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Research Article **Araştırma Makalesi**

Impacts on Aquatic Life for Indiscriminate Exploitation of Baby Shrimp (*Penaeus monodon*) in the Coastal Area, South-Western Region of Bangladesh

Bangladeş'in Güneybatı Bölgesindeki Kıyı Bölgesinde Yavru Karideslerin (*Penaeus monodon*) Ayrım Gözetmeksizin Tüketilmesinin Su Yaşamı Üzerindeki Etkileri

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Abstract: Baby shrimp (*Penaeus monodon*) post-larvae fishing is a major source of income for the most fishermen in the coastal region of the south-western part of Bangladesh during the whole year. These post-larvae collectors lack financial security and are socially regressive. Other aquatic species are destroyed by the indiscriminate exploitation of baby shrimp for aquaculture. According to the present study, about 98-99% of other larvae are destroyed to catch nearly 1-2% of indiscriminate exploitation baby shrimp in our study area where averagely 0.35% *Penaeus indicus*, 0.06% *Penaeus merguiensis*, 0.037% *Metapenaeus monoceros*, 3.58% other shrimp, 6.59% fin-fish larvae, 5.95% crab larvae, and 82.42% small organisms. Actually, the government of Bangladesh already has declared a ban period and outlawed baby shrimp fishing. However, the poor fishermen are fishing continuously in order to maintain their 's livelihood. Furthermore, because of wild baby shrimp are said to have a far higher survival rate than baby shrimp raised in hatcheries, farmers prefer wild baby shrimp. For thousands of Bangladeshi coastal landless and jobless poor people, wild prawn baby shrimp fishing has created employment opportunities. This study describes the impact of wild baby shrimp fishing in coastal area of Bangladesh.

Keywords
- Baby shrimp
- Indiscriminate
- Exploitation
- Bycatch

Özet: Yavru karides (*Penaeus monodon*) avcılığı, tüm yıl boyunca Bangladeş'in güneybatı kesimindeki kıyı bölgelerindeki çoğu balıkçı için önemli bir gelir kaynağıdır. Bu larva sonrası evredeki yavru toplayıcılar finansal güvenceden yoksunlar ve sosyal durum olarakta gerilemekteler . Diğer su türleri de, yavru karideslerin su ürünleri yetiştiriciliği amacıyla ayrım gözetmeksizin kullanılması nedeniyle yok edilmektedir. Mevcut çalışmamız göstermektedir ki ortalama olarak %0,35'i *Penaeus indicus*, %0,06'sı *Penaeus merguiensis*, %0,037'si *Metapenaeus monoceros*, 3,58'i diğer karides, %6,59'u yüzgeçli balık larvası, %5,95'i yengeç larvası ve %82,42'si küçük organizmalar olmak üzere, araştırma alanımızda

Anahtar kelimeler
- Yavru karides
- Ayrım gözetmeksizin
- İstismar
- Hedef dışı av

gelişigüzel kullanılan yavru karideslerin yaklaşık %1-2'sini yakalamak için diğer larvaların yaklaşık %98-99'u yok edilmektedir. Aslında Bangladeş hükümeti hali hazırda bir yasak dönemi beyan etti ve yavru karides avcılığını yasadışı ilan etti. Ama yoksul balıkçılar geçimlerini sağlamak için avcılığa devam etmektedirler . Ayrıca yabani yavru karideslerin, kuluçkahanelerde yetiştirilen yavru karideslere göre çok daha yüksek hayatta kalma oranına sahip olması sebebiyle , balık çiftçileri yabani yavru karidesleri tercih ediyor. Yabani yavru karides avcılığı, Bangladeş kıyılarındaki binlerce topraksız ve işsiz yoksul insan için istihdam fırsatları yarattı. Bu çalışma, Bangladeş'in kıyı bölgelerinde yabani yavru karides avcılığının etkisini açıklamaktadır.

1. INTRODUCTION

Bangladesh is a land of rivers. Brackish water covering the entire southern section of the country is around 710 kilometers wide (Pramanik, 1988). The south-western districts of this country are Satkhira, Khulna, and Bagerhat. One of the grazers of saline water bodies is marine shrimp. Khulna is even known as the place of white gold for shrimp production. The biodiversity of Bangladesh is very rich in fish, mollusks, crustaceans, and other aquatic animals. 151 genera have been identified from the Bay of Bengal which is a habitat to 442 species of fishes, 36 marine shrimps, and about 336 molluscs (Ahamed et al., 2012). This shrimp collection method has caused significant ecological damage over decades. Bycatch from shrimp fishing is common and can account for as much as 65 percent of all caught fry. The collectors entirely discard this bycatch, which results in a great loss for other aquatic species (Das et al., 2016). The fast growth of commercial shrimp farms, indeed focused on export in the country's coastal regions, has significantly raised the demand for baby shrimp over the last 20–25 years (Ahmed et al., 1998). Although many hatcheries have been established here compared to previous years, local fishermen are still involved in the collection of baby shrimp. Generally, they use destructive fishing gear. According to field observation, they claim that natural baby shrimp are more demandable than hatcheries because of their quality and they have no alternative income sources. Since the 1970s, shrimp fry harvesting has expanded in potential as a substitute occupation for the marginal farmers' means of subsistence along Khulna's southwest coastal zone (Mahmood & Ansary,2013). Shrimp farming provided a significant early economic return, expanded rapidly, and quickly developed into a multibillion-dollar business. Large-scale hatchery productions are a possible source of coastal pollution even though hatcheries were developed as a viable alternative and mostly replaced the natural seed source (Islam et al., 2004). In Bangladesh's coastal regions, the interaction between human societies and the environment in this area is highly noticeable. Management of coastal resources has become crucial and essential for reasons related to nutrition, the economy, and the environment (Bergin & Michaelis, 1996). Currently, one of the most significant areas of the national economy is fish farming. Due to its export potential, its development has received a lot of attention during the past 20 years. As a result, a sizable region along the coasts of Khulna, Satkhira, and Bagherhat has been transformed into a prawn farm. The giant freshwater shrimp *Macrobrachium rosenbergii* and the black tiger prawn *Penaeus monodon* are the two species that are most commonly cultivated for their rapid growth in Bangladesh (Ahmed, 2000; DOF, 2002). This study will focus on the extent of damage to shrimp fry by illegal fishing along with other fish fry.

2. MATERIALS AND METHODS

The sampling station in the coastal region of Bangladesh was selected for a preliminary investigation based on the availability of shrimp and fish larvae and other aquatic animals. The present study was performed in the coastal rivers and seashore part of the Khulna region from July 2022 to June 2023. Monthly interval sampling was done using a rectangular drag net of nylon netting (mesh size 0.3 mm) and bamboo split structure (1.6×0.6 m) of Fixed Bag Net (FBN) and Push Net (PN). Samples were taken in the course of full-moon and new-moon. The net was operated in the shallow water of the beach. Each hauling time was 60 minutes. Two samples were collected at the time during low and high tides. The net was tilted three times at each station. Samples were immediately stored in a 250 mL plastic pot and preserved in 5% formalin (45% formaldehyde) after collection for sorting shrimp PL, larvae of fin fishes, shellfish (example), and other organisms. Then, the samples were taken to the Khulna Agricultural University (KAU) laboratory for quantitative and qualitative analysis.

Shrimp larvae were identified up to order/species level and macro-zooplankters including fin fishes and other aquatic species were identified. Data were entered and analyzed using the Excel program (Microsoft Office 2020) and statistical analyses.

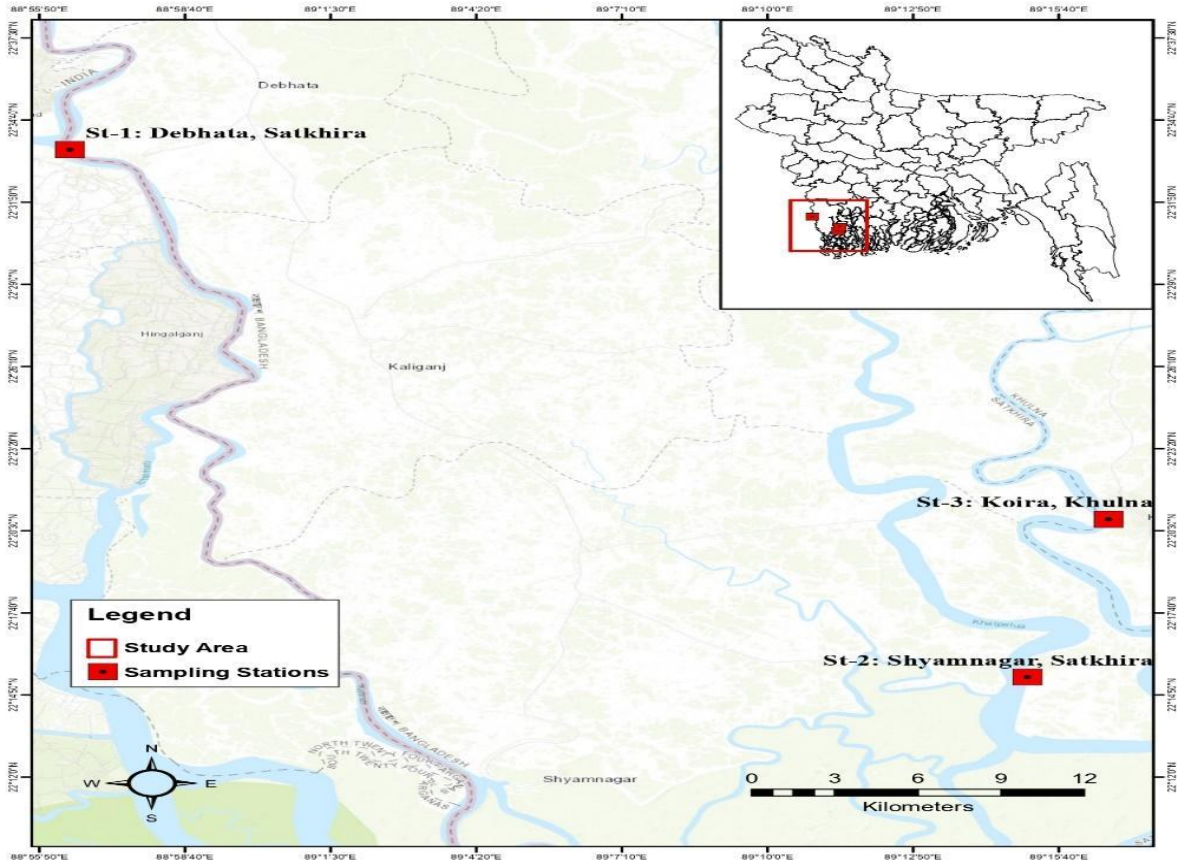

Figure 1. Study area map (using GIS tools)

3. RESULTS

The catch composition of various species and groups with Fixed Bag Net (FBN) and Push Net (PN) is shown at Debhata, Shyamnagar and Koira (Figure 2, and Table 1). The largest catch of baby shrimp (*Penaeus monodon*) was Debhata (0.83%) at the same time Shyamnagar (0.60%) and Koira (0.67%) with FBN. In the case of FBN, the percent composition of *Penaeus indicus* was high at Shyamnagar (0.39%) followed by Debhata (0.26%) and Koira (0.25%). The catch percent of *Penaeus merguiensis* was high at Debhata (0.09%) during FBN catching where Shyamnagar (0.05%) and Koira (0.08%). With FBN, the percent of *Metapenaeus monoceros* and other shrimp was high both at Koira (0.05% and 5.95%, respectively) where Debhata (0.02% and 3.24%, respectively), and Shyamnagar (0.03% and 2.47%, respectively). The most catching groups were fin-fish larvae, crab larvae and small organisms (numerous zooplankton).

Table 1. Species composition (%) with Fixed Bag Net (FBN) and PN Push Net (PN) at Debhata, Shyamnagar and Koira.

Species/Group	% of species composition					
	Debhata		**Shyamnagar**		**Koira**	
	FBN	**PN**	**FBN**	**PN**	**FBN**	**PN**
P. monodon	0.83±1.15	1.14±0.21	0.60±0.34	1.32±0.69	0.67±0.36	1.51±0.56
P. indicus	0.26±0.20	0.50±0.18	0.39±0.16	0.32±0.03	0.25±0.07	0.36±0.22
P. merguiensis	0.09±0.01	0.05±0.03	0.05±0.02	0.04±0.02	0.08±0.01	0.06±0.02
M. monoceros	0.02±0.01	0.04±0.02	0.03±0.02	0.02±0.01	0.05±0.03	0.06±0.01
Other shrimp	3.24±0.71	1.27±0.41	2.47±0.26	4.62±0.54	5.95±0.27	3.95±0.93
Fin-fish larvae	5.12±3.61	5.69±0.74	7.40±5.84	6.42±0.29	6.59±2.77	8.33±3.68
Crab larvae	5.16±2.23	3.86±0.51	7.10±1.50	6.53±1.63	5.54±1.78	7.53±2.90
Small organisms	85.29±7.88	87.47±5.25	81.96±7.88	80.73±1.93	80.86±4.57	78.19±7.52

The largest catch of fish larvae was at Shyamnagar (7.40%) followed by Debhata (5.12%) and Koira (6.59%). The catch composition of crab larvae was high at Shyamnagar (7.10%) where Debhata (5.16%) and Koira (5.54%). During the study period, amount of small organisms (numerous zooplankton) was noticeable. The catch percent of small organisms was high at Debhata (85.29%), then Shyamnagar (81.96%) and Koira (80.86%).

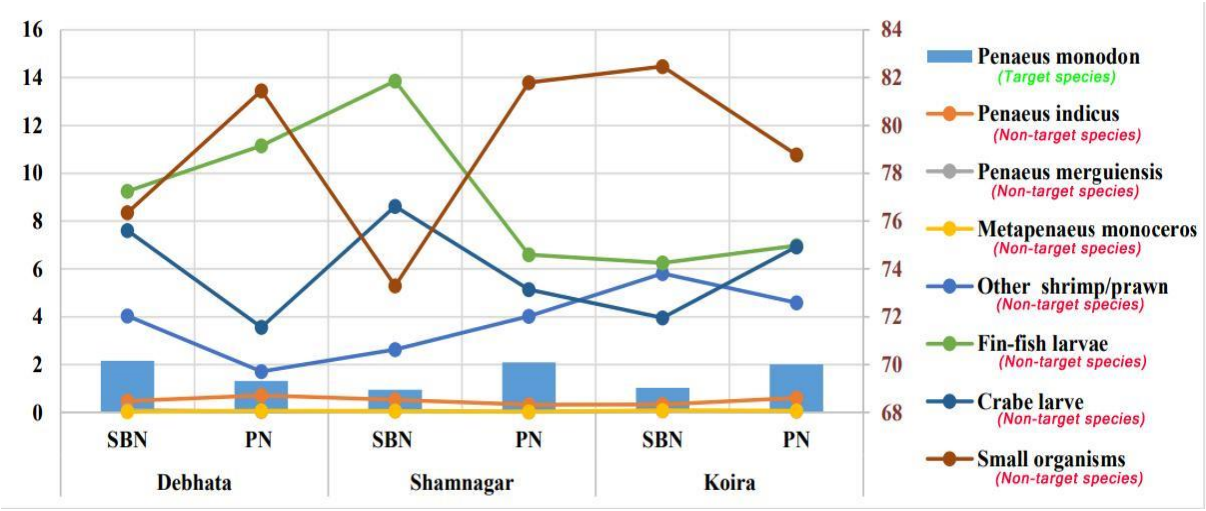

Figure 2. Species composition (%) with Fixed Bag Net (FBN) and PN Push Net (PN) at Debhata, Shyamnagar and Koira.

In the case of the second fishing gear push net (PN), the percent composition of baby shrimp (*Penaeus monodon*) was Koira (1.51%) as the same time Debhata (1.14%) and Shyamnagar (1.32%). The largest proportion of *Penaeus indicus* was high at Debhata (0.50%) followed by Shyamnagar (0.32%) and Koira (0.36%). The catch percent of *Penaeus merguiensis* was high at Koira (0.06%) where Debhata (0.05%) and Shyamnagar (0.04%). The percent of *Metapenaeus monoceros* and other shrimp was high at Koira and Shyamnagar (0.06% and 4.62%, respectively) whereas Debhata (0.04% and 1.27%, respectively), Shyamnagar and Koira (0.02% and 3.95%, respectively) (Figure 2 and Table 1). The most catching groups were also fin fish larvae, crab larvae, and small organisms (numerous zooplankton) during catch with push net (PN). The largest catch composition of fish larvae was at Koira (8.33%) where Debhata (5.69%) and Shyamnagar (6.42%). The catch composition of crab larvae was high at Koira (7.53%) followed by Debhata (3.86%) and Shyamnagar (6.53%). During the study period, amount of small organisms (numerous zooplankton) was also remarkable. The catch share of small organisms was high at Debhata (87.47%), then Shyamnagar (80.73%) and Koira (78.19%). The total catch of all organisms by a person from three study periods averagely about

2602.69 kg whereas the main target species Penae us monodon was only 25.44 kg. During the study period, due to baby shrimp collection, total amount of by-catch was 2577.25 kg per person (Table 2).

Table 2. Yearly total catch (kg) per person at the study area.

	Total catch [Kg/Year (8 months)/person]								
	Penaeus monodon	***Penaeus indicus***	***Penaeus merguiensis***	***Metapenaeus monoceros***	**Other shrimp**	**Fin-fish larvae**	**Crab larvae**	**Small organisms**	**Total**
Debhata	25.64	9.50	1.83	0.72	65.49	147.46	122.53	2198.37	2571.55
Shyamnagar	24.36	10.01	1.24	0.77	90.27	194.29	189.42	2214.96	2725.33
Koira	26.32	7.89	1.84	1.48	132.91	186.26	158.73	1995.76	2511.20
Average	25.44	9.14	1.64	0.99	96.22	176.00	156.89	2136.37	2602.69
Total	101.76	36.54	6.55	3.96	384.89	704.01	627.57	8545.46	10410.77

4. DISCUSSION

The biological, ecological, and social integrity of the aquatic socio-ecological pattern can be well-indicated by aquaculture (Pandit et al., 2019). By addressing the issues of indiscriminate exploitation and the extent of juveniles' economic harm to other fin fish during the collection of baby shrimp (*Penaeus monodon* larvae), the study aims to investigate the complexities of the socio-ecological system. The findings show that price is a significant factor in determining a fish's value.

4.1. Species composition in by-catch

This study clearly shows that 98.86-99.17% of other larvae are lost to catch 0.83-1.14% of baby shrimp at Debhat. Even, in Shyamnagar 98.68-99.40% of other larvae are lost to catch 0.60-1.32% of baby shrimp, in Koira 98.49-99.33% of other larvae are lost to catch 0.67-1.51% of baby shrimp (Table 1). *Penaeus indicus*, *Penaeus merguiensis*, *Metapenaeus monoceros*, other shrimp larvae, fin-fish larvae, crab larvae, and various small organisms are notable among other larvae. Paul et al. (1993) reported that 98.84% of other larvae are wasted for an average catch of 1.16% baby shrimp. Ahamed et al. (2012) reviewed that hatcheries are available but they are unable to provide quality full larvae. Moreover in Khulna, 99.90% of other larvae are indiscriminately harvested due to only 0.1% baby shrimp. Although, a lot of hatcheries are available in Bangladesh to provide baby shrimp, currently, the land area for shrimp farming in Bangladesh is 263025 hectares (DoF, 2021) where the number of hatcheries is 995 (BER, 2012).

Table 3. Fin fish, shellfish, and macro-zooplankton (small organisms) losses (%) during baby shrimp collection in Bangladesh's coastal waters

Study year	Other Shrimp & prawn larvae	Fin fish larvae	Macro-zooplankton (small organisms)	References
1989-90	12.75	12.64	62.12	Paul *et al.*, 1993
1990	21.5	30.8	46.5	Deb, 1998
1992	16.0	10.0	73.4	Rahman *et al.*, 1985
1995	13.2	3.2	83.2	Ahmed *et al.*, 1998
1996	7.6	2.1	90.1	Islam *et al*., 1999
1999	17.2	7.2	75.4	Hoq *et al.*, 2001

4.2 Biomass and economic loss of fish species

The figure shows the annual loss of different larvae as a result of *Penaeus monodon* by-catch during the study period. The loss of other non-target species due to baby shrimp collection from the natural environment is a matter of concern for biologists, ecologists, and policymakers as well as environmentalists. Fisheries could be reduced in the future if this activity keeps up. In general, this activity of collecting larvae is related to people's livelihood. Coastal aquaculture undoubtedly supports rural employment and livelihood to a large extent, but ecological costs and unfavorable social consequences are currently impeding this.

Table 4. By-catch and estimated biomass after reaching maturity are compared (present study).

Non-target species	Yearly by-catch Weight (kg)	Yearly Estimated biomass (kg)	by-catch-adult biomass ratio (kg)
Penaeus indicus	9.13	271.33	0.034
Penaeus merguiensis	1.64	49.20	0.033
Metapenaeus monoceros	0.99	32.67	0.030
Other shrimp	96.22	2598.52	0.037
Fin-fish larvae	176.00	9750.29	0.018
Crab larvae	156.89	600.76	0.261
Small organisms	2136.36	9000.78	0.237
Total	2577.23	22303.55	

Ahamed et al. (2012) also discussed the indiscriminate exploitation of wild prawn post-larvae poses a threat to biodiversity, community livelihoods, and fisheries resources in Bangladesh's coastal regions. The author also summarized that the large amounts of bycatch, caused by baby shrimp (PL) fishing, is known to have a negative effect on biodiversity in coastal ecosystems. This led to the implementation of a ban on PL collection to protect fisheries resources by the government of Bangladesh. During the present study, the year-round catch for *Penaeus monodon* larvae was 101.76 kg at the south-western region (3 study locations) of Bangladesh where the by-catch was 2577.23 kg. Ultimately, the total loss due to illegal shrimp larvae collection is 22303 kg. There are thousands of baby shrimp harvesting points in this southwestern area of the country. According to Banks (2003), yearly about 2,000 million shrimp fries are harvested from wild sources in Bangladesh. More than 90% of the total protein in freshwater shrimp (*Macrobrachium rosenbergii*) and more than 50% of black tiger shrimp (*Penaeus monodon*) comes from natural sources. In the collection of a single *Penaeus monodon* post larva, Hoq et al. (2001) calculated that roughly 12–55 post-larvae of other shrimp species, 5–152 larvae of finfish, and 26–1636 other macro-zooplankton organisms were discarded. Shrimp hatchery operations rely on wild-caught brood stock instead of farmed ones in many countries. In shrimp farming, bycatch during the capture of wild broodstock is crucial.4.3 Impact on biodiversity

According to FAO (2007), while some of the coastal poor fishermen rely on the harvesting of wild prawn PL as their only source of income, this practice has significant negative effects on estuarine and marine fisheries as well as prawn stocks. This is a result of numerous non-target fin and shellfish species' larvae and juveniles being caught and discarded during the PL collection process in order to select the target species. Brackish water prawn culture, on the other hand, uses high-value species that are frequently exported along with a large portion of their production cycle.

5. CONCLUSION

Shrimp farming provides a profit but at the expense of livelihood loss, environmental harm, and related risks. Thus, more research is required on a few topics in order to achieve social justice and effective conservation. If we don't offer the locals an alternate means of subsistence, the conflict between livelihood and conservation will not be resolved. The government should provide funds to investigate different livelihood options that, by adhering to sustainable development principles, would not only offer financial security but also reinforce the community's social structure as a whole. The primary source of seed for the black tiger prawn (*Penaeus monodon*) in Bangladesh continues to be the wild baby shrimp (PL). Additionally, the harvesting of wild palm leaves provides a significant source of income for thousands of coastal landless people as well as vulnerable populations, particularly women and children. However, the very fisheries resources that the larger community depends on are destroyed as a result of the indiscriminate harvesting of wild baby shrimp. It is also impossible to overestimate the wider effects of these endeavors on the entire coastal population, the consequent loss of aquatic biodiversity, and the devastation of coastal ecosystems. These are just a few of the steps that could help preserve the marine, coastal, and estuarine fisheries by reducing the strain of overexploitation on aquatic and fisheries resources.

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STATEMENTS AND DECLARATIONS

- **Competing Interests:** I declare that the authors have no competing interests as defined by Springer, or other interests that might be perceived to influence the results and/or discussion reported in this paper**.**
- **Dual publication:** The results/data/figures in this manuscript have not been published elsewhere, nor are they under consideration by another publisher.

ETHICAL APPROVAL

Not applicable

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REFERENCES

Ahamed, F., Hossain, M. Y., Fulanda, B., Ahmed, Z. F., & Ohtomi, J. (2012). Indiscriminate exploitation of wild prawn postlarvae in the coastal region of Bangladesh: A threat to the fisheries resources, community livelihoods and biodiversity. Ocean & Coastal Management, 66, 56–62. https://doi.org/10.1016/j.ocecoaman.2012.05.025

Ahmed, S. S., Alam, M. S., Rokeya, J. A., Ali, M. M., & Haque, M. M. (1998). Destruction of finfish larvae during collection of bagda shrimp (Penaeus monodon) fry from natural sources. Bangladesh Journal of Fisheries, 21(1), 59-63.

Ahmed, N. (2000). Bangladesh is need prawn hatcheries: farmers seek solution to wild fry dependency. Fish Farming International, 27, 26e27.

Banks, R. (2003). Brackish and marine water aquaculture. Report on fisheries sector review and future development. Department of Fisheries, Matshya Bhaban, Ramna, Dhaka 1000, Bangladesh, pp 2–17.

Bergin, A., & Michaelis, F. B. (1996). Australia and the South Pacific: implementing the UNCED oceans agenda. Marine Policy, 20, 47e62.

BER, (2012). Bangladesh Economic Review 2011-12. Economic Adviser's Wing, Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh.

Das, P., Das, A., & Roy, S. (2016). Shrimp fry (meen) farmers of Sundarban Mangrove Forest (India): A tale of ecological damage and economic hardship. International Journal of Agricultural and Food Research, 5(2).

Deb, A. K. (1998). Fake blue revolution: environmental and socio-economic impacts of shrimp culture in the coastal areas of Bangladesh. Ocean & Coastal Management, 41(1), 63-88.

DoF, (2021). Jatio Matsya Soptah Sankalan, Ministry of Fisheries and Livestock. The Government of Peoples Republic of Bangladesh, Dhaka, pp: 143.

DOF, (2002). Balancing Resource Conservation with Livelihood Protection for Shrimp Fry Collectors: An Integrated Approach to Managing Coastal Resources. Department of Fisheries (DOF), Ministry of Fisheries and Livestock, Dhaka, Bangladesh, 14 pp.

FAO, (2007). The State of World Fisheries and Aquaculture 2006. FAO Fisheries and Aquaculture Department. Food and Agriculture Organization of the United Nations, Rome, Italy, 180 pp.

Hoq, M. E., Islam, M. N., Kamal, M., & Wahab, M. A. (2001). Abundance and seasonal distribution of Penaeus monodon postlarvae in the Sundarbans mangrove, Bangladesh. Hydrobiologia, 457, 97-104.

Islam, M. S., Islam, M. M., & Ahmed, S. U. (1999). Colossal loss of shell and fin-fish larvae during collection of Penaeus monodon (Fab.) fry in the rivers of Satkhira.

Islam, M. S., Wahab, M. A., & Tanaka, M. (2004). Seed supply for coastal brackishwater shrimp farming: environmental impacts and sustainability. Marine Pollution Bulletin, 48(1-2), 7-11.

Mahmood, S. M., & Ansary, B. S. (2013). Shrimp Fry Collection as Alternative Livelihood: A Case Study on the Southwest Coastal Region of Bangladesh. ASA University review, 7(2).

Pramanik, M. A. H. (1988). "Methodologies and techniques of studying coastal systems: Case Studies II", Space and Remote Sensing Organization (SPARSO), Bangladesh, pp. 122-138.

Pandit, A., Ekka, A., Das, B. K., Samanta, S., Chakraborty, L., and Raman, R. K. 2019. Fishers' livelihood diversification in Bhagirathi–Hooghly stretch of Ganga River in India. Current Science, 116(10), 1748-1752.

Paul, S. C., Mustafa, M. G., Chowdhury, Z. A., and Khan, M. G. 1993. Shrimp fry collection. Studies of Interactive Marine Fisheries of Bangladesh, Working Paper, (89).

Rahman, M., Bhuiyan, A. L., and Kader, M. A. 1985. Occurrence of fish larvae and post-larvae in the Karnafully river estuary. Bangladesh Journal of Fish, 8, 1-7.