A Comparative Analysis of Different Types of Flood Shelters in Bangladesh



Final Report
August, 2010

Prepared for
The DIPECHO Partners in Bangladesh (DPB)

IWFM, BUET

PPDM, BRAC University

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August 30, 2010

To
The DIPECHO Partners in Bangladesh

Subject: Submission of Final Report.

Dear Sir/ Madam,

We are pleased to submit herewith the FINAL REPORT of the research project "Conducting a Comparative Analysis of Different Types of Flood Shelters in Bangladesh". Your feedback on the draft report has been of immense value in preparing this final version of the report.

We appreciate DPB for entrusting this study with us.

Thanking you,

(Professor Rezaur Rahman *PhD)*

(Professor Fuad H Mallick *PhD*)

Copy to:

1. Shakeb Nabi, Program Manager, DIPECHO-V, ActionAid Bangladesh
2. Manish Kumar Agrawal, Program Manager, DIPECHO Project, Oxfam GB Bangladesh
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List of Abbreviations

CDMP	Comprehensive Disaster Management Programme
CIRDAP	Centre on Integrated Rural Development for Asia and the Pacific
CPP	Cyclone Preparedness Programme
DFID	Department For International Development
DIPECHO	Disaster Preparedness ECHO
DMB	Disaster Management Bureau
DRR	Disaster Risk Reduction
ECHO	European Commission Directorate General Humanitarian Office
EED	Education Engineering Department
EPC	Engineering and Planning Consultants Ltd.
FGD	Focus Group Discussion
GBM	Ganges-Brahmaputra-Meghna (Basin)
GC	Group Consultation
GoB	Government of Bangladesh
HFL	Highest Flood Level
INGO	International Non-Government Organization
IWFM	Institute of Water and Flood Management
IWM	Institute of Water Modeling
JICA	Japan International Cooperation Agency
KII	Key Informant Interview
LGED	Local Government Engineering Organization
MoFDM	Ministry of Food and Disaster Management
NGO	Non-Government Organization
NWRD	National Water Resources Database
PEP	Poor and Extreme Poor
PWD	Public Works Datum
RCC	Reinforced Cement Concrete
SHOUHARDO	Strengthening Household Ability to Respond to Development Opportunities
UDMC	Union Disaster Management Committee
USAID	United States Agency for International Development
VDC	Village Development Committee
VDMC	Village Disaster Management Committee
WARPO	Water Resources Planning Organization

Foreword

Bangladesh is extremely vulnerable to disasters. Every year people suffer from flood, cyclone and many other hazards. The country is also internationally recognised as one of the worst victims of climate change and unpredictable weather patterns.

With the support from DIPECHO Partners in Bangladesh, Institute of Water and Flood Management of BUET and Post Graduate Programme in Disaster Management of BRAC University have carried out a comparative study of different types of flood shelters in Bangladesh. Flood shelters are very important of flood disaster management in our country and this study provides some guidelines on proper choice of our shelters and how to improve its functionality.

I believe that the analysis of socio economic, technical and environmental considerations of various types of flood shelters and subsequent recommendations mentioned in this report will help their relevant stakeholders in taking decisions for selecting various types of flood shelters and its construction. I therefore thank DIPECHO partners for supporting this study.

I sincerely hope that the findings of the study report will be helpful to reduce the vulnerability and sufferings of the flood affected people.

Ahsan Zakir 09/09/10
Director General
Disaster Management Bureau

Ahsan Zakir
(Additional Secretary)
Director General
Disaster Management Bureau
Disaster Management & Relief Division
Ministry of Food & Disaster Management

BRAC UNIVERSITY

Professor Ainun Nishat
PhD FIE
Vice Chancellor

Foreword

In 2004, sometimes in the month of August, when the whole country was in the grip of a devastating flood, I received a phone call from one of the radio channels of BBC. The Presenter, at the other end, from a live program, asked me a few questions about the flood situation prevailing in Bangladesh. After self introductions and he had recognized me as a professional with interests in flood management, our conversation was something like as follows. "Is it true that more than half of your country is under water? If you confirm it, what are the consequences?" "Yes, your information is correct. Possibly, this is the worst flood in terms of extent of the country that has been flooded. Also, the duration of flood is alarmingly long. Timing of the flood is very critical because the main monsoon crop that is '*aman*' is being seriously affected and unless, flood waters recede completely, in two weeks time, Bangladesh may face a major challenge to feed her teeming millions". "Please tell me what are the plans for evacuation of the affected people; is the Government taking adequate measures to rescue them; do you have enough shelters to accommodate the evacuated people; and, do you have sufficient food to feed the displaced"? Obviously, the Presenter was not interested on impact of the flood on our economy and food security. His angle of questioning was from disaster management considerations and he did not have any clue about the size of population that was affected. My reply was: "Before I respond to your queries please understand the magnitude of the problem. When I say that more than half of the country is affected possibly we are talking about 40 to 50 million people. In a normal year about one fourth of the country is inundated and people living in those areas face such a situation on their own, without any external assistance. Rest of the affected people, who live in rural floodplains, are also used to floods that hit them at regular interval and usually, they build their homesteads on raised earthen mounds, safe from flooding. Some people do move to flood shelters; school buildings in the vicinity, are usually converted into such shelters. Others opt for make-shift arrangement by constructing *'machna'* (platforms) with bamboo etc., at a level, higher than the anticipated level of flood and move their family members and valuable belonging to the platforms. People also move to safe higher ground, mostly on top of flood dykes and road embankments, and live on temporary houses built with bamboo and polythene. The Government makes every effort, best to their capacity, to support the affected people, mainly by providing food and clothing". The Presenter then asked me: "since your country is flooded regularly, why your Government has not built sufficient flood shelters and what is your recommendation for such future events". I responded by stating that "your observation is right that Bangladesh faces floods as natural disasters at regular intervals. One must appreciate the resilience that communities have developed and capacity to look after themselves. However, time has come to review the situation as the population has gone up, and the new generation is not readily prepared to face floods. The situation is further aggravated

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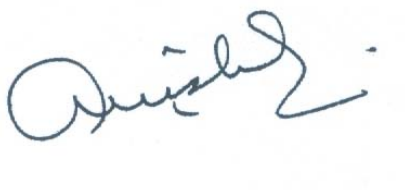
by the false sense of security, provided by structural measures such as flood dykes/ embankments that often do not perform effectively. We now need to support construction of infrastructures, in flood vulnerable areas, that can be used as flood shelters, at the time of need. Construction of school buildings will, obviously, be the first choice for this purpose and school grounds may be raised to be used as shelters for bovine population. At the same time local population should be encouraged to flood-proof their own homesteads by constructing them, at a level higher than that of anticipated flood. The families, who can afford, may be encouraged to have a two storied house and soft loans may be provided for this purpose."

Through the conversation that I have narrated above, I had expressed my views on the best approach for planning of flood shelters in Bangladesh. There are few purpose-built flood shelters in the country. Personally, I do not encourage construction of buildings for the sole purpose to serve as flood or cyclone shelters. Rather, we should go for infrastructures that can be used as shelters if needed but these infrastructures should have a normal time use for making the investment more useful for the society. We also need to develop effective shelter management practices for three distinct phases of its operation. First, it's operation and management prior to a flood event, that is, when the threat of a flood is eminent and affected people need to be moved in an organized and planned manner; second, during the flood period when people have moved to the shelter and support is needed on management issues with emphasis on health and security related concerns; and, third, after the flood water has receded and support is required to assist people to move back to their own homesteads and allow the school (or, the infrastructure) to resume normal function. To me, a homestead, converted into a shelter, to serve the family and neighbors, is possibly the best option.

I read the report "A comparative Analysis of Different Types of Flood Shelters in Bangladesh" with keen interest. It contains practical recommendations and suggestions. Traditionally the rural communities living in flood plains as well as in the *haor* areas build their homesteads on artificially built mounds, raised above recorded highest flood level. But this traditional practice is some how not being given due considerations in present day planning process. This report provides useful guidelines for proper construction of flood shelters.

I would like express my appreciation of DIPECHO's effort in commissioning and publishing this report which deserves serious consideration of disaster managers of the country. I commend Professor Rezaur Rahman and Professor Fuad Mallick and their team for the excellent work.



Dhaka, September 10, 2010

Professor Ainun Nishat PhD
Vice Chancellor
BRAC University

পানি ও বন্যা ব্যবস্থাপনা ইনস্টিটিউট
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FOREWORD

I am pleased to know that the final report of the study 'A Comparative Analysis of Different Types of Flood Shelters' is being published. Flood management is one of the focal areas of the research and academic programs of IWFM. I am glad that IWFM has been a part of this important study which is very relevant to our programs.

I am also very happy to learn that this study has been an interdisciplinary study. Since interdisciplinary research and education in water resources management is the main objective of IWFM, I believe involvement of the institute in this study has given us more practical exposure to the field. I see that this study analyzed both technical and socio-cultural parameters in comparing different types of shelters. The policy guidelines and recommendations are then made on the basis of integration of findings on these equally important aspects.

Since flood is a recurrent phenomenon in Bangladesh, management of flood has always been a priority of all our governments. While traditionally hard options for flood management dominated the agenda, we have learned with experience that softer measures are preferable given the hydro-morphological and socio-economic contexts of the delta. I believe one of such measures - flood shelters, especially raised homesteads, has a greater role to play in flood preparedness.

In the recent past, government and non-government agencies have invested heavily in construction of different types of shelters. This trend is likely to continue because of many appealing features of flood shelters, especially cost effectiveness in case of community shelters and raised homesteads. As indicated in this report, there is scope for improvement in construction quality and shelter management. I am sure that the policy guidelines and recommendations made in this report, if implemented, will make the shelters more effective in flood management of the country.

I thank my colleagues who have been involved in this important study. I also express my thanks to DIPECHO partners for supporting this study.

Dr. M. Shah Alam Khan
Professor and Director

Acknowledgement

We very much appreciate DIPECHO partners in Bangladesh (DPB) for entrusting this study with the Postgraduate Programme in Disaster Management, BRAC University and Institute of Water and Flood Management, BUET. The study team found the task particularly engaging and appreciates the opportunity to work in such an important study.

The study is thankful to Mr. Manish Kumar Agrawal of Oxfam, Mr. Shakeb Nabi of ActionAid and Mr. Michiel Slotema of Plan International. They have facilitated and supported the study team whole-heartedly throughout the study.

The study team acknowledges various agencies including LGED, Education Engineering Department and CARE for helping with data, information, and structural and architectural drawings. We very much appreciate the field support that we received from various local NGOs including AKK at Faridpur, MMS at Sirajgonj and RDRS at Lalmonirhat. We are immensely grateful to all key informants and participants in various consultation sessions and FGDs for giving time and many valuable inputs to the study. The villagers as always, were immensely helpful and hospitable wherever we went.

Executive Summary

S.1 Background

Over the years, a number of agencies have built many flood shelters in Bangladesh. The shelters may be raised homestead, flood proofed schools/colleges, which are used as temporary flood shelters or community flood shelters. The selection of type of shelter has however, been rather ad-hoc than systematic. Moreover, the agencies mostly followed their own guideline for planning and design of the interventions in absence of a common approach limiting thereby, the effectiveness of the interventions.

S.2 Objective

The overall objective of the study is to conduct a comparative analysis of the effectiveness of different flood shelters of Bangladesh from socio-economic, cultural and technical point of view and come up with specific recommendations and policy guidelines for such future interventions.

S.3 Methodology

The study was conducted following a combination of conventional and participatory research approaches. The study made use of a mix of research techniques and tools including on-site assessment, consultation, KII, FGD transect walk and case studies. Various types of shelters were visited at Faridpur, Sirajgonj and Lalmonirhat.

S.4 Findings

Flood level and duration

During the field visit in Sirajganj, raised homesteads, raised community shelter, and raised cluster houses were found in the same floodplain. They all were in good condition except the problem of rain cuts. In Lalmonirhat, raised school-cum-shelter and homesteads were seen in the same char land and in good condition. It thus appears that there is not much choice among different types of shelters from flood depth and duration perspectives. However, the soils of the basement of a school-cum-shelter on stilts in Faridpur were found to be severely eroded due to the strong water current during the 2007 flood.

The use of a community or school shelter depends on the duration of a flood. People are reluctant to move to a shelter in the event of a short-duration flood. This was seen in Lalmonirhat during the field visit. There was a flood there in July 2010 and also there was a raised school-cum-shelter nearby in the community. But only cattle were moved to the shelter and no people moved there. The other reasons for not using the shelter by the people could be that the water and sanitation facilities were not ready for use at that time.

The current practice of estimating design height of shelter is based on the information provided by the local people. Using the global positioning system (GPS) technology, the shelter height at the desired location can be estimated more accurately. Thus, instead of relying only on the indigenous knowledge, a combined approach based on both indigenous knowledge and technology can be adopted.

Drainage

In chars, drainage channels are not well developed, there is no well connected road network and homesteads are scattered. Therefore, there is not much scope of hindrance to drainage due to the construction of any type of shelters. Though from a conceptual point, a school-cum-shelter on stilts will cause the least obstruction, followed by a raised community shelter, raised cluster village and raised individual homesteads, the hindrance will not be of any significant scale. There is a likelihood that the road communication in the char areas will develop with the raising of homesteads, construction of schools, community shelters, etc. It is important that adequate drainage opening in those road networks is kept at appropriate locations so that both flood and drainage water can move easily. Importantly, the shelters should not be constructed filling any drainage channel.

Soil

Clayey silt, silty clay and silt are preferred soil textures for shelter construction. However, such soils are not available nearby. Soils of finer texture are available in the area but the carrying cost would increase. Since in char areas soils are not always favorable for shelter construction, some other materials such as cowdung, saw dust and cement can be mixed with the available sand as a reinforcement.

Technical Feasibility

Schools-cum-shelters on stilts are the most expensive shelters. In high risk areas, such as new chars and erosion prone areas, they will not be technically feasible. Raised community shelters in high risk areas are subject to wave erosion and rain cuts. Maintenance is problematic in case of community shelters. Raised homesteads are however, feasible in high risk areas due to their good maintenance.

Capacity of Shelters

In community shelters, potential accommodation capacities are high; about 200-250 families can be accommodated or even more, if needed. The accommodation capacity of a four-room school shelter is lower than the community shelter. About 100-150 families can take shelter in a school. However, men and women can easily be segregated in different rooms. The advantage of raised homesteads is that the neighbors can take shelter.

The accommodation capacity of a shelter is also related with the duration of the flood. In areas where flood is of short duration, more people can be accommodated compared to an area where flood duration is longer.

Catchment area delineation and potential user identification are very important in planning and designing of a community shelter and a school-cum-shelter.

Basic Facilities

Basic facilities like water and sanitation could be better provided in school-cum-shelters and community shelters as more people could be attended to in one place. Ensuring basic services for individual raised homestead is difficult.

Environmental Impact

Loss of land for shelter construction is a concern. In case of community shelter however, there is scope for multi-purpose use of these community spaces. The availability of suitable soils is also a constraint and sandy soils blow during the dry months until the growth of vegetation. The raising of homesteads increases the vulnerability of the houses to wind hazard. Ensuring hygienic condition is a major problem in case of school-cum-flood shelters.

Accessibility

From the accessibility perspective and assuming that RCC structures (referring to the 'school-cum- shelter' type) are not usually constructed in *chars*, the individual homestead raising can be regarded as the best available option.

Land Availability

From the land availability point of view, school-cum-shelter seems to be the most suitable one. School compounds have been reported as the first place for flood victims to seek shelter. Moreover, school-cum-shelter is a good option in terms of ensuring maximum effective normal time use.

Operation and maintenance

Raised individual homesteads have direct ownership and hence the maintenance is easy and simple. The raised plinth of homestead requires regular maintenance after flood which can be easily done by the family. From the multipurpose use perspective, school-cum-shelter is a more preferred option and management is easier as compared to the other two types. As schools have year round activities, the maintenance is intrinsically done. But one problem as identified during the field visits is the unavailable or insufficient fund for maintenance operations.

Protection of lives and livelihoods

The conventional school-cum-shelter, though structurally most viable, might not be found within convenient distances for all flood victims. In that instance, community shelters are preferable since people can take along their livestock and other physical assets. However, considering the risk of drowning of cattle during transport, people prefer staying in their submerged house along with their livestock and undergo inhuman sufferings.

From the cost effectiveness point of view it is very difficult to name one single type of shelter as most appropriate. Each of these types of shelters has some distinct advantages that cannot be replaced by others. Moreover, the perception of the notion 'effectiveness' might vary from community to community when it is tagged with 'direct-indirect', 'tangible-intangible' aspects. Still, considering the cost of sheltering a household, community flood shelters can be considered as most cost-effective. Moreover, community flood shelters offer multi-purpose use during normal time.

Management during flood situation (Relief and response)

The difficulties in relief operations can be considered as a problem with the raised homestead type of flood shelter. From this point of view, school-cum-shelter and community flood shelter is a more convenient option. In a community shelter, a good number of people can be provided with relief assistance over a short period of time and ensuring provisions of some basic services (e.g. potable water, medical services etc.) would be more cost-effective.

Safety and security of women and children

Safety of women and adolescent girls in terms of harassment/assault is considered as a matter of grave concern. Literature suggest that in communal shelters they are vulnerable to abuse by men. Though at the time of consultation they did not seem to be much concerned about it, they regarded raised homesteads as a more preferred option.

During flood, the risk of death of children from drowning is very high. When the adults of a household are more likely to remain busy securing the safety of their belongings and ensuring food for the family, it becomes difficult on their part to look after the children round the clock. But at the community shelter or school cum shelter it is not difficult to find someone to look after the children. Thus the safety and security of children can be better assured in a community shelter or a school cum shelter than in individually raised homesteads.

Willingness and priority of potential users

After consultation with the flood affected people in Faridpur, Sirajganj and Lalmonirhat, it is evident that they prefer raised homestead to other two options. This is because raised homesteads save both their lives and their belongings.

Disruption of education

Disruption of education due to flood affected people taking shelter in schools is not a matter of great concern. School authorities have devised the mechanism of adjusting the lost work days with the designated vacations for extra lessons required and it has been well-accepted.

S.5 Recommendations

Risk zoning

The flood prone areas need to be divided into various zones according to the flood risk they face. These zones should be delineated based on flood as well as erosion hazard. There can be three zones high risk zone, medium risk zone and low risk zone. Island chars can be classified as high risk zone. Attached chars and mainland outside embankment can be treated as medium risk zone and area inside embankment can be considered as low risk zone.

Choice of shelters

It is recommended that the choice of shelters in different risk zones be as follows. Homestead raising and community shelters should be preferred options in high risk zone. Homestead raising, community shelters and easily dismantable schools on raised ground can be options in medium risk zone. School-cum-shelter on stilts can be the preferred option in low risk zone. Embankments with modified design, can be considered as another type of shelter for emergency use.

Design principles

Accessibility of shelters to the main route or the embankment is important. Durability of the structures is necessary for long term utilization, plantations can play a major role here. House construction to reduce flood damages needs attention. Homestead gardening can be encouraged, schools cum shelters need better maintenance for optimum use.

CHAPTER 1
Introduction

1.1 Rationale

Providing safe and secured shelter during floods is a major objective of a disaster risk reduction strategy. In a floodplain and downstream country like Bangladesh, where many mitigation measures have not been able to reduce risk up to expected level, the adaptation measures like different types of flood shelters are being looked into with renewed interest.

Over the years, a number of agencies have built many flood shelters in Bangladesh. The shelters may be raised homesteads, flood proofed schools/colleges, which are used as temporary flood shelter or community flood shelters. The selection of type of shelter has however, been rather ad-hoc than systematic. Moreover, the agencies mostly followed their own guideline for planning and design of the interventions in absence of a common approach limiting thereby, the effectiveness of the interventions.

It is important to learn from the experiences with different types of shelters in order to plan wisely for the future shelters. This is especially important given the large number of shelters that need to be built in the near future given the considerable number of still unprotected population. Expected aggravation of flood under climate change context is adding impetus in this regard.

1.2 Background of the study

European Commission Directorate General Humanitarian Office (ECHO) is currently funding six INGOs to implement its 5th Action Plan for risk reduction in Bangladesh. The six INGO's (ActionAid, Concern Universal, IFRC/BDRCS, Islamic Relief, Oxfam & Plan) are implementing pilot projects across Bangladesh to strengthen the capacity of communities and GoB to prepare and respond to natural disasters and reducing disaster risks.

At the start of their implementation, all the six INGOs recognized the need for carrying out research on various DRR discourses and come out with concrete ideas to give directions at the policy level. One of the issues that have been identified is flood shelter that is being promoted by various institutions including the government. Based on the secondary research and interaction with key stakeholders there are three models of flood shelters that the DIPECHO partners wish to do a detailed analysis. They are:

- Up gradation of a homestead into a flood shelter in such a way that it is resilient to floods.
- Upgrading school/college into a flood shelter through earth raising and provisioning of other basic amenities like water and sanitation space for cooking and medical facilities.
- Designing and construction of a community flood shelter following the basic minimum standards.

1.3 Overall Objective of the Study

The overall objective of the study is to conduct a comparative analysis of the effectiveness of different flood shelters of Bangladesh from socio-economic, cultural and technical point of view and come up with specific recommendations and policy guideline for future such interventions.

The specific objectives of the study are as follows:

1. Comparative analysis of all three types of flood shelters in view of
    a. Reducing risk on lives and health
    b. Reducing risks on property and livelihoods loss
    c. Safety and security of poor and most vulnerable population viz. women, children, old aged, disabled
    d. Cost effectiveness
2. Analysis of existing policy guidelines for the construction of flood shelters in Bangladesh in view of specific objective 1 and suggest areas for improvement (mandatory and desirable)
3. To develop simple guidelines for facilitating well informed decision about construction of different type of flood shelters and execution based on the socio-economic and technical parameters
4. To suggest model design for all the three types of flood shelters

1.4 Scope of Work

Technical analysis

- Flood intensity, pattern and duration (last 25 years) vis a vis suitability of flood shelters
- Drainage pattern (safe disposal of flood water) vis a vis suitability of flood shelters
- Soil characteristics vis a vis suitability of flood shelters
- Technical feasibility in view of Char (river islands) and non-char land
- Capacity of flood shelter vis a vis potential users (affected population)
- Availability of adequate (quantity and quality) basic facilities (water, sanitation, hygiene, health etc.) available at the flood shelters to reduce the vulnerability and suffering of men, women, children, old aged, disabled etc.

- Existing and potential use of silt deposited on the river bed for flood shelter construction
- Positive and negative environmental impact of all three types of flood shelters

Socio-economic and cultural analysis

- Location vis a vis easy and quick accessibility of potentially affected population in general and particularly of poor and most vulnerable section of the society such as women, children, old aged, disabled etc.
- Availability of land for all three types of flood shelters
- Effective management of flood shelters during flood situation, future operation & maintenance (O&M) and existing & potential multiple use of flood shelters; Sustainability
- Advantages and disadvantages in view of saving lives and protecting health; cost effectiveness
- Advantages and disadvantages in view of protecting livelihoods; cost-effectiveness
- Safety and security of women and children
- Willingness and priority of potentially affected population to use the flood shelters both during and post flooding
- Particularly in case of school cum flood shelters: Overall use for saving lives, health, livelihood *vis a vis* disruption of education

1.5 Structure of the report

Chapter 1 sets the rationale and background of the study. Chapter 2 describes the approach and methodology adopted in this study. A mix of top-down bottom-up approach has been adopted for this study. An adaptive methodology has been followed to fulfill the objectives within limited time and resources. Chapter 3 reviews some past reports in the light of the objectives of this study. Chapter 4 and 5 compares various types of shelters from technical considerations and socio-economic and cultural perspectives respectively. Chapter 6 puts forward a number of design principles related to various types of shelters along with sketches of model shelters. Chapter 7 provides few policy guidelines on the basis of this study. Finally, Chapter 8 draws the conclusions of the study.

CHAPTER 2
Approach and Methodology

2.1 General approach

The study was conducted following a combination of conventional and participatory research approaches. Conventional research is a researcher guided, inflexible, top-down approach of research widely used in academic arena, whereas participatory approach is a community led, flexible, bottom-up approach principally used by NGOs in development works. In this study, a combination of top-down and bottom-up approach was adapted. A schematic of the overall research approach is shown in Figure 2.1.

The present study made use of a mix of research techniques and tools. The choice and application of tools and techniques were continuously updated based on the overall objective of the study (comparative study and policy guideline), type and quality of information at hand during a particular time of the study, resource and time constraints, and local situations. This adaptive approach was necessary to fulfill the objectives of the study in most efficient manner.

Research was conceptualized based on review of existing literature and professional experience of the team members. The team members comprised academics from different disciplinary background.

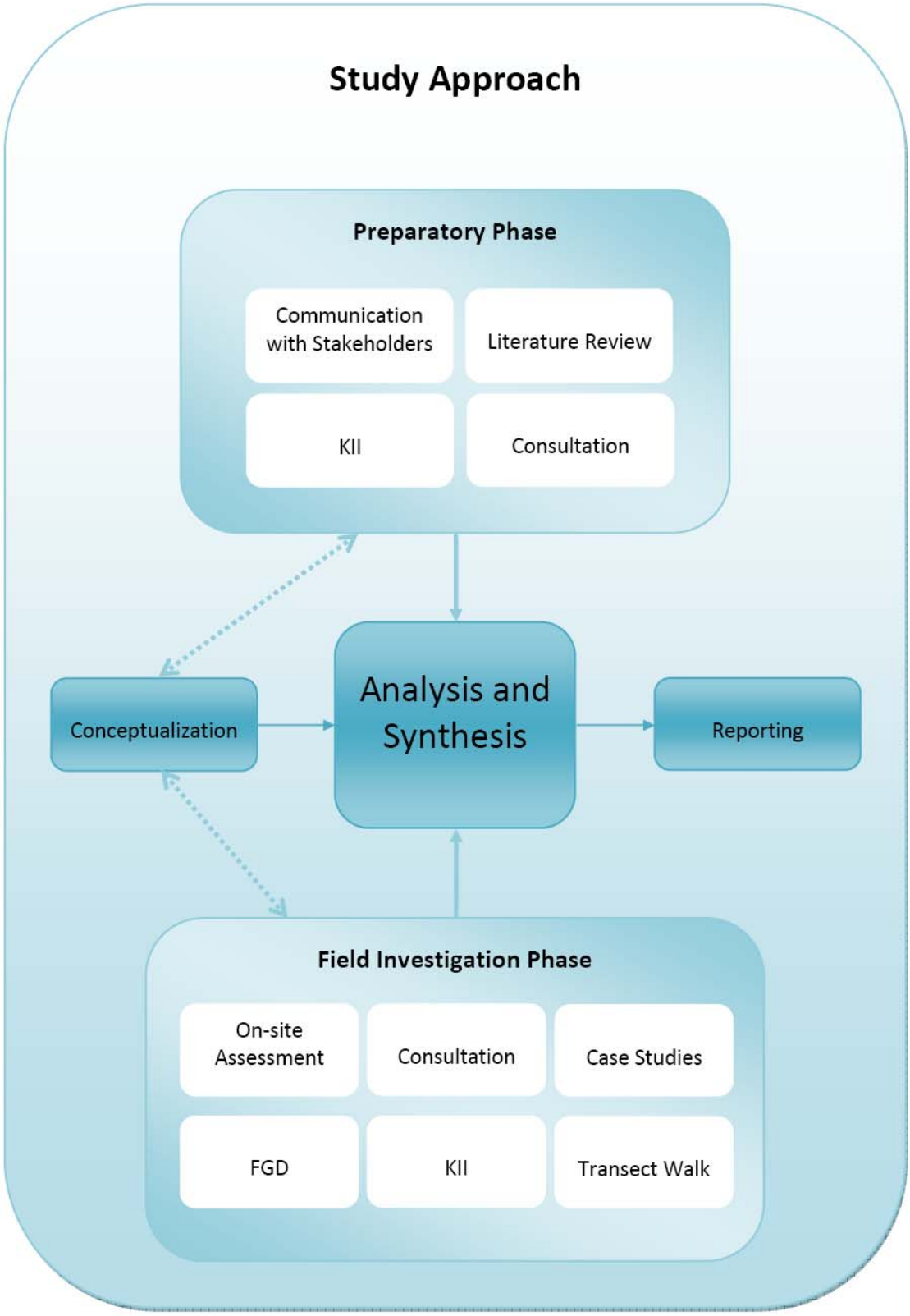


Figure 2.1: The Study Approach

2.2 Field Visit Sites

Data and information were gathered from both Dhaka and the field. In Dhaka, key informant interviews and group discussions were held. Three field sites (Figure 2.2) were selected from three river basins – Faridpur from the Padma basin, Sirajganj from the Jamuna basin and Lalmonirhat from the Teesta basin. The nature of floods in these basins is different. The Teesta basin experiences flash floods of 3-4 days duration, whereas the Padma and Jamuna basins experience normal riverine floods of long duration in the range of 2-3 weeks. The chars in the Teesta basin are relatively stable than the chars in other basins, as it appeared from the discussion with the local stakeholders. Hydro-morphological characteristics of the three field sites are shown in Table 2.1.

Table 2.1: Hydro-morphological characteristics of the field visit sites

Site	River	Type of flood	Type of area
Faridpur	Padma	Monsoon	Char land
Sirajgonj	Brahmaputra/ Jamuna	Monsoon	Floodplain
Lalmonirhat	Teesta	Flash	• Char land • Main land

The study was conducted during May-August 2010 and the field visits were made during 7-8 July to Faridpur, 9 July to Sirajganj and 22-25 July to Lalmonirhat. There was a flood during the time of visit to Lalmonirhat.

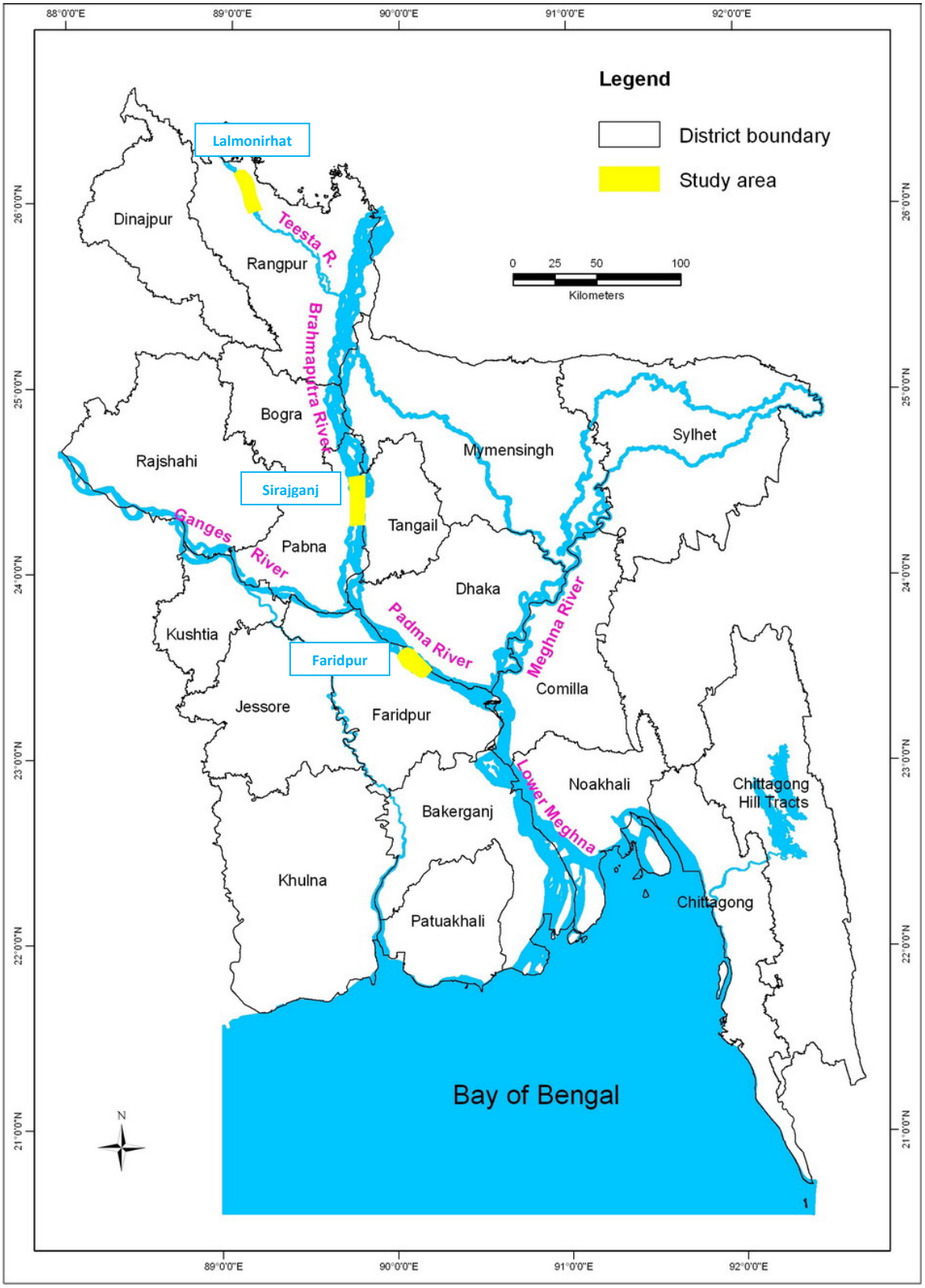


Figure 2.2: The Study Area

2.3 Types of Shelters Visited

Generally three types of flood shelters are seen in Bangladesh: individual homestead, community shelter and school-cum-shelter.

The **individual homestead** type is basically a house on a raised plinth. The plinth level is raised considering the perceived highest flood level and in a manner so that the household assets such as cattle can be accommodated and homestead gardening can be done on it.

The **community flood shelter** is a large earthen mound with the provision of accommodating a large number of people. Some community shelters have structures erected on them where schools and other community functions are held during normal time. The other normal time uses of community flood shelters include play ground and local market. Usually community flood shelters keep provision of toilets and water supply for the shelter seekers and they can bring along their cattle during emergency.

The **school-cum-shelter** is a building structure standing on stilts. The ground floor is for cattle and people take refuge upstairs. During normal time the whole building is used as a school and in flood time the school functions are reorganized.

A school-cum-shelter on stilts in Sadipur, a raised community shelter in Mollah Kandi and a raised market-cum-shelter in Char Nasirpur of Sadarpur upazila in Faridpur (Photo 2.1) were visited by the study team. A brief description of the shelters visited in different districts is given in Table 2.2. A raised community shelter in Kalia Haripur, a raised cluster village in Paik Para, a number of raised homesteads in Paik Para, a community school-cum-shelter and a school used as shelter at Gunapara in Sirajganj Sadar upazila were visited. In Lalmonirhat, raised homesteads in Purba Dawabari, two raised school-cum-shelters in Dawabari and Pachim Bichundi, two school/college-cum-shelters on stilts in Singimari, two raised children's disaster risk reduction spaces in Pachim Bichundi and Singimari and two schools used as shelters in Patikapara and Dawabari were visited.

Photo 2.1: A view of the raised market-cum-shelter at *Chowdhury'r Haat*, Char Nasirpur, Faridpur

Table 2.2: Description of visited shelters

Type of shelter	Number	Site	Size	Capacity	Year of construction	Use during flood
School-cum shelter on stilts	1	Faridpur	4 class room - two storied	100 families	2006	Partially used once in 2007
Community shelter (raised ground)	1	Faridpur	228×213 feet	300-350 people	2010	New – not used yet
Community shelter (raised market)	1	Faridpur	6 bighas		2010	New - not used yet
Community shelter (raised ground)	1	Sirajgonj	392×295 feet	400 families	2007-10	Not yet used as shelter
Cluster village	1	Sirajgonj	7.5 acres	90 families	2001	2007
School-cum-community shelter	1	Sirajgonj	80 decimals		2007-2010	Not used
School used as shelter	1	Sirajgonj	3 rooms	50 families		Used as shelter

Type of shelter	Number	Site	Size	Capacity	Year of construction	Use during flood
School-cum-shelter in char	1	Lalmonirhat	167.5×105 feet		2010	Partially used in 2010
School-cum-shelter on stilts in mainland	1	Lalmonirhat	Four class rooms – two storied		2006-07	Partially used in 2007
School-cum-shelter on stilts in mainland	1	Lalmonirhat	Four class rooms – one storied		2010	Not yet used in 2010
School-cum-shelter on raised ground in attached char	1	Lalmonirhat	Three class rooms		2008-09	Used in 2009
Disaster risk reduction space	2	Lalmonirhat	Two rooms	10 families	2008	Not used
Schools used as shelters	2	Lalmonirhat	Large schools	>100 families	Old schools	Used many times

2.4 Research Tools Used

Data and information were gathered using a wide range of research tools – key informant interview (KII), group consultation, focus group discussion (FGD), etc. Table 2.3 shows a list of the tools used in different spatial contexts. In addition, two transect walks accompanied by VDC members and local people were taken through the Paikpara and Gunapara villages in Sirajganj Sadar to see the raised cluster and individual homesteads. The researchers stopped at different locations during the walks and enquired about different matters related to raised homesteads. Furthermore, a number of short consultations were held with local people present at the time of visits at different spots including tea stalls. Three case studies were conducted for in-depth investigations into some critical planning and management issues of three different shelters. The purpose of the study and the field situation during the visits guided the selection of these tools. The details of these tools are discussed in later sections.

Table 2.3: Research tools used in different locations

Place	Research tools	Number	Agency/District
Consultation at Dhaka	KII	5	MoFDM, LGED, EED, EPC, World Vision
	Group consultation	1	CARE
Consultation at field	KII	19	Faridpur – 6 (Local businessmen, Woman user, School teacher-cum-shelter manager, boatman) Sirajgonj – 6 (Ex Chairman, Community leader, Woman members of VDC, shelter user) Lalmonirhat – 7 (local NGO employees: 2; School teacher-cum-VDMC member: 1; School teacher-cum-UDMC chair: 1; College Principal: 1; upazila chairman: 1; UNO: 1)
	Group consultation	4	Amra Kaj Kori - Faridpur School-cum-shelter management authority - Faridpur Manab Mukti Sangstha – Sirajganj VDMC – Lalmonirhat Plan Bangladesh - Lalmonirhat
	FGD	4	Faridpur – VDC (2) Lalmonirhat – Boishakhi Dal; flood affected villagers
	Transect walk	2	Sirajganj (cluster and individual homesteads)
	Short consultation (Tea stall meeting)	4	Faridpur -2 Sirajganj – 3 (at community shelter, VDC office of cluster village, Gunapara Primary School) Lalmonirhat – 3 (School teachers)

2.5 Types of Key Informants

A total of 24 KIIs were conducted. The informants were selected to represent a wide range of personnel involved in shelter planning, design, construction, and operation and management as well as local elites, politicians, administrators and users. The categories of key informants are given in Table 2.4.

Table 2.4: Categories of key informants

Category	Number
Design Engineer	3
Project manager	1
MoFDM official	1
Shelter implementer (NGO)	2
Shelter manager	2
Shelter user	4
Community leader	3
Local politician	2
Local elite	2
Local Government official	1
Local businessman	2
Local boatman	1
Total	**24 (Male 20; Female 4)**

2.6 Description of Research Tools

2.6.1 Collection of Literature and Secondary Data

Evaluation reports on flood shelters were collected for review from Oxfam, CARE and EPC. No other sources were available for such reports. The lists of shelters constructed so far by the EED, LGED and CARE were collected from relevant organizations to see the spatial distribution of shelters for future intervention. Typical architectural designs were also collected from these organizations to see the design parameters. Water level data of the Padma, the Jamuna and the Teesta were also collected for analysis of flood frequency and duration in these rivers.

2.6.2 Communication with All Stakeholders

A total of 144 organizations were identified to have stakes in this study. They can be categorized into three principal types: university and research institutions, development agencies (donors and implementing agencies) and government agencies. Letters were sent to the organizations requesting information on flood shelters and they were followed up through emails and over telephone. Fourteen organizations responded to the letters mostly through emails and over telephones Among the respondents were donors (ADB, JICA, DFID), research organizations

(IWM, CIRDAP, WARPO), etc. They provided information about their own organizational flood shelters, suggested possible key informers, expressed interests in the study, etc. The responses were satisfactory.

2.6.3 Interviews and Consultation in Dhaka

To gather general information on flood shelters as well as their technical, socio-cultural, economical, use and operational aspects, key informant interviews (KIIs) and group consultations (GCs) were conducted in Dhaka. KIIs were held with the Education Engineering Department (EED), Local Government Engineering Department (LGED), Engineering and Planning Consultants Ltd. (EPC) and World Vision. A GC was held with CARE Bangladesh. It is to be noted that EED, LGED and CARE have implemented the largest number of shelters. The informants were working professionals. Among the informants, four were civil engineers having direct involvement in planning, design and/or management of school-cum-flood shelters. The consultation with CARE was with a four-member multidisciplinary team of engineers, disaster manager and development management practitioner. Both IWFM and BRAC University members facilitated the discussions with open ended questions/queries driven by the scope of the study. The informants shared their working experiences, provided their thoughts on how to improve the current practices and so on.

2.6.4 Analysis of Flood Levels

The height of the ground to be raised depends on the return period of flood. With the increase in return period, the shelter height increases. To evaluate such changes in flood levels with return periods and to compare the different levels with the historical highest flood level, daily water level data of the Jamuna at Bahadurabad and the Padma at Mawa were collected from the Bangladesh Water Development Board. The data were available for a period of 50 years (1960-2009) for Bahadurabad and 42 years (1968-2009) for Mawa. The frequency analysis was carried out using Gumbel, Normal, Log Normal and Log Pearson Type III probability distributions.

2.6.5 On-site Structural Assessment of Shelters

The proper functioning of a shelter depends on its quality of construction, physical facilities available, design adequacy and proper operation and management. During the field visits, on-site assessments of the quality of earth works including soil texture, shelter height, top slope, side slope, turfing, erosion, rain cuts, etc. and quality of buildings/houses and facilities provided (tubewells, toilets, special facilities) were made by direct observation and discussion with local people (Photo 2.2).

Photo 2.2: On site investigation at Sadipur High School, Faridpur

2.6.6 Interviews, Consultations and Discussions at Fields

During the field visits, the team members interviewed local key informants (Photo 2.3), held meetings with local shelter implementing NGOs, consulted shelter management committees, had FGDs with local VDCs (Photos 2.4 and 2.5), had short consultations at tea stalls (Photo 2.6), etc. Oxfam and AKK at Faridpur, MMS at Sirajganj and Plan Bangladesh at Lalmonirhat guided the study team to different shelters. The researchers also visited some shelters independently. Char Nasirpur in Faridpur and Purba Dawabari in Lalmonirhat were very remote and accessible only by boats and walking through knee to waist high water. In Hatibandha, Plan Bangladesh in support of a local NGO (POPI) implemented 26 Children's Disaster Risk Reduction Spaces in 26 villages. The team members visited two such spaces and held a FGD with the local children comprising both boys and girls. Another FGD was held with *char* children in Purba Dawabari to know about their sufferings during floods and how their education is hampered.

Photo 2.3: KII – Interviewing a shelter user

Photo 2.4: A view of participants in a FGD at Chowdhury's hat, Char Nasirpur, Faridpur

Photo 2.5: Participants at a FGD in a raised community shelter at Char Nasirpur (shows number of women participants)

Photo 2.6: A typical tea stall meeting

A comprehensive checklist was prepared before going to the field. Field data and information gathering was guided by the list. The categories of the informants, their knowledge about the locality and issues, and their role and experience in disaster management were taken into consideration while using the checklist. This means that not all the questions were asked to all the informants. The information was gathered on technical as well as socio-cultural aspects of flood shelters.

The checklist covered the following issues:

- location of the shelter and its geographical and physical settings
- catchment area of the shelter
- planning and construction processes of the shelter
- physical setting of the shelter (construction type, size, elevation, top slope, side slope, landing facilities)
- infrastructural facilities (rooms, tubewells, toilets, running water, electricity, rain water harvesting, any special facilities)
- facilities for women
- uses of shelters during and after disasters (capacity, bringing belongingness)
- operation and management of shelters during and after disasters
- nature of flood: causes, depth, duration, frequency; flood recession (gradual, quick)
- return period for shelter design (highest, 25-year, 10-year, etc.) and how it is estimated and its reliability
- nature of flood waves (large, medium, small), current (strong, weak), and vulnerability of shelters to erosion, washout, slope failure
- soil types and age, and vulnerability of shelters
- shelter construction (soil, compaction, turfing, protection wall, construction materials, mason, availability, transportation, cost, affordability)
- drainage facilities at shelters (gutter, slope, berm) and obstruction caused by shelters and related facilities to free flow of water
- potential relation between hydraulic parameters and shelter types (school, community, homestead)
- potential relation between shelter types (school, community, homestead) and shelter uses
- community choice for shelter types and its link with hydraulic, technical and social parameters
- disabled people (number and types) and the facilities needed for them; how they can be provided with design modification and cost
- cost of different shelters and beneficiary contribution
- feasibility of low cost shelters with movable materials in chars
- problems faced by the shelter users during disasters

- livelihood management during disaster; cultivation; distress sale
- environmental and health impacts
- safety and security
- transfer of O&M responsibilities to communities, local NGOs, etc.
- community participation and integrated planning
- availability of *khas* land, and shelter for the landless people
- promotion of equity vis-à-vis shelter types.

2.6.7 Case Studies

Three case studies were conducted on three different aspects of shelter planning and management during the field visits. One case study was on the operation and maintenance aspects of a school-cum-flood shelter in Faridpur. Another case study was on multipurpose uses of a raised community shelter in Sirajganj. The last case study was on the erosion of the Jamuna River and its potential threats on the existence of a community flood shelter. These case studies revealed some critical and important factors which needed due consideration during the planning of shelters. The case studies were conducted following SWOT analyses of different types of shelters relating the context with normal and disaster time uses.

2.6.8 Compilation and Synthesis of Findings

A summary of each interview, group consultation or case study was prepared by one of the team members and circulated among all the members for feedback, comments, addition and subtraction. The summary was finalized after incorporating the comments of the team members. The case studies were prepared immediately after coming back from the fields and circulated through emails for feedback of the team members. The data and information gathered through other means during the field visits were shared among the team members through some tabular formats. Finally, the findings were synthesized under technical and socio-cultural aspects guided by the scope of the work and are reported in chapters 4 and 5.

CHAPTER 3
Review of Past Reports on Flood Shelters

CARE Bangladesh raised 3671 homesteads in char areas of the Jamuna and Teesta Rivers during 2006-2007 under the SHOUHARDO program funded by USAID and GoB. The objective was to reduce the vulnerability of the poor and extreme poor households (PEP) in char areas during floods. Tod et al. (undated) conducted a study to evaluate the cost-effectiveness and performance of the raised homesteads during the 2007 flood.

Homesteads are raised by placing earth in layers on top of the existing compound area until the level of the homestead courtyard is above the design flood level (usually taken as the 1 in 25 year flood level) plus a freeboard of 0.6 m (2 ft). Existing homestead buildings are dismantled and removed prior to raising the compound area, and reconstructed once earthworks are complete. Raising the level of homestead compounds directly benefits individual households or groups of households sharing the same compound and implementation of the measure is only targeted towards PEP households. The average (top) area provided on raised homesteads was 210 m^2/HH (ranging between 70m^2 and 230m^2), and homestead areas were raised an average height of 1.5 m. The average volume of earthworks was 308.9 m^3/HH. The average program cost of homestead raising was Tk. 18,032/HH.

The findings of the study suggest that homestead raising provides significant benefits to the PEP households. About 77% of the homesteads raised were above the 2007 peak flood level. The quality of construction was good, side slopes were turfed and the homesteads did not collapse during the flood. However, 23 homesteads were lost to river erosion. The financial analysis indicated that the raising of homesteads would be cost-effective if homesteads could sustain for 5-7 years after construction.

The study found that the benefits of creating a flood-free homestead area include more dry space for domestic activities, reduction in diarrhea and skin diseases, more scope for homestead gardens, fewer distress sales of livestock, removing need to move household and livestock to higher ground, reduction in building maintenance costs, increased social cohesion, increased confidence in dealing with floods and outside services, and enhancing the impact of other SHOUHARDO support services.

In the short-term, a major benefit of homestead raising is the generation of employment that can be targeted for women from PEP households. Overall, about 30-50% of the employment in homestead raising was allocated to women. Workers on homestead raising activities are paid the same wage rates. In the long-term,

raised homesteads directly benefit women by providing a greatly improved environment during floods for carrying out domestic activities; opportunity for year-round income and enhanced nutrition from homestead gardening; better conditions for livestock rearing; scope for greater mobility during the flood season as homestead area is more secure; better conditions for giving birth; access to safe drinking water during floods, improved family well-being and health, due to less diarrhea and skin disease; and scope for uninterrupted delivery of other SHOUHARDO services. During the FGDs, participants often said that women were empowered by raised homesteads due to several factors including increased bargaining power, improved access to markets, scope for developing income earning activities that continue throughout the flood, and enhanced capacity for leadership.

"Flood Rehabilitation Programme in Secondary and Higher Secondary Education Institutions Project" was undertaken during 2006-07 (EPC, 2007). Under this project, 360 Institutes were taken up for construction as a project. There were 181 three storied new academic building cum Flood shelter keeping the ground floor partly open on one side and constructing the teacher's room in other side by elevating the plinth on highest flood level in the premises of recent flood affected educational institutions and supply of requisite nos. of furniture with sinking of tube well. The floor area of each new building is about 200 sq.m. Average cost of each project was about Tk. 45 lakh.

The Principal objectives of the project were:

(a) To provide physical facilities for extension of education to flood affected and low lying areas.

(b) To construct 360 institutions (181 new & 179 extensions) which will also provide flood shelter to the affected people from the adjacent areas in case of flood.

(c) To supply furniture to the constructed institutions.

The project would ensure expansion of education and would also provide accommodation of local people in the event of flood. This, in the long run will bring about a substantial change in development of human resource and thus will activate acceleration in the cultural and socio-economic improvement in the country.

Khanam et. al. (2002) reviewed the post-flood shelter and housing program undertaken by various NGOs in Jessore- Khulna region in 2000. Severe flood occurred in October 2000 in Jessore-Khulna region which was traditionally known as flood free region. The flood caused huge damage- particularly to the housing. Generally, people's houses were mud built; they collapsed as they were inundated.

Local NGOs did not have prior experience but they had to engage because of the urgency of the situation. They – with donors' support – mounted relief and rehabilitation operation. A large element of it was shelter reconstruction. The review team checked 122 shelters.

NGOs provided a single room structure - but some added veranda, others did not. All had roof slit bamboo frame structure excepting two that had prefabricated metal structure. For roofing they had either CI sheets or clay tiles, then, varied combination of RCC and bamboo poles and numbers of wall panels. Again, they had varied combination of numbers of rings and wall panels for latrines.

Cost of CI sheet roof shelter was about Tk. 6,000. Cost of tile roof shelter was about Tk. 2,000 less than that of CI sheet roof shelter; veranda and wall panels needed Tk 2,000 and 1,000 extra, respectively, Shelter with metal roof frame required double the amount than the cost of shelter with slit bamboo roof frame.

Beneficiaries appreciated what they had received but they viewed that shelter should provide privacy or security women and adolescent girls, and space for women to work and children to play and study.

Each NGO worked individually and separately, and provided "complete set of shelters" to their respective "segment of beneficiaries". It did not help maximizing use of their resources and logistic capacities, as well they could gain from economy of scale. Some families "without land" did not receive assistance. A different model 'shelter reconstruction support' is needed for this category of people.

Rahman (undated) conducted a technical performance evaluation of 11 community flood shelters constructed by local NGOs with assistance from Oxfam UK and India. The selected shelters were mainly from the char areas of the Jamuna. The flood shelters were raised public grounds (typical size was 300X300 ft) generally with a pond and suitable structures on it. They included domestic water supply through hand tubewell, basic sanitation facilities, a small office and a cow shed. Three field visits were made to evaluate the performance of the shelters during 1996 flood. Physical locations, physical features, quality of construction, maintenance and management, and utilization during flood were used as indicators. The main objectives of the study were

- To evaluate the design and construction process of the flood shelters and to find out scope for further development.
- To monitor the maintenance needs and the present system of maintenance
- To evaluate the drainage system and sustainability of the flood shelters

- To develop recommendations for enhancing the effectiveness and sustainability of the flood shelters
- To develop guidelines to be followed for the future construction of flood shelters.

The findings of the study reveal that the planning, technical design and quality of construction of the shelters were in general, satisfactory. The study also found that the operation, maintenance and management aspects were not finalized. The shelters were not used up to their potential accommodation capacity during 1996 flood – the reasons, however, were not reported. Some of the recommendations made by the study are as follows:

- Management aspect should be given full attention. Income generation activities for creating fund should be considered seriously, Fish cultivation in the ponds will probably be the best approach.
- Constant vigilance may be organized when a flood threatens to inundate the shelter. If necessary, temporary bund may be constructed on all sides.
- Wave causes major damages to the shelter. Breakwater may be developed by planting appropriate shrubs around the outer periphery of the shelters. Trees such as karai, babla may be planted to give the shelter better stability.

CHAPTER 4
Technical Analysis

4.1 Flood depth and duration

Flood is a natural event in Bangladesh. All the river basins including the Padma, the Jamuna and the Teesta are flood prone. The occurrence of a flood is indicated when the water level of the river exceeds its danger level. The danger level of the Padma at Mawa is 6.0 m PWD, the Jamuna at Bahadurabad is 19.5 m PWD and the Teesta at Dalia is 52.4 m PWD. The analysis of observed water level data at these stations indicated that the probability of flood in a year for the Padma is about 60%, for the Jamuna is about 75% and for the Teesta is about 45%. The average duration of a flood is about 23 days in the Padma basin, about 14 days in the Jamuna basin and about 4 days in the Teesta basin. The duration of a few large floods are given in Table 4.1.

Table 4.1: Duration of large floods in different river basins

Padma basin		Brahmaputra/Jamuna basin		Teesta basin	
Year	Flood duration (days)	Year	Flood duration (days)	Year	Flood duration (days)
1998	65	1998	63	1988	9
1987	52	1974	44	1981	7
2003	39	1970	26	1984	6
1971	35	1984	24	1989	5
1969	33	1977	22	1983	4
1995	30	1973, 1980, 2007	21	1980, 1987	3

Frequency analysis of annual maximum water levels was carried out to see the difference in water level due to the change in return period of flood. The results are reported in Tables 4.2-4.4 and Figures 4.1-4.3. The analysis was carried out using a number of probability distributions. The goodness-of-fit test using probability plot correlation coefficient indicated that the Log Pearson Type III distribution fitted best to the Bahadurabad and Mawa data and the Gumbel distribution to the Dalia data. It is seen from the tables that the difference between a 50-year flood and a 20-year flood is about 12 cm at Bahadurabad, 12 cm at Mawa and 43 cm at Dalia. The difference between the highest flood and the 20-year flood is about 23 cm at Bahadurabad, 38 cm at Mawa and 109 cm at Dalia.

Table 4.2: Frequency analysis of flood levels of the Jamuna at Bahadurabad

Probability distribution function	Water level (m PWD) corresponding to the return period of					Highest flood in m PWD (year)
	5 year	10 year	20 year	50 year	100 year	
Normal	20.11	20.29	20.44	20.60	20.72	20.61 (1988) 20.40 (2007) 20.37 (1998)
Log Normal	20.11	20.29	20.45	20.62	20.74	
Log Pearson Type III	20.11	20.26	20.38	20.50	20.58	
Gumbel	20.06	20.30	20.53	20.83	21.05	

Table 4.3: Frequency analysis of flood levels of the Padma at Mawa

Probability distribution function	Water level (m PWD) corresponding to the return period of					Highest flood in m PWD (year)
	5 year	10 year	20 year	50 year	100 year	
Normal	6.50	6.67	6.81	6.97	7.08	7.14 (1998) 7.07 (1988) 6.84 (2004)
Log Normal	6.49	6.67	6.82	7.00	7.12	
Log Pearson Type III	6.50	6.64	6.76	6.88	6.95	
Gumbel	6.45	6.68	6.90	7.18	7.39	

Table 4.4: Frequency analysis of flood levels of the Teesta at Dalia

Probability distribution function	Water level (m PWD) corresponding to the return period of					Highest flood in m PWD (year)
	5 year	10 year	20 year	50 year	100 year	
Normal	52.92	53.19	53.41	53.65	53.82	54.63 (1981) 52.97 (1972) 52.88 (1980)
Log Normal	52.92	53.18	53.40	53.65	53.82	
Log Pearson Type III	52.80	53.20	53.59	54.12	54.52	
Gumbel	52.85	53.20	53.54	53.97	54.30	

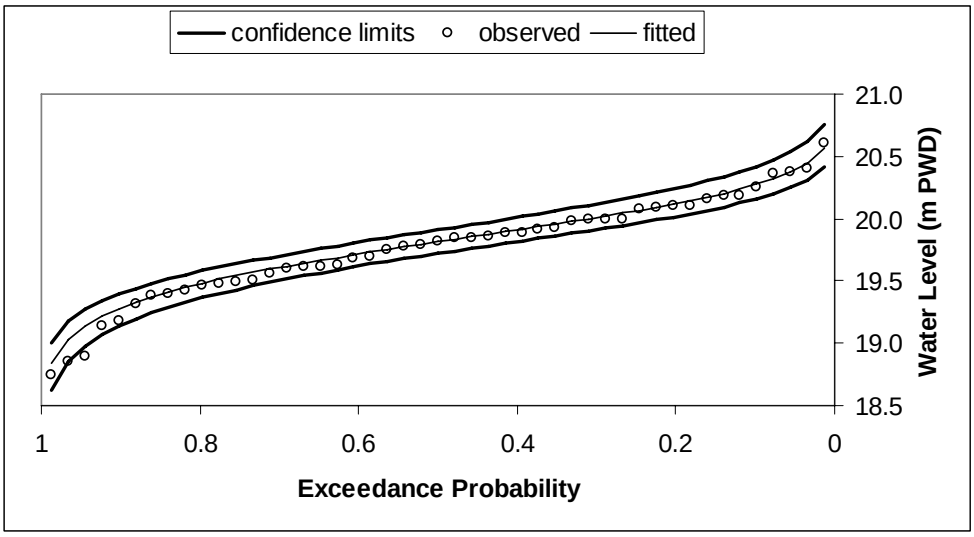


Figure 4.1: Probability plot along with 90% confidence limits of the fitted Log Pearson Type III distribution to the annual maximum water levels of the Jamuna at Bahadurabad

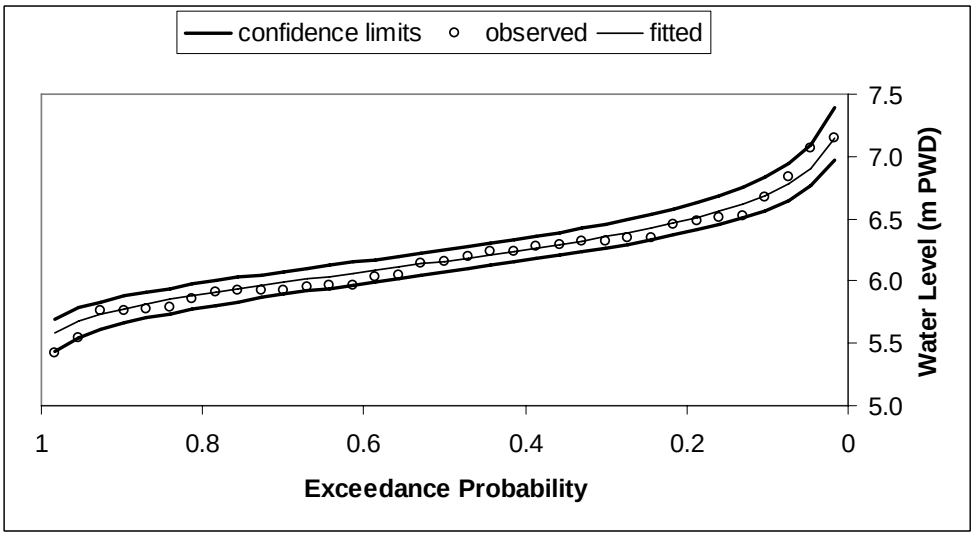


Figure 4.2: Probability plot along with 90% confidence limits of the fitted Log Pearson Type III distribution to the annual maximum water levels of the Padma at Mawa

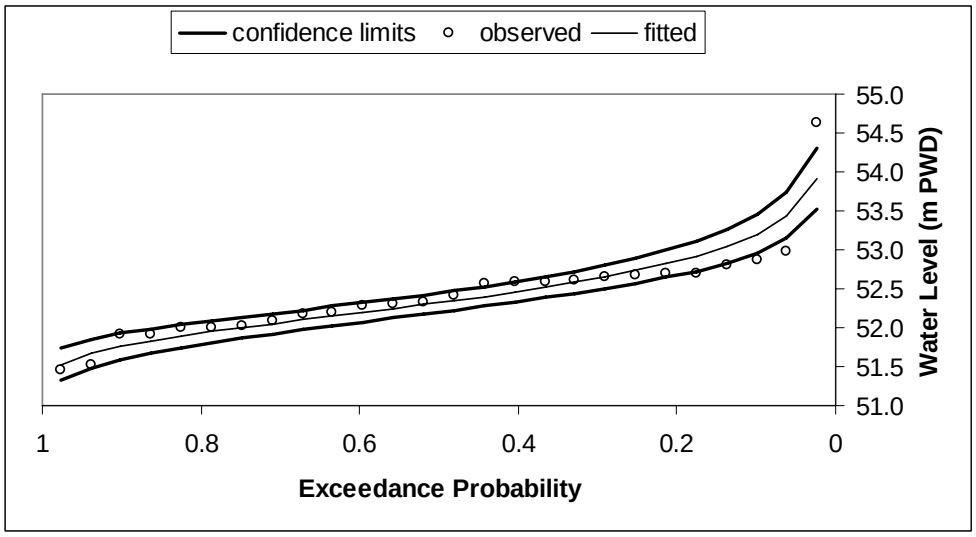


Figure 4.3: Probability plot along with 90% confidence limits of the fitted Gumbel distribution to the annual maximum water levels of the Teesta at Dalia

The current practice of shelter construction is that the shelter top is above the highest flood level with a free board of 0.6-1.0 m. The highest flood level is estimated based on the information provided by the local people to the shelter implementing organizations. The problem with this approach is the uncertainty associated with the indigenous knowledge, char age and instability. Many chars were young and people started living on them only a few years back. They might not have experienced large floods during their settlement period in the chars. Even in the mainland, it is difficult, if not impossible, to obtain a reasonable estimate of the highest flood level based on indigenous knowledge. Moreover, shelters are not as high valued establishments as to be above the historical highest flood level. A 20-year flood level could be used as the design level of a shelter. Tod et al. (undated) mentioned that the SHOUHARDO shelters were designed based on a 25-year flood though the field information at Sirajganj did not support that.

The colored post in the above photo shows the current practice of flood warning. Flood levels within the green, yellow and red color ranges indicate no warning, preparatory and evacuation phases, respectively. The markings can be improved using GPS technology.

Most of the chars are located in the major rivers of the country. These rivers are gauged. From the water surface slope and the frequency analysis, design flood level can be estimated. Using the global positioning system (GPS) technology, the shelter height at the desired location can be estimated. Thus, instead of relying only on the indigenous knowledge, a combined approach based on both indigenous knowledge and technology can be adopted.

During the field visit in Sirajganj, raised homesteads, raised community shelter, and raised cluster houses were found in the same floodplain. They all were in good condition except the problem of rain cuts. In Lalmonirhat, raised school-cum-shelter and homesteads were seen in the same char land and in good condition. It thus appears that there is not much choice among different types of shelters from flood depth and duration perspectives. However, the below the grade beam of a school-cum-shelter on stilts in Faridpur were found to be severely eroded due to the strong water current during the 2007 flood. The people were so scared that, even though they came to the shelter, they had to be evacuated by the management authority. So care must be exercised in constructing shelters in such locations.

The use of a community or school shelter depends on the duration of a flood as well. People are reluctant to move to a shelter in the event of a short-duration flood. This was seen in Lalmonirhat during the field visit. There was a flood in July 2010 and also there was a raised school-cum-shelter nearby in the community. But only cattle were moved to the shelter. The other reasons for not using the shelter by the people could be that the water and sanitation facilities were not ready for use at that time. Furthermore, the people of the area wanted their homesteads to be raised by the local NGOs.

4.2 Impact of climate change on flood

Climate change is now an added concern in shelter planning and design. To evaluate the effect of climate change on flood levels, annual maximum water levels of the Jamuna at Bahadurabad available for 47 years between 1960 and 2009 were analyzed. The trend analysis revealed that there is an increasing trend of 1.5 mm per year in the annual flood peak (Figure 4.4). However, this trend was not statistically significant even at a 50% level of significance. Climate Change Cell (2009) reported that the peak flood level at Bahadurabad would increase by 37 cm in a moderate flood year and 27 cm in a normal flood year in 2040 compared to 2004/2005. This was from a modeling study in which sea level rise of 17 cm and rainfall increase of 13% over the GBM basin were considered. It thus appears that a maximum allowance of 20 cm can be kept in shelter design considering the effect of climate change and a 20-year design flood level. The observed trend at Mawa based on a 35-

year data (1968-2009) is +3.6 mm per year and at Dalia based on a 26-year data (1965-2004) is +7.6 mm per year. None of these trends was statistically significant. Model results were not available at these two stations.

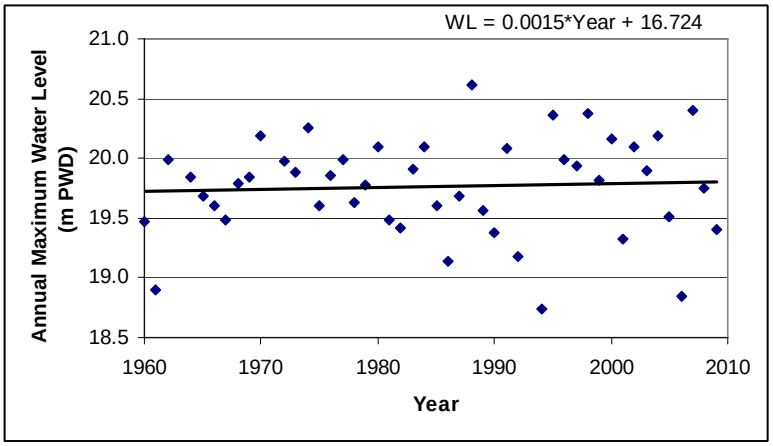


Figure 4.4: Trend in annual maximum water levels at Bahadurabad on the Jamuna

4.3 Flood duration

Flood duration data of the three stations were analyzed to see if there is any trend in the flood duration. The analyses revealed that there is a negative trend in the Jamuna at Bahadurabad and there are positive trends in the Padma at Mawa and the Teesta at Dalia. However, none of these trends was statistically significant even at a low confidence level, such as a 75% level of confidence. This indicates that the potential impact of climate change is not manifested on the duration of flood at these stations and the flood duration can still be considered trend free. A time series plot showing the duration of flood at different years along with the trend in flood duration at Bahadurabad of the Jamuna is shown in Figure 4.5.

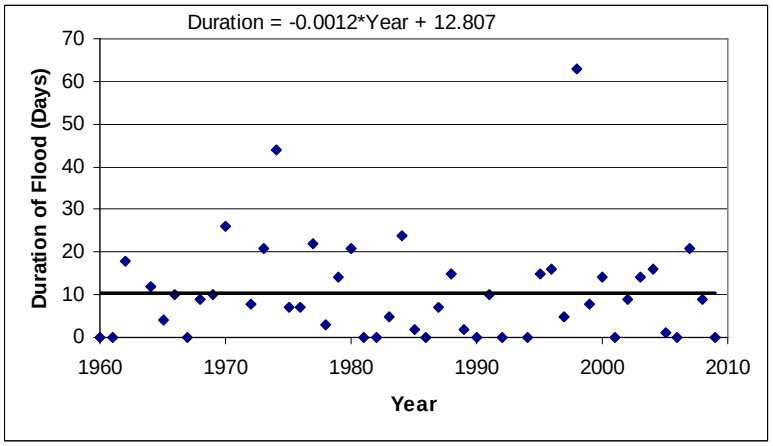


Figure 4.5: Trend in duration of floods of the Jamuna River at Bahadurabad.

4.4 Drainage

When flood water starts receding, any obstruction to receding water will delay the drainage process and exacerbate the flood situation. This is particularly true in situations where drainage channels are obstructed. In chars, drainage channels are not well developed, there is no well connected road network and homesteads are scattered. Therefore, there is not much scope of hindrance to drainage due to the construction of any type of shelters. Though from a conceptual point, a school-cum-shelter on stilts will cause the least obstruction, followed by a raised community shelter, raised cluster village and the raised individual homesteads, the hindrance will not be of any significant scale. It is likely that the road communication in the char areas will develop with the raising of homesteads, construction of schools, community shelters, etc. It is important that adequate drainage opening in those road networks is kept at appropriate locations so that both flood and drainage water can easily move. Also the shelters should not be constructed filling any drainage channel. During the field visits, people did not report any impediment to drainage flow due to the construction of any shelter.

Rainfall-runoff is the worst enemy of a flood shelter. If rain water stands on a flood shelter, it will become slushy and be damaged. It was observed during the field visits that appropriate slopes (top and side) were not maintained during the construction of raised schools and community shelters except for the raised community shelter in Sirajganj. Rain cuts (Photo 4.1) were prevalent in those shelters. Side slopes were measured as high as 1H:1V even for shelters constructed with sandy soils. The maximum permissible side slopes (horizontal : vertical) are 3:1, 1.5:1, 1:1, 2:1 and 3:1 for clay, silty clay, clayey silt, silt and sand, respectively (Rahman, undated). Except for one school-cum-community shelter in Sirajganj, none of the community shelters had longitudinal, lateral and side gutters for drainage of rain water. Such slopes and gutters are to be provided to let the water run down sideways during rains. Ideally, a shelter should have maximum elevation at its central part with a minimum gentle cross slope of 0.02 towards edges (Rahman, undated). Side gutters are to be provided at a maximum interval of 15 m. The implementing officials at field levels were not at all aware of this provisioning.

Photo 4.1: Rain cut in a raised community shelter in Sirajganj

4.5 Soils

Clayey silt, silty clay and silt are preferred soil textures for shelter construction. However, such soils were not available nearby in char areas for a raised community shelter in Faridpur and a primary school-cum-community shelter in Lalmonirhat. These two shelters were constructed using sandy soils. In Faridpur, the earthworks were carried out manually during the dry months (March-April). Sand blowing was a big problem during the construction period. The local people and the implementing officials informed that about 70 cm of filled soils were blown up even after the construction. The people at nearby houses could not stay at their homes. The implementing NGO had to water the surface to reduce the hazard. In Lalmonirhat, on the contrary, the earthworks were carried out mechanically using a dredger during the rainy months (May-June). There was a shortage of laborers in the area at that time and the wage rate was high. Due to the use of mechanized technology, the construction was completed in a month. Very wet but sandy soil was poured for raising the shelter ground. Adequate moisture content along with mechanized earth filling favored compaction. There was no sand blowing in Lalmonirhat shelter and the surface was found to be in good condition even after the flood. The authority was planning for surface turfing to avoid any future damage. So the optimum moisture content and the mechanized construction method can be useful in constructing

shelters under sandy soil condition. Local people also informed that soils of finer texture were available in the area but the carrying cost would have increased.

Since in char areas soils are not always favorable for shelter construction, some other materials such as cow-dung, saw dust and cement can be mixed with the prevailing sand. The cohesion among the soil ingredients will increase due to this treatment and their capacity against the erosive rainfall runoff and wave action will increase. At least a layer of favorable soil on top and sides of each shelter is required.

4.6 Technical Feasibility

Schools-cum-shelters on stilts are the most expensive shelters. On high risk areas, such as new chars and erosion prone areas, they will not be technically feasible. The morphological behavior of alluvial rivers is very dynamic and erratic. Local people during the field visits at all sites informed that the rivers were shifting and river bank erosion was prevalent in all the rivers. The case study on erosion of the Jamuna River at Sirajganj (given later in this chapter) demonstrates the risk of large investment in such areas and the need for an erosion prediction tool in shelter planning and construction (for erosion prediction see for example, CEGIS (2010)). Ground erosion due to high currents may also render the shelters unsuitable to use during the flood time. The poor operation and maintenance can further aggravate the situation. This is evident from the case study on operation and maintenance of the Saadipur school-cum-flood shelter given at the end of this chapter. This case study is a live example of non-use or poor use of constructed facilities due to lack of proper repair and maintenance and dysfunctioning of public institutions. It demonstrates that there should be adequate budgetary allocation and operation and management mechanism in place for each flood shelter.

Raised community shelters in high hazard areas may further be subject to wave erosion and rain cuts. Geo-bags were seen to use to protect such shelters from wave erosion (Photo 4.2). Rain cuts were seen in most of the community shelters. Lack of provisioning of appropriate slopes and gutters, adequate compaction, turfing, soil moisture and construction process could have led to the rain cuts.

Raised homesteads could however be feasible in high risk areas due to their good maintenance. In medium risk areas, both homestead raising and community shelters could be feasible given the moderate chance of river erosion. In matured and stable chars and in main lands within embankments, where the probability of river erosion is low, any type of shelters would be technically feasible.

Photo 4.2: Use of geo-bags in protection against wave erosion

4.7 Capacity of Shelters

Catchment area delineation and potential user identification are very important in planning and designing of a community shelter and a school-cum-shelter. Access to shelters, either by road or by boat, is also important for their proper use in the event of a flood. People come to the shelters only at the last moment when they have no other choice. They are reluctant to leave their belonging back home. In community shelters, people can move with their domestic animals and they make makeshift houses with polythene. There are only toilet and tubewell facilities in such shelters. The sizes of those shelters are large and potential accommodation capacities are high; about 200-250 families can be accommodated and even more if needed. The accommodation capacity of a four-room school shelter is lower than the community shelter. About 100-150 families can take shelter in a school. However, men and women can easily be segregated in different rooms. The advantage of raised homesteads is that the neighbors can take shelter. It was seen in Char Dawabari in Lalmonirhat during the field visit.

The accommodation capacity of a shelter is also related with the duration of the flood. In areas where flood is of short duration, such as Lalmonirhat, more people can be accommodated compared to an area where flood duration is long, such as Faridpur.

4.8 Basic Facilities

Basic facilities such as water, sanitation, hygiene, health, etc. are required in a shelter during a flood. These facilities could be better provided in school-cum-shelters and community shelters as more people could be attended to in a particular place. Ensuring basic services remains a challenge for individual homestead raising.

Tubewells were usually installed in community and school shelters to supply safe water. The tubewells were not operational due to poor maintenance, theft and submergence, and the number of available tubewells was not adequate in most school shelters. People in some cases had to carry water from other tubewells. In the absence of power supply, the people had to carry water upstairs. The current practice is to design school-cum-shelters by giving school environment a priority. The scale of the problem was (would be) lower in case of community shelters as there were (would be) more tubewells and there was (would be) no multi-storey building. Most raised homesteads had tubewells above flood level.

In terms of sanitation facilities, the community shelters ranked the highest, followed by school-cum-shelters and individual homesteads. Hygiene and health was a concern in community and school shelters as many people lived in one place. There was a chance of spreading communicable diseases. However, health services could be provided more easily in those places than at individual homes. Special facilities, such as change rooms, were needed for adolescent girls and women. At one community shelter in Faridpur, ramps were provided for disabled people. However, there was a concern about its usefulness during the flood time and given that there were different types of disabilities and wheel chairs were not usually used by the disabled people. Children, aged and disabled people can be better attended and looked after in a community shelter.

4.9 Environmental Impact

A large piece of land is required to construct a community shelter. Loss of land is therefore a major environmental impact in case of community shelter. However, there is considerable scope for multipurpose uses of a community property. Among the uses that have been observed are market, *eidgah*, playground, recreational spot etc.

The land is either *khas* land or donated by some community members. The shelter implementing agencies have no fund allocated to purchase land. The availability of a large area of land is a constraint towards implementing a community shelter. Since there is no permanent house on a community shelter, people are exposed to the open. Tents and CI sheets are sometimes arranged by the NGOs for the them.

The availability of suitable soils is also a constraint and sandy soils blow during the dry months until the growth of vegetation. Such sand blowing causes major inconvenience for the local population. Management of sandy soil during construction by watering the soil continuously is a major challenge.

The pits dug for burrowing soils become useless in case of individual homestead raising. The water quality degrades and becomes breeding ground for pests. Fish cultivation may be encouraged in the ponds. The raising also increases the vulnerability of the houses to wind hazard.

Water supply and sanitation is a major problem in case of school-cum-flood shelters. Sanitation facilities are inadequate. Drinking water cannot be pumped upstairs due to lack of electricity during flood. This makes maintaining basic hygienic practices extremely difficult especially for women. A solar powered water pump can be arranged for each school-cum-shelter.

Case Study 1

A flood shelter threatened by river erosion:
The need for erosion forecasting

Gunapara Flood Shelter

Village: Gunapara
Union: Kalia Horipur
Upazila: Sirajganj Sadar
District: Sirajganj

Year of Construction: 2008
Total area: 38 decimal
Capacity: 40 families (comfortably) with livestock
Implemented by: LGED, Sirajganj
Financed by: USAID and GoB

Gunapara flood shelter was considered a safe haven for the people of the village during flood. At the time of construction, according to the village dwellers, the Jamuna was some 2 km away from the shelter site, it is now just around 30 m and awaits unavoidable destruction. After the construction, the management and maintenance of the shelter was vested on the Union Disaster Management Committee (UDMC). Considering the posing threat of river erosion, UDMC now contemplates on dismantling the structure and shifting it to another place to continue its use.

After the completion of construction, the shelter has been once used for a couple of days as a refuge for a group of people who were the victims to river erosion. During normal time it has been used as a place for some income generating activities (*karchupi*) for the under-privileged group of the community and a place for holding meeting for various community level committees. This is very unfortunate that the shelter meets its end before it has not even been once used for the purpose it was supposed to serve.

Case Study 2

Operation and maintenance of a school-cum-flood shelter in Faridpur

Saadipur High School Flood Shelter (Photo 4.3), located in Aliabad Union of Faridpur Sadar Upazilla, was constructed in 2005 by the Department of Relief and Rehabilitation, Ministry of Food and Disaster Management. The shelter was constructed at a cost of Taka 5.5 million funded by USAID. The selection of the location was dominated by the political consideration. The study team visited the shelter on 7 July, 2010 and talked to the school teachers, shelter users and the students. The school-cum-shelter is a two-storey building constructed on stilts. In each floor, there are two rooms, two bath rooms with four latrines. Sandy soil was used to fill in the space below the grade beam. There was no problem of availability of construction materials. The construction of the shelter took about six months. The quality of the construction was good. However, there is no access road to the shelter and the existing school compound is at lower elevation and regularly flooded. Sand bags and bamboo pool were used to go to the school during flood times. The school authority and students informed that the school remained closed for a period of two weeks in each year due to the inundation of the school ground. The students also suffered from skin diseases due to the contact with flood water and wet and muddy soil.

The shelter is located outside a flood embankment constructed in 2008. The Padma River was far (about 15 km) away from the shelter during its time of construction, but now a new channel is flowing very nearby (about 200 m away). The school was used as a shelter by about 100 people in 2007, when there was a large flood in the area. People came to the shelter with their livestock, poultry, etc. The school teachers and the local member of the union council oversaw the operation and management of the shelter during the flood period. One side with one room and one bathroom in each floor was allocated to the female and the other to the male. There was no incidence of major damages to school properties by the shelter users.

In the year 2007 there was a large flood. The depth of water was about 3 feet on a nearby road and more than this height on the school ground (Photo 4.4). Floods occurred twice in the year and the duration was about 15-20 days in each period. The school had to remain closed during that period. The hand tubewell was inundated during the flood. There was an overhead water reservoir, but it could not be used as there was no power supply. People had to carry water from another tubewell. The velocity of the flood water was very high. The soil under the grade beam was completely eroded (Photo 4.5). The water supply and sewerage lines, which were made of plastic pipes, were broken by the flood waves (Photo 4.6).

People were scared to stay in the shelter and they thought that the building would collapse. Ultimately, they had to be evacuated.

It has been about three years since the 2007 flood, but the wreckages of the flood are still evident as no repair work was done. The school authority repeatedly informed the Deputy Commissioner, Upazilla Nirbahi Officer and Upazilla Education Officer about the situation and requested for allocation of fund to carry out the repair works. However, nothing has happened so far.

Photo 4.3: Two-storey Saadipur school flood shelter

Photo 4.4: The flood mark of 2007

Photo 4.5: Erosion of basement soil by the 2007 flood

Photo 4.6: Pipes damaged by the 2007 flood

CHAPTER 5
Socio-Economic and Cultural Analysis

5.1 Accessibility

In terms of physical accessibility, community shelters in *chars*, irrespective of their locations, have been found having almost the same level of difficulties. The shelters visited in Faridpur, Sirajganj and Lalmoirhat have been found sufficiently raised; but except for the one in Lalmonirhat (Hatibandha), others did not have any designated access routes. It is well understood that since the houses in *chars* are constructed in a disperse manner, it is not feasible to ensure access from all targeted households to the community shelters. Even when the provision of a designated access from a certain point can be ensured, without regular maintenance they might be rendered unusable.

Photo 5.1: Access path to the community shelter cum school in Hatibandha

The difficulties of physical accessibility associated with community shelters in *chars* can be reduced to an acceptable level by the provision of boats as part of the shelter management activities. In Faridpur and Sirajganj it has been observed that boats are quite available for transporting people and their belongings; but in Lalmonirhat the situation was a bit different. Very few boats were found available for transportation and the fare seemed pretty high for those underprivileged people; this came out from the statements of some flood affected families who failed to move their physical assets, mostly CI sheets and bamboo thatch, to a safe place because there were no boats available at the time of emergency. The unavailability of boats in the *chars* of the river *Teesta* can be attributed to the nature of flood (flash flood). Unlike Faridpur and Sirajganj where flood occurs for relatively longer period of time, boats are not a part and parcel of the daily life of the people living in *chars* of the Teesta.

From the accessibility perspective and assuming that RCC structures (referring to the 'school-cum-shelter' type) are not usually constructed in *chars*, the individual homestead raising can be regarded as the best available option.

Photo 5.2: Saadipur High School cum Flood Shelter, Sadarpur, Faridpur.
There is no designated access path to the shelter

Accessibility is not an issue to be dealt with only for shelters in *chars*; rather shelters constructed on the mainland might fail to serve its purpose because of lack of discretion regarding accessibility. The school-cum-shelter in Sadarpur, Faridpur, though apparently a sound structure, did not have a well-designated access path which needs be constructed above the highest flood level. People from the catchment of the shelter complained of the sufferings they undergo during flood in order to get to the shelter because there is no raised access path to it.

5.2 Land Availability

While consulting the community, the research team came across several people who had to shift their houses more than 10 times in their life so far. This indicates the unstable nature of *chars* which poses a threat to individual homestead and community shelter equally. From this point neither individual homestead raising nor community shelter can be considered as a permanent solution. But, since the whole char population cannot be shifted to shelters on mainland during flood, either of the options or a combination of both has to be chosen keeping in mind the nature and type of assistance that the community would require during flood.

Finding land for individual homestead raising is not an issue; but in case of a community shelter where a good number of people can seek shelter, this might be difficult. An individual land owner might be willing to give off a piece of land for community welfare, but not as much land as is required. Yet, land for community shelters is made available through some formal arrangement between the land owner, the community and the implementing agencies.

From the land availability point of view, school-cum-shelter seems to be the most suitable one. School compounds have been reported as the first place where flood victims seek shelter. School management committees and the teachers have accepted this practice well and consider it as part of their social responsibilities to

provide shelter to the people. Moreover, school-cum-shelter is a good option in terms of ensuring optimum effective normal time use to the most.

While school-cum-shelter can be regarded as the best available option from land availability perspective, it has to be noted that there are not as many schools in *chars* as necessary to ensure refuge to all shelter seekers. Furthermore, the unstable nature of *chars* might require proper justification of investing on schools in *chars*.

5.3 Future operation and maintenance

Raised individual homesteads, as observed in the districts of Faridpur, Sirajganj and Lalmonirhat, act as individual family flood shelters. This type has direct ownership and hence the maintenance is easy and simple. The raised plinth of homestead requires regular maintenance after flood which can be easily done by the family.

As stated earlier, from the multipurpose use perspective, school-cum-shelter is a more preferred option and management is easier as compared to the other two types. As schools have year round activities, the maintenance is intrinsically done. But one problem as identified during the field visits is the unavailability or insufficiency of fund for maintenance operations.

Photo 5.3: Improperly stabilized earthen plinth of Saadipur High School (above). Sewer lines get exposed after the flood (below).

The school in Saadipur, Faridpur was structurally sound when the construction was completed; but the damage that it incurred during the first flood it encountered has not been overcome yet. As the earthen plinth of the structure was not properly stabilized, flood water washed it away rendering the building 'unsafe' in the

perception of the people. The toilets of the building remain unused as the sewerage lines got exposed and subsequently damaged. The building keeps the provision of an overhand water tank, but no means to pump water up there. Once these issues are adequately addressed and provision of maintenance fund is ensured, school-cum-shelter could be considered as a more sustainable solution.

5.4 Protection of lives and livelihoods

There are not sufficient flood shelters to accommodate the entire flood affected population of the country. Perhaps it is not practical or necessary when the concern is saving lives. During flood, the majority of the affected people find their way to nearby embankments or the national highway which is raised well above the highest flood level. The reported number of deaths that can be directly attributed to flood is not significant compared to deaths occurring in the aftermaths. Most of the deaths relating to flood actually takes place after the flood when the sources of potable water are all contaminated and when there is an acute crisis of water and food. This is necessary for discussion because just keeping provision of shelters during flood is not sufficient to save lives. Ensuring food and safe water when flood water starts receding and the flood affected people start leaving the make-shift shelters for their homes, can contribute more in this regard.

Photo 5.4: Temporary shelter on embankment cum road turned into permanent homes.

When structural viability is an indicator of safety against floods, the conventional school-cum-shelter can be regarded as the best option. However, such safe structures might not be found within convenient distances for all flood victims. Community shelters are preferable. Another reason identified in favour of these types of shelters is that the affected people can take along their livestock and other physical assets to these places.

The main income generating activity of *char* dwellers is agriculture and cattle-rearing. In the *chars* of Faridpur, Sirajganj and Lalmonirhat, quite a good number of families have been found whose main living is cattle-rearing. For those families cattle are the only asset they have and saving these cattle is as important to them as saving their own lives. Though school-cum-shelters and community shelters have enough space to accommodate cattle, sometimes households fail to get there before it's too late. When the water level has risen significantly people might not consider it safe to transport their cattle to safe places as there have been reported cases of livestock losses from drowning. To avoid such loss, people rather prefer staying in their submerged house along with their livestock and undergo inhuman sufferings.

Photo 5.5: Raised homestead in Hatibandha with provision of space for homestead gardening and livestock.

For raised homesteads, when the plinth is extended beyond the house structure, it helps to keep the livestock safe and also allows space for homestead gardening which secures food safety during flood to a considerable scale. Nevertheless, an individual raised homestead extends its benefits to the neighbours whose homesteads are not sufficiently raised. The neighbours are allowed to keep their livestock and other physical assets safely at a nearby home which has a raised plinth above the flood level and can even seek shelter for the family temporarily until they find another suitable place to move to.

For flash flood prone areas like Hatibandha, warning cannot be issued well ahead of the event and individual homestead raising is the only preferred solution. People reported that sometimes flood occurs in the middle of the night when all are asleep and they hardly get time to move to any nearby community shelters. It gets further difficult since boats are not readily available for transportation.

Raised homesteads have certain limitations from the point protection of livestock. *Char* dwellers reported abduction of their cattle by dacoits/miscreants even in broad daylight. Usually they come in engine-boats and take away the cattle. Most of the time the household members have little to do to resist them. Flood facilitates the quick movement of the thieves and no help is available from neighbours because of the inundation.

Depending on the area of the homestead, the cost of raising the plinth level ranges between Taka 10,000 to Taka 17,000 as observed in the three aforementioned districts. For community shelters the cost varies between Taka 250,000 (in Hatibandha, Lalmonirhat) to Taka 21,00,000 (in Paikpara, Sirajganj) while a standard school-cum-shelter requires approximately Taka 30,00,000 (Singimari, Hatibandha). Taking the lowest figure the cost of sheltering a household comes to around Taka 10,000 in case of raised homestead, Taka 2,500 per household in case of community shelter and Taka 30,000 per household in case of school-cum-shelter.

From the cost effectiveness point of view it is very difficult to name one single type of shelter as most appropriate. Each of these types of shelters has some distinct advantages that cannot be replaced by others. Moreover, the perception of the notion 'effectiveness' might vary from community to community when it is tagged with 'direct-indirect', 'tangible-intangible' aspects. Still, community flood shelters can be considered as most cost-effective especially considering its potential for normal multi-purpose use.

5.5 Management during flood situation (Relief and response)

The difficulties in relief operations can be considered as a problem with the raised homestead type of flood shelter. People living on raised homestead expressed their concern that they are more likely to be left unattended by the relief delivery team. From this point of view, school-cum-shelter and community flood shelter is a more convenient option. In a community shelter a good number of people can be provided with relief assistance over a short period of time and ensuring provisions of some basic services (e.g. potable water, medical services etc.) would be more cost-effective.

5.6 Safety and security of women and children

People on raised homesteads are left marooned and are less likely to receive social support at the time of emergency. While interviewing a female headed household in Sirajganj, the household head expressed her interest to move to a community shelter though her homestead was sufficiently raised. The reasons she underscored included safety of her children. During flood the risk of death of children from drowning is very high. When the adults of a household are more likely to remain busy securing the safety of their belongings and ensuring food for the family, it becomes difficult on their part to look after the children round the clock. But at the community shelter or school-cum-shelter it is not difficult to find someone to look after the children. Even in community shelter children from all the households that took shelter in it might engage themselves in playing games provided that there exist

such provisions. Thus the safety and security of children can be better assured in a community shelter or a school-cum-shelter than in individually raised homesteads.

Safety of women and adolescent girls in terms of harassment/assault is considered as a matter of grave concern. Literature extensively suggests that in communal shelters they are rendered vulnerable to abuse by men. Interestingly at the time of consultation they did not seem to be much concerned about it although they regarded raised homesteads as a more preferred option.

5.7 Willingness and priority of potential users

After consultation with the flood affected people in Faridpur, Sirajganj and Lalmonirhat, it is evident that they prefer raised homestead to the other two options. This is because raised homesteads save both their lives and their belongings. Sometimes it is difficult to shift all their belongings and they might not be allowed to move to a communal shelter with all their belongings; this was the case in Hatibandha. In a discussion with a UP member who is also a member of the Union Disaster Management Committee, it was revealed that the shelter management committee did not encourage people to come to the *killa* with their dismantled house fearing that they might not want to leave when flood is over.

For floods of unprecedented severity and of prolonged periods, the limitations with raised homesteads become evident. This includes the chances of running out of household savings, the fear of failing to avail relief assistance and living without communal supports. Hence, communal shelters cannot be ruled out from the preferences of the community.

Photo 5.6: Flood victims shifting their house in Hatibandha.

Flood in *char* areas is usually accompanied by soil erosion. The strong wave action during flood aggravates the erosion and the affected households sometimes have to think beyond a mere temporary refuge. In Hatibandha of Lalmonirhat district, it was more evident. Some people were carrying the dismantled parts of their house and searching for a place to settle for the coming days though a raised earthen plinth

(*killa*) for community shelter cum school stands unused nearby. This is also attributable to the fact that the region is flash flood-prone and floods usually do not prolong over many days as is the case in Faridpur and Sirajganj.

5.8 Disruption of education in schools

The issue of disruption of academic activities of schools because of turning them into shelters is perceived as a matter of grave concern. The reality is, during flood time the schools are rendered unable to continue their regular activities as the students and the teachers might have been the victims of the flood. School authorities reported that in order to compensate for the flood affected working days, the common practice is to cut off the designated vacation and arrange extra classes for students. This has been widely accepted in all the areas visited. Except the case of extraordinary floods that stay over a month, as it was in the years 1988 and 1998, the number of days for which schools are turned into shelters is not too many to adjust with the designated vacation for the schools.

Case Study 3

Eidgah at Paikpara,
Kalia Haripur, Sirajganj

The *eidgah* at Paikpara, 9 no Kalia Haripur Ward of Sirajgangj thana, Sirajganj district is a raised land prepared by earth filling to be used as a flood shelter. It is beside the Paikpara- Kazipur road which also acts as a *beribandh* to protect the area that has extensions of river channels inside the locality. It has been a practice of the inhabitants to take shelter on this road during floods. The usual land form is low with agricultural and habitation lands. The raised *eidgah* was constructed after the 2007 flood as a project under Local Government Engineering Department and funded by World Food Program. It is estimated that it can accommodate 150 -200 families.

Previously the *eidgah* was a low land and used to get submerged with the surrounding area in the monsoon when the water rose. Its only function was for Eid prayers. But after earth raising it has become a significant site and the use has been extensively increased. Children find this as an excellent play ground, it is dry, breezy, among open surroundings, and communication is easy for the road. Play grounds are recently becoming scarce in communities like this as most of the lands grow two or three crops annually and the limited fallow lands are used for grazing. The inhabitants also use this for evening sitting. Recently it is also been used as cow market before Eid.

Accessibility is good as this is just beside the road and this connects with the Jamuna Multipurpose Bridge Highway. But not all the homesteads in the locality have connectivity with the road. Availability of land was easy as it already had community use. It is maintained by the Union Disaster Management Community. It may be assumed that safe disposal of flood water will be possible for the water channels. Jackfruit saplings have been planted at the boundaries but plant selection could be more sensible. Suitable landscaping may increase the quality of multipurpose community places like this that act as landmarks. The slopes may be stabilized with stepped *ghat* and other sitting places. Different earth constructions by soil compaction, soil retention by grass and other plants can also enhance the functional and aesthetic qualities.

CHAPTER 6
Design Principles and Model Shelter Designs

6.1 General guidelines

Through observations in the field relating to the design construction and use of the flood shelters and the dynamics of movement of people during floods it is possible to identify some general patterns that may be considered in the future planning and design of such shelters. In order to actually work out detail designs for the same a much more in depth analysis is required.

There are some general guidelines that are applicable for all types of flood shelters irrespective of type and location. They are:

- Network of roads/routes that are usable during floods is needed between the homesteads in a settlement, between school or the community flood shelter and the community. The emphasis here is on connectivity which may not necessarily be roads but means that allow people and goods to move.
- The above is particularly true for char areas where the settlements are dispersed and people need regular communication for collecting tube well water, going to school etc.
- For any shelter which is on raised ground it is important for the mound to be stable. The mound or in some cases the plinth, has to be well rammed and may also be stabilized using a 5% cement mix.
- The slope of the raised land should be gentle to avoid erosion. A maximum of 45° to the ground is recommended. Steeper slopes may be used but need to be stabilized with plantation or if affordable geotextiles.
- Bamboo can be planted on the slopes for soil retention. This is also a good source of building material.
- Banana plants can also be used to prevent soil erosion. This is a source of fruit and for making rafts during floods.
- Large trees need to be planted around a shelter for protection against strong wind. These may be planted in zigzag pattern for more effectiveness.
- Shelters should importantly consider livestock and animals. Protection of livestock and animals is an important issue not only for keeping them safe but also livelihood retention in the post flood scenario. Spaces or raised open ground for them need to be provided.
- Gender issues are cross cutting across all types of shelter from homesteads to community type. Sensitivity to female privacy is important through allowing spaces that are visually segregated.

6.2 Homestead raising

With regard to situations where a homestead performs the role of a flood shelter the primary objective is to raise the homestead above flood level, which is usually achieved by placing the living quarters on raised ground. Design considerations are related to the raising issue and to factors relating to construction.

- Usually homesteads are raised by collecting soil from nearby land. Thus the created ditch can be used for fish cultivation, growing vegetables like amaranth, eddoes.
- Water hyacinth planted on water in the lowlands can reduce the force of waves during flood.
- Vegetables grown on *macha* (raised platform) and rooftops should be encouraged as source of food that grow above the water during floods.
- Trees planted should not be overly shady, they should allow the courtyard to have enough sun necessary for agricultural and domestic chores, particularly during floods.
- Cowshed can be made on raised platforms with storage space for fodder, fertilizer, firewood etc.
- Buildings should be easy to construct and dismantle so that they or parts of them can easily be relocated to higher ground if necessary. Materials should be lightweight for easy movement. It is preferable for the roof to be of CI sheet as this is more durable and easy to move and can also be used as a walling material.
- The construction vernaculars including materials, layout and techniques of a region should be taken into due consideration. Nevertheless new approaches can be adopted to reduce flood damage. For example, use of CI sheet up to sill level in the walls, RCC columns as vertical frames, RCC footings for bamboo columns, brick periphery walls around plinth, mixing of cement with mud for stabilization.
- Walls with local natural materials like different kinds of grass can have more thermal and ventilation comfort, although they will need frequent maintenance.
- Platforms (*macha*) over the head height can be used for storage space for valuables.
- Finally the development of a settlement plan for the homesteads, cultivable lands, evacuation shelters having road network with the major connecting routes as a comprehensive approach to make homesteads work as flood shelters.

6.3 School cum flood shelter

Schools need some special design considerations like student number, sitting arrangements and required daylight. Moreover government organization like the Education Engineering Department is assigned to design and construct schools. Though these are used as shelters, the main concerns is delivering and receiving education. Some interventions that may be implemented to ensure their adequacy as flood shelters during emergencies are:

- Selecting land as site that has natural protection like inside the embankment, beside road or railway that is above flood level, higher topography, away from water channel.
- Raising the plinth of the site considering the inundation and the surrounding topography.
- Detailed site preparation including brick periphery retention walls around the site.
- Appropriate plantations.
- The open ground floor space, if any, can be used as class rooms partitioning it with bamboo mats.
- Running water provision for drinking water. If tube wells have to be used, the base should be above flood level.
- Toilets with running water provision. Solar power may be used for electricity.
- Toilets at ground floor in case the ground floor is used as shelter.
- Gender sensitive toilets. Disabled friendly facilities.
- The informal schools targeted for the hard to reach children may be used as shelters and for education during emergency.
- It is important to consider schooling options during floods. As such a lot of school hours are lost during long term floods, that can not be made up using vacation time. School come shelters should be designed to allow smooth continuation of classes during floods. This is related to the first point of the general guidelines which suggests accessibility to the school for children not taking shelter in them.
- Remote areas may need assistance to facilitate education in emergency situation where schooling becomes difficult during disasters. Small structures initiated by CBOs, NGOs working there may be provided in those communities to continue schooling. These can be near or inside the community flood shelters. Designs may differ according to need, available human, material and financial resources, and behavior of flood.

6.4 Community flood shelter

Community flood shelters provide the opportunity to focus more on the flood aspect since that is the primary function of such a building. However if they are not the dismantleable type there should be consideration for normal time use.

- With reference to the first point of the general guidelines, accessibility is most important, such shelters should be in proximity of major access routes not only for access by flood victims but also for emergency services and relief material.
- The design of such shelters should follow a general scheme with options for variations due to locational and socio cultural features. Example of such a schematic diagram with a possible solution is provided in the next section.
- Sphere standards are established criteria for emergency situations and have the scope for application here.
- The livestock area needs to provided so that affected people may bring and keep their livestock and be assured of their safety. This may be located near the management office for better protection.
- Separate spaces may need to be provided for lactating mothers, elder persons and people with special needs.
- Spaces should be disabled friendly with features like railings, gentle slopes and low height steps where necessary.
- Gender sensitive toilets and bathing facilities should be provided.
- Toilets should be low maintenance i.e easy to wash and of low water consumption type. It may be possible to incorporate rainwater harvesting for cleaning (since the first five minutes of rain is not suitable for consumption , it could be used for cleaning)
- As mentioned in the consideration for School cum shelter, children in community shelters should be able to continue their education. This may be either through communication routes to the school or if not then the establishment of education areas in the shelter.

6.5 Conceptual notions

Apart from the design suggestions made in the previous sections, it is possible to conceptualize some design suggestions. Although some specific types have been mentioned in relation to these concepts, they may be applicable across all types,

Smaller scaled community flood shelters on stilts which may be dismantled after use

This practice is followed in some of the cases observed and can be rationalized in the design process of the shelters. Since shelter is taken on a high ground during floods which has to be vacated after them, it is possible to design structures using some

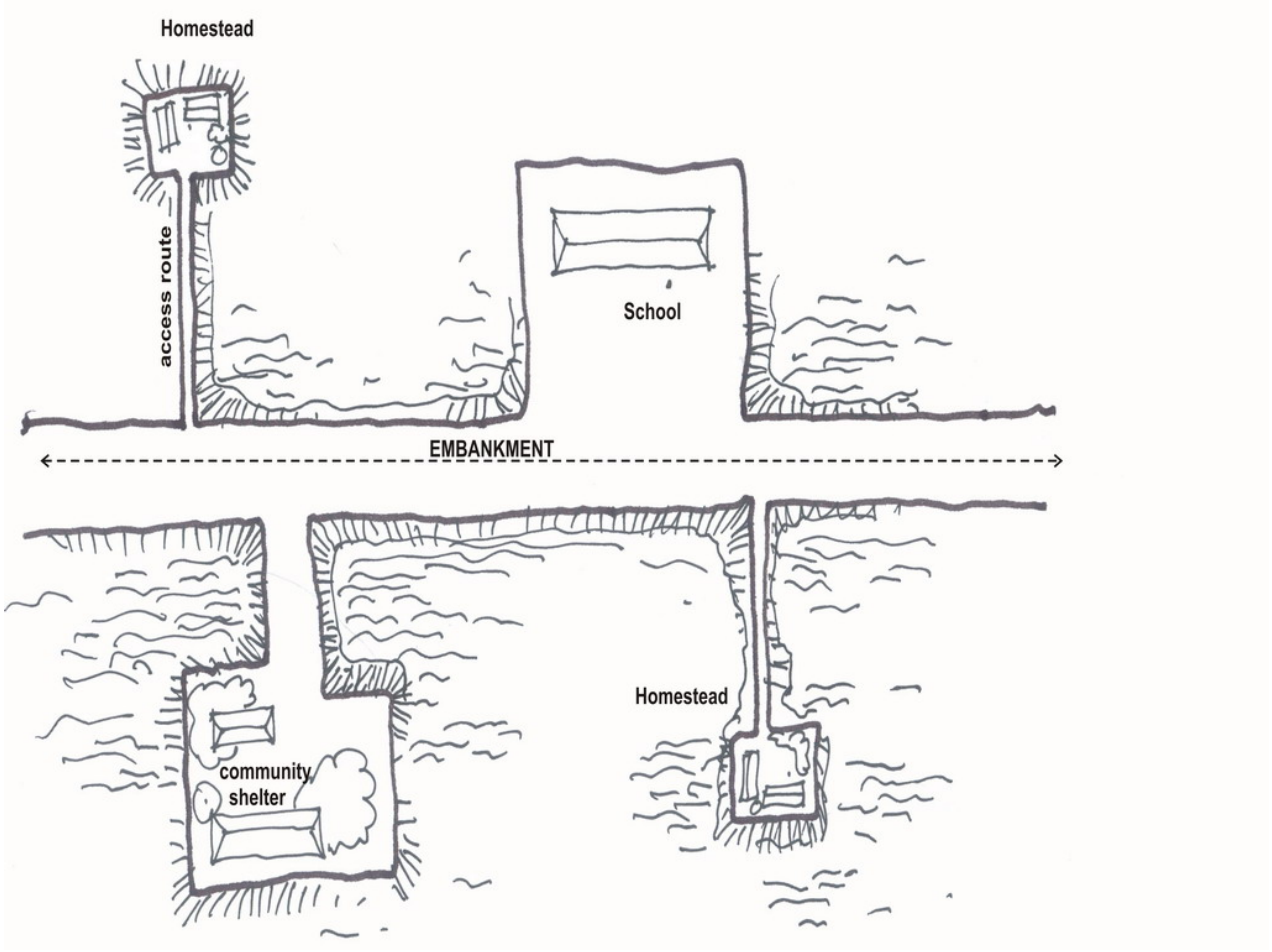
modular principles where the shelter can be assembled and dismantled quite easily. This particularly important in places that are susceptible to erosion.

Floating houses as flood shelters

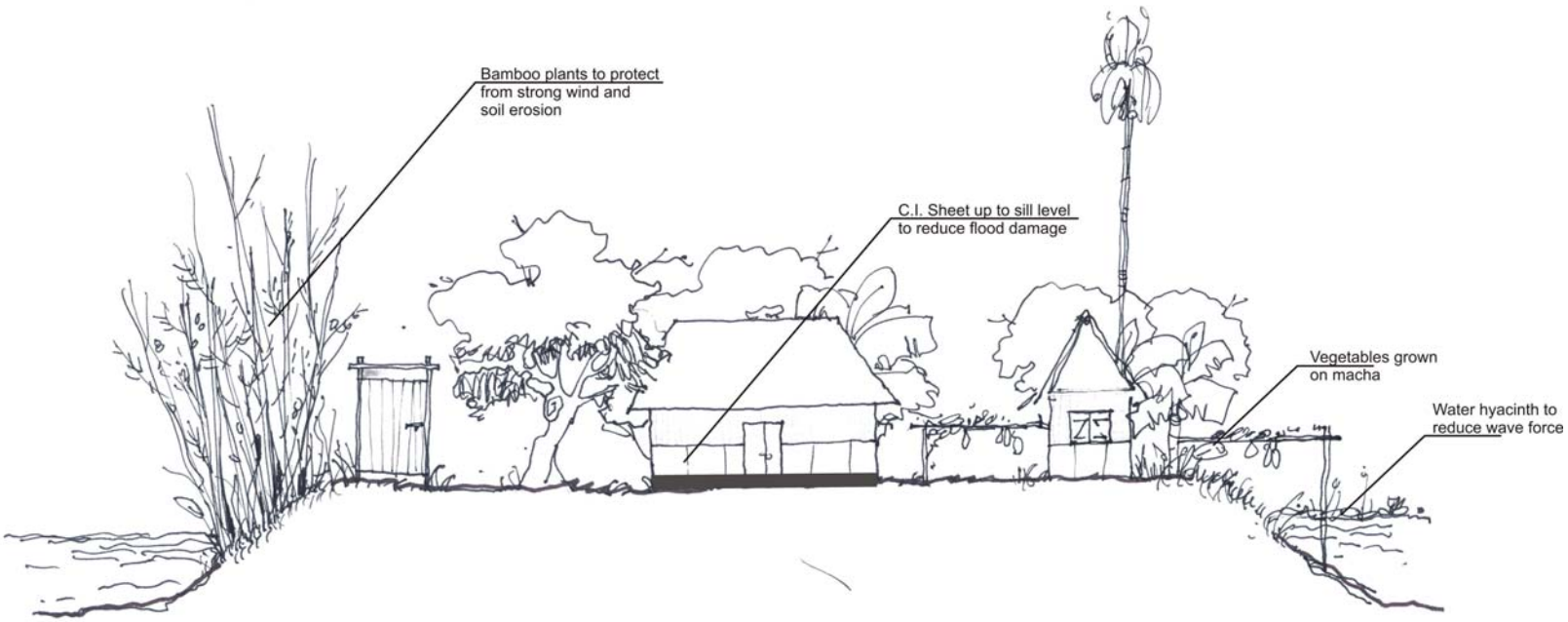
Floating houses are not an entirely uncommon practice. There are examples of such ideas in south-east Asia. It is possible to have structure on a base e.g. a pontoon which is anchored to the ground. During floods this will rise along with the water and remain anchored to the ground below. These will be of better advantage if placed along embankments.

Increase the potentiality of embankments as flood shelters

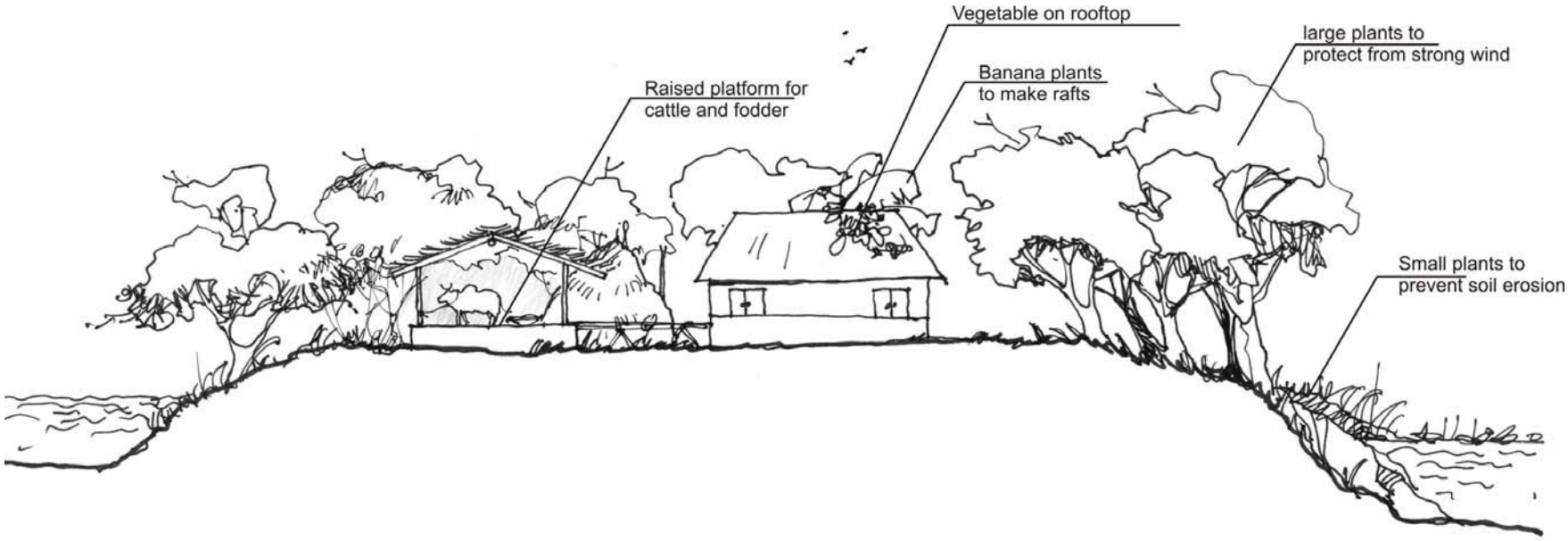
Since embankments are potential places for refuge during floods and are also routes for communication their role in flood management is important. Embankments may be designed in a manner so that they are easily accessible i.e they may be routed near settlements or houses. Or smaller raised access paths attached to them to reach communities who are far away from them. Furthermore embankments can be designed in a manner so at places they widen up to accommodate community shelters. They may remain just as plain raised open ground where temporary accommodation may be constructed during floods, or may be places for keeping cattle. During normal times they can be used in a variety of ways e.g. vegetable gardens, place for small shops etc.



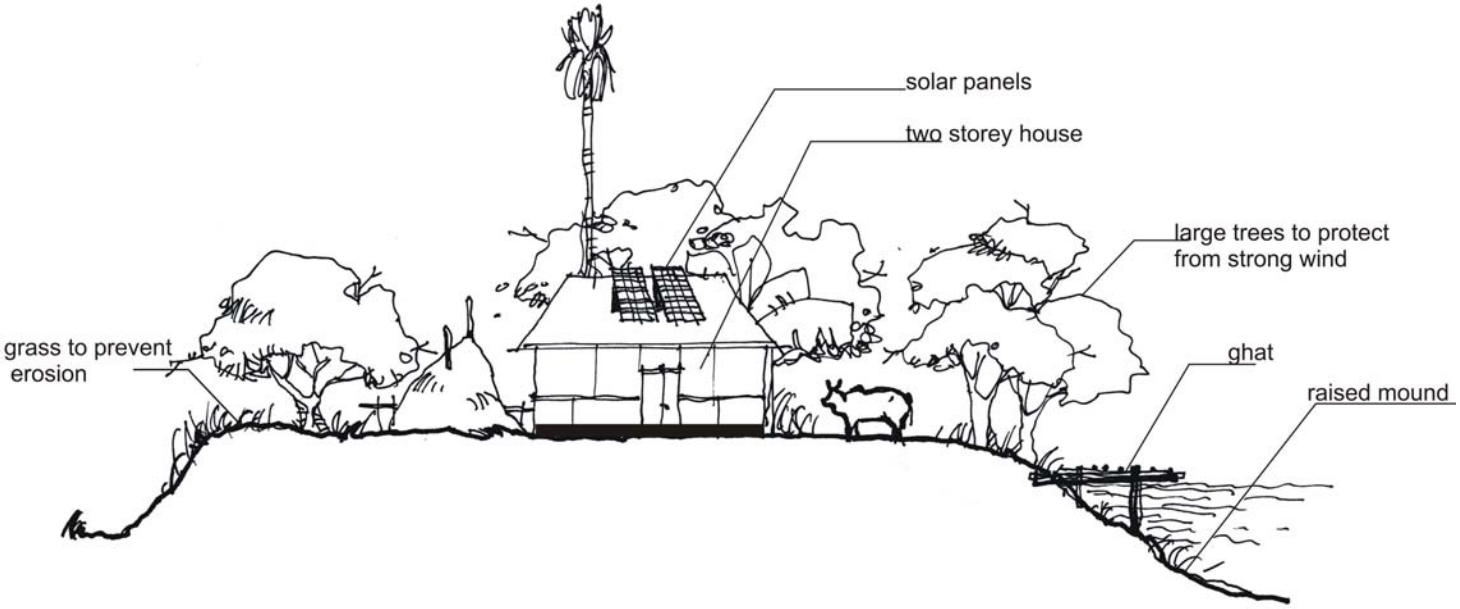
Sketch 6.1: Accessibility to Embankment



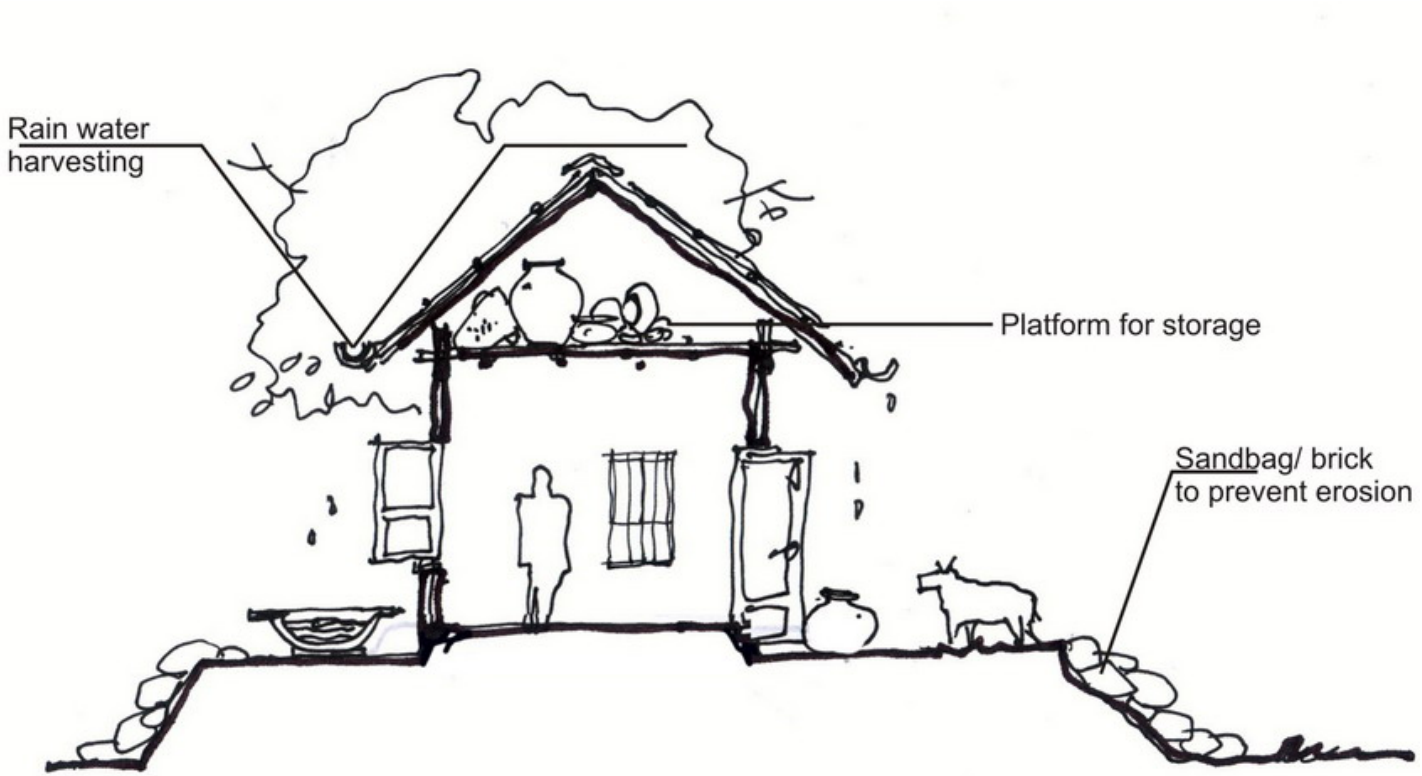
Sketch 6.2: Design Factors to be considered in Homestead Raising



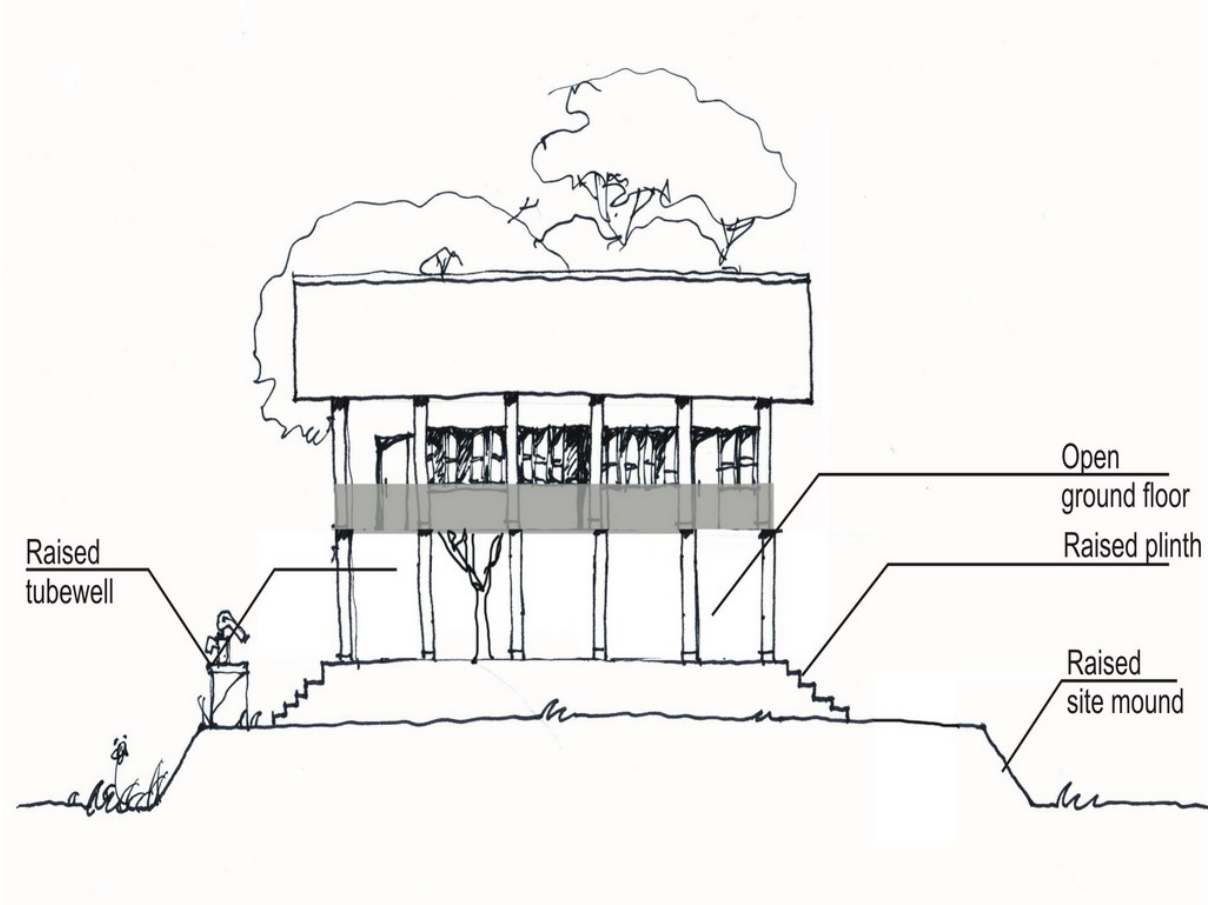
Sketch 6.3: Design Factors to be considered in Homestead Raising



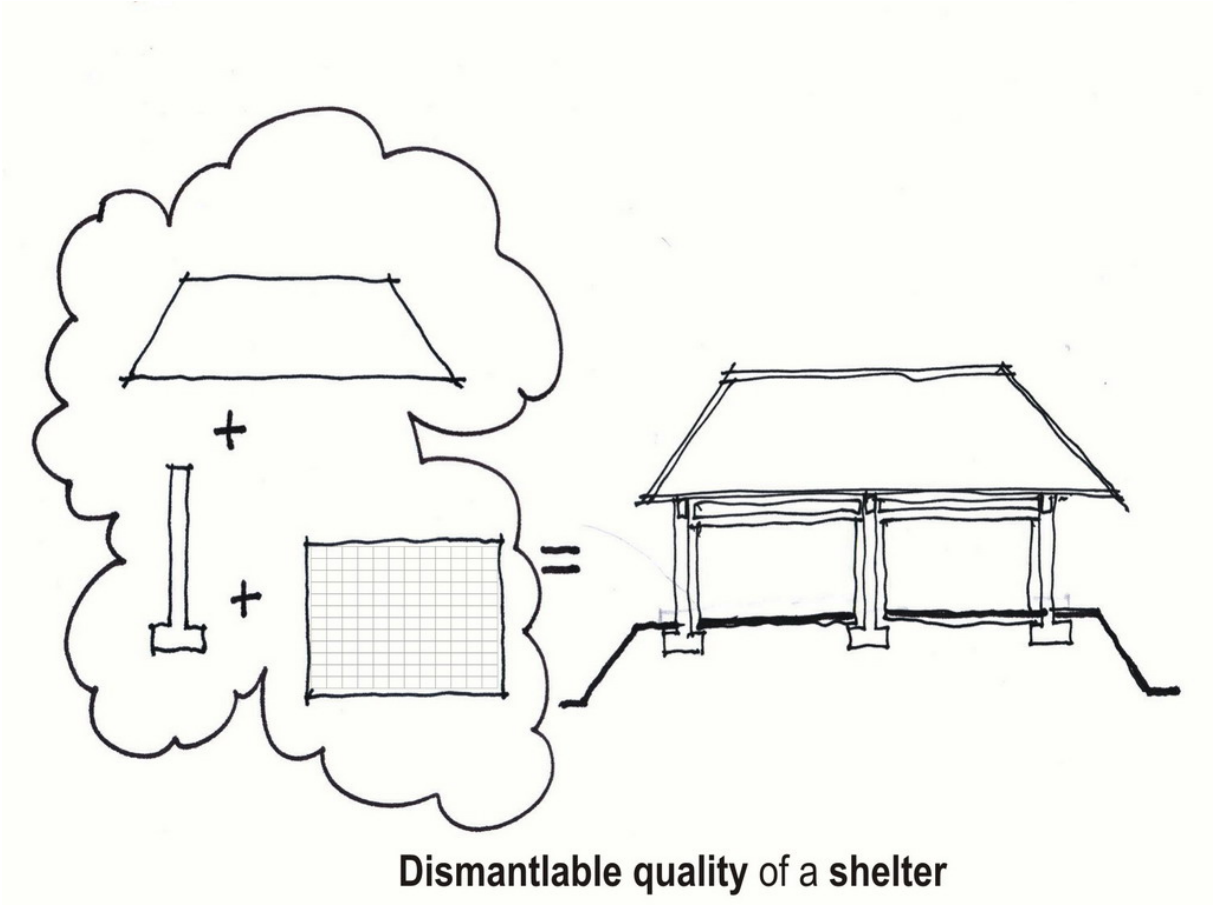
Sketch 6.4: Design Factors to be considered in Homestead Raising



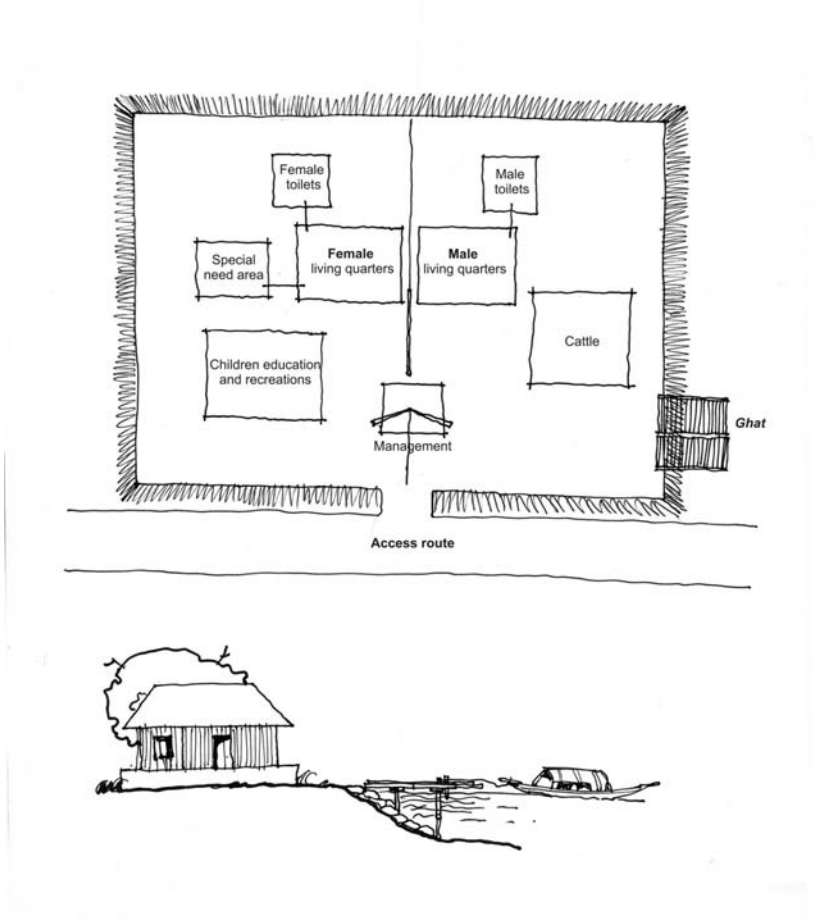
Sketch 6.5: Design Factors to be considered in House Construction



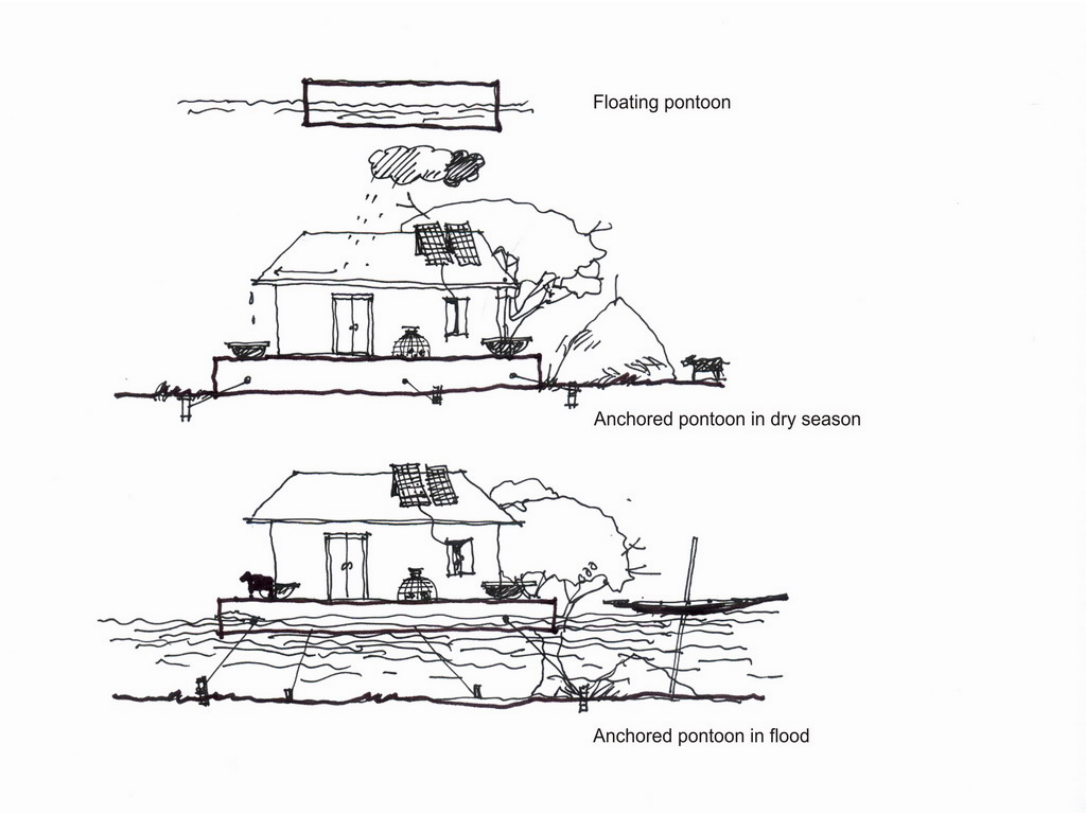
Sketch 6.6: Design Option to School cum Shelter



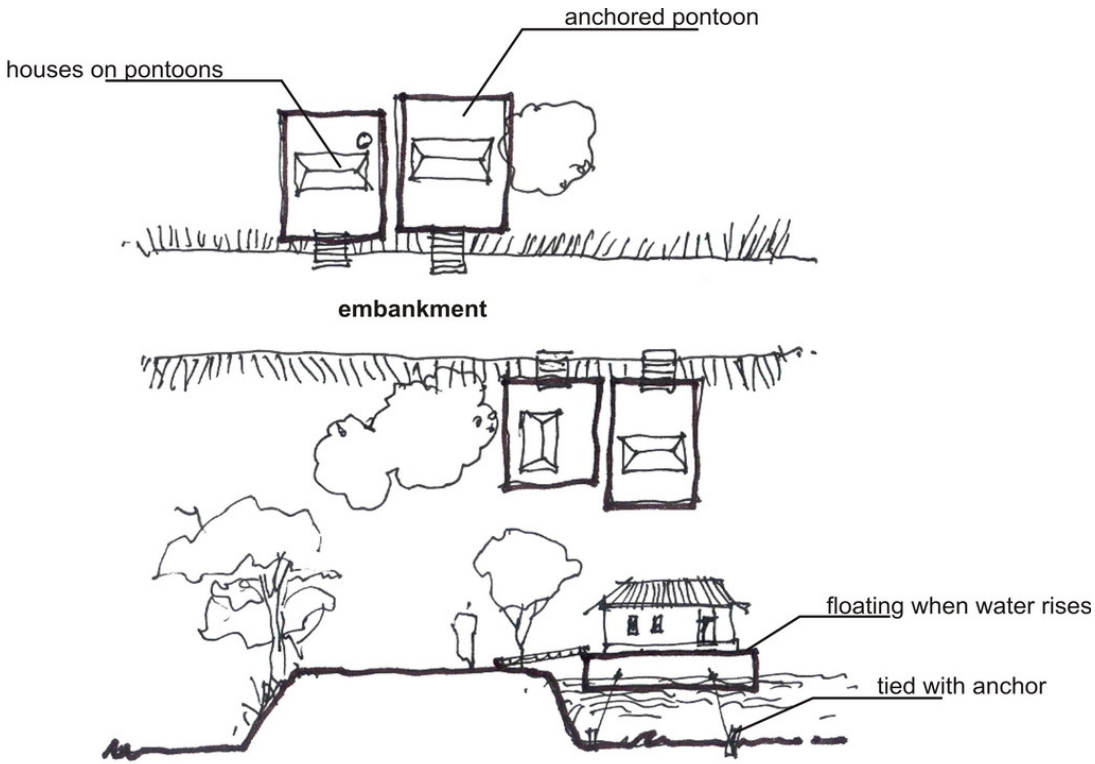
Sketch 6.7: Dismantlable Quality of a Shelter



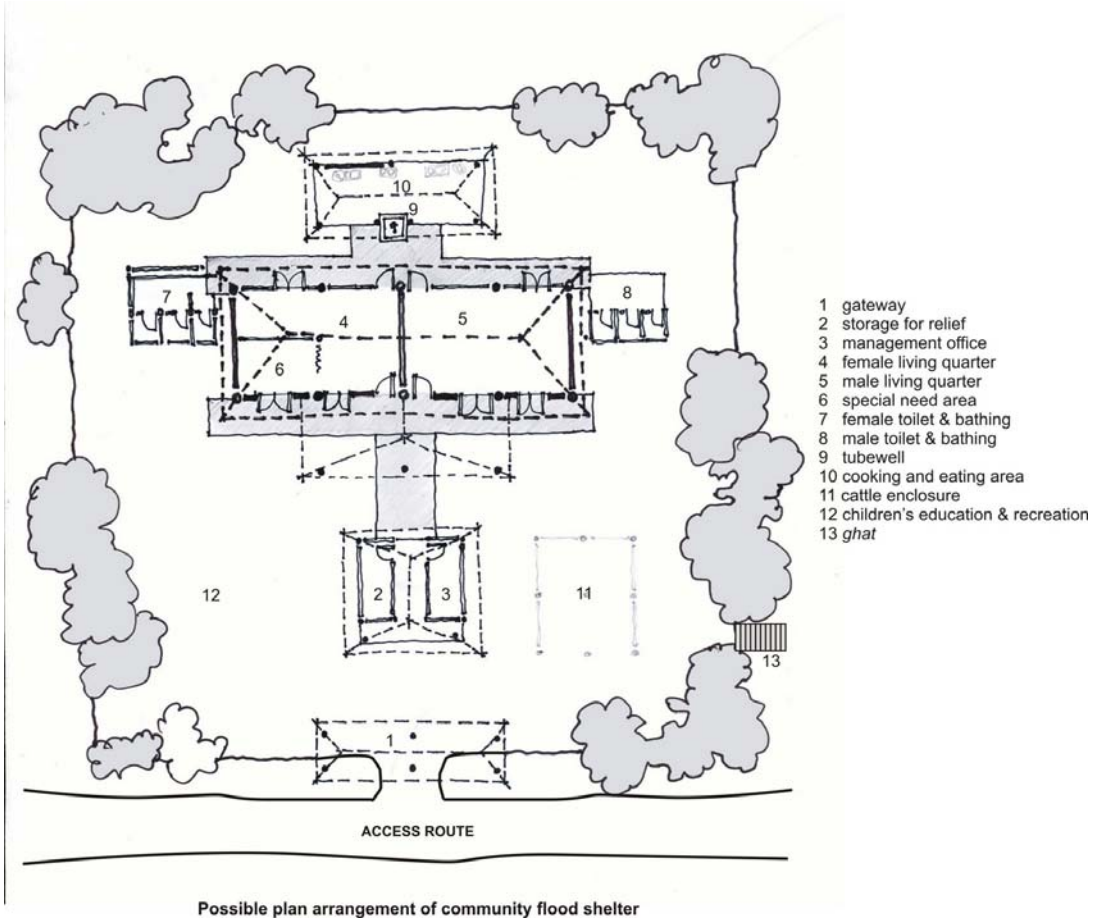
Sketch 6.8: Schematic Plan of a Community Flood Shelter



Sketch 6.9: conceptual Idea: Floating Homestead



Sketch 6.10: Conceptual Idea: Floating Shelter with Embankment



Sketch 6.11: Possible Plan Arrangement of Community Flood Shelter

CHAPTER 7
Flood Shelter Policy

Design flood level

The flood shelters are now built above highest flood level (HFL). Currently, HFL is determined mostly on the basis of local knowledge which may not be very accurate on two grounds. Firstly, in the char areas, where the average age of a char may be 8-10 years, the highest flood experienced by the char dwellers during this period may not be the HFL of the river on record. Secondly when only local knowledge is used for determination of design flood level, some errors are likely to occur which may be easily avoided by taking help of modern technology. Improved and readily available technology such as GPS can be employed to gain more accuracy. So a combination of local knowledge and modern technology can be adopted to determine design flood level.

Hazard mapping

In order to make the right choice about the type of flood shelter, a flood hazard mapping is necessary. Such flood hazard map should take into account not only the flood depth but also the erosion potential. During flood, the hazard due to erosion is equally threatening as hazard due to flood depth. Erosions are of two types. One is river bank erosion and another one is foundation erosion of structures during flood. Both are very serious in nature. Depending on the intensity of hazard, the hazard prone area can be divided into three zones – high risk zone, medium risk zone and low risk zone. Island chars can be classified as high risk zone. Attached chars and mainland outside embankment can be treated as medium risk zone and area inside embankment can be considered as low risk zone.

Choice of shelters

It is recommended that the choice of shelters in different risk zones be as follows. Homestead raising and community shelters should be the preferred option in high risk zone. Homestead raising, community shelters and easily dismantable schools on raised ground can be options in medium risk zone. School-cum-shelter on stilts can be the preferred option in low risk zone. Embankments with modified design, can be considered as another type of shelter for emergency use.

Climate change

Flood levels will increase under climate change scenario. Design flood levels should be adjusted for the expected higher level due to climate change. This is

recommended for school-cum-shelters which are long term interventions. In case of raised homesteads and community grounds which are rather short term interventions such adjustments are not required at this moment.

Safety and security

During a flood not only taking shelter, but ensuring safety and security of life and assets is a major concern of a household. A community wide voluntary group in the model of CPP can be developed in this regard. Such a group should be well equipped with various emergency equipments such as fast running boat, communication tools, first aid medicines etc.

Maintenance fund

Because of lack of maintenance funds, many shelters quickly fall into disuse especially immediately after a flood. A provision for maintenance fund can be created during the implementation phase, especially in case of school-cum-shelter which requires large amount of money for maintenance, which is usually beyond the means of local community. In case of community shelters, the maintenance fund can be generated from its multipurpose use (e.g. market place etc.).

Central database of flood shelters

Currently there is no central inventory of flood shelters constructed by different agencies and the capacities. This is of utmost necessity for efficient planning of future interventions. A database on cyclone shelter exists and is maintained by CDMP on behalf of DMB. A flood shelter database can be housed at WARPO which currently maintains National Water Resources Database (NWRD). Different attributes related to flood shelter such as location, type, dimension, cost, year of construction, capacity, implementing agency etc. need to be stored in the database.

CHAPTER 8
Conclusions and Recommendations

Selection of a particular type of shelter for construction by an implementing agency does not seem to depend on the depth or duration of floods. The decision of people for using community or school shelter is largely governed by the duration of a flood.

The current practice of estimating design height of a shelter based on local knowledge can be supplemented with technology in order to reduce uncertainty.

Scope of hindrance to **drainage** due to the construction of any type of shelter is limited. However, there is a likelihood that the road communication in the char areas will develop with the raising of homesteads, construction of schools, community shelters, etc. It is important that adequate drainage openings in those road networks are kept.

In char areas where **soils** are not always favorable for shelter construction, some other materials such as cow dung, saw dust and cement can be mixed with the prevailing sand as a reinforcement.

In high risk areas, such as new chars and erosion prone areas, schools-cum-shelters on stilts will not be **technically feasible**. Raised community shelters in high risk areas are subject to wave erosion and rain cuts. Raised homesteads are however, feasible in high risk areas due to their good maintenance.

In community shelters, potential accommodation **capacities** are high. The accommodation capacity of a four-room school shelter is lower than the community shelter. The advantage of raised homesteads is that the neighbors can take shelter.

Delineation of catchment area and identification of potential users are very important in planning and designing of a community shelter and a school-cum-shelter.

Basic facilities like water and sanitation could be better provided in school-cum-shelters and community shelters as more people could be attended to in a particular place. Ensuring basic services for individual homesteads is difficult.

Loss of land in case of community shelter is a major **environmental impact**. However, there is scope for multi-purpose use of theses community spaces. The raising of homesteads increases the vulnerability of the houses to wind hazard. Ensuring hygienic condition is a major problem in case of school-cum-flood shelters.

From the **accessibility** points of view and assuming that RCC structures (referring to the 'school-cum- shelter' type) are not usually constructed in *chars*, the individual homestead raising can be regarded as the best available option.

Land availability for shelter is a major concern. In this regard, school-cum-shelter seems to be the most suitable one. School compounds have been reported as the first place for flood victims to seek shelter. Moreover, school-cum-shelter is a good option in terms of ensuring effective normal time use to the most.

Raised individual homesteads have direct ownership and hence the **maintenance** is easy and simple. From the multipurpose use perspective, school-cum-shelter is a more preferred option and management is easier as compared to the other two types. However maintenance fund for government schools is often insufficient or unavailable.

The conventional school-cum-shelter can be regarded as the best option, followed by a community shelter in **protecting lives and livelihoods**.

From the **cost effectiveness** point of view it is very difficult to name one single type of shelter as most appropriate. Each of these types of shelters has some distinct advantages that cannot be replaced by others. However, community flood shelters can be considered as most cost-effective especially considering its potential for normal multi-purpose use.

The difficulties in **relief operations** can be considered as a problem with the raised homestead type of flood shelter. School-cum-shelter and community flood shelter are more convenient options where various life saving provisions can be supplied in the most cost-effective manner.

Safety of women and adolescent girls is not a major problem in community or school-cum-shelter. However, due to privacy reason, raised homestead is a more preferred option. The **safety and security of children** can be better assured in a community shelter or a school-cum-shelter than in individually raised homesteads.

The extent to which school **education gets disrupted** is well managed by school authorities. The designated vacations after the flood are reduced in order to make provision for extra class to make up the lessons required.

Users prefer raised homestead to other two options. This is because raised homesteads save both their lives and their belongings.

The flood prone areas need to be divided into various **risk zones**. These zones should be delineated based on flood as well as erosion hazard. There can be three zones high risk zone, medium risk zone and low risk zone.

The **choice of shelters** in different risk zones can be as follows. Homestead raising and community shelters in high risk zone; homestead raising, community shelters and easily dismantable schools on raised ground in medium risk zone; and school-cum-shelter on stilts in low risk zone.

Compactness of the mounds of shelters has to be considered in **design principles** and plantations can improve the quality against erosion and wind hazard. Accessibility is essential with the main route or embankment.

The overall SWOT analysis of different types of shelters is shown in the following page.

SWOT analysis of different types of shelters:

Type of shelter	Strength	Weakness	Opportunity	Threat
Raised homestead	• Users preference is high • Neighbours can take shelter • Has demonstration effect • Normal life is not disrupted • Scope for vegetable gardening and plantation • Self maintained	• Becomes marooned during high flood • Safety and security is a concern during flood • External financial assistance is required especially for the poor	• Soil treatment can improve quality of raised mound • Relatively a more sustainable solution	• River erosion
Community shelter	• Easier to ensure safety and security • Can be used as post- flood relief distribution center • Cost-effective in terms of cost of shelter per household	• Difficult to get large tract of land • Being a community property, maintenance is difficult	• Can be designed for multi-purpose use • Soil treatment can improve quality of raised ground	• River erosion
School-cum-shelter	• Safe and secure • Shelter management during flood is easier under supervision of school teachers • When fund is available, regular maintenance can be better ensured	• Difficult to maintain hygienic condition during flood • Costly • Maintenance fund is difficult to get	• Schools can be designed as shelter • Scope for better design	• The height of the shelters may become inadequate to face the higher flood level due to climate change

References

CEGIS (2010). Prediction of River bank Erosion along the Jamuna, the Ganges and the Padma Rivers in 2010. Prepared for Jamuna-Meghna River Erosion Mitigation Project, Bangladesh Water Development Board. Center for Environmental and Geographic Information Services. April, 2010.

Climate Change Cell (2009). Impact Assessment of Climate Change and Sea Level Rise on Monsoon Flooding. Department of Environment, Dhaka.

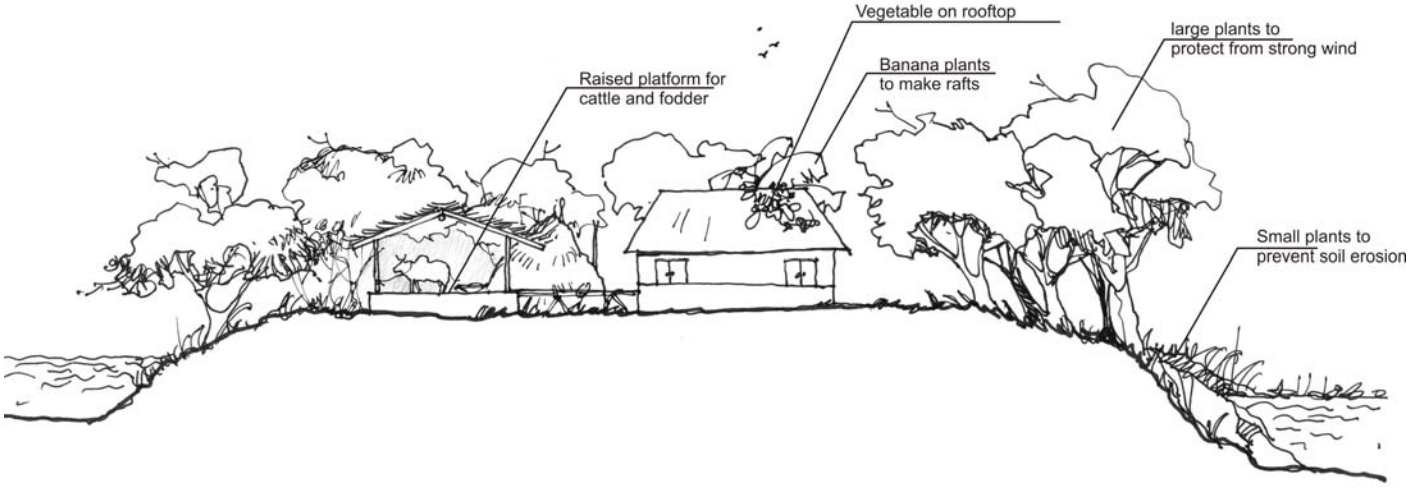
EPC (2007). Flood Rehabilitation Programme in Secondary and Higher Secondary Education Institutions Project, Project Completion Report. Education Engineering Department, Ministry of Education. Government of the People's Republic of Bangladesh.

Khanam, F., Uddin, T., Mondal, P., Ahsan, S.M. (2002). Review of Post-Flood "Shelter and Housing Program" 2000. Adisaster Forum Review supported by DFID and Save the Children Alliance.

Rahman, M.L. (undated). Technical Performance/Evaluation of Oxfam Assisted Flood Shelters, Disaster Management Program, Oxfam (UK & I), Dhaka.

Tod, I., Afroz, D. and Ali, M.S. (undated). Assessment of the Effectiveness of Homestead Raising and Mound Protection Works Implemented by the SHOUHARDO Program, USAID, GoB and CARE Bangladesh, Dhaka.

Institute of Water and Flood Management (IWFM),
Bangladesh University of Engineering and Technology (BUET)
And
Postgraduate Programs in Disaster Management (PPDM),
BRAC University



Appendix 1:Terms of Reference (TOR)

CONDUCTING A COMPARATIVE ANALYSIS BETWEEN DIFFERENT TYPES OF FLOOD SHELTERS

By DIPECHO Partners in Bangladesh (DPB)

BACKGROUND

European Commission Directorate General Humanitarian Office (ECHO) is currently funding six INGOs to implement its 5th Action Plan for risk reduction in Bangladesh. The six INGO's (ActionAid, Concern Universal, IFRC/BDRCS, Islamic Relief, Oxfam & Plan) are implementing pilot projects across Bangladesh to strengthen the capacity of communities and GOB to prepare and respond to natural disasters and reducing disaster risks.

At the start of their implementation, all six INGOs recognized the need for carrying out research on various DRR discourses and come out with concrete ideas to give directions at policy level. One of the issues that was identified is flood shelters that are being promoted by various institutions including the government. Based on the secondary research and interaction with key stakeholders there are three models of flood shelters that the DIPECHO partners wish to do a detailed analysis on. The three flood shelters are as follows:

- Up gradation of cluster homesteads into a flood shelter in such a way that it is resilient to floods.
- School cum flood shelter ; Upgrading school/college into a flood shelter through earth raising or other means and provisioning of other basic amenities like water & sanitation space for cooking and medical facilities.
- Designing and construction of a community flood shelter following the basic minimum standards.

RATIONALE:

Construction of various types of flood shelters has been one of the very popular and useful interventions of both GO and NGOs as part of flood preparedness. However, based on previous experiences, it has been observed that decisions about the type of flood shelter is taken on an ad-hoc basis and not considering various socio economic and technical parameters such as appropriateness in view of location, accessibility of most poor and most vulnerable groups, safety and security of women and children, protection to property and livelihoods etc. As a result, usefulness and sustainability of these flood shelters has become questionable. Therefore, there is a need of an effectiveness analysis of socio, economic, technical and environmental considerations of various types of flood shelters in order to take well-informed decisions for selecting the type of flood shelter.

OVERALL OBJECTIVE OF THE STUDY

The overall objective of the study is to conduct a comparative analysis of socio, economic, technical and environmental considerations of different flood shelters of Bangladesh and come up with specific recommendations and policy guidelines for future shelter interventions

SPECIFIC OBJECTIVES OF THE CONSULTANCY

1. Comparative analysis of all three types of flood shelters in view of
    a. Reducing risk on lives and health
    b. Reducing risks on property and livelihoods loss
    c. Safety and security of poor and most vulnerable population viz. women, children, old aged, disabled
    d. Cost effectiveness
2. Analysis of existing policy guidelines for the construction of flood shelters in Bangladesh in view of specific objective 1 and suggest areas for improvement (mandatory and desirable)
3. To develop simple guidelines for facilitating well informed decision making about construction of different type of flood shelters and execution based on the socio-economic and technical parameters
4. To suggest conceptual design and principles of design for all the three types (but not limited to) of flood shelters

SCOPE OF WORK:

Technical analysis:

- Flood intensity, pattern and duration (last 25 years and future 10 years considering Climate Change trends and shocks) vis a vis suitability of flood shelters
- Drainage pattern (safe disposal of flood water) vis a vis suitability of flood shelters
- Soil characteristics and water table vis a vis suitability of flood shelters
- Technical feasibility in view of Char (river islands) and non-char land
- Capacity of flood shelter vis a vis potential users (affected population)
- Availability of adequate (quantity and quality) basic facilities (water, sanitation, hygiene, health etc.) available (in line with Sphere) on the flood shelters to reduce the vulnerability and suffering of men, women, children, old aged, disabled etc.
- Existing and potential use of silt deposited on the river bed for flood shelter construction
- Positive and negative environmental impact of all three types of flood shelters

Socio-economic and cultural analysis

- Location vis a vis easy and quick accessibility of potentially affected population in general and particularly of poor and most vulnerable section of the society such as women, children, old aged, persons with disablity etc.
- Availability of land for different types of flood shelters
- Effective management of flood shelters during flood situation, future operation & maintenance (O&M) and existing & potential multiple use of flood shelters; Sustainability
- Advantages and disadvantages in view of saving lives and protecting health; cost effectiveness
- Advantages and disadvantages in view of protecting livelihoods; cost effeteness
- Safety and security of women and children
- Willingness and priority of potentially affected population to use the flood shelters both during and post flooding
- Particularly in case of school cum flood shelters - Overall use for saving lives, health, livelihood vis a vis disruption of education

PROPOSED GEOGRAPHY FOR THE RESEARCH:

- Nine community flood shelters in three districts
- Nine school cum flood shelters in three districts
- Six villages in three districts where homestead raising has been done

The above is proposed but after consultant has completed literature review and logistical considerations, the consultancy firm will propose most appropriate sample size.

- The name of three districts are as follows :

    - District Faridpur (Ganga river basin)
    - District Pabna (Ganga river basin)
    - District Gaybandha (Yamuna river basin)

This study is confined to riverine and monsoon floods (excluding flash floods) geography

TIMELINE:

Total of three (3) months starting from signing of contract.

MAJOR TASKS:

S. No.	Tasks
1	Submission of detailed work plan (desk and field work)
2	Undertaking desk and field work
3	Submission of structure of final report for feedback of DPB and finalisation
4	PowerPoint presentation for sharing research findings with DPB
5	Draft report submission to DPB for the comment and feedbacks
6	Submission of final report and PPT
7	Participate and present the research findings in the national level sharing workshop (to be organised by DPB)

Consultant is to submit methodology and detailed tasks / schedule based on above proposed.

EXPECTED OUTCOME:

- 5 page executive summary
- A concise report (in soft copy form) not more than 30-35 pages (A4, Ariel 11) covering all the specific objectives
- A PowerPoint presentation on the key findings of the research
- All the above deliverables will be in Bangla and English

Appendix 2: List of Key Informants

Serial No.	Name of Key Informant	Particulars of Key Informant
1	Md. Mahbubur Rahman	Assistant Engineer, Education Engineering Department
2	ABM Nazrul Islam	Senior Design Specialist, Local Government Engineering Department
3	Md. Anwarul Alam	Engineering and Planning Consultants Ltd.
4	Arif Abdullah Khan	Ex Engineer, World Vision
5	M. Abu Sadeque	Deputy Secretary, Ministry of Food and Disaster Management
6	Abdul Jabbar Pramanik	Assistant Head Master, Sadipur High School, Aliabad, Faridpur
7	Ayesha Akter	Female Teacher , Sadipur High School, Aliabad, Faridpur
8	Amena Begum	School-cum-shelter user, Sadipur High School, Aliabad, Faridpur
9	Abdur Rahim	Tailor, Chowdhury'r Haat, Char Nasirpur, Faridpur
10	Abdur Rab Pradhan	Shop Keeper, Chowdhury'r Haat, Char Nasirpur, Faridpur
11		Boatman, Char Nasirpur, Sadarpur, Faridpur
12	Mujibur Rahman	Ex. Chairman, Haripur Union, Sirajgonj Sadar
13	Sohel	Shelter user, Paikpara, Sirajganj
14	Sabuj	Shelter user, Paikpara, Sirajganj
15	Md. Badiuzzaman	Community leader, Paikpara Adarsha Gram, Sirajgonj
16	Sarah Begum	Inhabitant, Paikpara Guchchha Gram, Kalia Haripur, Bonbaria, Sirajganj
17	Aklima Khatun	Inhabitant, Paikpara Guchchha Gram, Kalia Haripur, Bonbaria, Sirajganj
18	Md. Lokman Hossain	School Management Committee President-cum-Union Parishad Member, Purba Dawabari, Hatibandha, Lalmonirhat

Serial No.	Name of Key Informant	Particulars of Key Informant
19	Md. Alamgir Hossain	Program Manager, RDRS, Hatibandha, Lalmonirhat
20	Rakibul Arifin	Area Coordinator, Plan Bangladesh, Hatibandha, Lalmonirhat
21	Shamsul Alam	Principal, Hatibandha Women's Degree College
22	Md. Golam Mostafa	UP Chairman-cum-UDMC Chairman-cum-Headmaster, Singimari Model School, Hatibandha, Lalmonirhat
23	Badiuzzaman Velu	Upazilla Chairman, Hatibandha, Lalmonirhat
24	Md. Asrafuzzaman	UNO, Hatibandha, Lalmonirhat