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Wild Shrimp Larvae Harvesting in the Coastal Zone of Bangladesh: Socio-economic Perspectives

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Abstract

About 0.42 million people are involved in shrimp post larvae collection along the estuaries and coastline of the Bay of Bengal in Bangladesh. Shrimp fry collection from wild sources has assumed a notorious image for being ecologically destructive. In 2000, the Government of Bangladesh imposed regulation to stop shrimp seed collection to protect the fisheries resources. But thousands of people involved in post larvae collection are defying the ban. There is an apprehension that strict implementation of the banning ordinance may displace the people who depend upon the income from catching the larvae. To get the socioeconomic patterns of fry collection 72-85 collectors were interviewed weekly from three harvesting sites. This paper analyzes the larvae collection and distribution efficiency, livelihood strategy of fry collectors, user options for fisheries management and role of various stakeholders empirically. Results show that poverty, migration, credit systems and lack of coordination of service-providing agencies all have important influence on shrimp fry collection in the coastal zone. With an ever-increasing demand for

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sustainable use of coastal fisheries resources there is a need for consensus among the stakeholders. We propose alternative employment opportunities for fry collectors, community participation and integrated coastal zone management approach for the development of fisheries resources.

Introduction

The capture of wild post larvae to stock in aquaculture facilities is a critical point of shrimp farming (Paez-osuna 2001). Although hatchery produced post larvae are now available in many countries in Asia and Latin America wild fry still provides the significant source of seed in many locations (World Bank et al. 2002; FAO 2007). Shrimp farming in Bangladesh mainly depends on wild source post larvae (PL) both for giant fresh water prawn (*Macrobrachium rosenbergii*) and black tiger shrimp (*Penaeus monodon*). It has been estimated that approximately 2 billion shrimp fry are collected annually from wild sources (Banks 2003). With respect to fresh water prawn (*M. rosenbergii*) more than 90% of the total PL is derived from natural sources and in the case of black tiger shrimp (*P. monodon*), more than 50% is derived from wild sources (Banks 2003). Shrimp seed collection has given employment opportunity for thousands of coastal landless and unemployed people (Angell 1990; FAO/NACA 1995; Islam and Wahab 2005). Globally, there are more than 1 million people engaged on a part time basis collecting wild source PL (World Bank et al. 2002). A USAID (2006) study estimated that about 0.42 million collectors were involved in shrimp seed collection along the estuaries and coastline of Bangladesh. On the other hand, wild PL harvesting has assumed a notorious image for being ecologically destructive (Primavera 1998; Islam et al. 1999; Hoq et al. 2001; Bhattacharya and Sarkar 2003). In Honduras, for example, the collection of 3.3 billion larvae of *P. vannamei* and *P. stylirostris* destroyed 15-20 billion fry of other species (De Walt et al. 1996). In Bangladesh approximately 40% of the collected seed died before stocking in culture facilities due to poor handling and transportation (Brown 1997). It has also been observed that about 99 fin fish and other shrimp species fry are discarded for collecting a single shrimp post larvae (Rashid 2000). A number of comprehensive assessments on coastal capture fisheries, fry collection and ecosystems have been conducted in recent years in various countries (Graaf and Xuan 1998; Turner et al. 1999; Hoq 2000; Hossain 2001; Sarkar and Bhattacharya 2003). But few studies have focused on the patterns of livelihood of the fry collectors and the fishers (Hoq et al. 1995).

In 2000, the Government of Bangladesh promulgated a regulation to stop shrimp seed collection from wild sources to protect the fisheries resources. The declaration states that “no person shall catch or cause to be caught fry or post larvae of fish, shrimp and prawns of any kind in any form and in any way in the estuary and coastal water of Bangladesh” (Ministry of Fisheries and Livestock 2000). Unfortunately, thousands of people still harvest PL and market their catch. Yadava (2002) reported that harvesting of wild seed is banned by the State Government of West Bengal, India but some collections in remote estuarine areas still continue. There is an apprehension that the strict implementation of this ban will displace thousands of men, women and children who depend upon the income from catching of shrimp fry. As a widespread controversy exists on the shrimp seed collection issue, this research was set out to evaluate the site specific socioeconomic characteristics of shrimp PL collection, in relation to management of coastal fisheries resources.

Materials and Methods

The study area

The study area comprises three sites (Amtoli, Kolapara and Kuakata) in Patuakhali and Barguna districts which are located in the central coast of Bangladesh (21-22° N and 90-92° E). Geographically these two districts have been identified as the most important areas for wild post larvae of *P. monodon* and *M. rosenbergii* across the coastal zone. About 749.25 million *P. monodon* (Rashid 2000) and about 5.4 million *M. rosenbergii* (Alam 2001) post larvae are harvested from these areas per season (from mid December to June). The study site Kuakata is located on the shoreline of the Bay of Bengal. During the British colonial time the Rakhain tribal community took shelter after clearing the deep mangrove forest of this area. But presently most of the land is under the control of the Muslim community. These people have migrated from the northern part of Patuakhali and from the Barisal districts (Alam 1998). The study site Kolapara is located about 20 km inland from the sea. Kolapara is surrounded by the rivers *Andermanik* and *Arpangashia*. This is one of the polder areas which were constructed during the 1960s and 1970s under the Coastal Embankment Project (Choudhury 2001). The study site Amtoli is located about 15 kilometers farther inland from Kolapara site. This site lies by the river *Paira*.

Data collection

Both qualitative and quantitative data collection techniques were used for this study. To get information about socio-economic patterns, semi-structured interviews and different Participatory Rural Appraisal (PRA) approaches were applied. To get site specific data, 35-40 fry collectors from Kuakata, 12-15 fry collectors from Kolapara and 25-30 fry collectors from Amtoli were interviewed weekly. Data were analyzed using MS Excel and SPSS 11.0 software programs. In addition, secondary data including reports of the Department of Fisheries were used as references for study purposes.

Results

PL harvesting gears, operation and efficiency

Among the fry collection gears, the set bag net (locally called *Behundi*) is the most common in the Kuakata site, while drag net (*Baksho jal*) is popular in Kolapara site. The collectors of Amtoli site prefer to use relatively bigger size set bag net (locally called net jal *Behundi*) as well as dragnet (DN) to harvest larvae. The collectors used a series of set bag nets to harvest shrimp fry along the shoreline. The nets were set with the help of long nylon rope, floats and weight. They use bamboo or wooden frame and long nylon rope for the operation (Fig. 1). At Amtoli site the collectors used a single set bag net (SBN) with the help of a bamboo frame and ropes. Locally available nylon mosquito nets were used as netting material. High-density monofilament net materials (locally called *net jal*) were used in the Kuakata and Amtoli areas. The average cost for SBN of high-density polyethylene (HDPE) and mosquito net were 1200 Tk (US\$ 21) and 800 Tk (US\$ 14), respectively. The cost for drag net was about 170 Tk (US\$ 3).



Fig.1 A. Set bag nets in operation



Fig.1 B. Drag net in operation

In all the study sites, the tows (for DN) and fixing/hauling time period (for SBN) were collected during the data collection and precisely observed during the research period. The owners of SBN at Kuakata site fixed/towed their nets all day and night during the months of January and February. After February the collectors stopped to fix their net at night time as bigger size jellyfish and triggerfish created a problem to manage the net. The fry collectors at the Kolapara site started harvesting in the month of February. On the other hand the collectors at Amtoli site started harvesting in the month of March. From the weekly sampling data (Fig. 2) it was calculated that a collector harvested an average of 128 shrimp fry using the SBN (HDPE), 29 fry using SBN (mosquito net) and 112 fry using DN per day. At the Kuakata site, the average number of SBN in each series was 12 and generally two operators owned those nets. So each operator harvested 174 fry using six SBN nets per day. On the other hand the fry collectors at the Amtoli site used only one SBN (HDPE) per person and harvested an average of 128 fry per day. The collectors at the Kolapara site used only drag nets and harvested about 112 fry per day (Table 1).

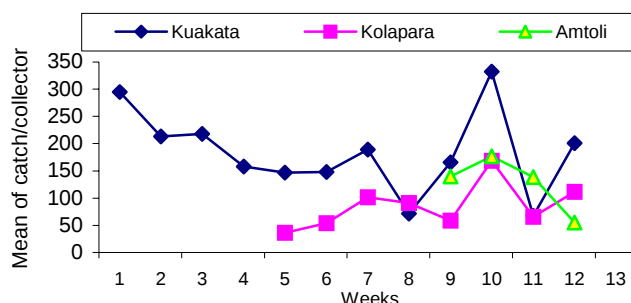


Fig. 2 The mean of fry harvested per day in different weeks (first sampling on 22 January 2003 and last sampling on 12 April 2003)

Table 1 Comparison of gear efficiency for larvae collection

Gear types	Fix/Tow time	Average PL catch per day	Total operation time per day	By catch mortality (%)
SBN (HDPE)	3 hours	128	12 hours	60
SBN (mosquito net)	3 hours	29X6=174	12 hours	60
DN	13 Minutes	112	4.5 hours	15

The abundance of fry depends on the lunar cycle and wave action. It was observed that fry collectors harvested a good number of fry during the spring tide (full moon) after which the number decreased (Fig. 2). Again the number of fry increased during the new moon and gradually decreased. However on the 10th week of the study period the collectors in all sites caught a significant number of fry. The mean numbers of fry per day were 332 at Kuakata site, 168 at Kolapara site and 177 at Amtoli site.

PL marketing and credit system

It was observed that four to five powerful middlemen were involved in the fry collection and credit distribution process. These middlemen often formed some sort of association locally called syndicate. These associations provided credit to the fry collectors just before the harvesting season, on condition that they sell all the fry to the syndicate. The *arotdars* (1st middlemen) were the key players within the actors' groups of the credit distribution channel. The *arotdars* of shrimp/prawn farming area including Bagherhat and Khulna districts borrowed money from the local commercial bank and distributed it to fry collectors through the middlemen of Patuakhali and Barguna area. On the other hand the *hawkers* (1st middlemen) were the key players within the fry distribution channel.

The *hawkers* collect the fry from the collectors and send it to the *arotdars* of the shrimp farming area through the middlemen (Fig. 3). Results revealed that about 79 % of the fry collectors had taken loans (locally called *dadon*) from the local money lenders (Table 2). The highest number (63 %) of respondents reported that they received loans from the *hawkers*.

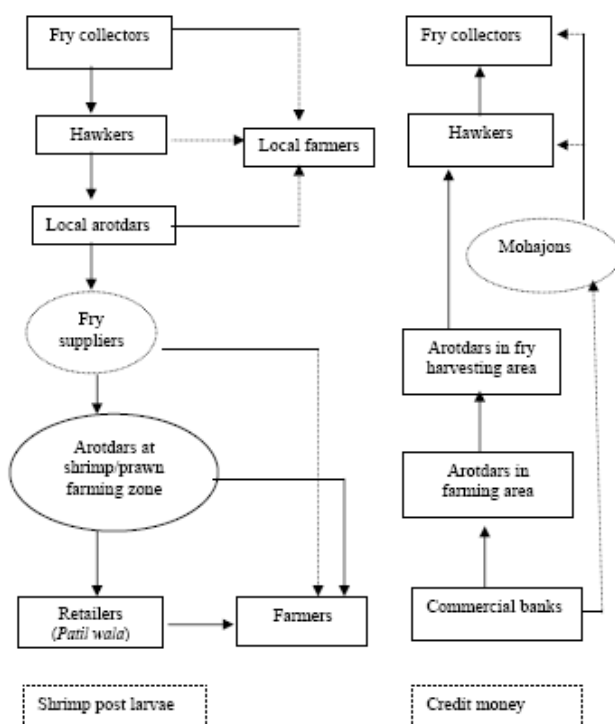


Fig. 3. Distribution channels of fry and credit in Patuakhali- Barguna region

A significant number (11 %) of fry collectors had taken loans from the *mohajon*. *Mohajons* were generally not directly involved in fisheries related activities but invested money to make profit. During the focused group discussions (FGDs) they reported that the local money lenders also provided loans during the hilsha (*Tanualosa illisa*) harvesting season. A good number of respondents (45 %) informed that they received loans

from non-governmental organizations (NGOs) during the hilsha season (Table 2). However, only 3% of the respondents reported that they have taken loans from the commercial bank. Absence of collateral, complexity to get loans and fixed monthly repayment system discouraged the fry collectors from taking loans from the commercial bank.

It was observed that the fry collectors could not reveal the rate of the interest that they paid for their loans. The interest was not paid directly in cash. They supplied PL to repay the loan and interest. The syndicate usually fixed the price of the fry and the

collectors are kept in the dark about the price. The farmers (ultimate buyers) on the other end also remain in darkness. Usually the *hawkers* gave 7-8% lower price of the fry compared to market price. It was found that when the farmers paid 80 Tk (US\$ 1.40) for 100 fry, the collectors got only 28 Tk (US\$ 0.50) for 100 fry. It means that the fry collectors got 35% as share of the buyer's money. The local *hawkers* and traders (locally called *arotdar/godhighor*) took 12 and 12%, respectively. The *arotdars* (farming area commission agents) took 13% of the buyer's money. The rest is spent for carrying and quality (mortality) loss costs. The daily income from fry collection was 30 Tk for DN, 36 Tk for SBN (HDPE) and 48 Tk for SBN (mosquito net) owners, respectively (US\$ 1=58 Tk).

Gender and age group of fry collectors

People aged from 10 to 62 years old collected fry for their livelihood. At the Kuakata site the adult males and boys were the dominant groups among the fry collectors. Only a few women were found at the Kuakata site who migrated with the family from far inland villages and settled at the *Gucchagram* (cluster of homes in public land for the homeless) to harvest shrimp fry. Due to seclusion (*pardha*) they did not expose themselves and most of them harvest fry in the evening time. At the Amtoli site, young girls were dominant within the female group. But at the Kola-para site, most of the collectors were female. They migrated from far villages and settled at the *Gucchagram*. They could harvest shrimp fry even at day time. This was possible because they have already broken the traditional norms of society by coming out of their houses. Some of the qualita-

Table 2. The sources of credit for the fry collectors

Sources of credit	Frequency	%
Bank	2	3
NGOs	36	45
<i>Hawker</i>	50	63
<i>Mohajon</i>	9	11
<i>Arotdar</i> (local)	4	5
Relatives	3	4
Neighbors	1	1

Total number of respondents (n): 80 (respondents gave more than one answer)

tive information which was collected through FGDs showed that a significant number of women who engaged in this occupation were separated or deserted by their male family members. However, result shows that the highest (30%) number of fry collectors was within the 10-20 years old followed by 21-30 years old (29%) (Fig. 4).

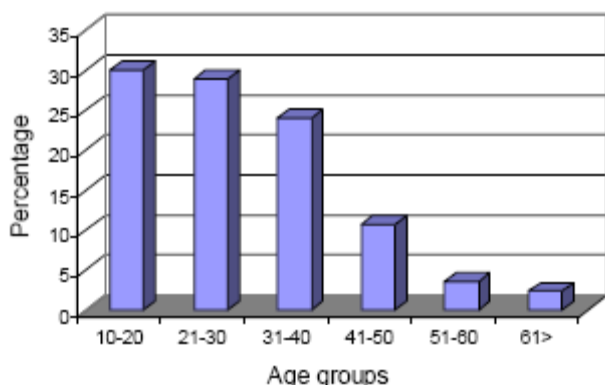


Fig. 4. The percentage of different age groups involved in fry collection

Occupations of the fry collectors

Besides fry harvesting, almost all of the respondents have a much diversified secondary occupation. The highest (27.7 %) number of collectors was previously involved in food fish harvesting and this occupation was still in top position (49.4 %)

as secondary occupation. Previously, about 18.1 % of the fry collectors were students but presently only 7.2 % are studying (Table 3). Again, previously only 3.6 % of the respondents informed that they had no secondary job but this increased to 8.4 %. The discussants informed that a good number of male and female fry collectors had worked in garments factory but due to the September 11, 2001 crisis in the USA the garments factories faced a major setback and they returned from Dhaka (capital city) and engaged in fry collecting activities. They reported that still a good number of people are migrating to Dhaka for better income.

Fry collector's family income

Income from fry collection was calculated from the weekly collected data. But income from other sources was calculated from the seasonal activity calendars and the questionnaire survey. It was found that the people of Kuakata fishing community were involved in two major fishing seasons. One was with fry catching and another with hilsha fishery. On the average a collector spends about 150 days a year in catching fry and about 135 days in harvesting hilsha at the Kuakata site. The fry collectors conceded that during the off-season they work as earth workers, farm hands and household chores. The fry collectors at Kolpara spend only about 105

Table 3. Major occupations of the fry collectors

Previous occupation	Frequency	%	Secondary occupation (Present)	Frequency	%
Food fish harvest	23	27.7	Food fish harvest	41	49.4
Study	15	18.1	Study	6	7.2
Wages labor	14	16.9	Wages labor	12	14.5
Agriculture	16	19.3	Agriculture	7	8.4
Small trade	6	7.2	Small trade	1	1.2
No job	3	3.6	No job	7	8.4
Handicrafts	2	2.4	Handicrafts	2	2.4
Plant nursery	1	1.2	Rickshaw pulling	3	3.6
Garments factory	3	3.6	Wood collection	2	2.4
-----	--	--	Poultry farming	1	1.2
-----	--	--	Vegetable gardening	1	1.2
Total	83	100		83	100

days a year catching fry. But they were very much dependent on small scale fishing and spend about 150 days a year in this activity. They were also involved in earth work and agricultural labor during off-season. At the Amtoli site they caught *P. monodon* and *M. rosenbergii* simultaneously for about 90 days and only *M. rosenbergii* for 35 more days of the year. Besides these they were also engaged in hilsha fishery and small scale fishery including adult prawn harvesting on an average of 135 days a year. They also have opportunities to be involved in earth work and agricultural wage labors during the lean season. Male members were also involved in rickshaw (human-pulled three wheeler) pulling and small scale trading (especially at the tourist resort of Kuakata site). A few female members resorted to handicraft (mat and locally called *katha* weaving) industries as secondary occupation. They collected mangrove plants *Typha elephantina* (locally called *hogla*) as mat weaving material. Besides the major sources there were few minor sources of income. For analytical advantage the minor sources were merged with the major sources of income into broad categories (Table 4).

Although the average annual family income was more or less same at the three sites, the highest (36800 Tk) was found at Kuakata site. Of the total income, about 30 % at Kuakata and about 26 % at Amtoli came from fry collection occupation. Only 11 % of the income came from fry collection at Kolapara site. The collectors of Kolapara site were highly (46 %) dependent on small scale fish harvesting activity. They still earned a significant (17 %) amount from wage labor. On the other hand, a major pro-

portion of the annual income (44 and 40 %) came from hilsha fishery at Kuakata and Amtoli sites, respectively (Table 4).

Table 4. Annual average family incomes of fry collectors

Types of occupation	Income (Taka)		
	Kuakata	Kolapara	Amtoli
<i>P. monodon</i> seed collection	11100	3570	1800
<i>M. rosenbergii</i> seed collection	-	-	6930
Hilsha fishing	16200	-	13500
Small scale fishing	-	15000	-
Prawn and others fishery	-	-	2500
Agricultural product	2000	-	2500
Wages labor	3500	5600	4500
Handicrafts	-	2625	2000
Mangrove wood collection	-	2000	-
Rickshaw pulling	-	4000	-
Migration for wages labor	4000	-	-
Total	36800	32795	33730

The banning ordinance and response

The ordinance banning wild fry collection is one of the Government's long time legislation. Promulgated on September 2000, this ordinance came under the Fish Act-1950 (revised 1985), which generally deals with inland fisheries issues. Result shows that most (87 %) of the fry collectors know about the ban in fry collection. During the FGDs they represented the action of the Government, as most of them have no alternative occupation, especially in the months of December to April. When asked about the sources of the banning news most fry collectors (53 %) said that they got the news from the *hawkers*, 26 % from neighbors and only 15 % got the information

from the Department of Fisheries officials (Table 5).

Key stakeholders analysis

The key stakeholders for this

Table 5 Source of information of fry collectors on ban of wild fry collection

Sources of news	Frequency	(%)
Neighbors	19	26
Hawkers (1 st middlemen)	38	53
Upazilla Fisheries Officials	11	15
Television	2	3
Arotdars	2	3
Total	72	100

study are the middlemen, the Upazilla (sub-district) Fisheries Officers (UFOs), Marine Biologists, Divisional Forest Officer (DFO), shrimp/prawn hatchery owners and NGO extension workers of the coastal districts.

The middlemen reported that long before engaging in fry collection, the collectors were already facing financial problems in addition to several reported incidents of anti-social activities such as robbery in the area. However, reported cases of criminal activities reduced as people earn money through fry collection for their livelihood. They suspect that the owners of shrimp/prawn hatcheries pressured the Government to ban the fry collection as the hatcheries produced seed that is not popular among the farmers. The middlemen conceded that the fry collectors were getting lower price of fry after the circulation of the ordinance as they were spending more to offer bribe to the law enforcing agencies including the fisheries and forest department officials.

The Marine Fisheries Biologists reported that prior to the circulation of this ordinance the Marine Fisheries Directorate arranged a training for the fry traders to collect fry in relatively less destructive ways. They also provided bowls and *patils* (fry sorting materials) to fry collectors so that they can release the non-targeted species into the water but this stopped upon the circulation of the ordinance. The UFOs informed that they circulated the regulation through loudspeakers as well as through community meetings. They opined that it is very difficult to supervise such vast areas with limited manpower. Moreover, they have no magistracy power and often need help from law enforcement agencies (e.g. police, coast guard). Within the limited resources the UFOs sometimes organized mobile court, seized and destroyed gears and filed cases against fry collectors.

In Bangladesh the water bodies within the mangrove forest are owned and controlled by the Forest Department. The Department exercises its control on fishing through toll collection. The officials informed that prior to the implementation of the banning ordinance they used to indicate fry collection permission in the permits. They acknowledged that although it is no longer indicated in the permits, in practice the collectors are still harvesting fry in the forest water bodies.

The hatchery owners reported that the shrimp seed marketing is difficult as the farmers have strong preference to wild source larvae. Farmers believe that hatchery produced fry have low disease resistance and slow growth. They reported that they used mostly wild broods for seed production. The hatchery owners believed that fry from wild sources are becoming scarcer each day.

It was likewise observed that the local NGOs were not so interested in dealing with fry harvesting issues. They generally deal with the poor

people as well as with environment and biodiversity issues. The fry collection issue represents both the poverty of the fry collectors and aquatic biodiversity. If the NGOs raised their voice in favor of the fry collectors then it might go against the environment and biodiversity. On the other hand, if they opined in favor of the environment it might go against the fry collectors. These are perhaps their reasons for keeping silent. However, officials of the Community Development Centre (CODEC), a local NGO that works mainly with coastal fishing communities informed that they have arranged some awareness building meetings regarding fry collection legislation.

Options for better management

When community people were asked about a better management option for coastal fisheries they suggested very diverse measures (Table 6). About 26 % (the highest number) of the respondents suggested alternative jobs be arranged during the fry collection season. Although they have no alternative job opportunities, 23 % of the respondents agreed to stop fry collection as soon as possible. The fry collectors identified the estuarine set bag net (locally called *behundi jal*) as the most destructive one. A significant number (14 %) of respondents opined to stop the estuarine set bag net (ESBN) to save the fisheries resources of the coastal zone. About 10 % reported that although the operation of beach seine nets is officially banned, the owners still use it very often. They claimed that beach seine

Table 6. Management options for coastal fisheries

Management options	Frequency	(%)
Banning ESBN	12	14
Leave by catch larvae into water	3	4
Stop shrimp fry harvesting	19	23
Stop beach seine net	8	10
Stop small meshed <i>hilsha</i> gill net	4	5
Stop broods (shrimp/hilsha) harvesting	9	11
Arrange alternative jobs	22	26
Stop shrimp seed harvesting at peak season	5	6
Close the beach seine nets source points	3	4
Don't know	14	16

Total number of respondents - 83 (respondents gave more than one answer)

owners are relatively well to do in the community and they have good connections with the law enforcing agencies including UFOs. On the other hand 11 % of the respondents suggested stopping the harvest of brood fish (shrimp/hilsha) in off-shore areas as killing of one brood means killing thousands of fish. Finally,

16 % of the respondents did not give any suggestions as they were not aware about the management of the fisheries resources.

Community participation in fisheries management

To include the community participation concept in fisheries resources management the present study attempted to take the opinion of fry collectors as resource users and the UFOs as resources managers. Among the fry collectors, 63 % were in favor of community participation on fisheries management (Table 7). They are of the opinion that it is impossible for government agencies to supervise the vast coastal areas all the time. So community participation in management plan might be helpful. On the other hand, 25% of the respondents resented the concept. About 12% of the fry collectors remained silent as they did not know whether it would be good or bad. However, during FGDs, the majority (70%) of the Fisheries Officers did not agree in involving community people in the management process. But 30% of the officials were in favor of community participation.

Table 7. Fry collectors' opinions on community participation

Opinions	Frequency	%
Good	52	63
Bad	20	25
Don't know	10	12
Total	82	100

Discussion

It was observed that DNs were less destructive and only 15% of the trapped by-catch died. The owners of DNs harvested less number of targeted PL than the SBNs owners (Table 1). The difference may be due to site specific differences, gear type and duration of operation. The abundance of fry also depends on the lunar cycle and wave action. However, on the 10th week of study period collectors from all sites caught a significant number of fry. There was an equinoctial tide (a tide of high amplitude occurring when the sun is or near the equinox locally called *Joba*) on the 10th week that helps to bring a large number of fry with wave and tidal actions (Fig. 2). The collectors at the Kuakata, Kolapara and Amtoli sites started fry collection in the months of January, February and March, respectively. Paul et al. (1993) reported that the collectors harvested the highest number of fry during the months of February to March in Patuakhali area. The result shows that average catch rates were only 112, 174 and

128 for DN, SBN (mosquito net) and SBN (HDPE), respectively per day of operation (Table 1).

The fry collectors were forced to sell their catch to middlemen as they received credit from them. The complex systems of commercial banks discouraged the fry collectors to take loans from the commercial bank. They preferred to take loans from traditional money lenders as they have already established long relationship with them. During the communal unrest in 1990 and 1992 the Muslim money lenders protected and helped the Hindu fishers (Alam 1998). Also in 2000, when the Government imposed the regulation, the money lenders raised their voice in favor of the fry collectors (Daily Janakantha 2000; Daily Jugantor 2000). Furthermore, the money lenders know the problems of the fry collectors and usually provide flexibility in repayment of loans. These are perhaps the reasons why the fry collectors are more interested in taking loans from the local money lenders or middlemen. However, the fry collectors could not come out from the vicious cycle of traditional loans. Generally they could not repay the total amount of loan in a year resulting in continuation of loan year after year. Some of the fry collectors complained that the money lenders forced them to harvest fry even during lean periods for fry. In case of failure to supply sufficient quantity of fry, they were verbally abused and often subjected to physical torture. They could not even tell the rate of the interest that they paid because the interest was not paid directly in cash. They supplied PL to repay the loan money. The present study revealed that a fry collector's average income was only 38 Tk (US\$0.60) per day (Table 1).

Men, women and children were engaged in PL collection but results showed that 59% of fry collectors were from the younger group (Fig. 4). Low skill requirement and low capital investment perhaps attracted them to engage in this occupation. Among the younger group only 7% were involved in studying. The BCAS (2001) study reported that 74% of the involved children were school drop outs. Previously, no secondary jobs were available for 3.6% of the respondents but it increased to about 8% (Table 3) which indicated that employment and education are becoming limited for the new generation. However the important activities that the fry collectors adopted in recent years are poultry farming and vegetable gardening. These were also supported by USAID (2006) study for other parts of the coastal zone of Bangladesh. Integrated fish-vegetable-poultry farming created some employment opportunities for the local community (Haque et al. 2001). Azad et al. (2004) observed that integrated prawn (*M. rosenbergii*)-rice-vegetable farming emerged as a profitable venture for

coastal poor and marginal farmers. Although the families of fry collectors adopted diversified activities for their livelihood it was still evident that fry collection was an important source of income especially for the Kuakata (30%) and Amtoli (26%) communities (Table 4). This mainly is the reason why they resented the Government action. They do not have an alternative occupation. Although most of the fry collectors (87%) know about the banning ordinance they still believed that the Government might change the law as the local leaders and money lenders raised their voices in their favor (Daily Janakantha 2000; Daily Jugantor 2000). Furthermore some international donor agencies including the Department for International Development (DFID) of UK (Akester 2002, pers. comm.) submitted a memorandum to the Government to review the banning ordinance.

Among the stakeholders, the *hawkers* and other middlemen were more concerned about the regulation because they thought that they might lose their investment if the legislation was implemented properly. In response to one query in the consequences of the regulation, the middlemen reported that the ban raised their insecurity and the level of paying bribes for the local Government officials. Although the marine fisheries sector arranged trainings and provided fry sorting materials, it was stopped after the circulation of the ordinance. The TFOs, who are the main authority to implement the regulation, claimed that they could not implement the regulation due to lack of logistics support and poor cooperation from law enforcing agencies. The forest department officials acknowledged that fry collection still continues in mangrove water bodies although this is not mentioned in the permits. The NGOs remained silent on fry collection issues as they thought that it might go against the poor people if they raised their voice in favor of biodiversity. All of these information demonstrated that the regulation created inter and intra-sectoral confusion, conflicts and chaotic situations. Similar situations have been observed in many Asian and Latin American shrimp farming countries (Barraclough and Finger-Stich 1996; Tobey et al. 1998). Also, the stipulated regulation has not been analyzed in regards to its impact on social, cultural and environmental factors. When asked for better management options for coastal fisheries resources, the fry collectors suggested diverse measures. Chambers (1997) observed that a community's preferences and priorities are very diverse and different from those supposed for them by Government departments, donor-aided projects and even NGOs. The fry collectors suggested stopping ESN operation and harvesting of brood fish (shrimp, hilsha) that has harmful impacts on fisheries. The Tanzanian fisher folk also have experienced dramatic declines in their own catch due to commencement of indus-

trial shrimp trawling (Bryceson 2002). So the local community could be an important part of fisheries resources management process (FAO 1999). Ralph and Samuel (1995) and Hoozemans et al. (1996) discussed different co-management approaches and models for coastal resources management. Many coastal nations including Canada (Pinkerton 1994) and Australia (Miller 2001) have adopted this concept. The present study revealed that 63% of the fry collectors were in favor of involving the community in the management process. But 25% of the respondents resented the concept as they were afraid that the local elite might be involved only to achieve their own interest at the expense of others (Table 7). On the other hand majority (70%) of the fisheries officials believed that community involvement might empower the fishers to illegal harvesting and other more destructive ways. Sometimes well specified regulations on resource use are inconsistent with social goals (Hanna et al. 1995).

However the results reflect that alternative employment opportunities and coordination among the actors could help achieve the coastal fisheries development goals with least disturbance to natural balance. Local commercial banks and NGOs should come forward with micro-credit financing programs to start the alternatives. Integrated coastal management (ICM) approach could be adopted for better coordination. The key principles of the ICM framework should be vertical integration between national and local policy; horizontal integration between different sectors and comprehensive community involvement (Fig. 5).

Under ICM, fisheries resources management is just one of many activities which must be planned and managed with a view to meeting some broader coastal development (Hambrey 2000).

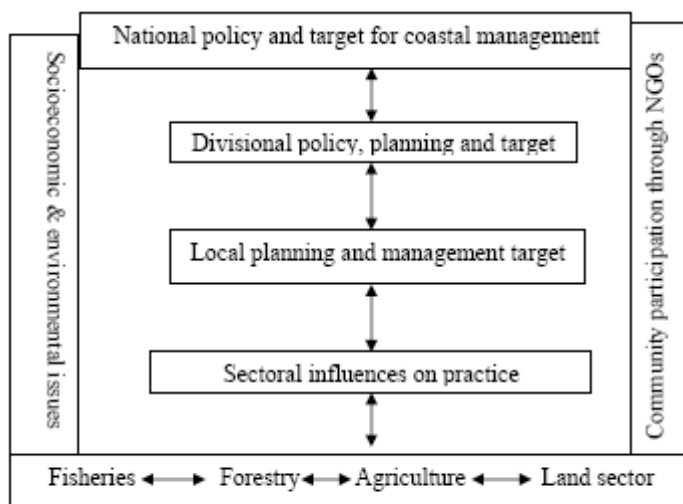


Fig. 5 Vertical and horizontal integration for coastal zone management

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