

**Management options for the shrimp fry fishery
A regional stakeholder workshop in Coxes Bazar**

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A workshop hosted by the Department of Fisheries and funded through Fourth Fisheries Project by the Department for International Development as part of the Shrimp Action Plan.

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1. Background

In February 2002, the MOFL decided to place the enforcement of the fry collection ban into abeyance pending further review of how the resource and biodiversity could be conserved at the same time as protecting the livelihoods of 400,000 fry collectors. A Shrimp Action Plan for the period April - September 2002 was drawn up to identify trends impacting on distribution and growth in the shrimp sector, and to explore alternative models for the management of fry resource and to assess their social, institutional and economic implications. This was jointly prepared in early February 2002 by representatives from DOF, DFID, FFP, Global Environmental Facility (GEF), BWDB and Environmental Geographic Information System or EGIS. A position paper will be presented to Secretary in September establishing options for managing the fry resource and the economic, social and environmental costs and benefits.

The Action plan provides for a full consultative process with development agencies (at local level and sector ministry level), private sector and Donors. This has been ongoing since April 2002. The aims of this workshop were: to identify trends impacting on the growth and distribution of the shrimp sector, and to engage stakeholders from civil society, Government and the private sector in identifying and agreeing on appropriate management options for the wild shrimp fry fishery in south west Bangladesh. The workshop identified a number of key priority issues and challenges specifically relating to the following areas: fry collection management, alternative livelihoods for fry catchers, appropriate training and awareness for fry catchers, the role of hatcheries and the potential for certification along with identification of key policy issues relating to the supply of shrimp fry.

The workshop took place in Coxes Bazar in south-east Bangladesh on 23rd July 2002. In this part of Bangladesh, the ban on fry collection was not enforced¹ to any great extent due to: political pressure from wild fry traders, low awareness of the ban, a lack of alternative income opportunities for fry catchers, a continuing demand for wild fry from farmers and inadequate resources to enforce the ban. Shrimp fry are harvested from the coastal areas extending from Tecnaf in the south through to Chittagong. Coxes Bazar is the main centre for hatchery produced Bagda, there are 46 hatcheries in this area². Despite the plentiful supply of hatcheries in Coxes Bazar, most local shrimp farmers in this region still use wild fry³.

In all, 57 participants from the wide range of stakeholder groups attended the workshop, these included: fry catchers and traders, hatchery operators, shrimp farmers, NGOs, Fisheries Research Institute, District Fisheries Officers and Senior Upazila Fisheries Officers, the Department of Forestry, Administration, Bangladesh Water Development Board, the Social Welfare Department, and a number of specialist consultants. Open discussions took place around 5 presentations and group work by each stakeholder group. Consensus between these different stakeholders was reached on a number of issues; these are described below.

2. Summary of main points

The DFO for Coxes Bazar opened the workshop by highlighting the shrimp sector as the second largest foreign exchange earner of Bangladesh. Considering the importance of sector to the national economy the government has declared the shrimp sector as an industry and tax holiday enjoyed by the entrepreneur of this sector.

Impact of fry catching on commercial fisheries

The demand for shrimp fry increased with the rapid expansion of the shrimp industry after the mid 80s. According to a recent survey by DOF, there are 40 Upazilas under 12 coastal districts along the 710 km long

¹ Although it is reported to have encouraged rent seeking behaviour among some Police Officers

² However, despite efforts by DOF to invite local hatchery operators, only one hatchery operator took part in this workshop.

³ 73% of farmers in Coxes Bazar use wild fry instead of hatchery fry compared to 23%, 28% and 45% in distant districts of Satkhira, Khulna and Bagerhat respectively (Shrimp Sector Technical Review, FFP, Nov 2001).

coastal area where shrimp fry are collected. The increased fishing pressure on the fry fishery has long been thought to be contributing to the gradual decline in abundance and distribution of mother shrimp causing serious damage to the productivity of coastal and marine fisheries resources. Moreover, a huge number of eggs, larvae and juveniles of non-target fish and shrimp during shrimp fry collection are included in the by-catch⁴.

Md. Giasuddin Khan presented interim findings from a GEF (Global Environment Facility) study under Forth Fisheries Project. He cited the shrimp PL fishery, the estuarine setbag net (ESBN) fishery (which catches juveniles) and the shrimp trawl fishery (which catches brood shrimps) as the three most destructive coastal fisheries. Overfishing of these fisheries has occurred to the extent that fishing in the artisanal sector is no longer remunerative. The penaeid shrimp stock in particular is over-exploited in all three fisheries but the fry fishery in particular⁵ which removes an estimated 90% of the *panaeus monodon* fry stock. The ESBN fishery further reduces the chances of recruitment to the offshore adult stock.

In contrast to the *P. monodon* stock, the *M.monoceros* (brown shrimp) stock is relatively healthy, because it has little vulnerability to PL fishing. The overall low catch of *M.monoceros* (less than 10%, meaning more than 90% of it's population is released) from push nets⁶ in the fry fishery results in a relatively high catch in the ESBN fishery. In the trawl fishery, brown shrimps offer the highest yields (eight times higher than the tiger shrimp and 30 times higher than the white shrimp). If a similar level of recruitment took place for the other species (tiger shrimp, white shrimp etc.) there would be a substantial increase in the total catch.

In spite of three times higher fishing effort, the abundance of bagda PL in the Khulna area was only 18% of a total of 2035 million. The total abundance of bagda PL is significantly higher in the south-east coast; the Catch Per Unit Effort in the Cox's Bazar area (1375 bagda PL per/day/net) is eight times higher than in the Khulna area (170 bagda PL per day per/net). Despite higher yields and fishing pressure in the south east, the loss of other by-catch species from fry catching is significantly higher in the south-west part of the coast. Out of the total by-catch produced for the whole coast, 75% came from Khulna area alone. This area possesses much higher biodiversity than the Cox's Bazar area as apparent from the proportion of by-catch in the two areas (1:365 in Khulna and 1:24 in Cox's Bazar). The by-catch in the Khulna area was as high as 145 billion compared to 40 billion in the Cox's Bazar area. The shrimp fry collection scenario strongly suggests that the shrimp PL collection process particularly in the areas of Khulna zone is extremely damaging to marine fish and shrimp stocks.

According to the most recent survey data of the Marine wing of the DoF, the fry collectors are mostly located in the Barisal zone (around 50%) followed by about 35% in the Khulna zone and the lowest at the Cox's Bazar zone (only 20%) although the major PL catch comes from the Cox's Bazar zone (accounting for around 65% of the total catch). Despite much higher levels of fishing effort, yields of bagda PL in Khulna zone accounted for only 10%. The total catch amounts to 3,000 M PL (*Penaeus monodon*) together with a further 300,000 M other species, 62 % of which is zooplankton, 10.9 % other shrimp, 13% caridean prawn and 13% finfish larvae. Of the other shrimps, *Penaeus indicus* and *Metapenaeus monoceros*, the frequency of catches in PL collection is particularly high for *Penaeus indicus* (80% of the total by number), but this species is largely discarded.

Md Giasuddin discussed the possibility of applying the ESBN analytical model to the shrimp PL fishery where a reduction of effort by 50% and an increase of mesh size by 100% was suggested to make the ESBN fishery sustainable. It was realised that these options were too difficult to achieve, mainly because of the socio-economic impact and displacement of professional fisher communities who have limited access to other means

⁴ The FFP Shrimp and Coastal Aquaculture sought to counter this with training for 29,500 fry collectors and 500 fry traders in improved methods of fry collection and transportation. However, the ban on catching fry effectively criminalised this activity making it impossible to work in this capacity with these communities. In the meantime, fry catching has continued because the ban was never enforced.

⁵ Virtual population analysis showed that fry collection fishes out more than 90% of this species before it can be recruited to offshore adult stocks.

⁶ due to lower catchability of this gear

of income/livelihoods. An alternative short term solution was to reduce effort by 15% with no changes in mesh size (for the time being) and a closed season of 4-5 months a year (in two seasons) at only two out of the six areas of the coast would save 60% of juveniles from destruction. It is considered possible to rehabilitate this small displacement with alternate IGAs available within the capture fisheries sub-sector e.g. introduction of trammel nets in the areas of Patuakhali zone.

Training and extension needs

Md. Nuruzzaman presented findings from a review of fry catching activities in 2001. Although training is thought to be effective, very few fry catchers have been trained. Around 2000 fry collectors have so far been trained in improved collection methods, sorting, and storage and transportation systems along with some alternative income generating activities by the Strengthening of Coastal Fisheries Management Project under DOF. Other agencies including Caritas, FAO, and BFRI have also provided training to fry collectors. Potential alternative livelihoods for fry catchers include: operation of shrimp fry nursery, shrimp fry trading, making fishing traps and gears, operation of fish feed mills, shrimp de-heading for processing, crab fattening, hogla and mat making, bee keeping, coir industry, tree plantation, horticulture, tailoring and knitting etc.

The lack of extension services in shrimp polders continues to dominate discussions with farmers. There are about 15,000-20,000 shrimp farms throughout the coastal districts covering an area of 1.4 lakh ha, located mainly along the coastal rivers and canals without good road communication systems. Unlike fresh water pond operators, the public sector extension workers face difficulty in visiting the shrimp farmers regularly. One result of the lack of support is the prevalence of diseases, reducing survival, lowering yields and reducing profits. Md. Nuruzzaman presented a number of recommendations from local DOF officials in the coastal zone. These included: coastal aquaculture extension and training in 30 Upazilas in six coastal districts; establishing and strengthening existing shrimp Demonstration Farms in farmer's ponds and nurseries; establishing diagnostic laboratories and mobile facilities for rapid trouble shooting, sampling and monitoring of shrimp diseases; production of training materials (manuals, leaflets, newsletter, and audio-visual materials); and introducing a credit program for small holders shrimp farmers.

The hatchery sector: options for change

Bagda farming is the fastest growing food production enterprise in the coastal areas of Bangladesh but since the early 1990's, the sector has been plagued by disease outbreaks in the coastal polders. Many farmers consider shrimp disease as the single most limiting factor to sustainable production. The high incidence of disease outbreaks in recent years has been blamed by many on the poor quality of mainly hatchery fry. However, some observers point out that poor survival of fry is not always due to disease. Dr Alfredo Santiago believes the three main contributory factors for poor quality fry in Bangladesh relate to the quality of Bagda broodstock used, the hatchery techniques employed in hatchery production and the transport and storage of fry. Broodstock collection by commercial trawlers causes huge stresses to shrimp. At the same time, hatchery techniques are not standardized, and hatchery technicians and owners do not share technology among themselves even during an outbreak of disease. Hatchery technicians and shrimp farmers need to manage the rearing environment properly to help prevent and control disease outbreaks. The lack of handling, transporting and pond stocking techniques of traders and pre-nursery operators and the shrimp farmers themselves also contributes to poor survival rates of fry (estimated at 60-70%). Dr Santiago identifies the need for training in basic procedures on proper packing, appropriate transport facilities, and acclimatization of newly delivered fry by the Department of Fisheries in collaboration with the shrimp association in every Upazila. The current practice of intentional mixing of young and old PL and selling of underage PL by some hatchery operators needs to stop to increase farmer confidence in hatchery fry. Moreover the widespread current practice of stocking farms with fry during the height of winter and/or during mid-summer when low survival rates are expected needs to be curbed through extension of improved techniques to reduce losses and unnecessary expenditure by farmers.

Dr Dilip Kumar, FAO, presented plans to develop a hatchery seed certification scheme. This is a joint initiative by Government and the private sector through the Shrimp Hatchery Association of Bangladesh (SHAB) to develop and introduce shrimp seed certification system to bridge the gap between the seed producers (hatchery operators) and seed users (farmers). Seed certification is required to ensure the continued production and supply of hatchery bred quality shrimp seeds through screening of shrimp brooders and seed lots following molecular based precise, quick and reliable diagnostic techniques. The objective of the proposed project is to develop and promote government and private sector based participatory programme of shrimp seed certification in Bangladesh. It is expected that the initiative would help to develop mutually agreed modalities of brood and seed certification system including cost sharing to by the Government (DOF /BFRI) and private sector (SHAB). This will entail setting up a PCR based laboratory, training personnel (both Government and Private Sector – SHAB), trials and nation wide introduction through developing mutually agreed modalities by way of expert consultations. Seed certification would also help in developing a functional and accountable relationship between the hatchery operator (seed producers) and shrimp farmers.

Dr Kumar explained the relevance of this seed Certification project to another FAO Project in Coxes Bazar, “Empowerment of Coastal Fishing Communities for Livelihood Security”. The project aims to promote participatory community based coastal fisheries management in selected coastal fishing villages of Cox’s Bazar district⁷. The primary target group of the project are coastal fishing communities, from the poor and disadvantaged parts of society most prone to recurring natural disasters. It is envisaged that farmers enhanced confidence in fry, following certification, will reduce the demand for uncertified seed collected from natural sources, thereby enhancing the natural recruitment of finfish and shell fish along with shrimp in the coastal waters. This is likely to enhance the catches and livelihoods of an estimated one million coastal fishers in Bangladesh who depend exclusively on coastal fishing for their livelihood. A reduction in wild catch would also reduce the colossal damage to seed of non-target species thereby significantly improving the aquatic biodiversity of coastal resources. The step would also help Bangladesh in the implementation of FAO Code of Conduct for Responsible Fisheries.

Conditions needed for growth and investment in the shrimp sector

Rafiq Sarker from ATDP-II presented the conditions need for the growth and investment in the shrimp sector. He highlighted the need for a land-use policy defining and demarcating areas in the brackish water coastal belt and low-lying lands in the fresh water areas for uninterrupted shrimp farming. Public sector support was seen as essential for developing site-specific development plans and creating basic water supply and drainage networks on both sides of selected rivers. This should coincide with improvements to other infrastructure including roads, waterways, power supply and telecommunication in the farming areas. The requirement for the timely supply of disease free and healthy shrimp fry to all farming areas and the availability of effective technical services at all levels along with the availability of cheap and effective pellet feeds (free from any unacceptable chemicals, hormones or antibiotics) were also highlighted. Good security and freedom from theft and other criminal activities is also required in the farming areas, roads and waterways in the polders. Mr Sarker also gave an outline of ATDP’s proposed Seal of Quality scheme, as a brand to ensure shrimp is clean, safe to eat, free from antibiotics, harmful chemicals’ residues and growth hormones. It would also guarantee that the shrimp has been produced in an acceptable physical and social environment honoring human rights. ATDP is organizing shrimp farmers, suppliers and feed millers and launching consultant services to support the process of introducing a SOQ program. ATDPS’s other activities include: organizing HACCP training for shrimp depot operators, farmers, factory representatives; business management skill development using computer programs for factory accounting and finance staff; organizing visits to international seafood shows to establish new export linkages with shrimp and fish importers; feed formulation and business management training to feed millers; preparing for demonstration of and training in improved fish drying in cost-effective solar driers to coastal fishing communities. ATDP-II works in close collaboration with DFID, EU Commission, GOB, NGOs.

⁷ Project activities include: organising the coastal fishing communities, creating awareness, promoting alternative income generating activities, improving their access to social and extension services, enhancing flow of information, and strengthening linkages between organized communities and local government institutions and administration.

Regulating the capture of wild fry: stakeholder viewpoints

Fry traders recognise the need to gradually phase out wild fry collection but recommend interim measures to reduce the impact of fry catching. These include provisions for: an open season from April to September, training for catchers and traders in correct catching, handling, storage and transport methods, licensing of full time fry catchers. They also advocate further regulating the broodstock fishery to protect stocks along with releasing hatchery fry into coastal areas to replenish stocks. This was also supported by hatchery owners.

Fry catchers present at the workshop were mostly landless people living on *khas* land or land from the Department of Forestry who had been catching fry in the Coxes Bazaar area for the past 15-20 years and completely dependent on this for their income⁸. Most were unaware of a ban but were harassed by the police who take bribes from them. Most fry catchers practice improved catch techniques⁹, returning the by-catch to the water body, they blame the trawlers and current nets for the decline in wild shrimp stocks. They urged development agencies to provide them with training on improved catch methods, alternative livelihoods, allocation of *khas* land and credit to reduce their dependency on money lenders. In the meantime, they oppose any type of restriction on fry catching.

Shrimp farmers highlighted the need for improved technology, infrastructure, low cost credit and good quality fry. They expressed concerns over the viability of hatchery fry and over price fixing by hatcheries. Farmers regard DOF and NGOs as the most appropriate agents for primary extension of improved technology. They also highlighted the need for better policing to improve the security condition in shrimp farming areas.

Local government agencies highlighted the problems associated with trying to enforce a ban on fry collection. These include: a lack of manpower, financial resources, pressure from the Dadondars (fry traders who also lend money), a lack of security in remote areas and the influence of politics over local administration. They support a ban on fry collection to preserve biodiversity and promote tourism¹⁰ but point out the need for increased manpower and logistical support, improved security in the fry catching areas, support for alternative livelihoods for fry catchers (they suggest providing a financial incentive of Tk15 per day for fry catchers not to catch fry) and improved co-ordination between different agencies.

The hatchery owners advocate a complete ban on the capture of wild fry highlighting the capacity of hatcheries to supply the whole market need and the harmful effect of harvesting wild fry on recruitment to wild stocks. They welcomed moves towards certification to improve the quality of hatchery fry. They also recommended routine inspection of mother shrimp, laboratory back up and disease screening of fry and broodstock at all stages from the hatchery to the farmer along with the development of improved trading, transport, handling and storage methods for fry. They were dismissive of farmers' claims on hatchery fry being of lower quality than wild fry and claimed that fry catchers could easily move into other areas of employment because they used fry catching only to supplement income from other livelihoods. They believed that the ban should be enforced but backed up with support for goat, chicken and duck rearing, fish culture, vegetable production and other cottage industries. They also recommended the introduction of a policy on the use of foreign technicians in hatcheries with measures to support the emergence of skilled technicians from the Bangladesh workforce.

The workshop included representation from a group of fishers supported by FAO's coastal communities empowerment project. They believe fry catching is having a severe impact on wild stocks and should be banned. They are highly critical of seasonal fry catchers as non-traditional fishers who deplete the resource for the traditional fishers dependent on fishing year round stating that the livelihoods of traditional fishers also merit protection. They believe a ban would benefit gill net and behundi net fishers¹¹ through increased yields as well as increasing the broodstock fishery. They proposed community-based management in fishing areas to protect stocks and livelihoods of traditional fishers.

⁸ This view is not widely accepted by researchers and Government who believe fry catching to be a secondary source of income for fry catchers.

⁹ Local Government agencies disputed this, reporting only a limited effect of training on the fishing habits of fry traders.

¹⁰ They complained about the dumping of by-catch on the beaches deterring tourists

¹¹ and ultimately benefiting the consumers

BFRI and the Marine Section of DOF advocate a complete ban on the harvest of wild fry due to the adverse impact on biodiversity and declining yields of commercial fish stocks with associated effects on the livelihoods of marine and artisanal fishers. According to the researchers a ban would also be justified given the sufficient supply of PL from hatcheries.

Appendix A: Agenda

0930 Introduction

Welcome. Mr Moslehuddin Ahmed, District Fisheries Officer Coxes Bazar
Introduction to the Fry Collection Action Plan. Md. Shahjahan (DAD, Fourth Fisheries Project)/ Debbie Williams (Coastal Shrimp Aquaculture Development Co-ordinator, DFID).

1000 Presentations and open discussion

1. *Government priorities for sustainable growth of the shrimp sector and sustainable management of the fry fishery.* Mr Mosleh Uddin Ahmed, (District Fisheries Officer Coxes Bazar).
2. *Current trends in the fry sector: status of hatchery operations, trends in supply and demand.* Dr Alfredo Santiago/ Md. Nuruzzaman (Fourth Fisheries Project).

1100 Tea break

3. *Seed certification and Coastal Empowerment Project.* Dr Dilip Kumar, FAO.
4. *Seasonal and geographical distribution of fry collection.* Dr Md. Giasuddin.
5. *Conditions needed for future growth and investment in the sector.* Rafiq Sarker, ATDP-II.

1300 Lunch

1400 Group sessions and presentations

An opportunity to state the key interests and concerns of each stakeholder group.

Group 1: Fry traders

Group 2: Fry catchers and NGOs

Group 3: Fishers and FAO

Group 4: Local Government agencies and FFP

Group 5: Research organisations

Group 6: Shrimp farmers

Group 7: Hatchery operators

1600 Close

Appendix B: Presentations

B1 Government priorities for sustainable growth of the shrimp sector. Dr. Moslehuddin Ahmed, (District Fisheries Officer, Cox's Bazar and NPD)

Shrimp sector is the second largest foreign exchange earner of Bangladesh. Considering the importance of sector to the national economy government has given priority towards the development of the shrimp sector. This sector has been declared as industry and tax holiday enjoyed by the entrepreneur of this sector. In practice during post liberation period when international market price increased for shrimp and shrimp products, this sector draws government's attention. A number of development projects were successfully implemented in this particular sector. Mentionable development activities done during eighties through a number of development projects.

Development projects

1. **Bay of Bengal Programme (BOBP) supported by FAO/SIDA:** This was multiagency project implemented during 1982 to 1987. This project established demonstration shrimp farms for improved shrimp culture technique, extension worker and farmers training.
2. **Aquaculture Development Project (ADB):** Through this project 118 shrimp ponds (11 acre each) were constructed with improve dyke, sluice and canals and leased out to farmers. There was a demonstration shrimp farm under the project. One fresh water prawn hatchery also established through the project which is still running well producing Bagda postlarvae.
3. **Second Aquaculture Development Project (ADB):** Shrimp culture development activities including Thana level extension programmes in 24 coastal thanas under Khulna, Satkhira, Bagerhat and Cox's Bazar districts through the projects. A total of 148 demonstration farms in farmers pond were conducted. The project was implemented during 1987-1994 and also provided interest free credit for input support to the farmers.
4. **Shrimp Culture Project (IDA):** Under the project 2-areas were developed under BWDB polders. In Khulna areas 1430 ha and in Cox's Bazar area 5594 ha were developed. The development includes main embankment, canals and regulators. About 5000 acres of coastal land were developed with required infrastructure at Chakaria Sundarbans, Cox's Bazar and leased out to shrimp farmers for improve shrimp culture. One bagda shrimp hatchery and one galda hatchery was constructed at Cox's Bazar and Khulna respectively. 2-demonstration farm and training centre (DFTC) one at Teknaf, Cox's Bazar and another at Kaligonj, Satkhira also established. The Project implemented during 1985-1992.
5. **3rd Fisheries Project:** A total of 10454 ha of private land was developed through improved water exchange infrastructure at Khulna and Satkhira districts. The project took initiatives to organize the community by an NGO and constituted a total of 44 block committees.
6. **Fisheries Extension and Training Project (ODA):** This project provides extension and training support to the DoF field staffs. The field officers were supplied with kit boxes for checking water and soil quality parameters for shrimp farming.
7. **Disease Prevention and Health Management Project (FAO):** The project implemented during 1997-1999 on i] policy planning of quarantine and health certification in shrimp culture, ii] field level farmers training and iii] collect and analyse epidemiological data on shrimp disease to ascertain the causes of shrimp disease outbreak.

8. ***Shrimp Landing and Service Centre Project:*** *GOB funded project constructed 21 shrimp landing centres at 5 shrimp culture districts for quality assurance of harvested shrimp. The project also provides ample training to farmers, seeds collectors, depot operators, etc.*
9. ***Bagda Shrimp Culture Technology Extension Project:*** *GOB funded project aimed to be implemented during 1999-2004 for providing field training, diagnostic labs for shrimp disease and renovation of ADB shrimp hatchery and Kaligonj DFTC.*
10. ***Galda Hatchery Development and Culture Technology Extension Project:*** *Aimed to develop fresh water prawn production by construction of 12 galda hatcheries, 18 nurseries by renovating government fish seed farms. The projects will also provide training. The project is ongoing.*

Through the above development projects government provides training, extension, demonstration, credit, lands, product quality assurance to the shrimp culture industry.

Training

More than 70,000 shrimp farmers were trained on improved farming, hatchery operation, seed collection and product quality assurance of exportable frozen shrimp. Most of these training programme conducted at field level. These training results promotion of improved farming practice from old traditional shrimp farming in gher system.

Extension

Government extension service has been developed in the country through TFO's and EO's of the Dept of Fisheries. Technical advice on improved shrimp farming technology and disease prevention aspects has been transmitted among the field level farm operators through extension programme. Extension bulletins, booklets, posters, pamphlets, etc. has been published and distributed to shrimp farmers, nursery operators, traders on a regular basis.

Demonstration

Improve shrimp farming demonstration practice were conducted in different potential farming areas of the country. As a result farmers become interested to develop improve farming in their own ponds for higher yield.

Credit

Credit facilities are provided to a number of farmers for input supply to their culture ponds through development projects. Assistance also provided to Shrimp hatchery entrepreneurs. In addition nationalized banks come forward to provide loans to the entrepreneurs to this sectors.

Shrimp Culture Land

Through Aquacultur Development Project (ADB) and Shrimp Culture Project (IDA) a total of about 7000 acres government khas land has been leased out to about 500 shrimp farmers at Chakaria, Cox's Bazar. Besides this Ministry of Land leased out coastal inter-tidal lands suitable for shrimp farming.

B2 Status of Shrimp Fry Collection and strategies for alternative livelihoods. Md. Nuruzzaman (Fourth Fisheries Project).

The shrimp culture industry used to be entirely dependent on natural shrimp fry collected from coastal rivers, estuaries and mangrove areas. About 400,000 people are said to be engaged seasonally in this fry collection activities most of them are female and children. According to a recent survey by DOF, there are 40 Upazilas under 12 coastal districts along the 710 km long coastal area where shrimp fry are collected (Table 1). The fry collection is not their permanent or main occupation rather they used to see it as seasonal opportunity to earn

money. Shrimp Fry collection is a recent occupation and before two decades there was no occupation there like shrimp fry collection.

The demand for shrimp fry has tremendously increased with the rapid expansion of the shrimp industry after the mid 80s. Many coastal people have taken up this as an alternative option for their livelihoods. But the increased fishing pressure to collect more fry is thought to be contributing to the gradual decline of abundance and distribution of mother shrimp and shrimp fry, thereby causing serious damage to the productivity of coastal and marine fisheries resources. Moreover, the huge numbers of by-catch like eggs, larvae and juveniles of non-target fish and shrimp during shrimp fry collection are mostly discarded in the land after sorting of target fry. Thereby, the coastal biodiversity has been decreasing day by day. As mitigation measure the FFP Shrimp and Coastal Aquaculture component has a plan to train 29500 fry collectors and 500 fry traders, about improved methods of fry collection and transportation.

Given the potential demand and scarcity of shrimp fry, a great deal of attention was given to the development of hatchery technology to produce shrimp post larvae (PL) by induced spawning. During the last 3-4 years there has been a steady increase in the production of hatchery PL until today hatchery capacity is sufficient to supply the entire shrimp culture industry in Bangladesh. A total of 44 shrimp hatcheries mainly in Cox's bazar area are now engaged in PL production (Table 2) and many of those hatcheries had to stop production last year due to market over-supply and consequent price falls.

Following this development the government has taken the decision recently to impose a ban on shrimp fry collection from nature. A high level meeting chaired by the Prime Minister on Aug 23, 2000 discussed and proposed formulation of the necessary law/act to be enforced to protect the coastal fisheries resources.

As a result of this proposed ban on shrimp fry collection the fourth fisheries plan to provide training to the shrimp fry collectors has become redundant. It now seems better to focus on alternative livelihood options for the displaced fry collectors as well as improvement of management practices of shrimp farms in the coastal areas. The financial and manpower resources freed by abandoning the shrimp fry collector training programme can now be re-allocated to the following activities.

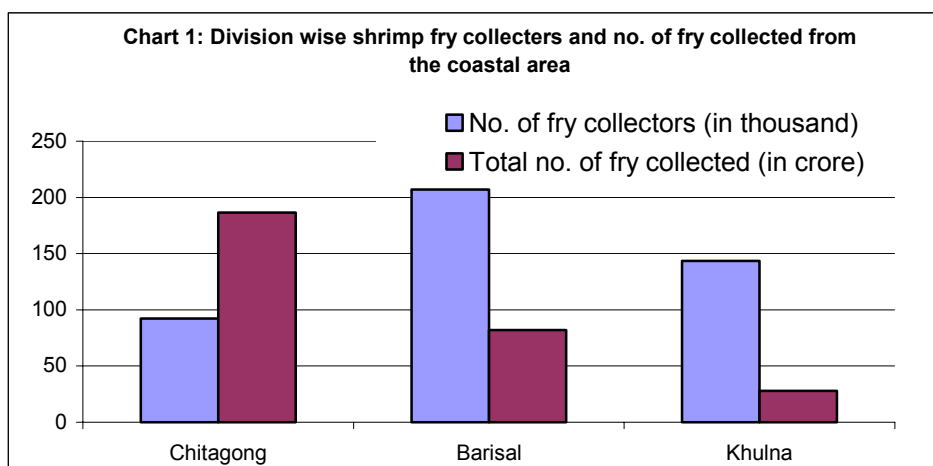
Strategies for alternative livelihoods

The distribution of fry collectors varies from region to region and division wise. The great majority (about 80%) of them are in the Barisal Khulna region with only 37 % of the total catch of the country (Chart 1). In other words Chittagong region harvest 63% of the total catch by 20% of the fry collectors and the Barisal region has the highest number of fry collectors. Therefore more attention should be given to the majority who are suppose to be more vulnerable condition after the ban is imposed.

About 2000 fry collectors so far have already been trained in improved collection methods, sorting, and storage and transportation systems along with some alternative income generating activities by the Strengthening of Coastal Fisheries Management Project under DOF. Livelihood training of fry collectors can be arranged in clusters for alternative income generating (AIG) activities to rehabilitate them. Many of them are migratory and used to live in temporary huts during collection season and disappear when shrimp fry are less abundant. The non-migratory fry collectors used to live in cluster villages and slums around the polders. They can be motivated and organised in groups by NGOs to provide training. Types of training to be provided, selection of groups like male, female, children, migratory and non-migratory etc. can be decided after PRA done by NGO. Following are the suggested options by the field officials of DOF and local NGOs working in the coastal areas:

1. Operation of shrimp fry nursery
2. Shrimp fry trading
3. Making fishing traps and gears
4. Operation of fish feed mills
5. Shrimp de-heading for processing
6. Crab fattening,

7. Hogla and mat making
8. Bee keeping
9. Coir industry
10. Tree plantation
11. Horticulture
12. Tailoring and knitting etc.



Improvement of management practices of shrimp farms

The existing farming practice is mostly traditional and extensive, producing an average of only 200 kg of shrimp per ha per year, whereas this level can easily be doubled with a little improvement of farming practices. Due to rough handling of fry during harvesting, post harvest, transportation and post stocking, it is believed that some 60-70% of fry suffer mortality. Therefore improvement of management practice will increase survival as well as production level.

There are about 15000-20000 shrimp farms throughout the coastal districts covering an area of 1.4 lakh ha. The shrimp farms are located mainly along the coastal rivers and canals without good road communication systems. Unlike fresh water pond operators, the public sector extension workers face difficulty in visiting the shrimp farmers regularly. As a result they remain outside of any major development intervention. One result of the lack of support is the prevalence of diseases, causing less survival, less yield and less profit. Moreover, indiscriminate intervention shrimp farmers in the tide prone area near mangrove forest are harmful to the environment. The following are the suggested initiatives by the local DOF officials can be taken:

1. Coastal aquaculture extension and training in selected Upazilas of the coastal districts. There are 30 Upazilas under six coastal districts can be brought under extension and training programme.
2. Establishment of shrimp Demonstration Farms in farmer's ponds in Khulna, Satkhira, Bagerhat, Cox Bazar, Ptua khali and Noakhali districts. There are five Polders under Khulna and Satkhira districts where FFP intervention will take place. A total of 18 demo farms per year can be set up in those 5 polders while another 9 demo farms per year can be set up in 9 Upazilas under Bagerhat, Cox's Bazar, Patuakhali and Noakhali districts. Thus 27 demo farms per year and 81 demo farms for three years can be primary centres for technology demonstration and *in-situ* training.
3. Establishment of Demonstration Farms for shrimp PL nursery in farmer's ponds. Hatchery produced shrimp PL has become available recently in our country. But the remote shrimp farms are not getting good supply of PL due to communication problem. Establishment of PL nursery will help to reach shrimp PL up to remote places. The increased survival rate after nursing will add value to the farmers. Some 150 demo nurseries can be good demonstration centres throughout the coastal districts.

4. Strengthening of two existing Demonstration Farms and Training Centres (DFTC) for shrimp culture training in Kaligonj, Satkhira and Teknuf, Cox's Bazar. TOT for DOF and NGO staff and training for selected advanced farmers can be carried out there round the year utilizing the existing facilities of training, demonstration and dormitory space for 20 persons at a time.
5. Setting up Diagnostic Laboratories in two DFTC (Kaligong and Teknuf). It requires placing some instruments and accessories from the FFP to collect samples, laboratory analyses and prescribing farmers for common diseases.
6. Setting up of mini Diagnostic Laboratories at District Fisheries Offices of Khulna, Satkhira, Bagerhat and Cox's Bazar districts.
7. Five mechanised boats with mini diagnostic facilities for rapid trouble shooting, sampling and monitoring of shrimp diseases.
8. Production of training materials like manuals, leaflets, newsletter, audio-visual materials etc.
9. Credit program for small holders shrimp farmers. Demo farmers can be the clients for this. FFP can provide some inputs and simple instruments for shrimp culture as incentive, but the stocking cost can be on credit from the project.

1. Logistic support and manpower.

To implement the proposed activities in the field under the FFP shrimp component the DOF does not have sufficient manpower and logistic support particularly at field level in the coastal districts. Therefore necessary manpower with logistic support can be replaced in the coastal districts from other fresh water districts where overlapping of extension programs by FTEP II and ADP (IFAD) have been identified already by the Extension and Training component.

For strengthening of two Training and Demonstration Centres experienced staff from the Shrimp Culture Project (IDA) under the revenue budget of DOF can be utilized.

Table 1: Distribution of Shrimp Fry Collectors and estimated catch per year

Division	District	Upazila	Estimated no. of fry collectors	Estimated total no. of fry collected (in lakh)	Remarks
Chittagong	Chittagong	1. Mirersorai	2479	29.41	Regular
		2. Sitakundu	4070	564.6	
		3. Banskhali	1567	168.38	
		4. Anowara	2190	287.63	
		5. Pahartali	550	90.33	
		6. Bandar	809	90.71	
		7. Sandwip	2970	389.87	
	Cox's bazar	8. Sadar	14500	4200	
		9. Moheskhali	3500	1000	
		10. Chokoria	5200	850	
		11. Kutubdia	3200	700	
		12. Ukhia	1800	700	
		13. Teknaf	18500	2000	
	Feni	14. Sonagazi	1000	50	
	Noakhali	15. Sudharam	10000	264.5	
		16. Kompanigong	15000	5714.6	

Division	District	Upazila	Estimated no. of fry collectors	Estimated total no. of fry collected (in lakh)	Remarks	
	Lokhmipur	17. Ramgoti	5000	1539.9		
Barisal	Pirojpur	18. Matbaria	3300	49.8		
		Bhola	19. Lalmohon	6530	180.3	
			20. Monpura	5000	120.6	
			21. Charfasion	10,200	350.7	
			22. Tozumoddin	3215	1.7	
	Patuakhali	23. Kolapara	55,339	2326.4		
		24. Golachipa	55,245	2015.5		
	Barguna	25. Sadar	10,165	50.7		
		26. Patarghata	44,230	2014.6		
		27. Amtoli	13,845	1085.3		
Khulna	Khulna	28. Paikgacha	5320	10	Irregular	
		29. Koira	28,200	344.8		
		30. Batiaghata	1890	40		
		31. Dacop	16,700	162		
		32. Dumuria	300	1.18		
	Bagerhat	33. Mongla	16,900	392		
		34. Morelgong	3160	62.68		
		35. Sarankhola	1230	203.6		
		36. Rampal	560	19.12		
	Satkhira	37. Asashuni	3880	85.2		
		38. Kaligong	5200	130.8		
		39. Shyamnagar	49,400	1254		
		40. Tala	110	4.49		
				443,024		29,639

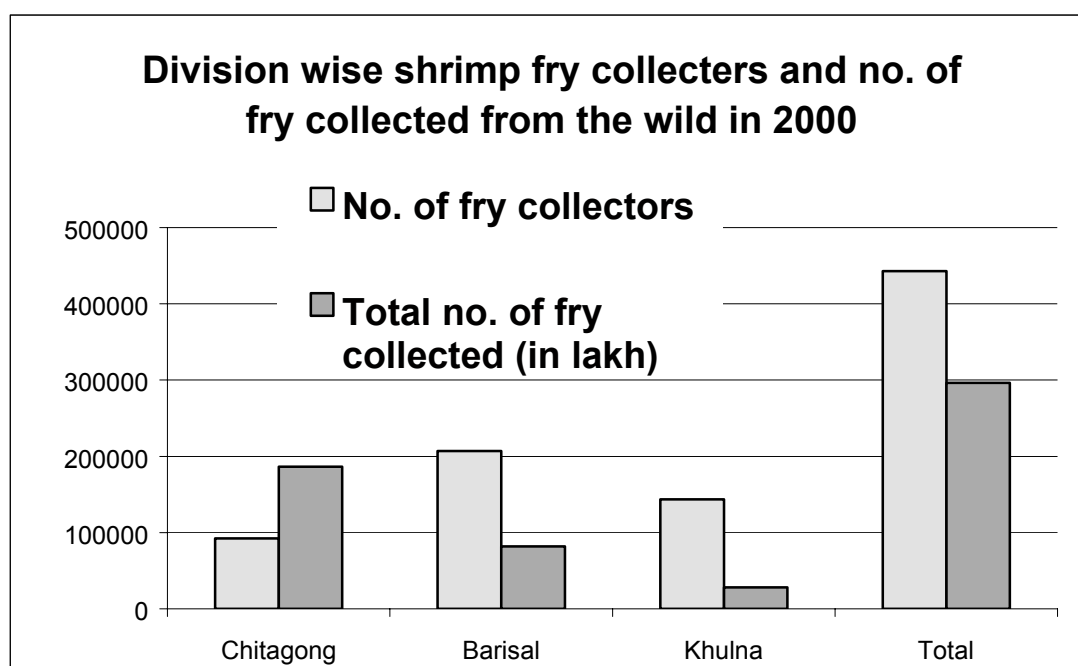
Source: PD, Strengthening of Coastal Fisheries Management Project, DOF, March 2000.

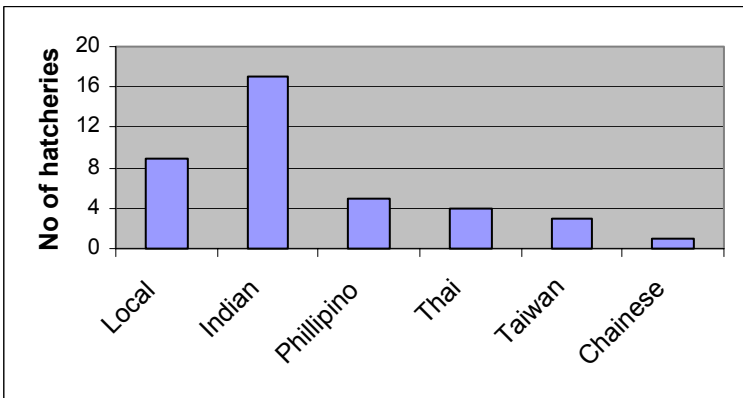
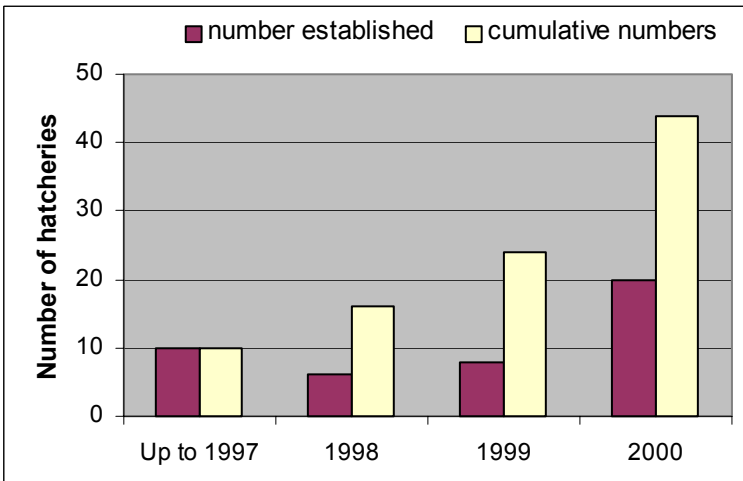
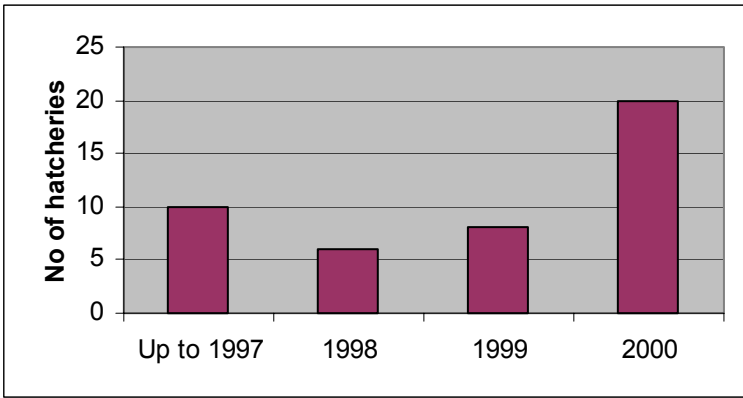
Table 2: List of Shrimp Hatcheries producing Shrimp Fry

Name of hatchery	Location	Annual production capacity (10 ⁵)	Established
IDA Shrimp Hatchery	Kolatoli, Cox's Bazar	100	1992
Pioneer Hatchery Ltd.	Kolatoli, Cox's Bazar	1000	1992
Niribili Hatchery	Kolatoli, Cox's Bazar	1000	1994
Modern Hatchery	Kolatoli, Cox's Bazar	3000	1998
Shimizoo Hatchery	Kolatoli, Cox's Bazar	600	1997
Satkhira Hatchery	Kolatoli, Cox's Bazar	500	1998
Sonargaon Chingri Prokolpo	Kolatoli, Cox's Bazar	900	1996
Golden Shrimp Hatchery	Kolatoli, Cox's Bazar	300	1999
Sea Gull Hatchery	Kolatoli, Cox's Bazar	250	1998
Thai Bangla Hatchery	Kolatoli, Cox's Bazar	350	1998
Gold Coast Hatchery	Kolatoli, Cox's Bazar	250	1998
Baly Shrimp Hatchery	Kolatoli, Cox's Bazar	400	1997
Prime Shrimp Hatchery	Kolatoli, Cox's Bazar	700	2000
Flora Hatchery	Kolatoli, Cox's Bazar	350	2000
Silvia Hatchery	Kolatoli, Cox's Bazar	-	2000
United Shrimp Hatchery	Kolatoli, Cox's Bazar	-	2000
Uniqe Bengal Shrimp Hatchery	Kolatoli, Cox's Bazar	-	2000
Unique Tiger Shrimp Hatchery	Kolatoli, Cox's Bazar	250	2000
ADB Shrimp Hatchery	Carpara, Cox's Bazar	100	1992
Sea Queen Hatchery	Sonarpara, Ukhia, Cox's Bazar	350	1998

Name of hatchery	Location	Annual production capacity (10 ⁵)	Established
Royal Hatchery	Sonarpara, Ukhia, Cox's Bazar	350	2000
Radiant Hatchery	Sonarpara, Ukhia, Cox's Bazar	300	1999
Bengal Bay Hatchery	Sonarpara, Ukhia, Cox's Bazar	300	1999
Merry Gold Hatchery	Sonarpara, Ukhia, Cox's Bazar	320	2000
White Gold Hatchery	Sonarpara, Ukhia, Cox's Bazar	300	1999
Inter Export Hatchery	Sonarpara, Ukhia, Cox's Bazar	600	2000
Sorex Hatchery	Sonarpara, Ukhia, Cox's Bazar	250	2000
Borac Hatchery	Sonarpara, Ukhia, Cox's Bazar	350	2000
Saodia Hatchery	Sonarpara, Ukhia, Cox's Bazar	650	1999
S Alam Hatchery	Sonarpara, Ukhia, Cox's Bazar	600	2000
Diamond Hatchery	Sonarpara, Ukhia, Cox's Bazar	350	2000
Sea Gold Hatchery	Sonarpara, Ukhia, Cox's Bazar	300	2000
Rainbow Hatchery	Sonarpara, Ukhia, Cox's Bazar	-	1999
Sea King Hatchery	Sonarpara, Ukhia, Cox's Bazar	300	2000
Beach Hatchery	Sonarpara, Ukhia, Cox's Bazar	500	1998
Mustafa Hatchery	Sonarpara, Ukhia, Cox's Bazar		2000
Khulna Hatchery Ltd.	Sonarpara, Ukhia, Cox's Bazar		2000
A & I Bagda Chingri Hatchery	Maheshkhali para, Teknaf	250	2000
Moon Star Hatchery	Maheshkhali para, Teknaf	200	2000
Sonargaon Sea King Hatchery	Maheshkhali para, Teknaf	3200	2000
Aqua Venture Shrimp Hatchery	Maheshkhali para, Teknaf	250	2000
Al-Mansur Hatchery Ltd.	Maheshkhali para, Teknaf		2000
BMC Hatchery Ltd.	Maheshkhali para, Teknaf		2000
Gulf Food Ltd.	Mongla, Bagerhat	-	1999
Red Star Hatchery	Dacop, Khulna	-	1999
Koia Hatchery Ltd.	Dumuria, Khulna	-	2000
Mausumi Hatchery Ltd.	Patenga, Chittagong		2000
Chungri Bangla Hatchery Ltd.	Benerpota, Satkhira	-	1998
Total		19,770	

Source: PD, Strengthening of Coastal Fisheries Management Project, DOF, March 2000.





B3 Shrimp fry quality: key issues. Dr Alfredo Santiago (Shrimp Sector Specialist, Fourth Fisheries Project).

Bagda farming is the fastest growing food production enterprise in the coastal areas of Bangladesh. However, disease outbreaks in the coastal polder *ghers* since the early 1990's have been significantly affecting Bagda production and trade. Up until now, many farmers consider shrimp disease as the single most limiting factor to sustainable production.

DISEASE DEVELOPMENT

The development of a shrimp disease in the hatchery, culture pond and while being transported involves a complex interaction among the shrimp itself, the disease causing organisms, called pathogen, and the water environment. For the shrimp to get sick or to have disease, a pathogen has to be present in the hatchery and pond water, the shrimp should be susceptible, and the water environment more favorable for disease organisms than the shrimp.

Pathogens or disease agents can be classified into physical, chemical and biological in nature. Extreme environmental changes like temperature, salinity and pH are physical agents of diseases. Chemical agents like environmental pollutants, toxins, and nutritional imbalances can cause shrimp disease in many ways. Biological agents, often called infectious disease agents, include viruses, bacteria, fungi and parasites. Their presence and reproduction rate within the hatchery and pond are largely dependent on various environmental factors like temperature, salinity, pH, dissolved oxygen, and food. Infectious agents are capable of multiplying within the host and can be transmitted directly.

The health of the shrimp is dependent on the stability of the environment. The fluctuations in temperature, pH, salinity, and dissolved oxygen outside the normal range for the shrimp may cause stress and lead to disease. Hatchery technicians and shrimp farmers should understand and manage the rearing environment properly to help prevent and control disease outbreak.

LACK OF QUALITY CONTROL

The sustainability of the shrimp hatchery and production sectors is very dependent on the kind of wild and hatchery produced fry being delivered to shrimp farmers. Buyers and traders usually refuse to pay the full cost of delivered fry if they think that low quality fry were sold to them. Actually, in Khulna and other areas where shrimp farming has become a popular activity even for the poor coastal folks, the high incidence of disease outbreaks in recent years has all been blamed on the poor quality of mainly hatchery fry. There were reports about size variation in hatchery fry, indicating poor quality of tank water, poor feeding technique, or intentional mixing of young and old PLs is resorted to by some hatchery operators.

Half of the problems on fry quality, in my observation, relate to the quality of Bagda broodstock being used and the hatchery techniques employed in hatchery production. In Bangladesh, broodstock collection by commercial trawlers is so crude, hatchery techniques are not standardized, and hatchery technicians and owners do not help and share technology among them even when there is already an outbreak of diseases.

The other half of the fry quality problems revolve around the lack of handling, transporting and pond stocking techniques of traders and pre-nursery operators and the shrimp farmers themselves. Basic procedures on proper packing, appropriate transport facilities, and acclimatization of newly delivered fry need to be demonstrated to all concerned farmers, by the Department of Fisheries in collaboration with the shrimp association in every Upazila. Otherwise, even the healthiest wild fry and perfectly reared hatchery fry will stand no chance in surviving even for a day in the farm. Stocking farms with any kind of healthy fry during the height of winter and/or during mid-summer is tantamount to gambling or engaging in a high-risk venture.

B4 Shrimp Seed Certification to promote Sustainable Development of Shrimp Aquaculture and relevance to the GOB/UNDP/FAO Project “Empowerment of Coastal Fishing Communities for Livelihood Security”. Dr Dilip Kumar, (FAO).

Background and justification

The growing demand of shrimp seed are currently satisfied from two sources – commercial shrimp hatcheries as well as wild catch from the coast. There are 43 shrimp hatcheries in Bangladesh with capacity to produce about 5000-6000 million post larvae of tiger shrimp but they produce just enough to meet the annual requirement of about 3000 million post larvae. About 500 million post larvae of this species are also caught from the nature.

One of the major technical constraints currently faced by shrimp aquaculture is the frequent incidence of disease and related heavy economic losses. Farmers doubt the quality of seed, usually delivered to them by seed traders who buy seed from hatcheries as well from natural seed collectors. This doubt poses a serious threat to the future of shrimp aquaculture industry. There is no direct sale of seed from the seed producers (hatchery operators or seed catchers) to shrimp farmers.

To overcome the situation and to regain the confidence of farmers the following two throng approach is required.

A Joint Government and Shrimp Hatchery Association of Bangladesh (SHAB) based initiative to develop and introduce shrimp seed certification system in the country, bridging the gap between the seed producers (hatchery operators) and seed users (farmers).

Seed certification is required to ensure the continued production and supply of hatchery bred quality shrimp seeds through screening of shrimp brooders and seed lots following molecular based precise, quick and reliable diagnostic techniques. This would develop confidence among shrimp farmers by reducing disease-mediated losses in shrimp culture.

Objective:

The objective of the proposed project is to develop and promote government and private sector based participatory programme of shrimp seed certification in Bangladesh. It is expected that the initiative would help to develop mutually agreed modalities of brood and seed certification system including cost sharing to by the Government (DOF /BFRI) and private sector (SHAB). This would necessarily require setting up PCR based laboratory, training of personnel (both Government and Private Sector – SHAB), trials and nation wide introduction through developing mutually agreed modalities by way of expert consultations.

Certification may not be able to certify against all the diseases of shrimp but to start with it may consider certification against at least one or more notifiable viral diseases to OIE/NACA which may be of greater relevance to Bangladesh.

Significant Viral diseases of shrimp (Notifiable to OIE / NACA)

- Yellowhead disease (YHD) caused by yellow head virus (YHV)
- Infectious hypodermal and haematopoetic necrosis virus (IHHN) caused by Infectious hypodermal and haematopoetic necrosis virus (IHHNV)
- White spot disease (WSD) caused by white spot syndrome virus(WSV)
- Baculovirus midgut gland necrosis (BMN) caused by BMNV
- Gill associated virus (GAV)
- Spawner mortality syndrome (Midcrop mortality syndrome)

Relevance of Shrimp Seed Certification to the GOB/UNDP/FAO Project “Empowerment of Coastal Fishing Communities for Livelihood Security”

The **project aims** to promote participatory community based coastal fisheries management following sustainable human development initiatives including livelihood security, in selected coastal fishing villages of Cox’s Bazar district. This involves organising the coastal fishing communities, creating awareness, promoting alternative income generating activities, improving their access to social and extension services, enhancing flow of information, and strengthening linkages between organized communities and local government institutions and administration. The project is attempting to achieve this through the following three **immediate objectives**:

1. Assist the coastal fishing communities to address their problems and needs collectively by stimulating them to get organized into village level organizations (VOs) that are self managed and self directed, develop skills to run and manage such organizations, facilitate access to information and improve linkages with Local Government Institutions.
2. Introduce various economic and community welfare activities which are operated and managed by VOs including savings, promotion of alternative income generating enterprises separately for men and women, improving access to social services and building their capacity to face and survive from natural disasters.
3. Facilitate sustainable conservation and management of coastal marine and estuarine fisheries resources and habitats through strengthening of participatory stakeholder and community based approaches, organization and empowerment of communities and promotion of income generating businesses through facilitation, networking and establishing linkages and venture management inputs.

Coastal fishing communities both men and women, who are poor and disadvantaged section of the society and most prone to recurring natural disasters, are the **primary target group** of the project.

Farmers confidence in certified seed will block marketing of uncertified seed collected from natural sources, thereby enhancing the natural recruitment of finfish and shell fish along with shrimp in the coastal waters resulting in catch enhancement and livelihood development of the coastal fishing communities numbering about a million in the country. This group of coastal fishers depend exclusively on coastal fishing for their livelihood. On the other catching seed from wild is basically a part time job to supplement family income. Seed certification would also help in developing a functional and accountable relationship between the hatchery operator (seed producers) and shrimp farmers. Reduction in wild catch would also reduce colossal damage of seed of non-target species thereby significantly improve the aquatic biodiversity of coastal resources. The step would also help Bangladesh in the implementation of FAO Code of Conduct for Responsible Fisheries.

B5 The potential for long-term livelihoods support from a depleting resource base:

A strategic analysis of management options in Bangladesh coastal fisheries. Md. Giasuddin Khan (GEF, FFP).

Introduction

Shrimp PL fishery (to catch post larvae of tiger shrimp), the estuarine setbag net (ESBN) fishery (to catch juveniles of miscellaneous marine fauna) and the shrimp trawl fishery (to catch brood shrimps) are the three major destructive fishing gears, the combined effect of which has made the coastal fisheries resource base too sensitive to depletion. Fishing in the artisanal sector is no longer remunerative. The impact of the trawl fishery on the shrimp PL fishery and the vice-versa was not visible, because the two fisheries came into operation almost at the same time. But the negative impact of both of these fisheries was visible on the catches and the overall income of the ESBN fishers (Khan et al, 1994).

It is noticeable that in the shallow water artisanal fishery, and in the ESBN fishery in particular, almost all of the nursery area visitors from marine as well as fresh water ecosystems are seriously overexploited and that is

a sign of gross overfishing. Nevertheless, some of the estuarine fauna are also overexploited. But majority of the estuarine fauna are underexploited e.g. *Acetes indicus* the estuarine shrimp which usually does not grow big. In the marine waters some fish and shrimp species are under exploited e.g. brown shrimp, Bombay duck, white grunter, lizard fish and threadfin bream.

The overall penaeid shrimp stock is under pressure. The stock of black tiger shrimp *P. monodon* in particular is under threat from all sides. Only less than 10% of the virtual population of this species and more than 80% of the white shrimp *P. indicus* were allowed by the shrimp fry collectors (Khan et al 1999) to go back to the sea. The added obstruction from the ESN fishery further reduces the chances of recruitment as adults as well as the regenerating capacity of the stock. In spite of having the highest virtual population, the white shrimp resource is simply misused and wasted for virtually no benefit. Due to the limited distribution, the *P. indicus* stock is hardly available in the trawling ground and also there is hardly any other effective means of fishing for it, on the other hand. This non-judicious exploitation process makes the economic return go down at geometric rate, despite a high level of basic potentiality of these resource bases to support a very sound and bio-socio-economically feasible fishery. Trammel net is the most effective fishing gear for this species all around the countries of tropical Asia, but the fishing effort is quite insignificant in Bangladesh. Major and high density distribution of *P. indicus* is in the Patuakhali zone where the trammel fishery is yet to develop.

Results

One good example of balanced exploitation and relatively high economic return is from the stock of *M. monoceros* (brown shrimp). The overall low catch (less than 10%, meaning more than 90% of it's population is released) of push net due to lower catchability of this gear on this species results in a high level of recruitment in the higher water depths inspire of relatively high catch in the ESN fishery. For only one simple reason brown shrimps offer the highest production (eight times higher than the tiger shrimp and 30 times higher than the white shrimp) in the trawl fishery, although the average individual size and weight of this species is comparatively low. If a similar level of recruitment took place for the other species (tiger shrimp, white shrimp etc.) there would be substantial increase in total catch as well as in economic and socio-economic return in a sustainable manner through a multi-fleet harvesting process.

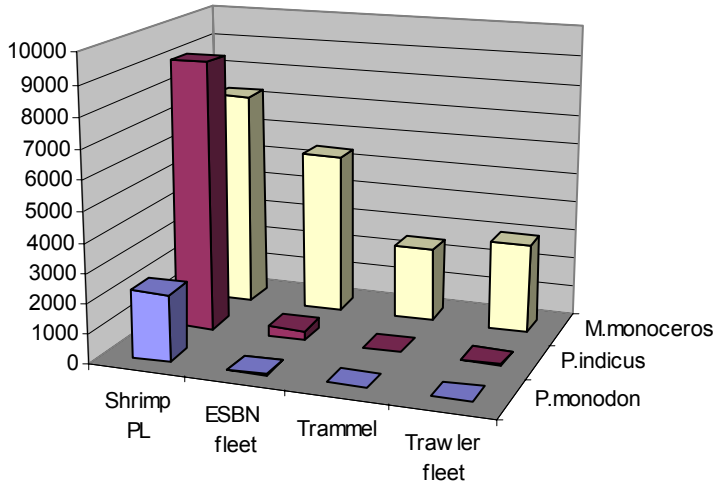
In spite of three times higher fishing effort, the production of bagda PL in the Khulna area was only 18% (of a total of 2035 million) compared to as high as 74% in the Cox's Bazar area. This was catalysed by eight times higher CPUE for bagda in Cox's Bazar area (1375 pieces of bagda per/day/net) than in Khulna area (170 pieces of bagda/day per/net only). Out of the total by-catch produced for the whole coast, 75% came from Khulna area alone. This area possesses much higher biodiversity than the Cox's Bazar area as apparent from the proportion of by catch in the two areas (1:365 in Khulna and 1:24 in Cox's Bazar). For only 18% of bagda PL, the by-catch in the Khulna area was as high as 145 billion, while for 74% of bagda PL, the by-catch in the Cox's Bazar area was 40 billion only. The above shrimp fry collection scenario strongly suggests that the shrimp PL collection process particularly in the areas of Khulna zone is a fatal exercise and that the parental resource base can not bear this pressure, and the nation can not allow it to continue for a relatively small and replaceable benefit. But since a very big community is involved in the process and the shrimp farming industry is still partly dependent on wild fry, a sustainable solution need be explored.

The ESN analytical model may be applied to the shrimp PL fishery where a reduction of effort by 50% and an increase of mesh size by 100% was suggested to make the ESN fishery sustainable. On the other hand it was also realised that these options are too difficult to achieve, mainly because of the socio-economic consequences of displacement of a big professional fisher community who are traditionally in this profession for more than 14 generations and who have hardly any access to other means of income/livelihoods. As an alternative and for immediate and partial solution, suggestions were made to the effect that with reduction of only 15% of the effort and with no changes in mesh size (for the time being) 60% of the juvenile can be saved from destruction by closing only 4-5 months a year (in two seasons) at only two out of the six areas of the coast. It is considered possible to rehabilitate this small displacement with alternate IGA available within the capture fisheries sub-sector e.g. introduction of trammel nets in the areas of Patuakhali zone.

Assessment of impact of fishing through virtual population analysis (VPA)

The stock of black tiger shrimp *P. monodon* in particular is under threat from all sides. Only less than 10% of the virtual population of this species and more than 80% of the white shrimp *P. indicus* were allowed by the shrimp fry collectors (Khan et al 1999) to go back to the sea. The shrimp PL fishery (i.e. catch of post larvae of tiger shrimp), the estuarine setbag net (ESBN) fishery (i.e. catch of juveniles of miscellaneous marine fauna), the shrimp trawl fishery (which catches brood shrimps) and the MSBNs are all major destructive fishing gears.

Fig 1. Recruitment (million number) of penaeid shrimp species in different fisheries



Collectively, it would appear that they are all contributing to the decline in shrimp recruitment, however it is extremely difficult to isolate the impact due to any specific fishery. The impact of the trawl fishery on the shrimp PL fishery and the vice-versa is difficult to quantify, largely because the two fisheries came into operation almost at the same time. ESNBs and beach seines catch significant quantities of juveniles (shrimp and finfish), thereby restricting recruitment into the offshore and other coastal fisheries. MSBNs target sub-adults and may also be perceived as being particularly damaging. The BOBP report on the shrimp PL (Paul et al 1993), the population dynamics analysis made by Khan et al (1994) and Khan (1999), BFRI (2001) report that the destruction in the initial phase of the life cycle is perceived to be highly significant. The destruction of the by-catches of other marine fauna, which was recorded as more than 100 times of the bagda PL (the target species), has also a big impact on the sustainability of the marine fish and shrimp stocks. However, there is no conclusive evidence in the report that supports this view.

On the other hand, overall survival of some species from the egg stage to recruitment is highly density-dependent, the crucial question with respect to PL harvesting is whether density-dependence occurs primarily before or after the PL stage. If density-dependence occurs after the PL stage, then the harvesting of PL would have little effect on recruitment unless spawning stocks are at a very low level. If, on the other hand, density-dependence occurs mainly before the PL stage and survival from PL to recruitment is density-independent, then PL harvesting would have a direct and proportional effect on recruitment and fishery yield. This crucial question is impossible to resolve without a better understanding of the recruitment process, which may be gained from ecological studies and/or statistical analysis of time series of fisheries data (including PL catches). However, it is possible to make an indicative assessment of worst-case scenario, i.e. assuming density-independent survival from PL to recruitment.

The situation in the penaeid shrimp fishery would be transparent if the exploitation pattern of the two major penaeid species i.e. *P. monodon* and *M. monoceros* are compared. The most distinctly noticeable factor is that the push net fishery takes about 91% of the tiger shrimp population at around 2 cm. length class and leaves only 9% to be recruited after natural deaths to all other fisheries including the trawl fisheries. As a result of poor recruitment at sub adult and adult sizes, the trawl fishery catches only 0.20% of the initial population of

the tiger shrimp for a total production of only less than 350 mt. It can be seen in the Table 2 and Figs 1 – 3 that this species has a relatively low vulnerability to the ESNB fishery.

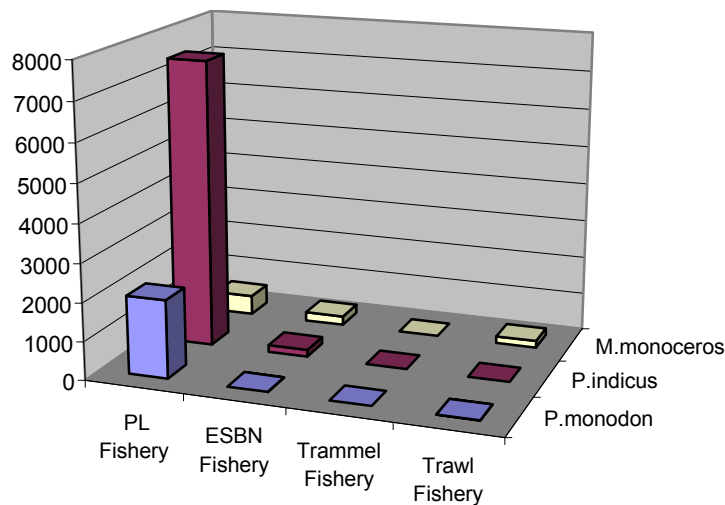


Fig 2. VPA - Catch (million number) of penaeid shrimp species in different fisheries

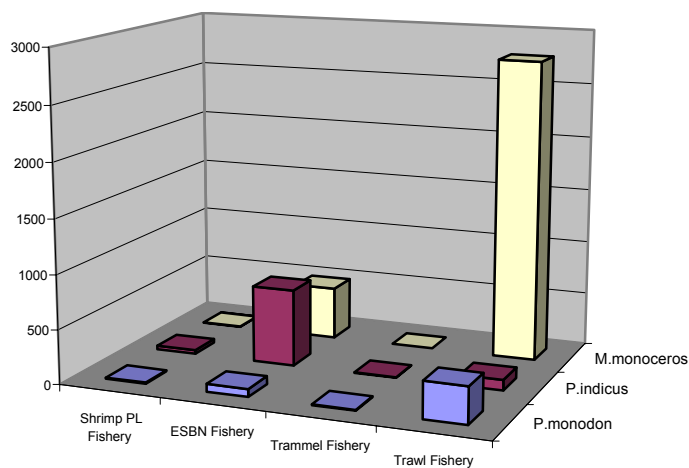


Fig 3. VPA - Catch weight (mt.) of penaeid shrimp species in different fisheries

On the other hand the shrimp PL fishery takes only 7% of the initial population of the brown shrimp recruited to this fishery and a very big part of the population i.e. 93% is released (just the opposite to *P. monodon*) and allowed to be recruited to other fisheries as juveniles, sub-adults and adults after several sequences of natural deaths. As a result, inspite of heavy fishing mortality on this species by the ESNB fishery at juvenile stage, the size of recruits and the total harvest in the trawl fishery was distinctly higher than the tiger shrimp (Table 6.3). Thus, inspite of the fact that catch as percentage of recruits in the trawl fishery was higher for tiger shrimp and the average weight of the brown shrimp caught in trawl fishery (15.52 gm.) was only about one fifth of the average weight of tiger shrimp (48.20 gm.) the annual production of the brown shrimp, from the trawl fishery was about 10 times higher (about 3,000 mt.) than the tiger shrimp.

Observations from virtual population analysis (VPA)

- Population of *P.monodon* drastically reduced

- M.monoceros stock is relatively healthy, because it has too little vulnerability to PL fishing
- P. indicus stock is virtually misused/wasted
- Trawl fishery gives eight times brown in weight than the tiger, because it has relatively very high off-shore recruitment
- P. monodon has higher fecundity than other two, and should have the highest VP size
- VPA clearly indicates depletion in population size

Summary Results from PL Studies of BFRI

- Months of May to November fall under non-stocking season when the biodiversity impact is high.
- Colossal loss of other by-catch species is significantly higher in the south-west part of the coast.
- CPUE & total production of bagda PL is significantly higher in the south-east coast.

According to DoF /BoBP,1993

- Production of bagda PL in the Khulna area was only 18% (of 2035 m)
- 74% in the Coxes Bazar area, CPUE 8 times higher
- 75% of the total by-catch came from Khulna
- The proportion of by catch: Khulna - 1:365 and Cox's Bazar - 1:24
- For only 18% of bagda PL, the by-catch in the Khulna area was as high as 145 billion, while for 74% of bagda PL, the by-catch in the Cox's Bazar area was 40 billion only.

According to Marine wing of the DoF 2002

According to the most recent survey data of the Marine wing of the DoF, the fry collectors are mostly located in the Barisal zone (around 50%) followed by about 35% in the Khulna zone and the lowest at the Cox's Bazar zone (only 20%), where as the major catch of PL comes from the Cox's Bazar zone (accounting for around 65% of the total catch). Despite much higher fishing effort, the production of bagda PL in Khulna zone accounted for only 10% (Fig 12). The total catch amounts to 3,000 M PL (*Penaeus monodon*) together with a further 300,000 M other species, 62 % of which is zooplankton, 10.9 % other shrimp, 13% caridean prawn and 13% finfish larvae. Of the other shrimps, *Penaeus indicus* and *Metapenaeus monoceros*, the frequency of catches in PL collection is particularly high for *Penaeus indicus* (80% of the total by number), but this species is largely discarded.

B6 Conditions needed for future growth and investment in the sector. Paper presented by Rafiq Sarker, Agro-based Industry & Technology Development Project- Phase II (ATDP-II)

Conditions need for the growth and investment in the shrimp sector

1. Land-use policy defining and demarcating areas in the brackish water coastal belt and low-lying lands in the fresh water areas for uninterrupted shrimp farming
2. Public sector support to develop site-specific development plans and create basic water supply and drainage net-works on both sides of selected rivers. This should include fully or partially tide-fed ponds, and completely pump-dependent areas. This will encourage farmers to undertake on their own initiatives further improvements of ponds. Examples of improvements include (1) construction of well-designed ponds with improved water supply and drainage, (2) reduction of large ponds into manageable small units (five to ten ha but not beyond ten ha for improved extensive type of farming), and (3) utilisation of a much greater proportion of the suitable land for shrimp culture.
3. Basic culture infrastructure with perennial water supply and drainage network under an infrastructure Master Plan for each existing and potential fresh water shrimp farming area
4. Timely supply of disease free and healthy shrimp fry near the farming areas

5. Model farms for various ecologically distinct environment
6. Easy availability of effective technical services at all levels
7. Easy availability of cheap but effective pellet feeds free from any unacceptable chemicals, hormones or antibiotics
8. Reasonably good infrastructure including roads, waterways, power supply and telecommunication in the farming areas
9. Security in the farming areas and in roads and waterways
10. Harmonious work of different stakeholders to ensure products according to HACCP rules
11. Commitments of all the direct stake holders to work under a Seal of Quality program

Seal of Quality

(SOQ is a brand, which will ensure that the shrimp is clean, safe to eat, free from antibiotics, harmful chemicals' residues and growth hormones. It will also guarantee that the shrimp has been produced in an acceptable physical and social environment honoring human right)

ATDP INVOLVEMENT

1. Organizing of field level HACCP training for shrimp depot operators, farmers, factory representatives
2. Business management skill development using computer programs for factory accounting and finance staff
3. Organizing visits to international seafood shows to establish new export linkages with shrimp and fish importers
4. Feed formulation and business management training to feed millers
5. Preparing for demonstration of and training in improved fish drying in cost-effective solar driers to coastal fishing communities
6. Organize a Seal of Quality (SOQ) program for the shrimp industry
7. Organizing shrimp farmers, suppliers and feed millers to harmoniously work to support the process of introduction of a SOQ program
8. Launching consultant services to progress with the SOQ program
9. Working in close collaboration with DFID, EU Commission, GOB, NGOs, etc to promote the SOQ program

Appendix C: Outputs from working groups

C1 Fry traders

Concerned over fry catchers ability to repay loans to traders if they are banned from catching fry. Claim a ban on fry catching would result in many job losses for traders¹². They proposed the following recommendations:

1. A complete and permanent lifting of the ban from April to September.
2. Training for fry catchers and traders in proper fry collection techniques that reduce the impact of fry catching on biodiversity.
3. Training for traders on correct handling, storage and transport of fry.
4. A licensing system for fry catchers (conditional on whether they had received a valid certificate following training) available only to fry catchers whose main income derives from fry catching.
5. DOF to issue identity cards to license holders and monitor and enforce restrictions. Licenses to be withdrawn if incorrect methods are used.
6. Gradual phasing out of wild fry catching through continued support for alternative livelihoods.
7. Restrictions on trawling for broodstock to protect the wild stocks.
8. 30% of hatchery production to be released into the sea to replenish wild stocks, to be supervised by DOF.

C2 Shrimp farmers

Need improved technology, low cost credit and good quality fry. They say that wild fry is superior to hatchery fry due to poor survival of hatchery fry during transport. If the transport system for hatchery fry can be improved farmers think the demand for wild fry will decline. However, they have concerns over price fixing by hatcheries if wild fry is not available in the markets. They are also concerned that a total reliance on hatchery fry would render the shrimp industry more vulnerable to the risks and constraints associated with the production of hatchery fry. Regard DOF and NGOs as responsible for primary extension of improved technology to farmers. Stressed the need for more nurseries and improved infrastructure in the polders along with better policing to improve the security condition in shrimp farming areas.

C3 Fry catchers and NGOs

The fry catchers present at the workshop described themselves as landless people living on khas land or land from the Department of Forestry. They have been catching fry in the Coxes bazaar area for the past 15-20 years and are completely dependent on this for their income. Each month their average income from fry catching varies from Tk4000 to 6000 for men and from Tk2000 to 4000 for women. Most are unaware of a ban but they are harassed by the police who take bribes from them. Most fry catchers practice improved catch techniques, returning the by-catch to the water body. They blame the trawlers and current nets for the decline in wild shrimp stocks. They urged development agencies to provide them with training on improved catch methods, alternative livelihoods, allocation of *khas* land and credit to reduce their dependency on money lenders. In the meantime, they oppose any type of restriction on fry catching.

C4 Local Government, FFP and FAO

This group cited a number of problems they face in trying to enforce a ban on fry collection. These include: a lack of manpower, financial resources, protection from pressure from the Dadondars (fry traders who also lend money) and a lack of security in remote areas. They reported only a limited effect of training on the fishing habits of fry traders.

They proposed:

¹² Especially for the hawkers who collect directly from the traders, each hawker typically collecting from 7-10 fry catchers and selling to a local depot. Assuming there are 400,000 fry catchers a ban could also affect up to 60,000 small traders.

- banning fry collection to preserve biodiversity and promote tourism¹³
- an increase in manpower and logistical support
- increased travel allowance to enable them to reach the fry catching areas
- improved security in the fry catching areas
- disengaging the administration from politics
- providing support for alternative livelihoods for fry catchers
- providing a financial incentive of Tk15 per day for fry catchers not to catch fry
- improved co-ordination between different agencies

C5 Hatcheries

Highlighted the existing capacity of hatcheries is sufficient to supply the whole market need and the harmful effect of harvesting wild fry on recruitment to wild stocks. The moves towards certification will ensure that the quality of hatchery fry can be maintained and assured in contrast to wild fry. The following points were made.

- The hatcheries advocate a complete ban on the capture of wild fry.
- They proposed introducing a programme of releasing hatchery fry into the wild (10% of each hatchery's production per year).
- Dismissive of farmers claims on hatchery fry being of lower quality than wild fry. Claimed that fry catchers could easily move into other areas of employment because they used fry catching only to supplement income from other livelihoods.
- Believed that the ban should be enforced but backed up with support for goat, chicken and duck rearing, fish culture, vegetable production and other cottage industries.
- Also recommended the introduction of a policy on the use of foreign technicians in hatcheries with measures to support the emergence of skilled technicians from the Bangladesh workforce.
- To improve the quality of fry they recommended routine inspection of mother shrimp, laboratory back up and disease screening of fry and broodstock at all stages from the hatchery to the farmer.
- Recommended the development of improved trading, transport, handling and storage methods for fry.

C6 Fishers and FAO

They believe fry catching should be banned to protect wild stocks. Highly critical of seasonal fry catchers as non-traditional fishers who deplete the resource for the traditional fishers who are dependent on fishing year round. The livelihoods of traditional fishers also merit protection. They believe a ban would benefit gill net and behundi net fishers¹⁴ through increased yields. It would also increase the broodstock fishery. Propose community based management in fishing areas to protect stocks and livelihoods of traditional fishers.

C7 BFRI and DOF (Marine)

Support a complete ban on the harvest of wild fry due to:

- Evidence of the adverse impact on biodiversity and declining yields of commercial fish stocks¹⁵
- Sufficient supply of PL from hatcheries
- Impact on livelihoods of marine and artisanal fishers
- Perception that many fry catchers harvest fry as a source of secondary income.
- Using the FFP catch figures of 3000 million wild fry, they estimate losses of 3 million tonnes¹⁶ from the commercial shrimp fishery.

¹³ They complained about the dumping of by-catch on the beaches deterring tourists

¹⁴ and ultimately benefiting the consumers

¹⁵ shrimp seed studies by BFRI, DOF, and BOBP and findings from GEF FFP on commercial shrimp stocks.

¹⁶ If each shrimp weighs 10g