services. Another bottleneck of prawn culture is due to insufficient source and supply of postlarvae as the further expansion of farming is heavily depends on it. Recently, climate change effects also place an additional effect as an environmental degradation and pollution to have a sufficient amount of wild postlarvae. Black-spot disease from postlarvae to harvest is affected by bacteria causing mortality and reducing amount of harvested prawns in Bangladesh. Therefore, the overall challenges in the prawn farming are fourfold and those are the fundamental issue in the case of Bangladesh.

**Quality standards:** Until recently Bangladesh had been encountered some standards of qualification problems to maintain during prawn processing. Bangladesh faced standards of qualification problem as traditional practice was used in production process and raw materials easily contaminated<sup>20</sup>. As a consequence, Bangladesh was banned following a detection of pathogenic bacteria and nitro furans in prawn processing. Most of the other Asian countries increased prawn exports to US market as an advantage during that time<sup>5,20</sup>. Another ban was placed in the year 2005-2006 due to nitro furan contamination and it was raising concerns and doubts of the effectiveness of prawn processing and process of inspection. The concern not only focuses for processing plants but also in the prawn farms, hatcheries, depots and feed industries. However, the ban has been lifted recently but still and quality control is a raising concern in prawn farming.

**Financial capital:** Overall the prawn farmers of Bangladesh are economically, educationally and socially having underprivileged for poor financial resource, credit facilities and institutional supports. Prawn farming required a substantial amount of financial capital which farmers most of the times unable to meet from their limited resources. Traders primarily finance prawn farming by disposing of assets to moneylenders with a very high interest rate. Prawn farmers are heavily indebted to middlemen and agents of prawn farming as well<sup>5,41</sup>. Repayments of credits from the middlemen begin from the following month of receiving credits and this kind of costly financing is another major constraint of prawn farming. Social capital has become very popular in the development of prawn farmers during the last decade however, it found not very useful due to strong middlemen's intervention<sup>42</sup>. Unfavorable social environments such as robbery and theft also create risk of losses of livelihood assets that effect to the poor financial resource and credit facilities further<sup>5</sup>.

**International competition:** Bangladesh not only is having underprivileged for poor financial resource, credit facilities and institutional supports but also international competition. The major competitors of Bangladeshi prawn market are currently Thailand, Taiwan, Vietnam and China. The freshwater prawn farms could not make its potential growth in Bangladesh. The records are obvious from the regional prawn farming figures are shown in Table 3. The production of prawn of in Thailand is 2,338 kg (ha year<sup>-1</sup>), whereas, in Bangladesh is 634 kg (ha year<sup>-1</sup>). Bangladesh is also behind of Taiwan (1,500 kg ha<sup>-1</sup> year<sup>-1</sup>), Vietnam (1,000-1,500 kg ha<sup>-1</sup> year<sup>-1</sup>) and China (1,500 kg ha<sup>-1</sup> year<sup>-1</sup>). The local supply chain in the prawn farming is creating a significant disadvantage as small farmers struggle. There are still significant opportunities to help the industry maximize its growth if a realistic pattern is ensured on its operation<sup>3</sup>. The prawn sector in the country is unable to achieve its full potential due to poor quality supply of postlarvae, mortality, high production costs, low quality feed, disease, water pollution and high transformation costs and ultimately low yields that have created a gap between the demand for and supply of prawn to local processing plants. How to narrow the demand and supply gap by increasing farm productivity and vertically integrating the value chain to comply with quality requirement; this is a fundamental question in Bangladesh for the long-run sustainability of prawn farming. Therefore, a strong and effective direction from related agencies on possible actions to enhance in marketing, processing, quality, traceability, finance and other related necessities are surely required immediately by the direct involvement of governments.



**Government's involvement:** A future thrust: The giant freshwater prawn (*Macrobrachium rosenbergii*) farming played an important role in the economy during 90s and it could play further at present to earn foreign currency and to contribute to increase employment opportunities. The literature suggests that the prawn farming had having an underprivileged for poor financial resource, credit facilities and institutional supports from the very beginning<sup>3,9</sup>. There is a huge significant and potential prospect of this sector but government agencies did not play an imperative and vital role to support for the further development. Recently, concerns arise for its long-term sustainability as it is having crucial problems such as poor financial resource, proper credit facilities, poor market infrastructure, high marketing costs, poor transport facilities, poor livelihood assets and inadequate supply of postlarvae, mortality issue, high production costs, high transformation costs, low quality feed, disease, water pollution, flooding and poor institutional support.

This study finds that that an absence of suitable structure and unavailability of institutional support is a key limitation to the progress of prawn farming in Bangladesh. Public agencies such as department of fisheries (DoF), judicial bodies, executive agencies and related ministries and private bodies such as NGOs, processing plants, commercial enterprises and civil society did not work appropriately in the prawn farming. The private sector should lead rather than follow in the development process of prawn marketing, but unsuccessful to push the lead effectively as the level of interaction between public the private sectors was limited in the last decade. Although over the last two decades, the prawn farming have grown positively in terms of volume, but concerns for quality standards have left in a fairly weak place<sup>5</sup>. Credit facilities to the farmers, institutional support and overall infrastructures are essential in sustaining prawn farming in Bangladesh. Thus, overall poor market infrastructures and lack of institutional support affect the livelihoods of farmers and associated members in prawn farming.

However, prawn industry what support received and what support supposed to acquire from the related agencies in the last two-three decades. Prawn farmers are also in a weak position as they have limited bargaining power on price due to strong position of intermediaries and farmers mostly are unable to communicate directly with marketing channel, as market communication is controlled by those intermediaries. Who are responsible to solve this government or market? We understand that an intervention is required to that end but

if we consider that related agencies are incapable to support for their limitations, then will market solve it by its own strategy what Adam Smith mention by his invisible hand? Obviously, no, it is not.

The transforming structures, policies and processes must have a profound influence in the greater prawn farming practice and system mostly absent in Bangladesh. The transforming structures, policies, processes and effective and efficient legislation that should shape overall livelihood such as income, source of revenue, employment, occupation, trade and business opportunity. Understanding institutional processes by the direct government intervention should resolve the barriers and create alternative transforming structures, policies, processes to facilitate the opportunities to sustainable prawn farming. The risk associated with the promotion of export, improvements of market infrastructure, handling, preservation and shipment facilities is a concern and it must not underestimate. Export Promotion Bureau (EPB) and DoF must integrate more efficiently to resolve the weakness in the prawn farming in Bangladesh. The direct involvement such as by the related government agencies and DoF needs to be incorporated further to improve both product competitiveness and quality standard. The direct involvement by the related government agencies should work to resolve inefficiencies of processing systems, marketing and prawn distribution to compete with the regional competitors.

Prawn preservation, curing and handling training facilities would improve by the government and government agencies. The low-interest credit provision would also help to poor farmers to reduce farming risks. The development of export products are directly related with credit facilities for sustainable marketing<sup>43</sup>. Hence, the movement on low-interest credit provision and institutional intervention is a must to promote further the industry. Government should work on the easy access to bank credit with effective institutional arrangements. Private and sector public initiative and investment should act together to understand the potential of prawn marketing growth further and need realize how to expand economic output from this sector. In addition, a positive policy at the government level, services, support and more research are necessary to have an effective vision and visualization for the associated groups in the prawn farming. Therefore, it is a national thrust that the present prawn production and promotion in Bangladesh could be substantially increased through the establishment of effective marketing channel by the direct government intervention within the national economy (Fig. 2).

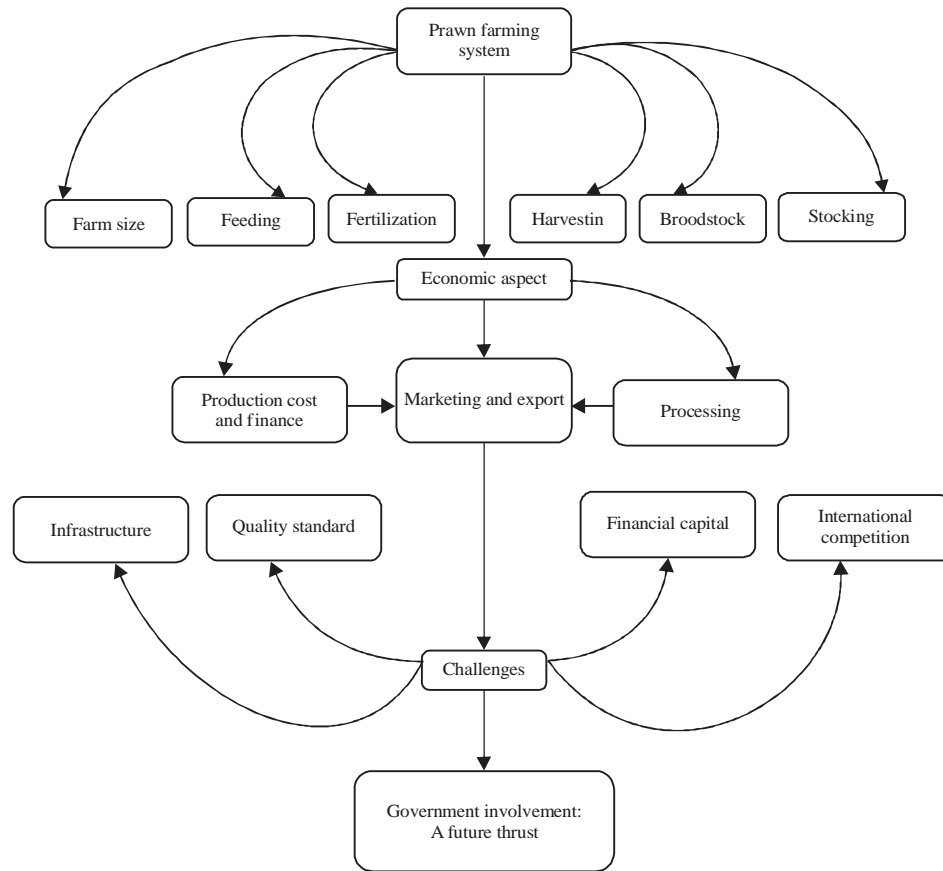


Fig. 2: Linkage: How governments may ensure sustainability to prawn

The prawn farming industry in Bangladesh is a major fundamental division of (a) Farm size, (b) Feeding, (c) Fertilization, (d) Broodstock, (e) Stocking and (f) Harvesting system. It is based on the traditional technologies as mostly innovated by the rural farmers and fishermen. As the correct government and institutional support did not fingered in the key limitation areas; hence, poor market infrastructure affects the livelihoods of farmers and associated groups in all the stages of its production system of the (a-f). Lack of appropriate knowledge of farmers and ignorance of effective practices in prawn farming are some of the obstacle that challenges to sustainability of this industry. There have been a number of setbacks on the production cost, harvesting and finance compared to other regional countries. In addition, there is a lacking in the post harvest quality maintenance and quality control of the exported product. There are several times antibiotic residues such as chloramphenicol and nitrofurans and salmonella have been detected in the exported prawns<sup>1</sup>.

There is also lacking on economic aspect of prawn farming system and development of improved techniques.

The development of improved techniques for brood management, seed production, rearing and grow-out of prawn did not go through consistent research towards the development of sustainability. Particularly, the gap between minimization of production cost, financial facilities, efficient marketing and effective processing system are yet to resolve by the suitable research support. Therefore, the major challenges of prawn farming industry often cause a loss to the marginal farmers are yet to be addressed effectively. Most of the prawn feeds are uncertified for their ingredients. The high price feed which diverted the marginal farmers to look for cheaper feeds, organic fertilizers and animal excreta also affect prawn production and farmers fetch negative economic return. Moreover, as the international competition with Thailand, Taiwan, Vietnam and China as the issue for Bangladesh; therefore, immediate efforts should be made to maintain the quality of the product up to the international level. Strict measures for certification at all levels from the broodstock management to the export should be resolved.

<sup>1</sup>As a consequences, Bangladeshi prawn has earned bad names for the country and the consignments have often been rejected and returned from different EU countries

There are currently 70 freshwater prawn hatcheries are involved for juveniles but their contribution only 2% in the total prawn farming in Bangladesh. The major reason of that low demand is due to low growth and survival rate from hatcheries than from wild juveniles. Research and development programme for broodstock management, improved techniques of juveniles and PL rearing, culture techniques for grow-out systems, health management and disease control, post harvest handling, quality maintenance in depots and quality and traceability issues should be undertaken by direct government support and intervention. Effective prawn farming management and proper application of measures for quality control must ensure sustainable development of freshwater prawn sector. There are three basic problems have recognized in connection to prawn farming such as economic hardship of marginal farmers, input availability and natural hazards that need to be resolved by effective planning.

Although, the ecological position is positive to the further development of prawn farming in Bangladesh, but most of the farmer's position is unfavorable. Therefore, it is a straightforward question: How to resolve the challenges in the prawn farming system? All factors from prawn farming system to government support which are shown in Fig. 2, equally significant for a sustained development of this sector. There is no doubt that government and related agencies are responsible to further improvement and care of the dynamics and nature of the social needs associated to prawn farming. Therefore, there are few recommendations can be taken care of such as government and related agencies (1) Should establish hatcheries to fill the demands of quality fries, (2) Should establish a proper structure to offer credit facilities to the farmers by low interest rate, (3) Should establish aqua feed industries to supply low cost protein supplementary feeds, (4) Should setup training institute to train farmers on new and modern technologies, (5) Should monitor farms frequently and finally and (6) Should take positive steps to develop an effective prawn marketing infrastructure with care and responsibility.

### CONCLUSION

Giant freshwater prawn (*Macrobrachium rosenbergii*) farming sector has been playing a significantly important role for national economy but sadly the sustainability of the sector is under an enormous threat that needs to be addressed as an important and urgent preference by ensuring an effective prawn farming system. Having said that we note that in order to address these constraints outlined throughout this study,

an implementable policy should be in place first; which is to be taken into an elite enforcement with a genuine and honest courage. This sector is currently helping to vibrate the national development of the country at the cost of its own sustainability. If this continues longer, we will lose the swan permanently in exchange of some quick eggs. In such climate, in order to enhance the capability of the community involved within the sector, a continued work-place learning concepts should be introduced by ensuring proper implementation of the model. Our suggestion will only help to take this sector long way when stakeholder's participation shares common interest and equal motivation.

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