RE-DESIGNING OF MODEL FISHING BOAT
Final Report

Submitted to
International Federation of Red Cross and Red Crescent Societies (IFRC)
Bangladesh Delegation

Submitted By
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Genesis of the Project:

As part of Climate Change Adaptation (CCA) program, the Bangladesh Res Crescent Society has taken up a number of activities to enable the vulnerable and poor communities in Bangladesh who are under various risks because of this ever increasing global threat. The activities are under the umbrella of “Building Community Resilience through Climate Change Adaptation (CCA) Project”

Being a part of the CCA program, the project decided to focus on the lives and properties of the coastal fishermen with their livelihood based on fishing in the sea. Accordingly, IFRC and BDRCS made a request to the current consultant to submit a proposal for taking actions aimed at minimizing the risks being faced by the fishermen while fishing at sea. In view of that, a proposal was submitted to IFRC. The proposal was accepted and a contract was signed between the IFRC and the consultant for “redesigning of fishing boat” for making the boat stronger in the face of impacts of climate change.
Table of Content

Genesis of the project ........................................... 1
Table of Content ................................................... 2
Acronyms .............................................................. 3

Chapter 01: Introduction
1.1 Preamble ....................................................... 4
1.2 Objectives ..................................................... 5
1.3 Methodology .................................................. 5

Chapter 02: Background
2.1 Fishing Vessels of Bangladesh ......................... 6
2.2 Previous studies on wooden boats ..................... 7
2.2.1 Linkage with previous studies conducted by IUCN 8
2.4 Structural strength of wooden boats .................. 9

Chapter 03: Recommendation
3.1 Process overview ........................................... 10
3.2 proposed design ............................................ 11
3.3 Execution ..................................................... 12

Chapter 04: Feedback & Evaluation
4.1 Feedback & Evaluation .................................... 14
4.2 Replication of the model boat ......................... 14
4.3 Issues related to safety .................................... 15

Chapter 05: Conclusion
5.1 Conclusion ................................................... 17
5.2 Limitations ................................................... 18

Annexure
**Acronyms**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIWTA</td>
<td>Bangladesh Inland Water Transport Authority</td>
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<tr>
<td>BDRCS</td>
<td>Bangladesh Red Crescent Society</td>
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<tr>
<td>IFRC</td>
<td>International Federation of Red Cross and Red Crescent Societies</td>
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<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature</td>
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<tr>
<td>MSO</td>
<td>Marine Shipping Ordinance</td>
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<td>NOAMI</td>
<td>National Oceanographic and Maritime Institute</td>
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</table>
1.1 Preamble:

Bangladesh due to its geographical setting, is one of the most disaster prone countries in the world. The country often becomes the landing and breeding ground of catastrophic cyclones formed in the Bay of Bengal because of the funnel shaped coastline. Now, with the added effect of climate change, such calamities are occurring with greater magnitude and intensity. Indicators of climate change have begun to appear in the Bay of Bengal. Coastal people are experiencing it in the form of weather extremes and higher frequencies of bad sea conditions. Consequently, significant rise in boat capsize incidences following casualties has been noticed. At this state, a need for study to formulate remedial measures is strongly felt. A number of Policies are being formulated and suitable action programs are undertaken to minimize the negative impacts of supposed climate change. This study makes an effort to review the existing structure of the local (Nijhumdwip area) fishing boat and redesign a cost effective, easily replicable boat with locally available materials.

International Federation of Red Cross and Red Crescent Societies (IFRC) and Bangladesh Red Crescent Society (BDRCS), being members of the global network, are working with the coastal population. The loss of life in the coastal belt is significant but reducing greatly with more and more precautions being taken. Apparently a significant reason of loss is sudden worsening of the sea condition, especially during the monsoon as a result of capsize of artisanal fishing boats. In most of the cases, fishermen are unable to move to safe places besides being aware of prior warnings because of the rapidity of such events. Loss of life, fish and boat contribute to the deteriorating financial condition of the fisher folk. This threatening condition was identified in the coastal communities.

IFRC and BDRCS together, decided to address this specific issue in the fishing boats of Nijhumdwip, an island close to Hatiya upazila of Noakhali district. This is a small island with about twenty five thousand population but rich in bio diversity especially birds. The people living in this island are poor and source of income is mostly fishing. Fresh water fishes are harvested from the numerous ponds inside the island but because of absence of systematic farming, the production is little and not a significant means of earnings of the people. Offshore fishing using small artisanal boats indigenously built are the main form of fishing in the island. The boats are mechanized ones with insulated fish hold suitable for preserving iced fish up to a week. Because of climate change, sea is getting rough more frequently and accidents involving such fishing boats are becoming more common. Observation from back ground study and FGD findings indicated that such sudden accidents while approaching sea are the major threat to the fishermen and also a reason of extreme poverty. Hence, a review of the structural design of the fishing boat and redesign it using locally available materials while ensuring durability are initiated.
1.2 Objectives:

The objectives of the present study/project are:

- Review the existing structure of the fishing boat of Nijhumdwip area
- Redesign a cost effective boat using locally available materials
- Construction of a model boat that can be replicated in geographically similar region.

1.3 Methodology:

The study was conducted in qualitative research method. The initial study phase consisted of analysis of secondary essentials such as IUCN Boat design report, research conducted by NAOMI etc. and news articles on boat capsize in the coastal belt. The ultimate aim was to identify stakeholders, selection of the most vulnerable community and prepare a frame work for collecting information from primary sources. After collecting and analysing secondary information, primary essentials were collected by conducting a Focus Group Discussion (FGD). This paper draws on a review of existing literature as well as focus group discussion and interviews in the Nijhumdwip community who are a regular victim of boat capsize because of rough sea and bad weather condition. A summary of the statements of the respondents and subsequent evaluations were finally compiled to arrive at the design proposal and identifying future scope of improvement.
2.1 Fishing vessels of Bangladesh:

The fishing vessels operating in the coastal and offshore areas of the country are divided into three segments:

- **Deep sea fishing trawlers:**
  Deep sea fishing trawlers are large steel hulled vessels imported from countries like Japan, Thailand and China. These vessels are usually 36 meter of length in average. The smallest ones are 25 meter long and the largest ones in excess of 40 meter. The vessels are categorically trawlers, i.e., dragging net thrown into the water. A small number of the boats are shrimp trawlers and the rest are bottom trawlers with white fish as the target.

- **Offshore wooden boats:**
  Offshore wooden boats are locally termed as ‘trawler’ but these boats are, in fact, gill netters. The smallest of these boats are 11 meter in length and the largest one 18 meter. Built either of local timbers or imported forest timbers and are not controlled by any regulation. The boats are to be registered with the Mercantile Marine Department having offices in Chittagong and in Khulna. The net deployment and hauling are strenuous operations, especially the hauling one. The smaller boats are usually built with poor quality timber resulting in a short longevity. The larger boats are built with timber imported from countries like Myanmar.

- **Small fishing boats:**
  Small fishing boats and fishing gear such as set bag net fisheries operating too close to the shoreline or in estuaries. These boats or gears operate during daytime catching fish fries or juvenile fishes. In fact, this segment is livelihood for a large number of poor to very poor people living in the coastal areas.

Different standards in design, construction and equipment are adopted or practiced in these three different categories. The steel hulled trawlers are mostly imported from South East Asia, either new or few years old. Few have been built locally. The vessels are not with any class notation but standards of local maritime administration are followed. The Mercantile Marine Department is the concerned administration in Bangladesh. Standards described in the Marine Shipping Ordinance (MSO) are followed. This concerns the construction, water tight sub division, stability, Life Saving Appliances, Fire Fighting Equipment, Manning etc. Vessels built outside Bangladesh are to be evaluated and inspected by the surveyors of the Mercantile Marine Department of the Government of Bangladesh. Usually inclining tests and other tests to evaluate turning and manoeuvring characteristics are performed by the surveyors. A satisfactory trial and test would qualify these vessels to be imported to Bangladesh. As part of periodic surveys, the vessels are inspected annually by the surveyors for the safety measures, communication equipment, regulations covering lifesaving appliances, fire-fighting equipment.
etc. Compliance to safe manning requirement is also rigorously inspected. Old vessels are replaced by the owner themselves to ensure economic fishing operation. Although there are some quite old vessels in operation but the standards relating to safety are observed. As a result, the cases of accidents in such vessels are small in number.

As regards standards in design, construction and equipment; the worst situating prevails in the case of the second category, i.e., the offshore wooden boats. Safety of a boat is mainly product of two factors; the in-built safety of the boat and the hazards in the environment in which the boat operates. Ironically, these boats are worst in both realms. These boats are built without any regulatory safety standard and thus are, in many cases, possess extremely poor inherent safety and operated in open sea which is frequently hostile

2.2 Previous studies on wooden boats:

A small number of studies have been carried out in the greater field of small wooden boats of the country. Amongst these studies the most important one is the “Experimental Project for Improving the Efficiency and Profitability of Country Boat Operation”, popularly known as “Country Boat Pilot Project CBPP”. This was a project of Bangladesh Inland Water Transport Authority (BIWTA) and funded jointly by the Dutch and Norwegian embassies in Bangladesh. The project was implemented by the National Oceanographic and Maritime Institute (NOAMI) during the years 1990-1992. The project was intended to improve the efficiency of boat operation but safety was an additional issue. The project was first conceived to improve the efficiency of sails used to propel the boats. This was during mid1980’s when the boats were not mechanized and sail, oaring and manual pull were the options available for propelling the boats. Experts identified that the efficiency of the sails were very poor and used a principle of parachutes rather than wings to generate the force for propulsion. Adoption of principle of wing would significantly improve the efficiency of the boats.

By the time Country Boat Pilot Project came into implementation, the boat sector of the country had experienced a massive transformation. Utilizing low cost diesel engines imported from China duty free for agricultural purpose were being massively used for powering the boats. A very low level of technology was employed for propulsion. Although extremely fuel efficient by propulsion technology standard, the option was attractive to the boatmen because of the increased speed of the boat and better predictability of voyage timing. Sails or any other manual means of propulsion were no more an option to the boatmen. In view of this change, the project attempted to improve the boats to improve propulsion efficiency and thus reduce the fuel consumption improving the efficiency of operation. The subsequent experimental works demonstrated that by use of reverse/reduction gearbox and appropriate propellers, fuels saving could be achieved by up to 45% with 30% being a very modest target to be achieved. This improvement will also increase the safety of operation by enabling the boats to move in the reverse direction as well which was not possible with the technology popularly adopted. The project also addressed some construction issues aimed at making the boats more durable through improved method of preservation of the boat and reducing the rotting process.
The works undertaken in the project also identified some of the structural issues of the boat and suggested remedies. However, the findings and remedies were never implemented or even tested. In brief, the project attempted to improve the efficiency of country boat operation and was successful in doing so. The study was, however, confined to inland wooden boats only. Although it was intended to disseminate the knowledge and experience, it was never done so and the benefits were not exploited.

During 1988-1991 the Economic and Social Commission of Asia and the Pacific (ESCAP) extended financial assistance to the National Oceanographic and Maritime Institute to conduct a short study project for improving the sail propulsion of country boats, especially the benefits of sail assisted propulsion. Although the project achieved some success in technical terms, but because of absence of any follow up, the works remained virtually fruitless.

Some other studies were also conducted on the socio economic aspect of the fishing boats. One of these was a socio economic study on the inland wooden boat sector of the country supported by the Ford Foundation and implemented by the National Oceanographic and Maritime Institute during 1986-87. Another project to study the socio economic condition of the offshore fishermen community was funded by Grameen Trust, the research component of the Grameen Bank and implemented by NOAMI. Grameen Trust also supported an experimental project which demonstrated the feasibility of fibre reinforced thin shell concrete as an alternative boat building material. This was an experimental project and was a success. All of these three projects were executed by the National Oceanographic and Maritime Institute.

2.2.1 Linkage with previous studies conducted by IUCN:

One the issue of safety and survivability of the small wooden fishing boats in the sea, only one study has been conducted so far in Bangladesh. During the year 2006 International Union for Conservation of Nature (IUCN) conducted a study on the safety of coastal fishing boats in the Subaran Chair Upazial of Noakhali District. The study tried to identify the exact reason and mechanism of such accidents and propose some improvements in boat design to minimize the risk as absolute safety cannot be ensured.

Carried out under the same background and objectives as of the present study, the IUCN study decided to make a detailed examination of the chain of events that usually leads to the capsize or near capsize of the fishing vessels. Once the chain of events leading to capsize is clearly understood, the reason and factors influencing the accident will be apparent. It will then be rational to try to devise remedies for improvement. It was thus decided to adopt a Focus Group Discussion approach. The focus group rationally included survivors from capsize or near capsize situations during bad weather in the sea. Accordingly, a total of 30 survivors from as many number of capsizes or near capsize situations were selected for the interview. The interviewees were asked to describe the chain of events leading to the accident. The outcomes of the interviews were almost similar. Out of the 30 interviews, 28 respondents reported that being slammed by wave and hitting shoals in bad sea, the planks from the bottom part of the boat came out loose and water rushed inside the boat which lead to capsize. The finding was
sufficient to conclude that improvement in structural strength would help prevent or at least minimize such incidences.

From more in-depth study on boat structure, locally available size of timber is not appropriate for using as structural member “Kurfa”. Small size of timber with more joints result in to a structurally weak boat. The study also included that integrating a larger number of structural members would make the boat stronger and ensure more safety while approaching deep sea in bad weather condition. In the same report, a cost effective remedy to the problem was recommended.

2.4 Structural strength of wooden boats:

Structure of wooden boats are not of monolithic construction like steel, aluminium, GRP or ferrocement boats. In steel or aluminium boats, metal components are welded to make a single continuum. This enables the hull to transmit sea current induced forces equally throughout the boat and minimize its impact. In wooden boats, timber planks and frames are joined in discrete points and these joints play the role of transmitting the forces applied to a point to its surroundings. Obviously, the transmission is not only ineffective but largely depends upon strength and rigidity of the joints, the longevity of the materials used, how firmly joining members are driven into the components etc. With this large number of parameters, the variation in the quality is understood. There is another major difference in the construction method in wooden boats compared to the others. Ships or boats are basically shells strengthened by transverse and longitudinal frames. In monolithic structures (steel, aluminum, GRP or ferrocement) there are transverse frames continuous across the perimeter of the hull. In the wooden boats, the frames are discontinuous and staggered. As a result, the frames are unable to provide strength to the shell in as effective manner as in the case of monolithic structures. In this case the manner in which the frames are connected with each other and with the shell of the boat is a major determinant. Although, there are no formal standard for wooden boat building but some adopted practices. The practices are different depending upon the boat size, geographical region, ability of the owner to spend for the boat etc.
3.1 Process overview

For redesigning the boat, it was decided to rely upon the specific finding of IUCN Study about structural strengthening of boat and to be discussed with the fisher folk about this in the Focus Group Discussion (FGD). The FGD was organized with the following objectives:

- Corroborating the IUCN study findings about the impacts of climate change and causes of capsize incidences.
- Discussion on the idea of strengthening boat with steel reinforcement.
- Discussion on the extent and arrangement of the steel reinforcement.
- Procedure to be adopted for the reinforcement works in the structure of the boats.
- Collecting feedback data and evaluation.

The FGD was participated by representative boat owners, boat crew, engine operators, engineering workshop technicians. There were total 8 participants. It resulted in complete agreement with the finding of the IUCN; weakness in the structure of the boat is the cardinal cause of accidents and capsizes of boats in sea and this phenomenon is increasing over the years. It also appeared that the participants especially the elder ones has a clear perception of the climate change and that the sea has become increasingly more hostile to the fishermen over the last 2 decades. The participants further corroborated the finding of IUCN that it is only just the turn of the side of the boat at the bottom where the structure is poor and thus common area of collapse.

The concept of steel reinforcement for the wooden boat received a mixed reaction at the beginning. Some felt that steel is totally incompatible as they have used timbers for building and repairing boats for ages. However, at the same time, they agreed that, using timber is no longer a feasible option for them. Unavailability of good quality, strong and long lasting timbers, poor financial condition of fisher folk, excessive price of timber etc. tightened the further strengthening work for the community. It was also appreciated that combination of some good quality timber for strengthening of the structure in certain places where the entire boat is built of poor quality timber is not a prudent option. At the end of FGD, all the participants agreed that, steel reinforcement is the most practical and financially affordable option for necessary strengthening work.

During FGD, some prime issues regarding reinforcement like importance of maintaining the flexibility of the wooden structure of boat, the number of holes to be made on timber planks, probability of further damage while retrofitting etc. were discussed and the participants themselves came up with solutions with the help of the consultant. It was unanimously agreed that removing of any components of the existing wooden structure must be avoided.
3.2 Redesigning of the boat

Boat is one of the ancient water transport which is still in use. The shape and other basic naval architectural characteristics of the boat has been evolved along with time. Any modification of the basic feature of such design must go through theoretical and practical studies, model test, simulation etc. Considering available time and resource of the project, redesigning has been kept limited to structural strengthening.

From the study findings it has been clearly identified that the planks in the bilge is of weak supporting structure (Baka and Kurfa). The short lengths of the timber available fail to integrate significant number of planks together resulting a feeble structure. A typical structural design of the boat is shown in figure 2. The non-monolithic structure is inherently poor in transmitting the current induced force to the entire structure of the boat including planks. As mentioned in the figure ..., the Kurfa is connecting together only four numbers of planks. An improvement in this part will inevitably enable the structure to survive in bad sea condition. It was thus decided to use steel reinforcement to a larger number of planks (8-10) in the bilge area and fix those with coach bolts.

From the drawings one can observe that every different transverse structural members (Gocha, Kurfa, Baka etc.) are about 15” centre to centre distance. This measurement remains almost same for boats from 25 ft to 35 ft in length. Larger boats have slightly longer spacing and smaller boats have somewhat different type of structural layout. It is also to be noted that the figure of 15 inch is indicative and because of the complexity on shape and use of timber, this spacing cannot be kept uniform. The structurally redesigned boat is shown in Figure 3.

For undertaking strengthening work, some issues regarding local artisanal boats were considered. The wooden structure of the boats are inherently a flexible and the non- monolithic feature increases the flexibility further. Because of this reason an analytic study of the structural response of the boats is impossible to be carried out by any sophisticated computer tool. Thus it was resolved that the reinforcement must not be too strong compared with the rest of the structure. A too strong steel reinforcement will desynchronise the harmony of the main wooden hull and reinforcement members in bad sea condition. In that situation the joint between the steel structure and the main wooden hull will give away. Considering all these, a steel section (angle) 1.5” x 1.5” x 3/16” was selected,

The proposed steel reinforcement will have to be bolted with the planks of the wooden hull in a manner that it must not weaken the boat and disturb the smoothness of the hull. It is strongly advised to be judicious in deciding the frequency of the reinforcement- plank connecting bolt. The design of the modified structure of the boat is shown in figure 3. Figure 3-2 can be seen for clarity. It may be seen from the figure that the distances between consecutive Baka or consecutive Gocha or consecutive Kurfa are between 14” and 15”. Thus the additional steel reinforcement is also suggested to be spaces 14”-15”. It is also important to point out that because of the hull form and method of construction, it is not possible to maintain a uniform spacing of the frames. The figures of 14”-15” must be treated to be a guidelines.
The bolting must not disturb the smoothness of the hull. In fact, this was the major reservation of the FGD participants. It was initially apprehended by the participants that the bolt head extending out of the hull will entangle the fishing nets and will be a handicap in fishing operation. The participants were informed about the mechanism of coach bolts, that those are appropriate for fixing and tightening of the boats will prevent any entanglement with fishing nets as shown in Figure 4.

3.3 Execution

In order to implement the re-design works in a manner commensurate with the objective of the project, it was imperative that a representative boat be selected for the purpose. However, this did not prove difficult since the fishing boats in the project area (Nijhumdwip) do have little variation in the type and size. Discussions with the community revealed that the mechanized fishing boats in the of the area varies from 25 feet to 30 feet in length. The reason is very simple; smaller boats are too risky in the sea and the boat owners are not able to afford larger ones because of financial constraints.

Accordingly, a boat was selected randomly from the community. The specifications of the boat are defined below:

- Length: 30 feet
- Breadth: 7 feet
- Depth: 3.75 feet
- Length of the fish hold: 11 feet.

A general arrangement plan of the vessel is shown in Figure 5.

The boat is powered with a single engine of 22 horse power and a 3 bladed bronze propeller of 24 inch diameter. Like all other boats the insulation thickness is just 1 inch using poly urethane foam shit. The other features of the boats are same as any other boats in the island and in the coastal areas of the Bangladesh.

It was considered prudent that the proposed works must pull the boat builder and the fisherman into confidence if the work is to be made successful. Giving them an ownership of the works will largely contribute to a success especially future dissemination. Before execution of the work consultation was arranged.

During implementation, it was proposed by the boat builder to tie a number of 7-8 planks together with the proposed steel reinforcements. The boat builders also suggested that the reinforcement may start from the lower turn of the bilge to the deck level. Although these did not have any rationale from engineering point of view but were incorporated into the design to give the carpenter an ownership of the works to ensure their enthusiast participation. Reinforcement work started from the engine room and ended at the fish hold considering the suggestion of the carpenters. The ‘Extent of re-designing’ can be seen in Figure 5. It was agreed by all that spacing of the reinforcements should be not more than 15 inch. Based upon these decisions the work was executed.
For providing the necessary directions and supervision, the consultant visited the site from 7th to 11th April 2014. The works included preparation of the design (prepared in Dhaka) and explaining the drawings to the workers, briefing the workers the necessary works to be done, the cares to be taken, necessary precautions including safety at work.

The subject boat had earlier been beached and prepared for the designed works. A workshop having the following facilities was earlier contracted for the purpose.

- AC arc wielding transformer
- Bench drill
- Small hand tools

The following equipment required for the purpose were earlier procured from Dhaka and taken to the worksite.

- Electric hand drill machine
- Electric socket board
- Files

The locations for placement of the steel reinforcements were decided as show in Figure 6. As appearing in the figure, there were five reinforcements in the fish hold and three in the void space forward. The reinforcement starts from the plank just adjacent inward of the turn of the bilge as shown in Figure 7. It was also decided that the reinforcements are to be bolted at alternate planks staggered between the reinforcements to obtain a comprehensive strength.

The steel reinforcement and wooden plank cannot mate perfectly without leaving any void with any extent of tightening of the bolts. Presence of this void will create a haven for water accumulation which will swiftly rot plank and corrode the steel. In order to avoid the same coal tar soaked hessian cloth were inserted between the steel reinforcement and the plank so that there is no void in between and water cannot make ingress. On the same consideration, coal tar soaked hessian threads were inserted at the root of the bolt. The bolts were placed and tightened in such a manner so as to avoid disturbance on the hull which would have entangled with fishing nets.

Upon completion of the works the boat was undocked for operation. In the meanwhile the boat underwent routine repairs and refitting carried out in this particular part of the year ahead of fishing season. The material required for modification works in shown in Table 1.
Chapter 4: Feedback & Evaluation

4.1 Feedback and evaluation:

In order to establish the efficacy of the works, especially with reference to the intended objective it is essential to record feedback and make an evaluation. Again because of the nature of the situation it is not possible to make apple to apple comparison of the situations before and after the improvement works. The objective is to prevent structural failure of the boats in bad weather and rough sea. This is not a deterministic phenomenon and perhaps no one can say if a certain impact will cause structural failure of a certain boat. Moreover, it is not possible to state that the all the improved boats will perform in the same way in the same disastrous situation. Thus any evaluation of the work has to be perception based and conclusion arrived at after diligent evaluation of feedbacks. Because of several limitations the work was done on a single boat. In order to systematically record any feedback the number of boats should be of statistical significance. A number of thirty would perhaps be appropriate. Even with a single boat collection of feedback from voyages during at least one season would be a minimum for any perception to be developed. Till now no feedback has been available from the boat. Thus as such there exists no opportunity of making any conclusive notion.

4.2 Replication of the model boat

The project will not have a true success until the works are replicated by boat builder of their own. A list of actions that will enable a boat builder or carpenter intending to replicate the works independently is included in the report. The following procedure may be adopted by any boat builder or carpenter intending to incorporate such improvement in a typical fishing boat.

1. Select a typical boat, estimate materials, equipment and manpower.
2. Choose the locations in the boat (4-5) where the steel frames (typically 1.5”x1.5”x 3/16”angles) which will be inserted on both sides of the boat. The locations should be in the middle of the boat. The steel angles must of soft mild steel, not hard ones.
3. Select the extent of each reinforcement (covering 8-10 planks will be sufficient).
4. Bend the steel angles to the shape of the hull at the location of fixing. If necessary cut the web of the angle for ease in bending
5. Set the bend angles on the hull and select the locations of bolting. This should preferably on alternative planks.
6. Take the steel frames to the workshop to make the drill for bolting.
7. Fix the frames accordingly with coach bolts. Insert coal tar soaked hessians between the frame and the plank and coal tar soaked threads in the root of the bolt.
8. Tight the coach boats. Do not tighten too much that there is any damage in the hull.
9. Launch the boat
It may be noted that all items required to carry out the works are available locally in any part of the country, especially where such boats are in operation. The only exception is coach bolt which is available perhaps only in Dhaka or Chittagong at the best. Sourcing the same will be the only difficult work. Equipment like electric hand drill is not easily available, but once demand generates, availability will not be an issue. So will perhaps be the case of coach boat. Although electric supply is not available in places like Nijhumdwip, there are workshops working with diesel generators. The cost will be higher compared to places where electricity are available from grid lines but once the viability of the work is established, the cost will not be a serious impediment. The works at the site of boat redesigning does not essentially require power supply. A generator was, however, arranged for the works under the project only to make the works smooth.

There is an obvious question of tuning the redesign to size of the boat. Certainly redesigning boat of any size is not to be performed using reinforcement materials of the same size and scantling. Fortunately, the sizes of the fishing boats under consideration do not vary widely. The smallest ones are 25ft in length and the largest 35 ft. As mentioned, smaller ones are not able to proceed to the sea and boats larger than 35 ft need to be built with stronger timbers since such boats need to fish at deeper water. These boats belong to different category of investors and vary in structural layout and arrangements. Separate studies are to be conducted for such boats.

The sizes, scantling and arrangement described in this work is expected to be a right choice for 30 ft -35 ft boat, For smaller boats, the steel reinforcement needs to be less strong. Detailed specification are furnished in Table 1 for boats of 25-28 ft in length. Other measures to be taken are as follows:

- Bolting should preferably be done at 3 plank spacing
- Bolts must be tightened with low torque
- Coal tar soaking should be carefully done

In any case, there will be teething problem but with the ingenuity of the workforce of our country, all such problems can be overcome. The main necessity is to establish the benefits of the work and make people believe the same.

4.3 Issues related to safety:

Although capsize happening due to wave impact resulting in structural collapse is a major reason of loss of life and property at sea, there are other reason as well that may be addressed to mitigate the situation. In course of this work and IUCN study, it appeared that community people have their own thoughts on their limitations as well as what measures may be taken to minimize the incidences of accidents. Some of these are very interesting and they came up with their own solution. These thoughts are segregated into three different themes as presented below:
<table>
<thead>
<tr>
<th>Operational factors</th>
<th>Measures that could enhance safety</th>
<th>Steps fishermen need to take</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of engine maintenance in time</td>
<td>Use of radio receivers</td>
<td>Fishermen need to use RADIO while fishing in the sea</td>
</tr>
<tr>
<td>Absence of proper knowledge about engine mechanism and training</td>
<td>Use of magnetic compass with training</td>
<td>They must use a COMPASS</td>
</tr>
<tr>
<td>Excessive excitement about fishing</td>
<td>Use of search light</td>
<td>Use of search light is also necessary</td>
</tr>
<tr>
<td>Low grade wood</td>
<td>Quality control in boatbuilding process</td>
<td>Every Machine man or Fitter should have a One week certificate course on engine driving and maintenance.</td>
</tr>
<tr>
<td>Lack of timely boat maintenance</td>
<td>Boats equipped with appropriate engine power</td>
<td>Every Sukani must have some knowledge about a COMPASS and its proper use.</td>
</tr>
<tr>
<td>Lack of sincerity</td>
<td>Fitness certification for fishing</td>
<td>Boats need to be constructed by a govt. approved Industry or by a certified carpenters.</td>
</tr>
<tr>
<td></td>
<td>Improving awareness and preparedness in emergency</td>
<td>Engine must be installed according to the size of the boat and properly calculated load.</td>
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<tr>
<td></td>
<td>Good quality of wood need to be used in boat construction (Gorjon, Goda, Gutia, Gudgudi, Jarul)</td>
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<td></td>
<td>Every boat must collect fitness certificate before voyage.</td>
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</tbody>
</table>
5.1 Conclusion

Because of time constrain no feedback on the benefit of the improvement made in the project has been available. Thus any benefit derived from the re-design works cannot be claimed conclusively. However, the fact that boatman boat builder have all agreed on the rationale of the works can be considered as a remarkable achievement in terms of obtaining consensus amongst the stakeholders on the causes of the accident and a possible remedy. There ought be reasons to strongly believe that there will be some benefits in the desired direction.

The initiative of the IFRC and BDRCS is aimed at welfare of the fishermen community of the coastal areas of Bangladesh. In order to elevate the living standard and welfare of the fishermen, there is perhaps quite few things that has been done and many different areas are there where interventions can be made. These include health, education, communication etc. However, fishing boats being the bread earning source, improvements in these boats rendering boat operation more profitable and safer can achieve fundamental improvement in their livelihood. The implementers can initiate activities in two main themes:

1. Basic improvement of the boats to improve profitability in operation
2. Making boats safer and thus consolidate the present state of earning from boat operation.

As elaborated earlier, the first of the two themes is an ambitious one and requires development on the basics of the boats. With climate changes, there is a need for boats better adopted to the changed environment. The process may include:

- Evaluation of the hull form for sea keeping, fuel efficiency, capsize bevious, structural strength, construction and even alternative materials
- Identify areas where development is needed
- Design improvements
- Apply improvements on pilot scale and obtain feedback

Further improve and repeat the cycle until acceptable outcome is reached. The process will be time and resource consuming in terms of funds and resource personnel. Organizations such and Food and Agricultural Organization (FAO) of the United Nations, IUCN and local organizations such as National Oceanographic and Maritime Institute (NOAMI) may get involved. The role of FAO is known to everyone. The work of IUCN has been discussed and NOAMI has conducted a series of studies on the wooden boat sector of Bangladesh including artisanal offshore fishing boats. IFRC and BDRCS may work as the initiating body. A comprehensive proposal may be equipped on request from the them.

The second of the option would be a full sized and comprehensive version of the present work. The first phase of the works will be to establish the current hypothesis, i,e, steel strengthening of the mid-ship will reduce the possibility of failure and capsize in bad seas. As the next step
feedback may be collected from this particular boat in which improvement has been made. The hypothesis may further be applied on a small number of boats (20-30) and collection of feedback information for at least one full fishing season will be required. With necessary refinement and the justification clearly visible, the BDRCS and IFRC may take further step to disseminate the concept along with providing the necessary logistical supports. Such a project has a potential to benefit the vulnerable fisherman in very short term. It is also recalled that any benefit has to be measured based on perception rather than physical finding. Thus the proposed program must clearly take care of this fact and arrive at an appropriate procedure to be adopted for evaluation.

5.2 Limitations

The present work suffers from the following limitations

1. The time frame was too shot and thus necessary feedback data were not available.
2. The size of the project (one number of boats) is too small to arrive at a conclusive outcome
3. Issues such as fuel consumption, longevity, repair and maintenance, overall structural design were not considered. The only issue considered was safety, that too during bad weather and bad seas
4. The focus was Nijhumdwip island which is a small area compared to the total climate change vulnerable fishermen community in Bangladesh. Thus any attempt to utilize the outcome has to be especially taken care of.
5. The expenses incurred by the project is not a typically market figures and this cost figure must not be used for any economic and financial justification or analysis
Proposal for consultancy services under  
Building Community Resilience  
through Climate Change Adaptation (CCA) Project  
of Bangladesh Red Crescent Society

In response to request from Project Manager- CCA project, BDRCS, the following proposal is submitted

Work Proposal

In a previous study, the major under IUCN limitations of the artisanal fishing boats of the country was identified. The most important one was the structural weakness, especially in the bilge area. The second most important factor was use of poor quality timber with minimum care for preservation.

The work proposal under the current program is to incorporate these improvements in some typical boats. The feedback from these improvements may be followed up under some program.

The Work Plan

The following works will be conducted under the program

- Specify the improvements in that will be incorporated in the selected boats
- Held discussions with the carpenters and technicians on the objectives and methodology for the improvements and also to elicit their opinion
- Specify the materials, equipment and skill for the proposed improvement
- Plan and organize incorporation of the proposed improvements
- Preparation of the details of the improvement including design drawings
- Supervise the proposed improvement works
Table 1: Material required for working with 1 boat of 30 ft length

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>Specification</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Steel angle bar</td>
<td>2&quot;x2&quot;x3/16&quot;</td>
<td>72</td>
<td>Kg</td>
</tr>
<tr>
<td>2</td>
<td>Flat bar</td>
<td>2&quot;x 3/16&quot;</td>
<td>28</td>
<td>Kg</td>
</tr>
<tr>
<td>3</td>
<td>Coach bolt</td>
<td>D-1/2&quot;, 3&quot;</td>
<td>45</td>
<td>no.</td>
</tr>
<tr>
<td>4</td>
<td>Spring washer</td>
<td>D-1/2&quot;</td>
<td>50</td>
<td>no.</td>
</tr>
<tr>
<td>5</td>
<td>Flat washer</td>
<td>D-1/2&quot;</td>
<td>50</td>
<td>Kg</td>
</tr>
<tr>
<td>6</td>
<td>Welding electrode</td>
<td>Vortic Marine</td>
<td>0.5</td>
<td>Packet</td>
</tr>
<tr>
<td>7</td>
<td>Coal tar</td>
<td></td>
<td>10</td>
<td>Kg</td>
</tr>
<tr>
<td>8</td>
<td>Jute Hessian</td>
<td></td>
<td>10</td>
<td>Kg</td>
</tr>
<tr>
<td>9</td>
<td>Thin rope</td>
<td></td>
<td>5</td>
<td>kg</td>
</tr>
<tr>
<td>10</td>
<td>Wood (mainly 1”-1.25” planks)</td>
<td></td>
<td>6</td>
<td>Cft</td>
</tr>
</tbody>
</table>

The above Bill of Quantities is estimated for redesigning of a typical 30 ft. boat. This can be used for boats up to 35ft. as there is no major difference in specifications. Boats having length below 25ft are not suitable for fishing in the sea and boats longer than 35ft belong to a different category both in technical and socio-economic terms.

For the smallest boats of this category (25 feet in length) a bill of quantities for redesigning is furnished in the table below:

Table 1: Contd. Material required for working with 1 boat of 25 feet in length

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>Specification</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Steel angle bar</td>
<td>2&quot;x2&quot;x1/8&quot;</td>
<td>50</td>
<td>Kg</td>
</tr>
<tr>
<td>2</td>
<td>Flat bar</td>
<td>2&quot;x 1/8&quot;</td>
<td>12</td>
<td>Kg</td>
</tr>
<tr>
<td>3</td>
<td>Coach bolt</td>
<td>D-2/16&quot;, 2.5&quot;</td>
<td>40</td>
<td>no.</td>
</tr>
<tr>
<td>4</td>
<td>Spring washer</td>
<td>D-1/2&quot;</td>
<td>45</td>
<td>no.</td>
</tr>
<tr>
<td>5</td>
<td>Flat washer</td>
<td>D-1/2&quot;</td>
<td>45</td>
<td>Kg</td>
</tr>
<tr>
<td>6</td>
<td>Welding electrode</td>
<td>Vortic Marine</td>
<td>0.5</td>
<td>Packet</td>
</tr>
<tr>
<td>7</td>
<td>Coal tar</td>
<td></td>
<td>8</td>
<td>Kg</td>
</tr>
<tr>
<td>8</td>
<td>Jute Hessian</td>
<td></td>
<td>8</td>
<td>kg</td>
</tr>
<tr>
<td>9</td>
<td>Thin rope</td>
<td></td>
<td>5</td>
<td>kg</td>
</tr>
<tr>
<td>10</td>
<td>Wood (mainly 1”-1.25” planks)</td>
<td></td>
<td>5</td>
<td>Cft</td>
</tr>
</tbody>
</table>
FIGURE 2-2: TRANSVERSE STRUCTURES OF WOODEN BOATS
FIGURE 2-5: TRANSVERSE STRUCTURES OF WOODEN BOATS

- Deck
- Deck Bari (Beam): Typically 4" x 2.5"
- Side Frame (Gocha): Typically 3.5" x 2"
- Kurfnquina (Bilge Frame)
- Bottom Frame (Baka): (Called floor in naval architecture) Typically 5" x 2"

Scale: 1:12.5
LOCATIONS OF BAKA
TYPICAL CENTER TO CENTER DISTANCE 15 INCH

FIGURE 2-6: LONGITUDINAL LOCATIONS OF BAKA
LOCATIONS OF KURFA/QUINA
TYPICAL CENTER TO CENTER DISTANCE 15 INCH

FIGURE 2-7: LONGITUDINAL LOCATIONS OF KURFA/QUINA
LOCATIONS OF GOCHA
TYPICAL CENTER TO CENTER DISTANCE 15 INCH

FIGURE 2-8: LONGITUDINAL LOCATIONS OF GOCHA
LOCATIONS OF DECK BARI (BEAM)
TYPICAL CENTER TO CENTER DISTANCE 15 INCH

FIGURE 2-9: LONGITUDINAL LOCATIONS OF DECK BARI (BEAM)

LENGTH 30 FT
BREADTH 7 FT
DEPTH 3.75 FT
TYPICAL STRUCTURAL DETAILS
OF A WOODEN FISHING BOAT

FIGURE 3-1: EXISTING STRUCTURE
(PERSPECTIVE VIEW)

NOT TO SCALE
FIGURE 3-2: RE-DESIGN OF STRUCTURE WITH STEEL ANGLE (PERSPECTIVE VIEW)
LOCATIONS OF STEEL REINFORCEMENT IN RE-DESIGN

FIGURE 3-4: LOCATIONS OF STEEL ANGLE
LOCATIONS OF TRANSVERSE STRUCTURAL MEMBERS

FIGURE 3-5: STEEL ANGLES VIS-A-VIS EXISTING STRUCTURE
FIGURE 4: COACH BOLT VS ORDINARY BOLTS