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Small-scale Fishermen along the Naaf River, Bangladesh in Crisis: A framework for management

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Abstract - Fishing is the most important traditional economic activity of the coastal communities in Bangladesh due to the availability of the diverse fishery resources. The Naaf River estuary is one of the large estuaries in Bangladesh coast, which plays a significant role in the socioeconomic condition of local community and considered as a major source of income through small-scale fishing. This paper highlights d the chronic problems and relative actions through sustainable management of small-scale fishermen of Naaf river. Community based participatory approach (PRA/RRA) was used for semi-structured questionnaire interviews of 120 small-scale fishermen from the three fishing communities soliciting information on their activities, financial flows and the main problems confronting their enterprise. Furthermore, 24 focus group discussions were arranged with different stakeholders to collect data on the organization and management of small-scale fishing as well as to get their opinions on the problems, causes and their consequences. The present study revealed that local communities in Teknaf coast are highly dependent on fisheries resources of the Naaf River. Major problems identified within the fishing community were high dependency to fishery resources, annual catch reduction, catch price fluctuation, by catch discard, lack of processing and preservation facilities, credit facilities, and training supports resulting in a disorganized fishing community with poor economic return. To ensure the sustainability, the fisheries sector need to overcome these increasing problems through management plan focusing on optimum fishery resources exploitation taking into account the top down and bottom up views of different stakeholders, "Community Based Fisheries Co-management" framework has formulated for long term sustainability and livelihood security of local community. This will go along way to help sustain the coastal fisheries resources with active participation of the fishermen.

Key Words: Naaf river, fisheries resource, small-scale fishing, sustainable management, Community Based Fisheries Co-management", Livelihood.

Introduction

Human dependence on marine and coastal resources is increasing (Berkes *et al.*, 2001). The fishing sector is a source of income and livelihood for millions of people around the world. According to the most recent estimate, in 2008, 44.9 million people were directly engaged, full time or, more frequently, part time, in small scale fishery. This number represents 167 percent increase compared with the 16.7 million people in 1980. It also estimated that global marine fisheries production in 2008 was about 90 million tonnes, with an estimated first-scale value of US$93.9 billion and over 98 % were small scale fisheries and 96 % of the world's fishery are from developing countries, producing 58 percent of the 98 million tonnes of annual marine fish catch (FAO, 2010). Fishing is an important economic activity in many developing countries including Bangladesh. Fisheries make 5.24% contribution to the GDP (Gross Domestic Product) and its value in the GNP (Gross National Product) is around Taka 150,486 million (1US$=Taka 70). The fisheries sub-sector provides full-time employment to over 1.2 million people among which 0.5 million are marine (DoF, 2010). The small-scale fisheries in Bangladesh are mostly open access and unregulated. The critical importance of the small-scale fisheries in Bangladesh can be inferred from the fact that > 90% of the production comes from marine catches (Hossain *et al.*, 2006). In the Set Bag Net fishery 12,561 gear units (Estuarine Set bag Net-ESBN) are being operated in the estuaries and coastal areas and 3,000 gear units (Marine Set Bagnet-MSBN) operated in open water (Khan *et al.*, 1994), where it supports 30% of total marine production (BBS, 2002).

Small-scale fishery is viewed as a complex system and it can be argued that livelihoods dependent on such a system are simultaneously destined to be complex and diverse. For most of the artisanal fishing, such a complex livelihood struggle indicates the failure to meet basic human needs and the denial of opportunity to live long, healthy and creative lives (Jentoft and Chuenpagdee, 2009). In 2008-2009, Total fish production of the country is around 2563,296 MT of which 20% come from marine fisheries. Coastal artisanal fisheries of Bangladesh contribute 497,573 MT (93% of total marine production) and the industrial sector contributes 34,159 MT respectively. Although the growth in the culture fisheries sector is appreciably positive, production in the inland and marine capture fisheries keeps dwindling (DoF, 2010).

The Naaf is a large estuary in the coastal region of Bangladesh an extensive and permanent interface with the Bay of Bengal that offers a rich potential for colonization of the fisheries species and Estuarine Set Bag Net (ESBN) fishing play significant role in the local economy as the dominant fishing gear. Naaf River estuary is a habitat of 161 different fin and shellfish species and as a result in terms of species number alone, the Naaf River can not only be considered a ecological hotspot, but also in terms of the ecological niche and life cycles, it has also a biodiversity close to or greater than that of many other river/estuarine systems in Bangladesh (Chowdhry *et al.,* 2011).

Information is scarcely available on both the practice and living conditions of small - scale fishermen along the river Naaf and the present

study marks a modest step to rectify this. This paper highlighted the precarious occupational and living conditions of the small-scale fishermen and the chronic problems facing their traditional industry. Framing the study are two concerns that bear directly on the practice and nature of fishery as a livelihood. The first concerns the common property status of fisheries, and the second, the outcomes of the financial insecurity arising from the seasonal and generally uncertain nature of small-scale fishery.

Materials and Methods

Study Area

The Naaf River is situated in the extreme southeastern part of Bangladesh. The river originates from the Arakan hill range at latitude 20°53 N and longitude 92°25 E, demarcating the boarder between Bangladesh and Myanmar (Fig. 1). It flows about 55 km toward the south along the east side of Teknaf coast and finally empties into the Bay of Bengal at latitude 20°47′ N and longitude 92°28′ E. It shows linkage with many canals, tributaries, creeks and stream corridors, forming criss-crossed coast. The area is characterized with a warm tropical climate and sufficient rainfall which give the opportunity to support a wide biological diversity. Such habitats include estuarine areas, mangrove forests and other wetlands, and tidal flats. These ecosystems provide essential nursery beds, feeding areas and shelter for a large variety of marine and estuarine biota.

Data Collection and Analysis

Primary data were collected from three fishing communities; Jatimora Jaladas Para (FV1), Teknaf Sadar Jalia Para (FV2) and Shahporir Dip Jalia Para (FV3), as the fishers' settlement clustered in these areas along the Naaf River. Rapid Participatory Rural Appraisal (RRA/PRA) was carried out using field observations and community level group meetings with different stakeholder groups on the fishing activities from March to October 2006 to gather primary information following the various approaches (Pido, 1995; Pido *et al.*, 1996; Townsley, 1996 and IIRR, 1998). Direct observation prevents rapid appraisal from being misled by myth (Chambers, 1992) and it often provides more valid and less costly information than other research methods (KKU, 1987). Group meetings with local communities are an important way of learning about local conditions and resources (Pelto and Pelto, 1978). Semi-structured questionnaire interviews of 120 small-scale fishermen from the three fishing communities solicited information on their activities, financial flows and the main problems confronting their enterprise. Moreover, 24 focus group discussions were arranged with local fishermen to collect data on the organization and management of small-scale fishing as well as their opinions on the problems, causes and their consequences. Local analyses of secondary information were done by using topographic maps and land use maps at 1:10,000 and 1:50,000 scale, a series of photographs and videos which also minimized the information gap. These sources were important to obtain supporting evidence regarding socio-economic context of the study area.

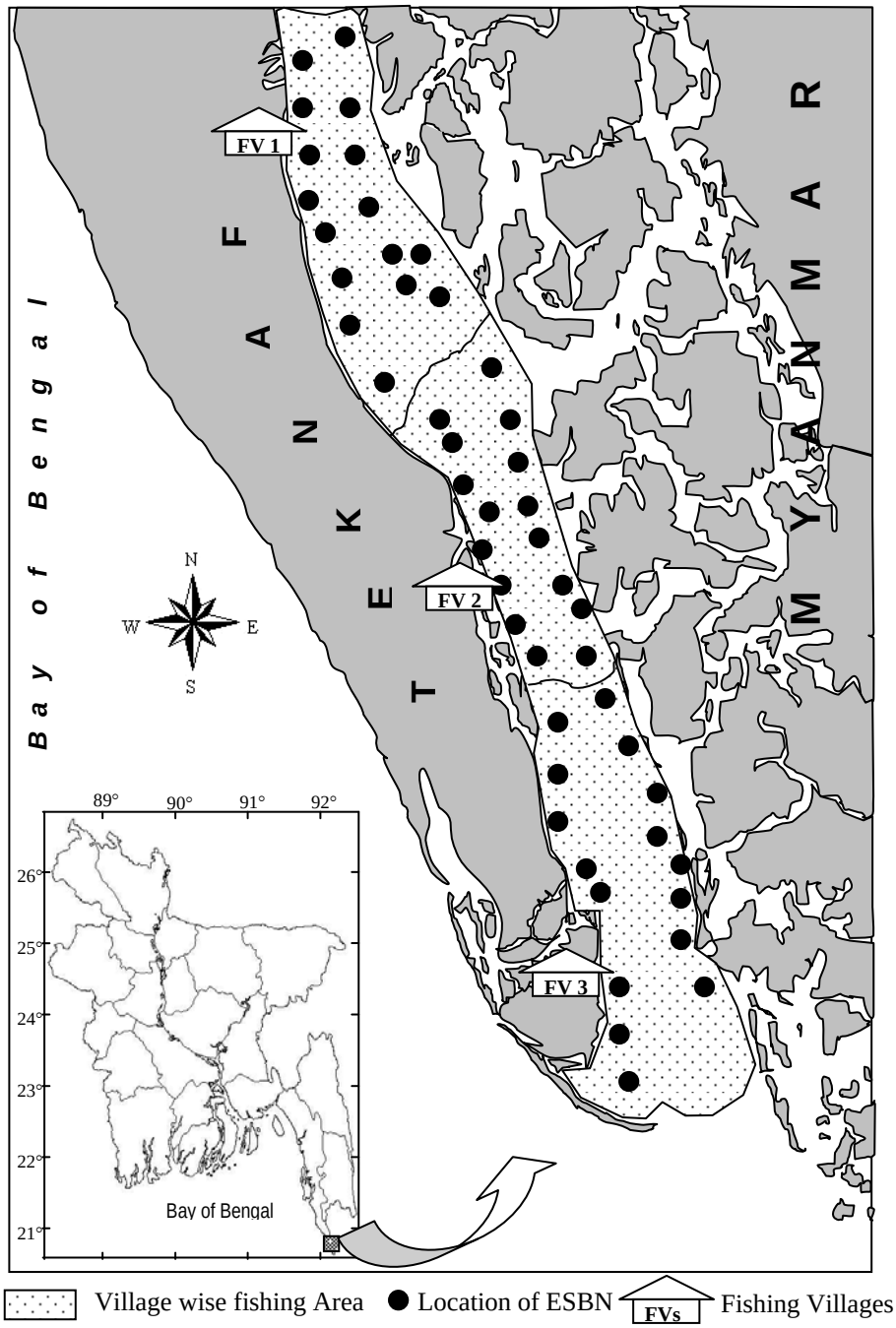

Figure 1. Geographical location of the Naaf River estuary with three fishing villages (FV1: Jatimora Jaladas Para; FV2: Teknaf Sadar Jalia Para; and FV3: Shahporir Dip Jalia Para), and location of ESBN operations.

Results

Demography

There are 878 households of 6750 populations in the three fishing villages; Jatimora Jaladas Para (FV1), Teknaf sadar Jalia Para (FV2), and Shahporir Dip Jalia Para (FV3), of which 52% male and 48% female. The main ethnic groups are Muslim, and Hindus representing about 85.93% and 14.07% respectively of the total population.

Assets and income generating options

A livelihood becomes sustainable when a family or a community has sufficient assets and the capability to use them to create a life free from hunger, disease, illiteracy and all the other factors associated with poverty. The asset pentagon has addressed five types of assets such as social, human, financial, physical and natural. Numerous assets have been identified (Fig. 2) with diverse livelihood options in the fishing villages along the Naaf River (Fig. 3). But most of the household heads (73.80%) have been directly involved in fishing, where fish trading, other business, net mending, agriculture, boat making, salt production and aquaculture are the major sources of income generation (Table 1).

The fishermen of the Naar River continue their fishing activities round the year, but March-April and September-October are favourable months for maximum catch (Fig. 4). Four types of fishing gears; namely are Estuarine Set bag Net (ESBN), small gill Net, beach seine and *Chor Jal* (enclosure net) are used in the Naaf River for fishing. At present, about 2299 fishermen of Teknaf three fishing villages with 250 ESBN units, 13 beach seines, 16 small gill nets and very few *Chor Jal* (Enclosure nets) have engaged in fishing in the Naaf River. ESBN was the most popular and dominant fishing gears, which can catch all sorts of fish species; even juvenile, post larvae and larger zooplankter. The annual average catch rate per 4-5 hrs haul was about 25kg. Their fishing strategy varies in accordance with depth, type of crafts and availability of fish. Three types of crafts have been identified as small row boat (148), medium boat (212) and large engine boat (35) with 16 to 22 HP. According to the net position (distance from the coast) large engine boats and small boats used for catch collection where as medium boats always fixed with the ESBN to look after the fishing gears and catch as well as resting, recreation and dining space of the fishers. Small gill net of mesh size 20-60 mm usually operated near the beach to catch jewfishes. The encircling beach seine operated in the shallow water to catch jewfishes, anchovies, clupeids and small shrimps. The average total catch rate (kg/day/net) of beach seine is 74 kg in the Naaf River Estuary. In addition, nearly 200 men, women and children were involved in the occasional shrimp fry collection along the riverbank. About 82% collectors used push net and only 18% used small set bag net to catch shrimp postlarvae (*Penaeus monodon)*. A synthetic monofilament net with knotless webbing of about 1 to 2 mm mesh is used in these gears.

Economic returns to local fishermen

The most dominant ESBN fisher (84%) takes four catches daily i.e., in every flood and ebb tide during full moon and new moon period (locally

Figure 2. Assets of the fishermen village along the Naaf River of Teknaf Coast.

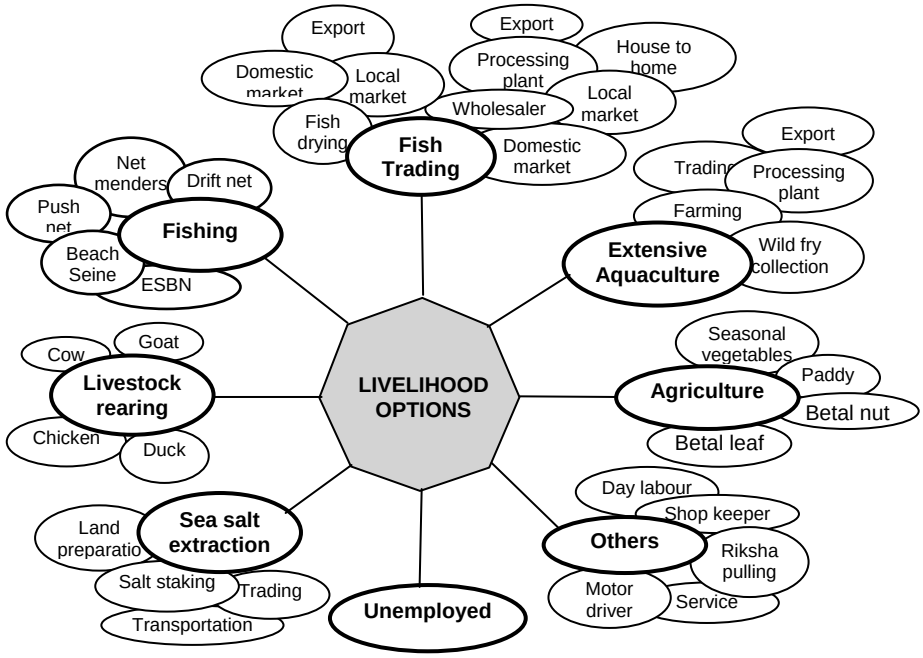

Figure 3. Livelihood options of the coastal communities along the Naaf River.

Table 1. Primary occupation of household heads of the fishing villages along the Naaf River.

SL No.	Occupations	Number of Household Heads	Percentage
1	Fisher	648	73.80%
2	Fish Trader	73	8.31%
3	Business	43	4.90%
4	Net menders	30	3.42%
5	Agriculture	27	3.08%
6	Boat makers	21	2.39%
7	Salt producers	15	1.71%
8	Aquaculture	12	1.37%
9	Others	9	1.02%
Total		878	100%

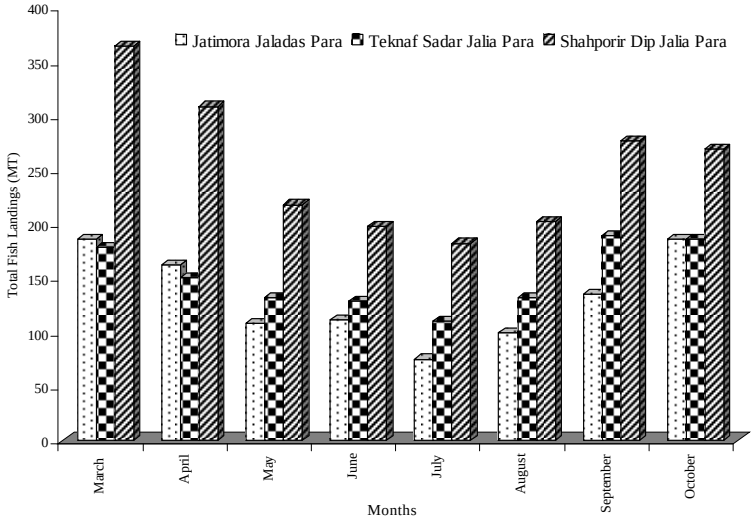

Figure 4. Monthly fish landing in the fishing villages.

called *Jow)*. The net owner (locally called *Bohoddar*) hires 2-5 fishermen (Locally called *Ghor*) in each ESBN operation under one supervisor (Locally called *Maji*) during *Jow* period (1 *Jow* = 10/11 days). The contract amounts varied BDT 1,200 – 2,000 per *Jow* depending on the level of expertise of the hired fisher, his negotiating ability and season. Catch sharing system among the fisher also observed in fishing communities of Jatimora Jaladas Para and Teknaf Sadar Jalia Para, where the total catch rate was distributed among the *Maji, Ghor* and *Bohoddar* in 24%, 20% and 56% respectively. Though the ESBN fishermen continue their fishing activities round the year, but March-April and Sepetmber-October were favourable months as maximum catch. Total catches were varied from 11 Kg to 48 Kg per (4 to 5 hrs) haul. Annually about 6000 ton fisheries resources including finfish, shrimps, crabs, molluscs, echinoderms, and others were caught from the Naaf River. During sorting on boat, about 20% of total catch was discarded. The noncommercial catch mainly composed of moray, eels, small cephalopods, jelly fish, crabs *Matuta lunaris*, *Potamon* spp. and mantis shrimp are not consumed by local people (Fig. 5). Though it requires BDT 122,700 - 221,400 (USD 1 = BDT 70) to install a complete set of ESBN (4 years longevity), monthly average income varies from BDT 1,815 - 4,248 from single ESBN operation where the operation cost ranges from BDT 9,146 - 22,412 (Table 2a, 2b). High prices of net (ranges BDT 40,000 - 120,000) and boats (BDT 20,000 - 42,000) were the major fixed costs. Owing to low incomes and limited personal savings, to meet the expenses of their enterprises, the greater majority of small-scale fishermen depend on informal source of financing. The major informal source of borrowing were

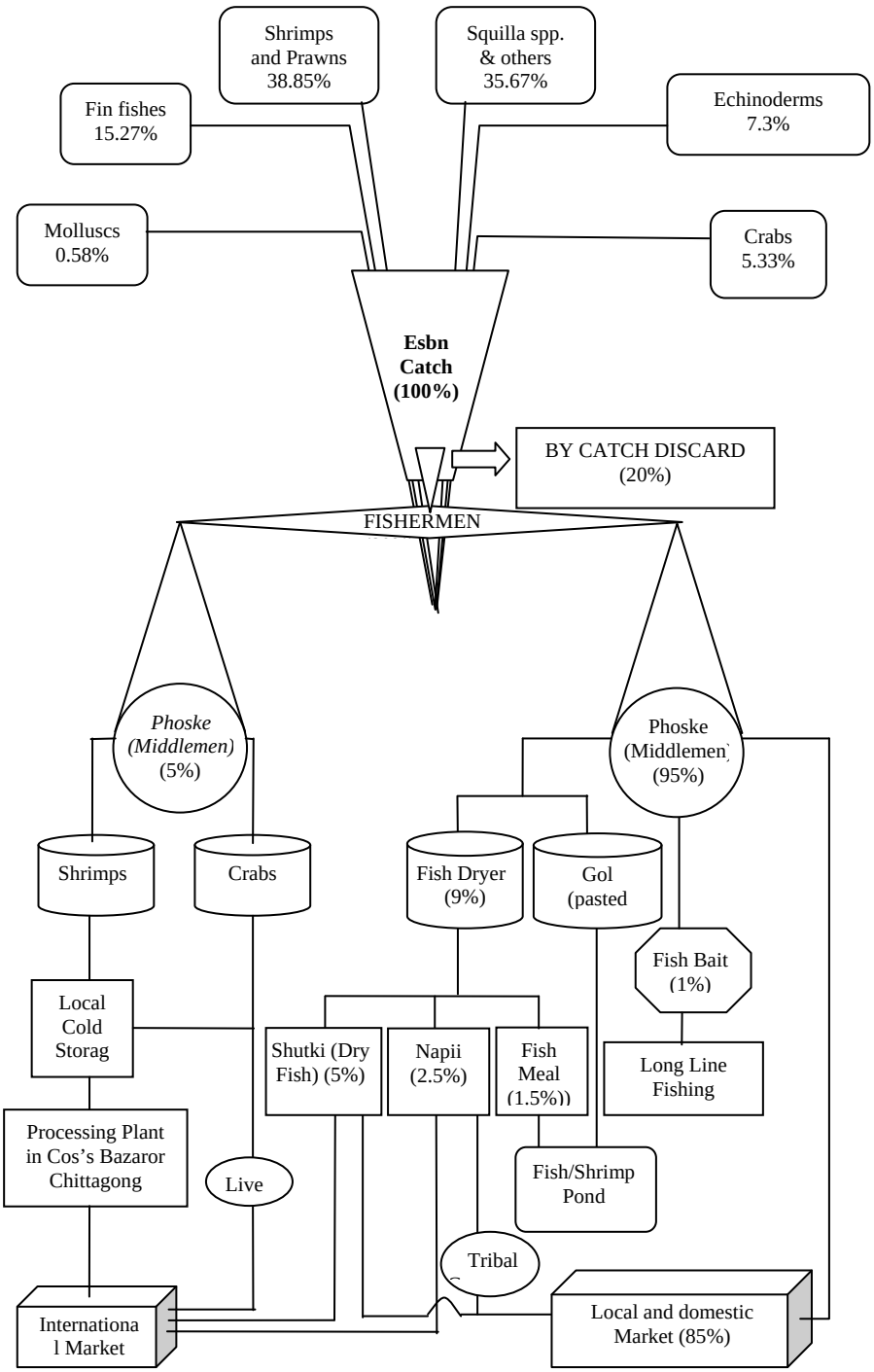

Figure 5. Utilization patterns of ESBN Catch from the Naaf River.

Table 2a. Cost benefit analysis of different ESBN operation.

Items			Jatimora Jaladas Para (Small ESBN)			Teknaf sadar Jalia Para (Medium ESBN)			Shahporir Dip Jalia Para (Large ESBN)		
			No	Unit Cost (BDT†)	Total Cost (BDT)	No	Unit Cost (BDT)	Total Cost (BDT)	No	Unit Cost (BDT)	Total Cost (BDT)
Fixed Cost* (4 Year Longevity) (BDT)	Net		1	40000	40000	1	90000	90000	1	120000	120000
	Boat	Small Boat	1	11000	11000	1	11000	11000	-	-	-
		Medium Boat	1	20000	20000	1	20000	20000	2	20000	40000
		Engine Boat	-	-	-	-	-	-	1	42000	42000
	Gos	Materials	2	-	1200	8	-	1600	8	-	2200
		Installation	-	-	300	-	-	400	-		800
	Float		4	150	600	-	-	-	-	-	-
	Phung		2	800	1600	2	1000	2000	2	1200	2400
	Different *Kachi* (rope)		-	-	8000	-		12000	-		14000
	*Bomo*** Charge (TEX)		-	-	40000	-	-	18000	-	-	-
	Sub Total				122700			155000			221400
	Depreciation rate/month				2556.25			3229.17			4612.50
Monthly Operational Cost (BDT)	Labour Wages	Maji	1	3000	3000	1	3000	3000	1	4000	4000
		Ghor	1	2500	2500	2	2500	5000	4	2500	10000
	Fuel (Engine & lamp)		-	-	150	-	-	220	-	-	1200
	Food		-	-	500	-	-	750	-	-	1500
	Net Repairing		-	-	120	-	-	250	-	-	300
	Boat Reparing		-	-	100	-	-	120	-	-	400
	Other		-	-	220	-	-	300	-	-	400
	Sub total				6590			9640			16800
Total Cost (BDT)/month					9146.25			12869.17			22412.5

† USD 1 = BDT 70

Table 2b. Cost benefit analysis of different ESBN operation (benefit).

Items	Jatimora Jaladas Para (Small ESBN)	Teknaf sadar Jalia Para (Medium ESBN)	Shahporir Dip Jalia Para (Large ESBN)
Average Catch per haul (kg)	21.5	21.37	31.87
Average Catch rate/haul (BDT)	650.00	698.00	1211.88
Catch number/month	20	21	22
Income/month (BDT)	13000.00	14658.00	26661.36
Total Cost (BDT)/month	9146.25	12869.17	22412.5
Net Profit (BDT)/month	3853.75	1815.83	4248.86

moneylenders, who charge exorbitant interest rates of not less than 30 percent and require repayment within fairly short periods. The fact that fishermen borrow from money lenders, even in the lean season, underscores the lack of alternative or accessible credit facilities. The fishermen rarely qualify for bank credits due to lack of collateral security and mostly have no bank accounts.

Utilization of Catch

Along the river bank, village wise fish landing center has established, where fishermen sell their catch to middle men (locally called *Phoske)* who carry the fishes to local market and *Arotdar* (who locally preserve the catch for selling to long distance). About 90% of the catch are usually distributed in the local and domestic market in the form of fresh, iced, dried, nappi, gol and fish meal (Fig. 5). Nappi is a popular food item to neighbor Myanmar people. Quality deteriorated fishes used to make fishmeal and fish ball (locally called *Gol*) to apply in fish and shrimp pond for better growth. Cephalopods (Octopus) were widely used as bait for long line fishing. Remaining 5% of total catch especially shrimp (*Penaeus monodon*) and large crabs (*Scylla* spp.) utilized as export commodities through well processed by the different processing plants.

Major problems of the small-Scale fishermen

The community was asked to brainstorm and listed down the identified problems or issues. They were asked to write these issues on small piece of paper and place on the floor. The participants were encouraged to explain the possible criteria for ranking the problem and analyzed each problem to identify and rank problems in order of priority by assessing their relative

importance. In this way the core problem "reduce fisheries resource" was identified which lead to insecure livelihood. The causes of the problems were identified through participants brainstorming by asking the question "why?" and then identified the effect or impact of the problem by asking "what happened?" The participants were allowed to continue for identifying the causes as well as effects until they can identify no more causes and effects. The research team helped participants produce a more polished version of the problem tree on another paper (Fig. 6). Moreover, SWOT analysis is important to optimize the strengths and opportunities as well as to overcome the weaknesses and threats. The SWOT analysis of the Naaf River fisheries management is presented in Figure (7). Other chronic problems faced by the small-scale fishermen interviewed summarized in Figure (8), include susceptible low seasonal catch, inadequate storage facilities, high input cost, unemployment during lean season, inadequate finance and credit support, dependency to middlemen to sell their catch, fishing safety, disorganized association and mismanagement of income. Sometimes, occupational hazards like cyclonic storm and strong currents occasionally capsizes the fishing gears and crafts leading to loss of property and life. Due to the combination of low incomes, poor housing and lack of social security, the overall socioeconomic situation became worse along the Naaf than the rest of the country, which led to children being co-opted in fishery activities rather than taking education among the fishing communities.

Fisheries management options

The perception result of the ESBN fishermen indicated that they know the fishing area and seasonality for major species, but their understanding of the nature and dynamic of the resources and their concept of fisheries management were poor. Many of them strongly felt that the annual catch was determined by the God and hence, the need to understand or regulate the fishery did not arise. They mentioned that the Naaf River was more diverse in fishery resources than present. The problem tree (Fig. 6) and SOWT (Fig. 7) analysis in the local context shown the similar result to problem identification. So, it is realized that there is an immediate need to develop a management strategy for long time sustainability of estuarine resources as well as for community livelihood.

There are numerous fisheries management related options for the Naaf River focusing fishing, fishers and their catch which include various management issues and their potential implementations at different management levels (Fig. 9). Fisheries management seeks equity to organize and empower the weak or less privilege groups of fisher to allow them to freely participate in collaborative management. Most of the fishermen in the Teknaf are not educated enough to have a basic understanding of the long-term management goals and therefore, it appears difficult to implement even a well formulated plan, which necessitates extension works and awareness building at different levels. Maintaining fishing communities and involving them in the management process depends on the existence of appropriate institutions relating education, training and demonstration and also creating alternative livelihood options. But the people of Tenkaf fishing

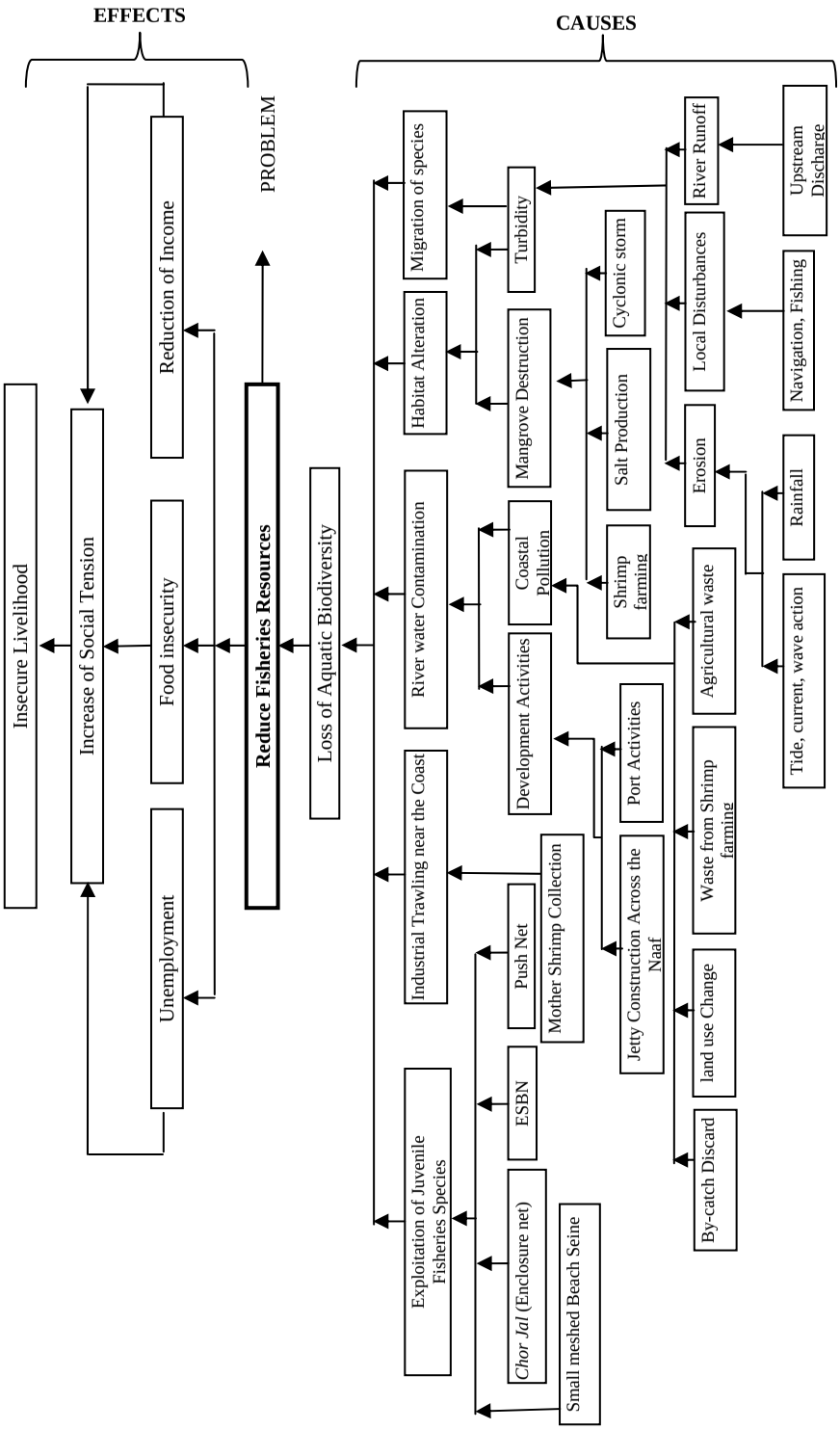

Figure 6. Problem tree analysis of reduce fisheries production at the Naaf River of Teknaf coast.

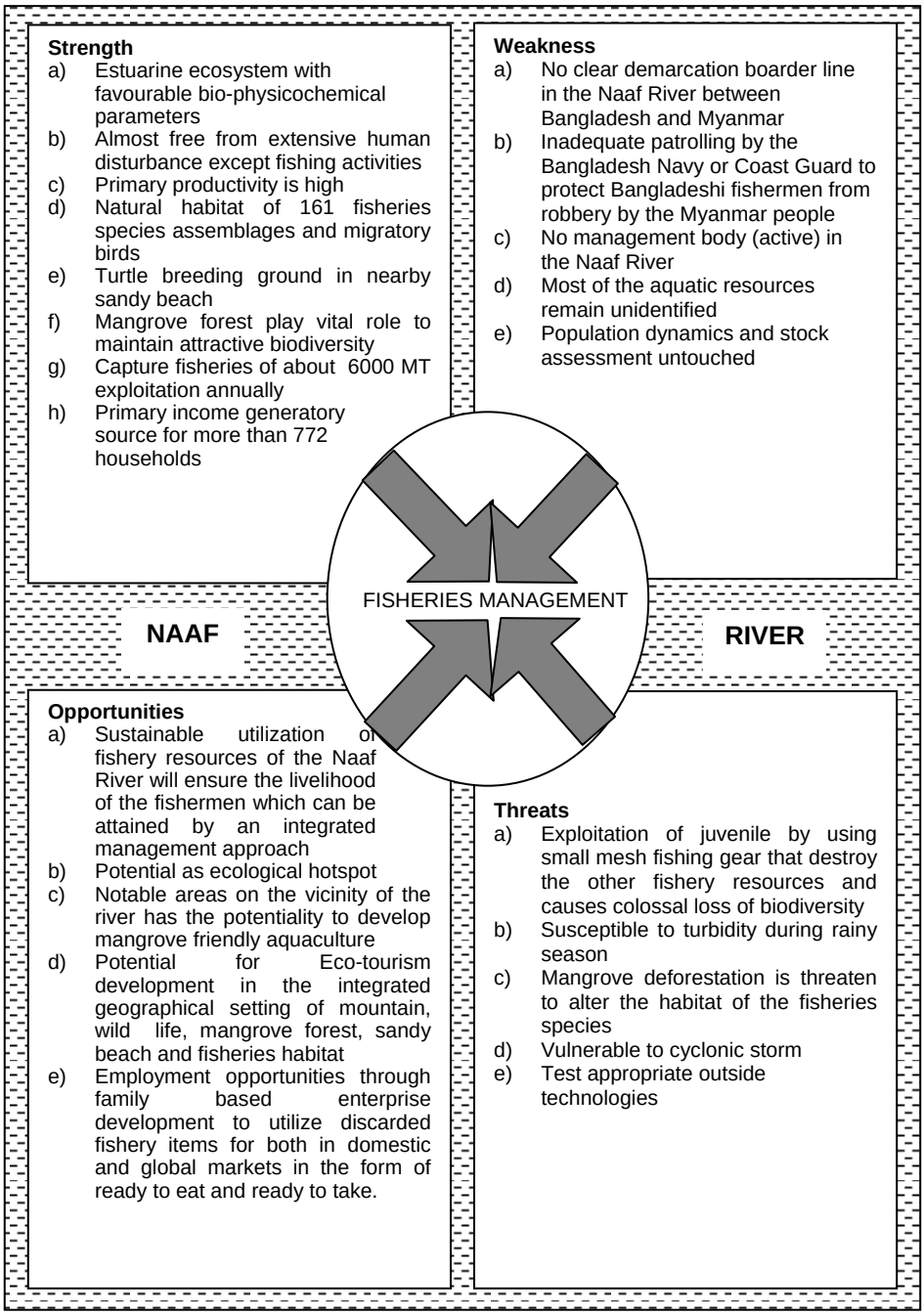

Figure 7. SWOT analysis for fisheries management of the Naaf River along the Teknaf coast.

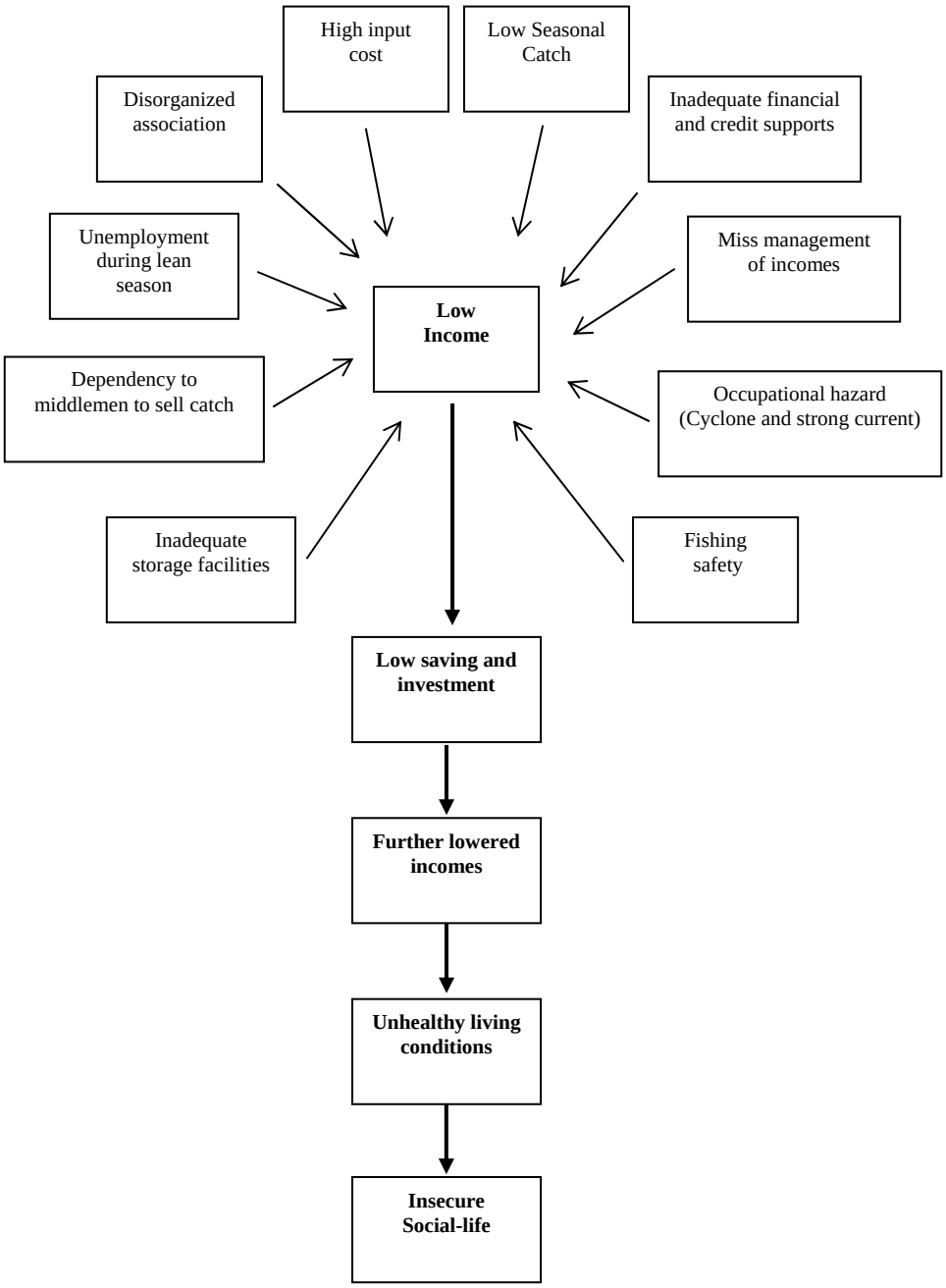

Figure 8. Schematic presentation of the chronic problems faced by the small-scale fishermen of the Naaf River.

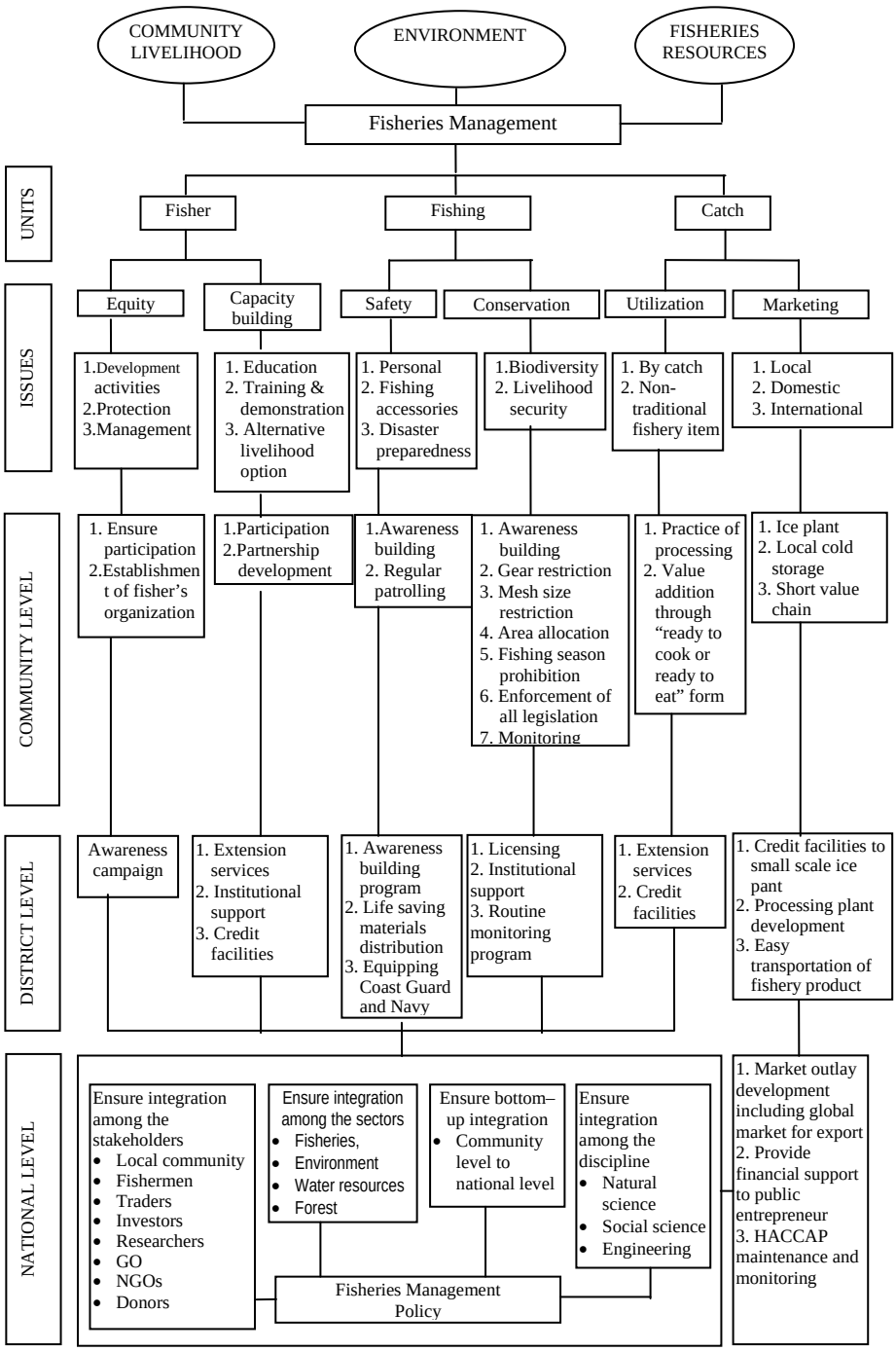

Figure 9. Fisheries management options in the Naaf River along the Teknaf coast.

villages are poorly organized. They don't have a history of associations and institutions, which resulted into little cultural background in collective action. A major challenge of capacity building is to reverse the effects of centralized resource management over many generations, which tends to suffocate the ability of fishing communities for self governance. Top-down resource management over a long period of time can result in the loss of civic institutions and local mechanism for consensus building, rule making, enforcement and monitoring. Personal and fishing accessories safety, disaster preparedness will reinforce the equity. Biological conservation plan should incorporate that will enhance the ecosystem and livelihood security as well. As regulatory approaches fishing gear or mesh size restriction, area allocation, fishing season prohibition i.e. closure of fishing during the peak recruitment periods (July to September and February to April in selected areas) can be introduced for ESBN on the assumption that the juveniles could escape. Development technique for processing by catch and non-traditional fishery items for the preparation of improved quality value-added products; development of post-harvest technology to prevent deteriorative changes occurring in fish and shell fish during different stages of handling, transportation, processing and preservation are some of the immediate needs for the development of the fisheries management of the Naaf River.

Discussion

It is well recognized that the dependency to fisheries resources was extremely high in the present investigated area. The present study observed that about 1932 fishermen with 250 ESBN units were engaged in ESBN fishing in the Naaf River, where 73.80% household heads were directly involved with ESBN fishing as primary source of income. About 55,000 fishermen engaged in ESBN fishing in whole Bangladesh and around 85,000 to 100,000 fishermen were dependent on ESBN and other fishery related activities for their livelihood (Khan *et al.*, 1994; Chowdhury *et al.*, 2009).

The major fishery related activities were fish drying, fish trading, net mending, and boat making in the fishermen villages along the Naaf River. There was little scope for improving income through any improvement in this activity. Non fishery income activities in the ESBN villages were also very limited, there were some agricultural activities, aquaculture, livestock rearing, manual labour, but lack of land for productive activities was a serious constraint (Kasem and Ibal, 1985; Islam *et al.*, 1988; Islam *et al.*, 1993; Khan *et al.*, 1994; Hossain *et al.*, 2007). Teknaf Peninsula is one of the longest sandy beach ecosystems (80 km) in the world. Important habitats at the site include mangrove, mudflats, beaches and sand dunes, canals and lagoons and marine habitat. Due to most favourable ecological environment Teknaf Coast is rich in marine and coastal recourses (Chowdhury, 2006). These resources were surrounded by a majority of fishermen communities who are obviously poor. They are poor because of their lack of access to alternative employment opportunities with handsome income. The existing environment often allow the local elites to capture the bulk of any benefits that come from more productive technologies adopted by such

communities. Shrimp culture and sea salt extraction have been initiated in the coast. A large scale entrepreneurs and local elites take an advantage of this opportunity rather than local small producers. The same elites are politically influenced and have access to institutional resources i.e. credit, government subsidies, licemse, etc. Thus the fisherman community do not avail the advantages of modern technology developed for small-scale or large-scale fisheries, aquaculture and sea salt extraction.

Another socio-economic problem was the dependency to middlemen to sell their catch. Lack of proper access and remoteness of their location made the fishermen maximize dependent on several tires of middlemen, who enjoy the maximum benefit with minimum effort. Credit sources available to these fishermen were found to be restricted to personal loans and the loans for the fish traders and marketing agent (Bennett and Alam, 1992). There were three marketing chains; (1) For large exportable quality, partially processed (deheaded) shrimp, agents were paid monthly and they, inturn, provide long term credit to fishermen-loans for guaranteed supply. (2) Juvenile and small fished were sold mostly through *Phoske* (hawkers) who sell door to door or at the local market places. Large quantities were purchased at river bank and small quantities directly from the boats at the fishing grounds. (3) High values fish like as pomfret, ribbonfish, tiger shrimps, etc were collected from boat at the fishing ground by agent for the whole sale market. Fish consumed by fishermen households, were generally of low value.

The catch of the ESBN which was generally low, ranged from 2 kg to 15 kg per operation for different stratum along Bangladesh coast (Khan *et al.*, 1994). This catch included huge numbers of juvenile and small fish, which fetch very low prices and gave a small income which ranged between BDT 23,550 - 54,723 annually. In the present study, it was revealed that the average catch/hual was about 25 kg (including all sort of organisms that entrapped in the ESBN) and the annual income varied from BDT 21,790 - 50,986 for each ESBN. There are two contrasting outcomes of fluctuating incomes pertinent to the situation of small-scale fishermen (Gillis *et al.*, 1996). The first is that fluctuation would make the household and local economy unstable and investment more risky. Fluctuating domestic demand, coupled with uncertain or prohibitive access to fishing inputs, would then discourage investment and stifle economic growth. The second, the permanent income hypothesis, suggests the opposite result: income earners count at least some level of relatively certain annual income and tend to maintain consumption patterns based on that. Most of the raw materials of the fishing gears are usually imported. There is no government subsidy on fishing inputs and rapid depreciation of the local currency (taka) has meant sharp increases in prices, making the inputs relatively expensive for the average small-scale fishermen. The prices of boats, fuel cost and repairs have also risen dramatically. In view of the high cost of inputs and maintenance, the ever pressing necessity to land more catch leads to some fishermen resorting to the harmful practice of reducing the net meshes (to 0.5 cm), which not only produces low quality of catch but also causes colossal loss of other non-target fisheries species, results in biodiversity loss or environmental imbalance. This situation is consistent with the

institutional vacuum surrounding the open access property regimes on the coastal waters that permits unsustainable practices and the wasteful exploitation of resources as discussed above.

The present study revealed that the fisheries activities in the Naaf River has suffered from a large number of management related problems that have produce poor economic return. There is a clear need to legalize fishing profession and their settlement; traditional fishing communities should be given priority in getting necessary support from all concern. Fishermen's organization/associations have a potential role to play in facilitating an enabling business environment. Whether as the primary beneficiaries or victims of policies for the fishery sector, small-scale fishermen would be better organized through effective associations that could help to influence the design and implementation of policies, or at least help to identify the problems and difficulties inherent in the small-scale fishery sector and suggest the relevant means for redress. Results from the field survey indicated that all three selected fishing communities had fishermen's association on village level that were invariable dormant, disorganized, having being formed in anticipation of managing external supports that no longer exist. Only 25-37% of the total fishers were member of the associations. The main reason given for non-membership was that the lack of awareness and yet associations were not perceived to offer benefit or support to convince other fishermen. This was because a few powerful local leaders and comparatively rich fishermen had hijacked the associations to represent and play dominant role to take decision infavour of their own interest. Thus, their weak bargaining power within the existing fishermen's associations and the lack of alternative channels had made it impossible for the small-scale fishermen to share experience and have a common platform specifically addressing their problems. However, participatory associations are a prerequisite for efforts to influence central government and local authorities to accord a higher priority to their needs. It will also assist in developing and complying local management plans. The extension officers of the Department of Fisheries (DoF) should intensify their visit to fishing communities to increase their awareness of the fishery laws and regulations and also direct and assist them in gaining access to micro-enterprise financing from institutions and NGOs.

Artisanal fishery along the Naaf River rely on the traditional processing and preservation methods of icing, drying and salting in contrast to the more capital intensive technologies of medium to large-scale processing plants employed by mechanised commercial operators (ILO, 1982; Hossain *et al.*, 2007). The lack of storage facilities to prolong shelf-life, such as low technology cold storage facilities, effectively creates a buyers' market during bumper season with the need to offload perishable stock. Encourage proper utilization of by-catch species both in domestic and global markets in the form of "ready to cook" and "ready to eat" for employment opportunity and value addition. It will create family based enterprise development; risk minimization of fishers and consumers as well as partnership development. Practices of processing and value addition of non-traditional fishery items and identify its market outlets can uplift socio-economic condition of fisher folk.

Catch limit or quota can solve the problems of resource conservation. Gear restrictions i.e., regulation of size and spacing of net meshes can be used to control fisheries, by allowing immature fish to escape being caught when small, and grow to an economically more valuable size before harvesting. Similar types of recommendation were made in the National Seminar on the Estuarine Set Bagnet Fishery in January 1992 (BOBP, 1993). Awareness campaign in media about the repercussions of using destructive gears and stern steps need to be taken against those gears. Closed season prohibits fishing during the time of the year when there is a need to protect a particular stage of the life cycle, e.g., spawning or juveniles. Closed areas also protect stock during certain stage of their life cycle in area closure where fishing is banned. Licensing may apply through the restriction of only licensed-persons to access in fishing activities. Small-scale fishery remains an unregulated traditional livelihood, requiring only valid traveling documents and identity cards. However, the more severe problem of overfishing by commercial operations in artisanal zone (below 40m depth) is due to the inadequate enforcement of existing regulations for licensed trawlers and the continual encroachment on inshore waters by unlicensed foreign vessels. All the boats should be sufficiently equipped with life saving appliances. The more obvious reasons for this include insolvency during lean season and illiteracy. Although fishing is a risky venture and the occupational hazards of fishermen include strong ocean currents and high waves and tides that occasionally capsize the fishing boats leading to loss of property and life, none insurance company does not cover any scheme to insure fishing equipments and lives. There should be scope of insurance of fishing equipment and fishermen as well. Coast Guard and Bangladesh Navy should have regular surveillance programme in the vicinity of the Naaf River so that fishermen can fish safely. It should ensure advance weather broadcasting system so that fisher can take measure following the weather forecast. In this regard, there is a huge need to develop some shelter bay to keep the fishing crafts and gears safely during probable cyclonic storm. Overall, it's essential to have a fruitful fisheries management policy by reflecting all above issues.

The integration among the stakeholders, sectors, and different disciplines and technology with the traditional practices and the integration of national level and local level management are crucial aspects in the co-management of the artisanal fisheries. There is a need for extensive network of linkage between participating communities to enable full management of resources. Addressing the wider problem, the Food and Agricultural Organisation (FAO, 1995) emphasizes that the needs of developing countries should be supported in areas of financial and technical assistance, technology transfer, training and scientific co-operation with respect to fisheries so as to enhance their abilities to develop and promote their own fisheries and achieve food security.

By considering the top down and bottom up view of fishing communities, VOs, GOs, NGOs, research organizations, fisheries co-management has been proposed (Fig. 10) which is people centered, community-oriented, resource based and partnership based (Pomeroy, 1998). Fisheries co-management has the community as its focus, but

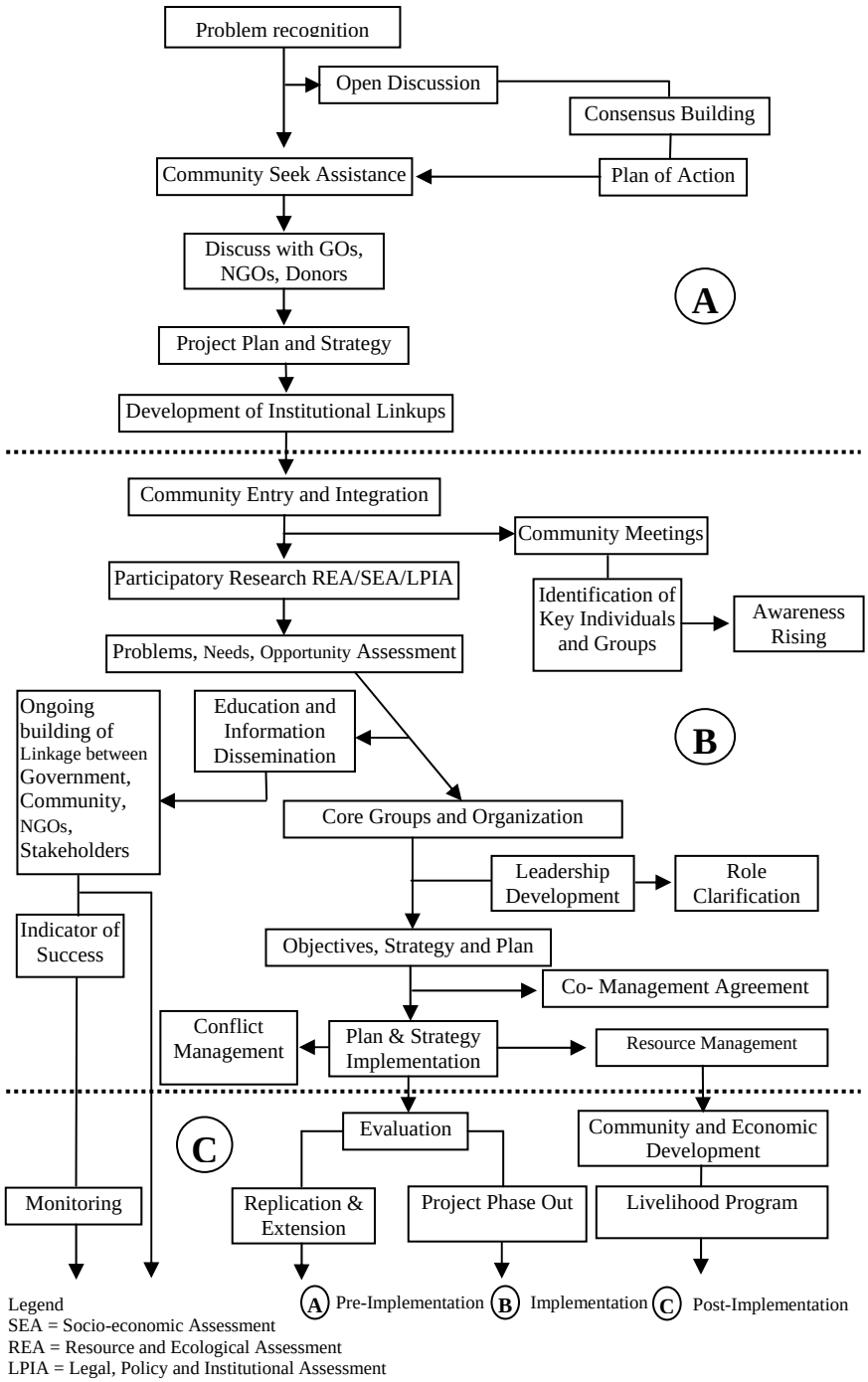

Figure 10. Framework for fisheries co-management at the Naaf River along Teknaf coast.

recognizes that "to sustain such action, a horizontal and vertical link is necessary" (Rivera, 1997). Co-management has been widely recognized as a promising option for reform of fisheries governance institutions (Nielsen *et al.*, 2002). An early case of a co-management was presented by Jentoft (1989) and Pinkerton (1989). The co-management concept as a basis for natural resource management was introduced by Kearney (1984). Frameworks for understanding common property resources including co-management arrangements were developed by Oakerson (1992) and OECD (1996). The early conceptual development and frameworks for analysis were open for wide interpretation. An attempt to use a more specific terminology by classification of co-management arrangements along one dimension was introduced by Sen and Nielsen (1996). The concept of co-management has however been used to cover a large range of institutional arrangements which have very little in common and has been adapted very differently in various situations. The acceptance of co-management as an important tool to modern fisheries management has thus been associated with the concept being adopted so vaguely that it has lost substance in the process. In addition, during the last decade the co-management concept has gained increasing acceptance among governments, development agencies and researchers as an important aspect of future management system (Nielsen *et al.*, 2002). But successful co-management and meaningful partnerships can only occur when the community is empowered and organized. The implementation of fisheries co-management can be viewed as having three phases: pre-implementation, implementation and post implementation (Chowdhury *et al.,* 2008; Berkes *et al.*, 2001).

In short, overcoming the major problem of the artisanal fishermen summarized in this study ultimately hinges on improving the standard of living of the coastal fishing communities and of the majority of the coastal people along the Naaf River whose livelihoods are directly or indirectly linked to small-scale fisheries. This would require policy measures and strategies to deliver and facilitate knowledge and skill acquisition for improved productivity; financial management training, government investment, as well as participatory planning and management know how to build linkages between and among different stakeholders. These measures would facilitate the learning process and enhance the sharing of pragmatic ideas and responsibilities to meet the survival needs of the fishing communities and of the sustainable development of coastal resources.

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