BANGLADESH FLOOD ACTION PLAN

Ministry of Water Resources
Flood Plan Coordination Organization (FPCO)

Charland Flood Proofing Study

April 1995

Prepared by

Environmental Study

FAP 16

ISPAN

IRRIGATION SUPPORT PROJECT FOR ASIA AND THE NEAR EAST

Sponsored by the U.S. Agency for International Development

IRRIGATION SUPPORT PROJECT FOR ASIA
AND THE NEAR EAST

ISPAN Technical Support Center
Suite 300
1611 North Kent Street
Arlington, Virginia 22209-2111
USA
Phone: (703) 247-8730
FAX: (703) 243-9004

TABLE OF CONTENTS

TABLES

FIGURES

LIST OF PLATES

PREFACE

This report is one in a series of reports covering the immediate riverine lands of the major rivers of Bangladesh—the Jamuna, Ganges, Padma, and Meghna. Riverine charlands are defined in this study as areas frequently subject to erosion and accretion within and adjacent to the main rivers of Bangladesh and unprotected by embankments. The Charland Flood Proofing Study consists of a survey of flood impacts and responses to flood loss mitigation in two study areas of the Brahmaputra-Jamuna charlands. The feasibility of possible flood proofing measures in two specific char areas is assessed.

The full set of charland reports is shown in the table below.

Overview Reports	Inventory Reports	Other Reports
Charland Summary Report	The Dynamic Physical and Human Environment of Riverine Charlands: Brahmaputra-Jamuna	Upper Jamuna (Brahmaputra) Charland Socio-Economic RRA
Charland Socio-Economic Summary Report	The Dynamic Physical and Human Environment of Riverine Charlands: Meghna	Middle Jamuna Charland Socio-Economic RRA
	The Dynamic Physical and Human Environment of Riverine Charlands: Padma	Upper Meghna Charland Socio-Economic RRA
	The Dynamic Physical and Human Environment of Riverine Charlands: Ganges	Meghna Confluence Charland Socio-Economic RRA
		Padma Charland Socio-Economic RRA
		Ganges Charland Socio-Economic RRA
		Charland Flood Proofing Study

ACKNOWLEDGEMENTS

The production of this report, the result of a team effort involving many of the staff of FAP 16, was overseen by Keith Pitman, Chief of Party, ISPAN.

The study was undertaken by Ian Tod, Masud-uz-Zaman, and Paul Thompson, with support from Mustafa Alam, Suzanne Hanchette, Qazi Salimullah, Mamoon Hamid, and Md. Badruddoza. A team of five enumerators conducted the household surveys, and FAP 19 assisted with maps and the charland GIS.

We are grateful to the Flood Plan Coordination Organization and its Panel of Experts for providing overall direction for the study. Information and data were obtained from FAP 3.1, FAP 24, the Country Boat Owners Association, Service Civil International, and Rangpur Dinajpur Rural Service. The Bangladesh Water Development Board (BWDB) assisted in the physical surveys of the case study chars.

GLOSSARY

acre	-	Acre = 0.4047 ha
aman	-	Late monsoon season paddy planted before or during the monsoon and harvested November-December
amin	-	Land surveyor
arat	-	Wholesale shop
aratdar	-	Wholesale trader with warehouse
aus	-	Early monsoon paddy planted in March-April and harvested in June-July
B. aman	-	Broadcast aman paddy, usually grown in deeper water
bangsha	-	Lineage-mates
BARC	-	Bangladesh Agricultural Research Council
bari	-	A homestead, usually consisting of more than one structure arranged around a central common area
BBS	-	Bangladesh Bureau of Statistics
BDR	-	Bangladesh Rifles
beel	-	An area of open water away from a river
bhatiya	-	People from downstream
BIDS	-	Bangladesh Institute of Development Studies
bigha	-	A local unit of area most commonly equalling 0.33 acre or 0.14 ha
bir	-	Stable
boro	-	Dry season paddy transplanted in December-January and harvested in April-May
BRAC	-	Bangladesh Rural Advancement Committee
BTM	-	Bangladesh Transverse Mercator (map projection)
BUET	-	Bangladesh University of Engineering and Technology
bustee	-	Slum
BWDB	-	Bangladesh Water Development Board
chaura	-	Original settlers in the Ganges char areas
china	-	*Panicum miliaceum*, a variety of millet
chowki	-	Bed/platform
cumecs	-	Cubic meters per second
dacoit	-	Bandit
dal	-	Any of a variety of pulses (lentils); a high-protein food staple usually eaten with rice
decimal	-	Unit of area equal to 0.01 acre
denga	-	Land near a river
desh	-	State, locality or district of origin
deshi	-	Original settlers in Ganges char area
DEM	-	Digital elevation model
dhaincha	-	*Sesbania aculeata*, a nitrogen-fixing plant used as live fencing, fuel, and building material
diara	-	The low bank of a river
district	-	A large administration unit under the authority of a Deputy Commissioner, now known as a zila
doba	-	Submerged
EIA	-	Environmental Impact Assessment
FAP	-	Flood Action Plan
FCD/I	-	Flood Control and Drainage or Flood Control, Drainage, and Irrigation
fitkiri	-	Alum
FPCO	-	Flood Plan Co-ordination Organization
FWC	-	Family Welfare Centre
GIS	-	Geographic Information System
GPS	-	Global Positioning System

goala	-	Person trading in dairy products
gur	-	Locally produced molasses
gushti	-	Lineage-mates
haor	-	Deeply flooded basin of NE Bangladesh
hat	-	Periodic market
hectare (ha)	-	Hectare = 2.4711 acres
hogla	-	A bulrush (*Typhus angustata*) used for making mats
HSC	-	Higher Secondary Certificate
HTW	-	Hand tubewell
HYV	-	High Yielding Variety
ISPAN	-	Irrigation Support Project for Asia and the Near East
jangal	-	Ground cover shrubs used for fuel and as herbs
jhau	-	Tamarisk bush used as fuel and an herb
jotdar	-	Landlord
JPPS	-	Jamalpur Priority Project Study
kabiraj	-	Traditional healer
kaisha	-	A variety of catkin grass (*Saccharum spontaneum*) giving three cuttings a year
kani	-	Local unit of measure equal to .13 ha (.33 acres)
karati	-	Saw operator
kash	-	*kaisha*
kayem, kayemi	-	Permanent, old, or established
kaon	-	Fox-tail millet
khas	-	Publicly owned
kheya ghat	-	Local boat landing point
khal	-	A drainage channel or canal either natural or man-made
kharif	-	Summer/wet season
kilogram (kg)	-	Kilogram = 1.11 seer
kilometer (km)	-	Kilometer = 0.625 miles
kutcha	-	Flimsy construction of a temporary nature, in the chars usually of grass, bamboo, straw, or similar materials
lathiyal	-	A stick-wielding private army employed to carry out the will of a locally powerful leader
macha	-	A raised platform
mashkalai	-	A type of pulse (lentil); see *dal*
matbar	-	Leader of the local community
maund	-	A unit of weight, 1 Maund = 40 sheer = 37.5 kilograms
mauza	-	A village revenue collection and cadastral mapped unit
MCSP	-	Multipurpose Cyclone Shelter Program
mile (mi)	-	Mile = 1.6 kilometers
MPO	-	Master Plan Organization (of Ministry of Irrigation Water Development and Flood Control), now called WARPO (see below)
MSS	-	Multi-Spectral Scanner (Landsat satellite sensor)
musur	-	A type of pulse (lentil); see *dal*
nara	-	Straw
NGO	-	Non-Government Organization
PACT	-	Private Agencies Collaborating Together
paiker	-	Wholesale trader
para	-	Neighborhood
PoE	-	Panel of Experts (of FPCO)
pourashava	-	a municipality, usually the urban center of a district
pucca	-	Sturdy construction of a permanent nature, usually of such materials as brick, concrete, or corrugated iron sheets

rabi	-	Winter/Dry Season
RDRS	-	Rangpur Dinajpur Rural Service (an NGO)
REIS	-	Riverbank Erosion Impact Study
return period	-	average interval in years between floods of a given magnitude
RRA	-	Rapid rural appraisal
sadar	-	The urban core (administrative headquarters town) of a thana or district
salish	-	local informal court
samaj	-	Society, community; an informal arrangement between members of a community whereby each member has certain rights and privileges
sarik	-	Co-sharers
SCI	-	Service Civil International (an NGO)
seer	-	A unit of weight = 1/40 maund = 0.94 kg
shabuk	-	Ancient
shon	-	A variety of grass (*Imperata cylindica*) giving one cutting a year; also a generic term for thatching grass
SPARRSO	-	Space Research and Remote Sensing Organization
SPOT	-	System Pour Observation de la Terre
SRDI	-	Soil Resources Development Institute
SSC	-	Secondary School Certificate
tahsil office	-	Local land record and revenue collection office
Taka (Tk.)	-	Bangladesh currency, US$ 1 equalled approximately Tk. 40 in late 1992-early 1993
T. aman	-	Transplanted aman paddy
thana	-	A sub-division of a zila, or district
til	-	Sesame (*Sesamum indicum*)
tishi	-	Linseed
TM	-	Thematic Mapper
ton	-	An imperial ton = 1,016 kg
union	-	Sub-division of a thana
upazila	-	Previous name for a thana (subdivision of a zila or district)
ustha	-	Bitter gourd (*Momardica charantia*)
uthuli	-	An informal contract between a landholder and a temporary migrant, under which the migrant is allowed to shelter on the landowner's property in exchange for labor services
WARPO	-	Water Resources Planning Organization
WHO	-	World Health Organisation
zamindar	-	Landlord
zila	-	A large administration unit formerly known as a district

EXECUTIVE SUMMARY

The Charland Flood Proofing Study, part of the Charland Study series, was undertaken to examine in more detail some of the issues raised by the charland inventory and socioeconomic studies and to identify and assess practical solutions to some of the flooding and erosion problems affecting the people living in charlands.

The Charland Flood Proofing Study focused on the Brahmaputra-Jamuna river to compliment and expand on the work of FAP 3.1 and some government and nongovernment agencies on developing the application of flood proofing in charlands. The study covered two areas, one comprising 148 mauzas adjacent to Bhuapur in the lower Jamuna and the other comprising 57 mouzas north of Kurigram in the upper Jamuna (Brahmaputra). The study included a formal sample survey to obtain detailed household-level data on flood losses and household-level impacts; 150 households were interviewed in each of the two study areas. In addition, the flood proofing requirements of two specific char communities were analyzed as case studies.

The results of the survey show that households in both study areas suffered major losses in the 1988 flood. The average homestead losses were Tk. 7,581 per household in Bhuapur and Tk. 5,300 in Kurigram, which is equivalent to about six months' agricultural wages (a summary of the 1988 and 1991 losses appears in the table below). The average gross agricultural losses per household were Tk. 12,886 in Bhuapur and Tk. 8,830 in Kurigram, which is equivalent to about a year's agricultural wages for each area (allowing for the lower wages in Kurigram).

Even in the much smaller flood of 1991, which was close to a normal flood, average homestead losses were Tk. 1,082 in Bhuapur and Tk. 423 in Kurigram, or the equivalent of about one month's agricultural wages. The average gross agricultural losses per household were Tk. 4,487 in Bhuapur and Tk. 3,503 in Kurigram, or the equivalent of about three month's agricultural wages.

The continuing vulnerability of char households to floods and erosion renders most families unable to make significant improvements to their lives because they find it necessary to allocate available resources to recover from the effects of flood and erosion. For example, livestock are a main economic activity, yet the number of livestock in the

Summary of Mean Household Losses (1988 and 1991 floods)

	Bhuapur		Kurigram	
	1988 (Tk.)	1991 (Tk.)	1988 (Tk.)	1991 (Tk.)
Housing Damage	3,238	514	2,031	242
Livestock	2,142	214	1,015	47
Boat Damage	83	200	25	3
Tree Damage	1,295	95	793	87
House Contents (including food grain)	818	29	1,153	36
Temporary Shelter	223	30	283	8
Total Homestead Losses	7,799	1,082	5,300	423
Crop Losses	12,886	4,487	8,839	3,503
Total Losses	**20,685**	**5,569**	**14,139**	**3,926**

char areas has decreased significantly since the 1988 flood. Some of the reduction may be due to losses in 1988 and subsequent floods, but most of the decline seems to be due to distress sales following the floods as people have sold cattle to raise money for other, more pressing, expenses.

The problems char people face during floods would be greatly reduced if they could stay in their own houses or, alternatively, move to community flood shelters nearby. Analysis undertaken in the two case studies shows clearly that raising house floor plinth levels and constructing flood shelters are technically feasible and give good economic rates of return. Raising plinth levels costs about Tk. 500-650 per house and gives an internal rate of return (IRR) of 39 percent in Kurigram and 92 percent in Bhuapur. Flood shelters cost between Tk. 100,000 and Tk. 250,000, depending on the size of the community served and the facilities provided. The shelters have rates of return of 34-64 percent if facilities are used for multiple purposes and the shelter is not lost to erosion within four years. Actual costs and returns may differ from these estimates depending on the communities and flood risks in a particular location. The rates of return presented are based on financial costs, but economic costs are likely to yield similar results as there are no crop benefits and mainly local materials are used for housing.

These flood proofing measures would have significant social effects, as they would benefit all income groups. At present, poorer families are particularly vulnerable to floods and erosion and often have to evacuate their houses and travel considerable distances to seek refuge. Local relief committees may pay some of their evacuation costs, but households generally have to bear most of the costs, as well as the subsequent cost of rehabilitation once the flood has receded.

For comparison, of the 17 FCD/I projects studied in FAP 12 (only two of which had irrigation components), only nine gave rates of return of more than 22 percent, and the "best" project gave a rate of return of 90 percent. Furthermore, the investment on the 17 projects analyzed ranged from Tk. 3,720 to Tk. 43,302 per household (the highest figure being a project with an irrigation component), with average being about Tk. 6,000 per household. Therefore, investment in flood proofing can give similar if not better rates of return than investment in FCD schemes at a much lower cost per household. Another consideration is that investment in FCD schemes would mainly benefit landowners and farmers, while flood proofing would benefit all households, including the most vulnerable groups in a community.

The main recommendation of the report is that flood proofing programs should be undertaken in char areas to reduce the vulnerability of households to floods and erosion. This will require initiatives on the part of local government bodies and NGOs. Initially, pilot programs lasting two to three years are required to develop the institutional arrangements for implementing flood proofing measures. To accomplish this, it may be necessary to mobilize the support of the Local Government Engineering Department (LGED) and the resources of food-for-work programs funded by the United States Agency for International Development (USAID) and the World Food Programme (WFP). In the longer term, more general development programs including the provision of credit will be required to improve the income of char people and allow them to undertake their own flood proofing measures.

The FAP regional studies have previously identified areas where major structural flood protection measures are not feasible, and these areas were earmarked for flood proofing activities. Prior to the regional studies, no study was made of potential flood proofing measures and their costs and benefits. Given the evidence of the Charland Flood Proofing Study, flood proofing is technically and economically feasible even in the charlands, where there are high erosion risks. Flood proofing may also be appropriate in other unprotected flood-prone areas. Flood proofing has been proposed before, but it has not been given serious attention

by the public sector for riverine areas (unlike cyclone shelters in the coastal belt). There is an urgent need now for a government agency to take up, at least on a pilot basis, a flood proofing program before another major flood occurs and people in the unprotected floodplain again suffer severe losses. A small investment in labor-intensive minor structural works would help millions of people cope with severe floods. Flood proofing would be the initial step in reducing vulnerability to flooding, once its success has been demonstrated, other measures for economic development could be added.

Chapter 1

INTRODUCTION

1.1 Background to the Study

1.1.1 History

The original design of the Flood Action Plan (World Bank, 1989) included among its components a socioeconomic study of the active floodplains of the Brahmaputra-Jamuna, Ganges, Padma, and Meghna rivers. The active floodplain was defined at that time as areas within the main river channels and nearby areas of mainland, both of which are frequently subject to erosion and accretion and cannot be protected from floods. The aims of the active floodplain study were to:

- assess present agricultural practices, settlement patterns, and disaster responses;
- estimate the number of affected households on chars (mid-channel islands created by accretion) and within a short distance of the riverbanks;
- estimate the number of households on existing embankments; and
- prepare guidelines to be used in feasibility studies to ensure that project planning took full account of the active floodplain populations.

As the detailed terms of reference for FAP 14, the Flood Response Study, were being drawn up by the government of Bangladesh and finalized with donor agencies, it became apparent that the intended study would not be possible before a more general study was undertaken to establish the context in which flood response occurred for the full range of flood environments inside and outside the chars. In addition, the active floodplain study required the use of remote sensing data and satellite image interpretation, but the facilities and trained staff to achieve this within the FAP would not be ready until at least late 1991.

During 1991, the first full year of FAP studies, the regional studies were unable to devote sufficient resources to the specialized work of socioeconomic study of the active floodplain, and they used the banks of the main rivers as their study area boundaries. In the other FAP studies, only FAP 3.1, the Jamalpur Priority Project, undertook detailed socioeconomic studies in the active floodplain of the Jamuna adjacent to their project area, and FAP 14, the Flood Response Study, carried out socioeconomic surveys in 10 villages located in active floodplains.

Finally, in 1992 ISPAN, on advice from the Flood Plan Coordination Organization (FPCO), agreed to undertake an inventory of resources and people in the main river charlands.[1] The inhabitants of the charlands, who are exposed to floods and erosion during most years, are among the most hazard-prone people in Bangladesh. Reliable information about char areas and the people who live in them has always been scarce, partly because of the difficulties in accessing the chars and their constantly changing environment. Past interventions that have altered the flows in the main rivers for the benefit of communities on the mainland have tended to ignore the impact of such interventions on the people in the charlands. In addition, the particular needs of the people living on the charlands have tended to be overlooked in programs aimed at reducing the impact of floods. The Charland Study has been undertaken to provide more information about the people living in the charlands and their environment.

1.1.2 The Charland Study

The Charland Study is a special study under the Bangladesh Flood Action Plan (FAP). The study was executed jointly by FAP 16, the Environmental Study, and FAP 19, the Geographic Information System (GIS), both of which are undertaken by the Irrigation Support Project for Asia and the Near East (ISPAN) and funded by USAID.

The Charland Study has two objectives. The first is to develop databases and a geographic information system (GIS) that can be used as planning tools both for direct interventions in the charlands and for other interventions (such as embankments) that may affect the char areas. The second objective is to use the data collected, along with additional socioeconomic studies, to make general policy recommendations for the charlands, including potential flood proofing measures, and to test and develop means of rationally assessing the potential benefits of flood proofing measures in these areas.

The study consisted of five tasks:

- Making an inventory of resources, people, and infrastructures in the Brahmaputra-Jamuna, Meghna, Padma, and Ganges charlands and collecting additional information on hazards (led by FAP 16).
- Using digital satellite images to analyze physical changes and land use in these areas, and integrating this analysis with inventory data using a GIS (FAP 19).
- Conducting supplementary socioeconomic studies using rapid rural appraisal (RRA) methods in six river reaches (building on FAP 14, the Flood Response Study).
- Conducting detailed studies of flood losses and flood proofing potential in two areas along the Jamuna River (building on FAP 23, the Flood Proofing Study).
- Integrating the results of the above tasks into a comprehensive report.

The areas covered by the Charland Study are shown in Figure 1.1, and the reports comprising the study are listed in the Preface.

The Charland Flood Proofing Study was undertaken as part of the Charland Study. Its purpose is twofold: to look into some of the issues raised in the inventory and socioeconomic studies in more detail, and to identify and assess practical solutions to some of the flooding and erosion problems affecting the people living in charlands.

1.2 Outline of the Charland Flood Proofing Study

1.2.1 Definition of Flood Response and Flood Mitigation

Flood Response consists of all measures taken by individuals, families, and communities to prepare for, cope with, and recover from floods. Mitigation measures taken in response to floods depend upon the resources and understanding available in a particular flood-prone environment and consist of both technical and social measures. Technical measures consist of physical alterations or adjustments to prevailing conditions, and social measures consist of mobilizing family networks, friends, patrons, jobs, credit, etc. Understanding the way people respond to floods under existing conditions is an essential prerequisite for planning future interventions that are designed to mitigate the effects of floods.

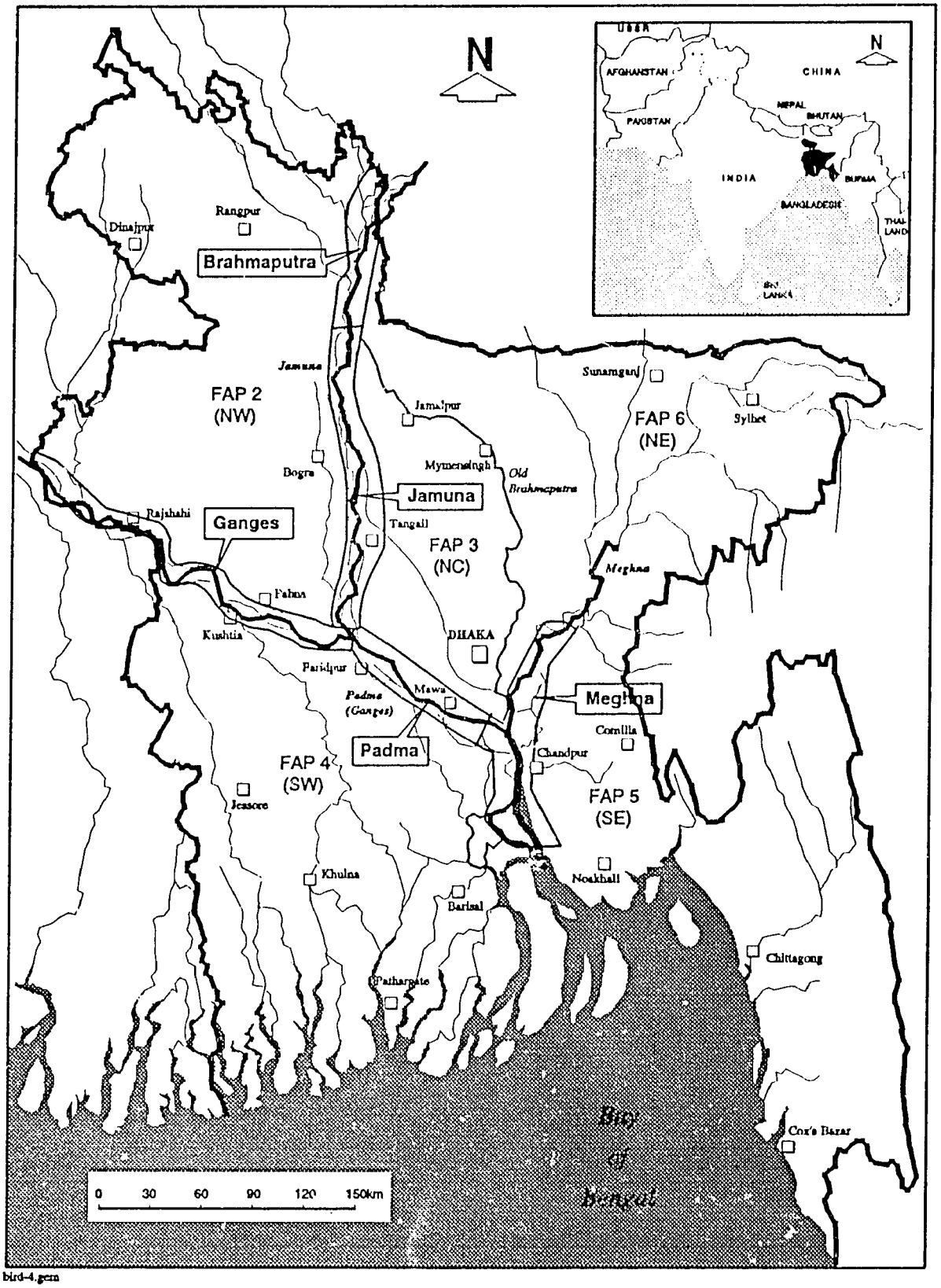
Possible flood loss mitigation measures undertaken by individuals, families, and communities include *flood proofing*, *flood protection* and *flood preparedness*.

Flood proofing is the provision of long-term, nonstructural or minor structural measures to mitigate the effects of floods. The objectives of flood proofing are to avoid loss of human life, to reduce the disruption of normal activities during and after a flood, and provide people with the security and motivation necessary to make and sustain improvements in their economic and social welfare to achieve prosperity in an environment that frequently floods.

Structural flood proofing measures include raising the floors of homesteads and industrial facilities

Figure 1.1

Charland Study Location



bird-4.gem

above flood levels, providing refuge areas or flood shelters, ensuring that water supplies and other health-related facilities operate throughout floods, designing roads to be above peak flood level, providing additional bridges or culverts to improve water flows through an area and to ensure embankments or structures are not washed away.

Nonstructural measures include institutional mechanisms to coordinate development activities related to flood control and drainage, planning developments in flood-prone areas to take account of prevailing hydrological conditions, and ensuring that hydrological data and analysis are available to those involved with the design and construction of infrastructure and other facilities.

Flood protection is the provision of major long-term structural measures that physically prevent some or all flood water from entering a designated area. Under the Flood Action Plan, flood protection does not necessarily mean complete protection from floods, it can also mean the provision of controlled flooding and drainage. The objective of flood protection is to ensure that normal or improved social and economic activity can continue within the designated area during and after a flood. In Bangladesh, flood protection measures involve the construction of earth embankments and appurtenant structures or improving the flow in drainage channels, as there is no potential for mitigating flood losses by providing storage reservoirs.

An essential component of flood protection is effective operation and maintenance of the facilities constructed. Operation and maintenance procedures include developing effective institutional arrangements, allocating the funds necessary to ensure the integrity of facilities, and continuous assessment of the performance of facilities during floods (for example, patrols to identify embankment erosion).

The main purpose of most existing flood protection facilities in Bangladesh is to protect and improve agricultural production. Secondary benefits include protecting the life and property of communities within the embanked area and utilizing the flood embankment as a refuge for people outside the protected area.

Flood preparedness is the provision of short-term measures for individuals, families, communities, and institutions to reduce the disruption and damage caused by floods. Flood preparedness is primarily the development of service delivery systems for people or institutions to use before, during, or after a flood. Flood preparedness measures are designed to ensure the readiness and ability of a society to forecast floods, take precautionary measures in advance of a flood, and respond to and cope with the effects of a flood by organizing and delivering timely and effective rescue, relief, and other post-disaster assistance.

1.2.2 Flood Mitigation in Charlands

In char areas, individuals and communities traditionally have been left to develop their own strategies for minimizing the effects of floods and erosion, but a shortage of resources or lack of information about floods leaves many people unable to adequately protect their land, possessions, or livelihoods from floods. Even in years with average floods, some households are flooded and lost to erosion, and income-earning opportunities are scarce in many places. The rural poor and other disadvantaged groups are often more adversely affected by such events as they have limited resources to protect their houses from floods and their traditional employment opportunities are more vulnerable to disruption.

Large-scale structural measures such as embankments and water-control structures are generally inappropriate for char areas because of the dynamic nature of the environment, low population densities, and low land productivity. Flood proofing measures, however, have the potential to significantly reduce the impact of floods on households and communities. Flood proofing involves small-scale measures that can be undertaken by individuals and collectively by the local community to avoid loss of human life, reduce the disruption caused by floods, and provide people with the security and motivation necessary to make and sustain improvements in their economic and social

4

welfare and general well-being in an environment that frequently floods.

Household flood proofing measures include making adjustments to structures to keep water out or reduce water entry (such as raising homestead floors above flood levels or improving the structural integrity of the house), and ensuring that possessions—including livestock—are above flood level. Community flood proofing measures include providing refuge areas or flood shelters and ensuring that water supplies and other health-related facilities operate and are accessible throughout floods. Union-, thana-, or district-level flood proofing measures include designing key roads to be above peak flood level, providing additional bridges or culverts to improve water flow through an area, and ensuring that public service areas such as markets, clinics, and schools are above peak flood levels.

Flood preparedness and flood proofing measures are complimentary, and both are appropriate for charlands. Flood preparedness measures include the development and regular testing of both flood forecasting systems (prediction of the timing, magnitude, duration, and location of floods) and flood warning systems (delivery of usable and credible advance information on expected flooding) to inform people of an impending flood. The latter would also include plans for evacuation or other activities to be undertaken during a flood alert period; the education and training of officials and the population at risk; the establishment of policies, standards, organizational arrangements, and operational plans to be applied following a flood; the securing of resources (possibly including the stockpiling of supplies and the allocation of funds); and the training of intervention teams. Implementation of flood preparedness along with flood proofing would ensure the full benefits of flood proofing are forthcoming.

1.2.3 Objectives of the Study

The objective of the Charland Flood Proofing Study is to show the potential of reducing flood-related losses in char areas by the application of flood proofing and flood preparedness measures. Since effective flood proofing should be based on local resources and local needs, the study conducted a household survey to assess local resources and the magnitude of losses and other impacts of floods on individuals and communities in char areas. Flood proofing measures were then developed and assessed by combining the results of the survey with information on flood proofing measures identified by the individuals surveyed.

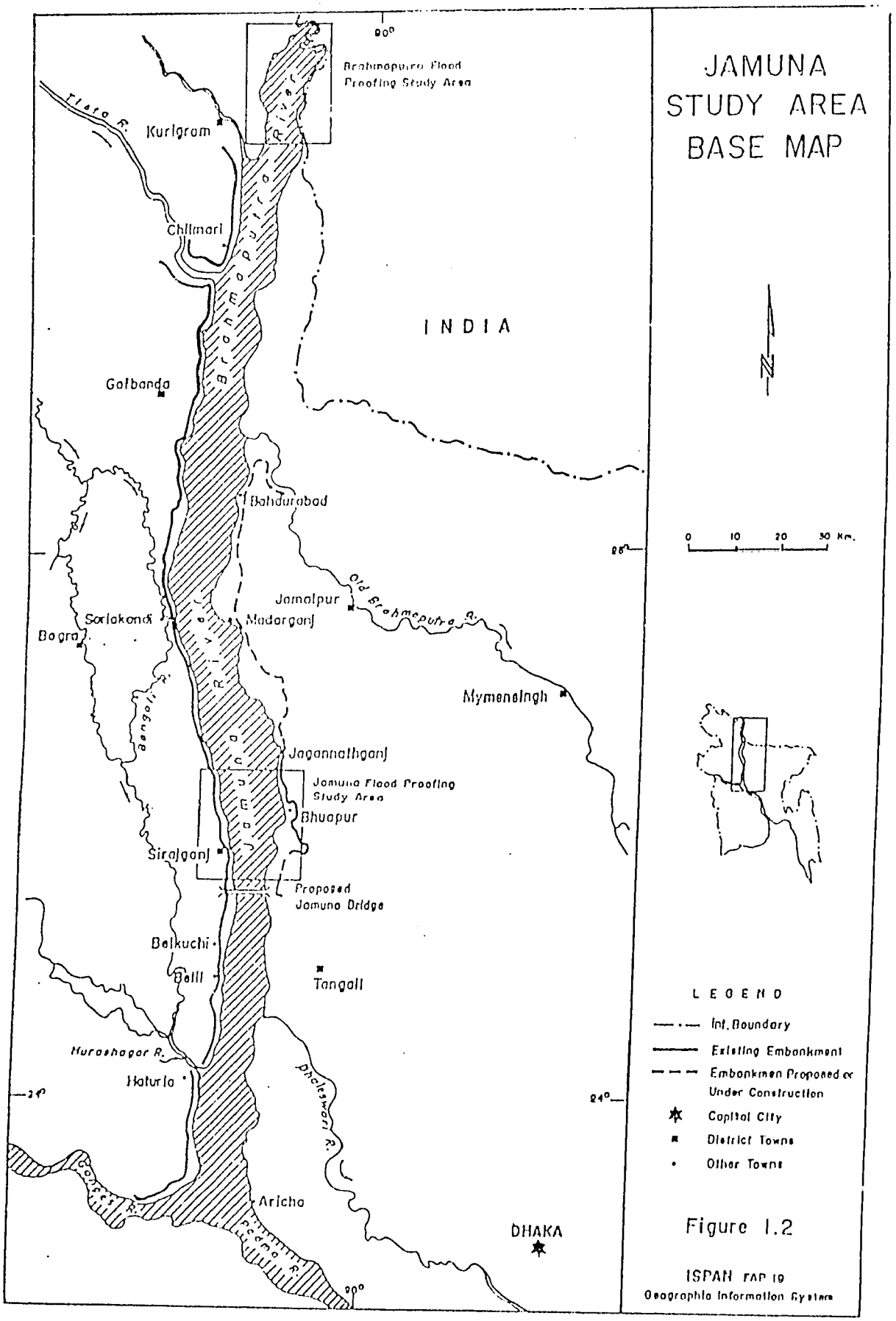
Two important concepts underlying the estimation of benefits from flood proofing and flood preparedness measures are **avoidable** versus **potential** loss. Flood proofing can be used to avoid losses from specific floods, but it will not prevent all potential losses from all future floods. For example, flood shelters may prevent loss of human and animal lives and enable household items to be saved, but they will not prevent damage to the houses left by those seeking shelter. Similarly, longer warning lead time may allow people more time to take action to mitigate the effects of the flood (enabling them to save part of the housing structure, perhaps, or even salvage crops that are close to harvest), but it will not prevent all losses. This study separated avoidable or preventable losses from potential total losses so that the former could be quantified for specific flood proofing measures. Practical experience of the impact and performance of specific measures during severe floods will be needed to verify their effectiveness.

1.3 The Charland Flood Proofing Study Areas

1.3.1 The Brahmaputra-Jamuna

The Brahmaputra-Jamuna river was selected for the Charland Flood Proofing Study for a number of reasons, among them:

- to complement and expand on the work already done by FAP 3.1 and some government and nongovernment agencies on developing the application of flood proofing in charlands;


JAMUNA
STUDY AREA
BASE MAP
INDIA
Brahmaputra Flood
Proofing Study Area
Kurigram
Chilmari
Gaibanda
Bahadurabad
Jamalpur
Old Brahmaputra R.
Sariakandi
Madarganj
Bogra
Mymensingh
Jagannathganj
Jamuna Flood Proofing
Study Area
Bhuapur
Sirajganj
Proposed
Jamuna Bridge
Belkuchi
Belil
Tangail
Hurasagar R.
Haturia
Aricha
DHAKA
0 10 20 30 Km.
LEGEND
Int. Boundary
Existing Embankment
Embankmen Proposed or
Under Construction
Capital City
District Towns
Other Towns
Figure 1.2
ISPAN FAP 19
Geographic Information System

- at the time of the study there was more information available for this river as the analysis of the inventory data and the digital satellite images for this river were most advanced; and
- there is some controversy about the potential negative impacts on charlands of improving existing embankments, constructing additional embankments and the Jamuna Multipurpose Bridge. The Charland Flood Proofing Study would assist in clarifying some of the issues involved.

That the Brahmaputra-Jamuna River system has two names in Bangladesh reflects a major historical change in its course (Figure 1.2). From the Indian border[2] in the north to the off-take of the Old Brahmaputra, the river is known as the Brahmaputra and has within known times followed this course. Between 1780 and 1830, however, the river changed course from the off-take with the Old Brahmaputra (its old course), and took a direct southerly route to the Ganges. This relatively new river channel is known as the Jamuna.

The charland boundary is the alignment of existing and proposed embankments along the main river; the area within the boundaries currently is unprotected and likely will remain so. The existing Brahmaputra Right Embankment comprises most of the western boundary and is being studied by FAP 1. Farther north, the Kurigram embankment forms the study area boundary. The left bank boundary is more complex. In the far north, the Indian border serves the purpose. In areas where there were no existing or proposed embankments, such as on the left bank of the Brahmaputra, boundaries were defined by natural flood extents identified on a peak flood satellite image of August 18, 1987. Farther south, existing and proposed embankments that would form the proposed FAP 3.1 controlled flooding embankment between the Old Brahmaputra off-take and Jagannathganj Ghat make up the boundary. Similar existing embankments or proposed alignments were followed south of that area. Survey of Bangladesh 1:50,000 scale maps, 1989 SPOT satellite images at 1:50,000 scale, and the 1993 Landsat image were used in determining the study area and its characteristics.

1.3.2 Charland Classification

This study is primarily concerned with riverine charland, the Bengali term for a "mid-channel island that periodically emerges from the riverbed as a result of accretion" (Elahi *et al.*, 1991), and more generally with the active floodplain, which is subject to erosion and accretion.

Land and mauzas in the study area were classified into the following three main types (subdivided by left and right bank as appropriate):

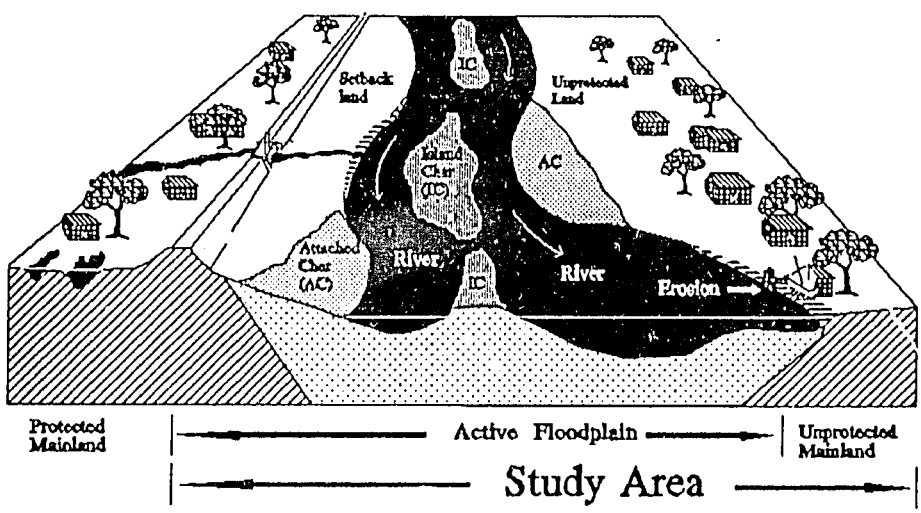


Figure 1.3 Charland Classification

- Island chars.
- Right and left bank attached charland.
- Right and left bank unprotected mainland.

Figure 1.3 illustrates the classification system developed for the Brahmaputra-Jamuna charland inventory.

For this classification, island chars are defined as land that, even in dry season, can only be reached by crossing a main channel of the river. Attached charland is accessible from the mainland without crossing a main channel during the dry season (although crossing lesser channels may be required), yet is inundated or surrounded by water during the peak of a "normal" flood (normal monsoon). Unprotected mainland has no embankment between it and the main river and is inundated during higher than normal floods. Unprotected mainland is included up to the extent of recent floods or features, such as roads, that restrict flooding. Setback land is unprotected mainland on the river side of flood protection embankments, it differs from other unprotected mainland because the embankments may provide refuge during floods but may also constrain flood water, thereby raising flood levels.

1.3.3 Survey Reaches

Two reaches of the river were selected for the study. One reach was in the north on the Brahmaputra in Kurigram district, and the other was on the Jamuna near Bhuapur in Tangail district (Figure 1.2).

The Kurigram study area was chosen because:

- it represents an established, older braided river system;
- it is unlikely to be affected by embankments and other proposed interventions downstream;
- the inventory indicated that flooding was more extensive and of longer duration than in lower reaches; and
- a flood proofing pilot project has been proposed in this area by CARE, an NGO.

The Bhuapur study area was selected because:

- it represents part of the newer braided river system;
- floods are likely to be affected by the Jamuna bridge, improvements to the Brahmaputra Right Embankment, and the proposed Brahmaputra Left Embankment;
- the inventory indicated that past flooding was less extensive and of shorter duration than upstream reaches; and
- NGOs have been active in flood proofing and charland development in this area.

1.3.4 Links with Other FAP Studies

The following FAP studies have been consulted and are directly relevant to these two Brahmaputra-Jamuna charland areas:

- Brahmaputra River Training Study (FAP 1), bank protection works at Sirajganj;
- Northwest Regional Study (FAP 2), right bank of the Jamuna;
- North Central Regional Study (FAP 3), left bank of the Jamuna;
- Jamalpur Priority Project (FAP 3.1), studies of charlands in the middle reach;
- Flood Response Study (FAP 14), general flood impact studies;
- Bank Protection and River Training (FAP 21/22), pilot works proposed for Jamuna;
- Flood Proofing Study (FAP 23), potential measures; and
- Flood Modeling and Management Study (FAP 25), details of flood levels and return periods at gauging stations, and analysis of impacts of embankment scenarios.

Potential uses and users of the flood loss and flood proofing data are discussed in Chapter 6.

1.4 Methodology

1.4.1 Background

The charland flood loss and flood proofing study built on the population and resource inventory

(which had already been completed for the Brahmaputra-Jamuna when the survey was designed). It was decided that a formal sample survey was required in order to obtain detailed household-level data not available from the inventory, which would enable the estimating of flood losses and household-level impacts. Population estimates of losses were needed for limited study areas, which could be used in estimating, on a preliminary basis, the potential benefits of flood proofing programs.

The Jamuna inventory survey, then, provided a mauza-level sample frame and background data on which to finalize the study areas. Rapid rural appraisals (RRAs) were then done in both study areas as part of the charland socioeconomic study. The RRAs provided more detailed background data on some of the villages included in the household surveys, provided some insight into flood impacts and the local economy, and facilitated the collection of household lists. Finally, detailed topographic-level data were collected during the household surveys for a small number of typical chars. These data have been used in the case studies in Chapter 5. The procedure was as follow:

- defining the study areas (Section 1.3.2);
- analyzing inventory data;
- designing the questionnaire;
- sampling of mauzas;
- RRA to collect background data and household lists (*khana*);
- field updating of household list and household sampling;
- conducting the questionnaire survey;
- entering and verifying data; and
- tabulating and analyzing data.

1.4.2 Sampling Method

Probability sampling was necessary in order to estimate confidence intervals for losses, as well as to enable testing of the significance of any differences between the two study areas. The method adopted was that used in FAP 12's "Project Impact Evaluations" (FAP 12, 1991), which had already been approved by FPCO, and which has subsequently been adopted by a number of other projects and departments including Department of Agriculture Extension.

No stratification was used within the two study areas; mauzas could have been grouped according to char type, but the mauzas quite often include areas of more than one type. Also, in order to achieve the same level of precision and confidence for samples from each of three land types in the two study areas, many more interviews would have been needed.

The standard formula (Casley & Kumar, 1988)[3] assumes simple random sampling; this implies a list of all households in the study areas from which a sample would be drawn. This would be inefficient in terms of the large amount of resources needed to draw up such a list. The method adopted in other studies (FAP 12, 1991), and in this study, is to use a cluster sample. Mauzas are selected as a first-stage sample, then households within these clusters are sampled. This reduces the task of compiling household lists, but there is a loss of efficiency due to positive intra-cluster correlation (members of the same cluster tend to be more similar to one another than to members of other clusters). Therefore, there is a trade-off: as cluster size increases the survey is easier to manage, but the number of interviews required is larger to counteract similarities within clusters.

A further complication was the desire in this study to have samples within each cluster that were large enough to give agencies devising pilot flood proofing programs some indication of the variation in flood experience and losses within each mauza. To achieve this, 10 households per mauza were surveyed. A total sample of 150 households (15 clusters of 10) was taken for each of the two study areas (a total of 300 interviews).[4]

1.4.3 Sample Implementation

The charland inventory provided a complete list of mauzas in the study areas, along with the number of households present in mid-1992.[5] The first-stage sample was drawn at random on a "probability proportional to size" (PPS) basis, "size" being

the number of households. This avoids biasing the results toward mauzas with smaller populations, and ensures that each household has an equal chance of being selected. This resulted in a list of 15 mauzas in each of the two study areas.[6]

During the RRA, the list of households compiled by the union parishads (the *khana* list, which is used for determining local taxes) was obtained for each of the mauzas. This formed the basis for sampling households. When the interview team visited the mauza the first task was to update the list before the survey. The *khana* lists needed updating for three reasons:

- erosion and accretion in the charlands mean that households move more frequently than those in mainland areas;
- poor landless households and those living on other people's land may be omitted from the list since they are not eligible for taxation; and
- the lists are usually a few years out of date.

Updating was done by checking the list with old residents of the mauza, from more than one neighborhood (*para*) where the mauza was large. Informants were asked whether households were still present, or divided, or had left; and whether any new households were present.

Sampling from the updated list was done on the spot. A simple linear random sample was drawn since the lists were usually ordered spatially by homestead (*bari*).[7]

1.4.4 Questionnaire

Household data was collected using a Bangla-language questionnaire (the original and an English translation are in Appendix A). The questionnaire was largely precoded and consisted of about 450 discrete pieces of information covering the following issues:

- household composition and occupation;
- land ownership and history;
- homestead and asset ownership;
- flood and erosion history;
- impacts of the 1988 flood;
- impacts of the 1991 flood;
- measures used to protect the homestead;
- recent erosion experience; and
- preferences for flood loss mitigation measures.

The survey required a mixture of household-level data and opinions from both male and female respondents (usually the senior man and woman in the household). The interviewers were instructed to ask the male respondent at the end of the interview—by which time a rapport had been built up—for permission to ask some of the same questions of his wife. Generally this was granted. Sometimes women's responses may have been influenced by the men, and sometimes permission was refused. In general, though, the data suggest that flood impacts on women, and their perceptions of those problems, are different from those of men.

1.4.5 Population Estimates

The two-stage sampling method adopted in this survey means that standard calculations of variances are not appropriate as they ignore cluster effects. Variance algorithms derived from Cochrane (1983) and Poate and Daplyn (1990) were used and are reproduced in Appendix B. These enable confidence intervals to be computed for estimates of means and totals for each of the study areas, which is important when estimating the losses incurred in past floods and the potential benefits of flood proofing measures.

1.5 Report Organization

The household interview surveys provide estimates of the numbers of households affected in different ways, the total and mean losses, and proportions favoring different measures.

Chapter 2 provides background information on the two study areas, derived from the inventory and

RRA, and information on the characteristics of the sample households. Chapter 3 reports the impacts of the 1988 and 1991 floods in these two areas. Chapter 4 reports the respondents' assessments of potential measures to reduce flood losses and makes preliminary estimates of the potential benefits and costs of some flood proofing options. Case studies of flood proofing in two char areas are in Chapter 5, and Chapter 6 presents the conclusions of the study and recommendations on the application of flood proofing in charland areas.

NOTES

1. The charlands in this study have been defined to include not only island chars but also the mainland areas referred to as active floodplain in World Bank (1989).

2. In all of the maps included in this report the international boundary has been derived from available map sources, it is approximate, and should not be taken as authoritative.

3. The classical theory of probability sampling determines optimal sample size for estimation of population parameters from a sample as a function of the following, see Casley and Kumar (1988) for formula:

- the parameter's variability;
- the acceptable margin of error in estimating a population parameter; and
- the required level of confidence that the true value of the population parameter being estimated lies within the specified margin of error.

4. As shown in FAP 12 (1991), for an 80 percent confidence level (two-tailed) with coefficient of variation of 50 percent, acceptable margin of error of 10 percent, and intra-cluster correlation coefficient of 0.2, the required sample size is 115 households. This intra-cluster correlation coefficient is recommended for agricultural data, but it is unknown whether it is reasonable for flood hazard and loss data, which may be more homogeneous within a cluster.

5. Probability sampling requires that every member of the population under study have a known non-zero probability of inclusion in the sample.

6. Except that one very large mauza in Bhuapur area (Lower Jamuna) appeared in the sample twice, so 20 interviews were conducted there.

7. Every nth household was selected where n = number of households divided by sample size (10), with a random starting point among the first n households.

Chapter 2

STUDY AREA CHARACTERISTICS

2.1 Study Area Description

2.1.1 General Features of Charlands

Charland is very young alluvial land located within the active floodplain of a river. Chars have complex patterns of ridges and inter-ridge depressions, in-filled channels and cut-off channels, and suffer a high risk of erosion. The annual flooding of rivers deposits sediments to form new charland and to bury old land; these deposits can be as deep as two to three meters or more in places. Few of the land masses studied have remained stable over the past 20 years.

Erosion and accretion phenomena greatly influence the lives of people who live on the chars. While the social life of char people is organized according to principles similar to those of rural people on the mainland, some important variations are imposed by the nature of the environment. Char villages, like those elsewhere, have neighborhoods (*paras*), but these frequently change as people move their houses around to avoid erosion or take advantage of newly accreted lands. Society is structured according to kinship groups—lineage (*gushti-sarik*) or marriage networks—and the all-important *samaj*, or community of people committed to mutual support. In matters of kinship, char society is relatively isolated from the mainland.

Groups of charland homesteads are set amid fields or sandy lands, and the layout of most settlements is linear; clustered groupings of households are less frequent than in mainland areas. Homesteads are arranged in groups of two to 20 households in continuous or broken lines set apart from each other. These homesteads are usually built along the higher land on ridges that are least affected by flood water. The quality of housing is extremely variable, reflecting not only the socioeconomic position of the households but also how long people plan to stay in a particular location. Changes in land formations sometimes require the shifting of whole villages.

The organization of homesteads (*baris*) is similar to that of mainland homesteads, most consisting of a group of three to five structures for cooking, sleeping, and storage set around a central courtyard that is partly shielded by small fences (Plates 1 and 10). Related households tend to live in adjacent homesteads. Buildings have earthen floor plinths and frames made of timber or bamboo, and wall and roof coverings are of catkin grass, jute sticks, or corrugated iron (CI) sheet. The temporary nature of many settlements results in house floor plinths that are low or absent and uneven house walls and fences. Another sign of the often temporary nature of charland homesteads is the absence of trees and gardens. The more stable a char settlement is, the more it resembles a mainland settlement with high packed-earth floor plinths, neatly built fences, and many trees.

The durability of building materials in charland dwellings varies. A thatched roof needs replacement every 1.5 to 2 years, while a CI roof lasts 30 to 40 years. Catkin walls need replacement either every 3 to 4 years for lighter weight stems or every 4 to 5 years for thicker stems. Like CI roofs, CI walls are long-lasting and need replacement only after 40 to 50 years.

Trees and other vegetation are indicators of a char's stage of development, the confidence settlers have in their ability to stay in a particular location, and the probability of submergence during the monsoon (Plates 9 and 10). The sandy land of newly accreted chars often becomes overgrown with catkin grasses (*Saccharum spontaneum*) that can grow up to 2 m in height. The most common and first-planted trees are banana, *Lannea coromandelica (jiga), Impomoea fistulosa (dholkalmi)*, and sometimes bamboo—all of which are useful as building materials and protection from wave action during floods. Older, more stabilized chars have more varied flora that may include mulberry, and possibly mango, coconut, betel, guava, teak, or plum. Fruit trees—mainly bananas—and vegetables are grown in small patches in and around homesteads and are tended by women.

Agriculture—direct cultivation or day labor—is a major source of income for people living on the island and attached chars and unprotected mainland. Only a few households depend on fishing. Business occupations are more likely on the mainland or near larger urban centers where there are more opportunities. Paid household work is the main activity for women outside their own home, and it is particularly important to female-headed households.

Agriculture activities vary according to erosion/accretion patterns and sand deposition as a result of flooding. Changes in soil quality force farmers to change cropping patterns from year to year. In average years, lowland often starts to flood during May-June and it remains flooded until September to depths of 1 to 3 m, depending on location. Medium land is flooded from June-July through September to depths of 0.5 m to 2 m. Highland is not often flooded, although some parts may flood during August and September to depths of as much as 1 m.

The main *rabi* crops are sweet potatoes, millet, pulses, and wheat. Groundnuts are grown in some areas as a commercial crop. In *kharif,* it is common practice to grow local varieties of mixed aus and aman. Some jute is also grown during the early *kharif* season, but its importance is declining. Catkin grass grows in all areas, and is harvested and sold for fodder or building materials. Crops are not irrigated in most areas.

The rearing of livestock is a major economic activity in most char areas because of the availability of grazing land and fodder and the ability to move the animals during floods. The constant demand for all forms of livestock also allows them to be sold in times of need. Milk is usually seen as a by-product of having cows rather than as a production goal in itself. Cattle are usually tended by men, while women care for goats and poultry.

Engine boats are the main form of transport in char areas, but there also are local boats powered by oars or sails. During the dry season people get around by using a combination of walking and ferry boats, which makes moving heavy goods during this season a problem. During the monsoon, strong currents and waves make navigation between villages and markets difficult. Rafts made from banana trunks are used to move within villages during the monsoon. Overall, there tends to be a shortage of boats, especially during floods when demand for boats is at its peak and boats are required to assist in evacuation and to carry people and goods to market.

2.1.2 Features of the Kurigram Area

The Kurigram study area consists of 57 mauzas in 10 unions in Kurigram and Nageswari thanas of Kurigram district (Figure 2.1). The charland classification of the study mauzas, as shown in Table 2.1, is: unprotected mainland, 44 percent; island char, 32 percent; and attached char 24 percent.[1] All of the mauzas are inhabited.

During the 1992 dry season, 11 percent of the total mauza area was water, 79 percent was land with some vegetative cover (including cultivated land, grazing land, etc.), and 10 percent was sand. The area of land with vegetative cover ranged from 95 percent on the unprotected mainland to 63 percent on the attached charland.

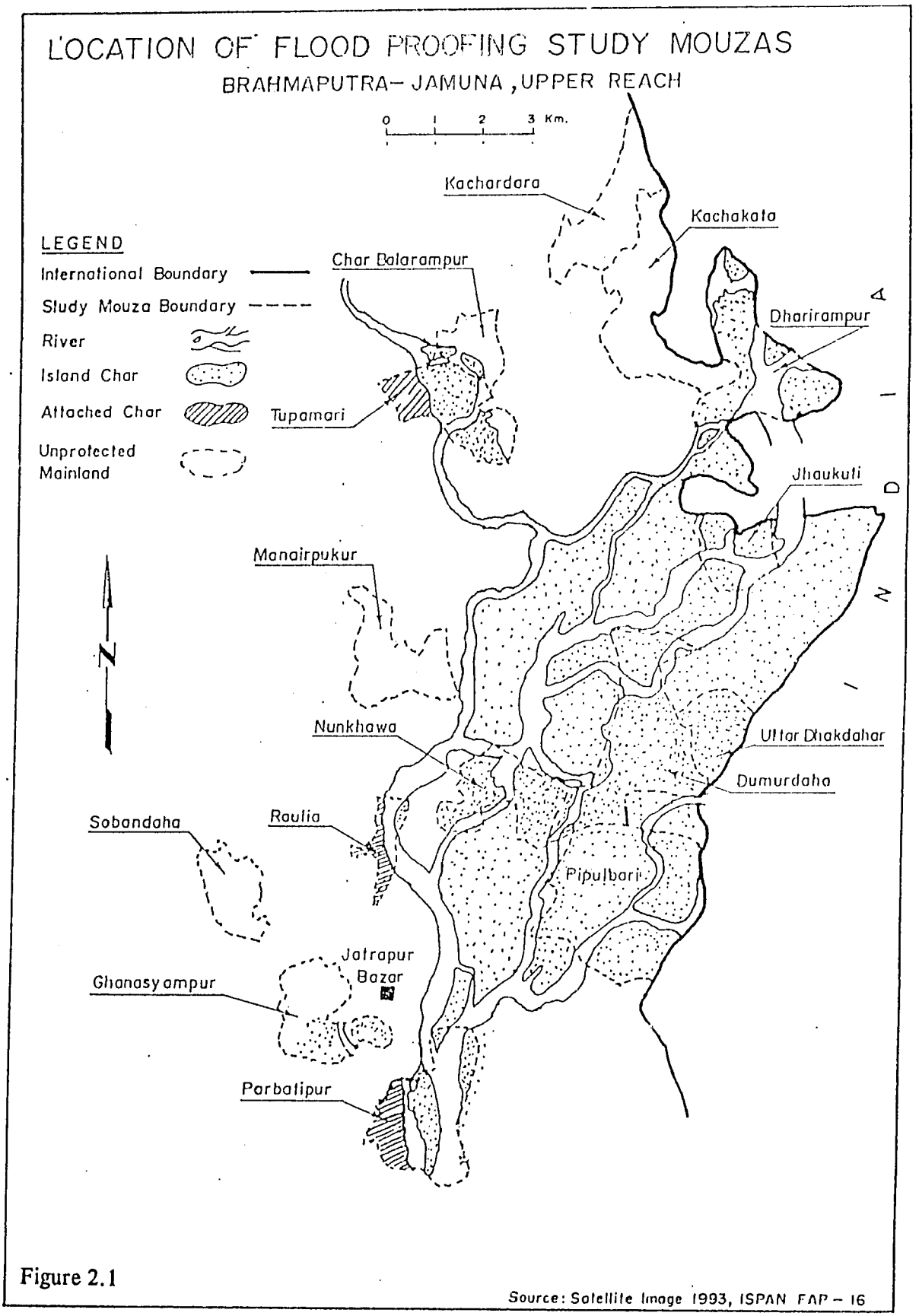


Figure 2.1

Source: Satellite Image 1993, ISPAN FAP – 16

15

Table 2.1 Population and Land: Kurigram

	Island Char	Attached Char	Unprotected Mainland	All
No. of Mauzas	15	16	26	57
Total Area (ha)	11,237	8,260	14,602	34,099
Water (%)	16	19	3	11
Sand (%)	16	18	2	10
Land (%)	68	63	95	79
1981 Population	17,927	22,788	92,507	133,222
1992 Population	27,971	30,498	113,056	171,525
1992 Households	4,248	4,991	19,519	28,758
1981 Persons/km^2	160	276	634	391
1992 Persons/km^2	249	369	774	503
Population Increase 1981-92 (%)	56	34	22	29

Source: Charland Inventory and FAP 19 image analysis

During the period from 1984 to 1992, attached charland was subject to bank erosion more than either unprotected mainland or island chars.[2] During that period, about 4.6 percent of the area was eroded and only 0.4 percent of the land was accreted, indicating a net loss of 4.2 percent of mainland area (Table 2.2).

The population of the mauzas in 1981 was 133,222, of which 13 percent lived on island chars, 17 percent on attached chars, and 70 percent on unprotected mainland (Table 2.1). The population had risen to 171,525 by 1992, and the distribution of population on the various land types was similar: 16 percent on island chars, 18 percent on attached chars, and 66 percent on unprotected mainland. Population density on the mainland (774 persons/km^2) is much higher than on the island chars (249 persons/km^2) and attached chars (369 persons/km^2), but it is similar to the average population density of the country (763 persons/km^2). The low population densities on the

Table 2.2 Bank Erosion and Accretion: Kurigram

	Island Char	Attached Char	Unprotected Mainland	All
Total Area (ha)	11,237	8,260	14,602	34,099
Eroded (land → water; %)	.7	15.0	1.8	4.6
Accreted (water → land; %)	.1	1.4	0	.4
Channel (water → water; %)	97.9	60.1	2.9	48.0
Land (land → land; %)	1.4	23.6	95.3	47.0
Mauzas with Erosion (%)	1.8	17.5	15.8	35.1
Mauzas with Accretion (%)	1.8	5.3	1.8	8.8

Source: FAP 19 image analysis

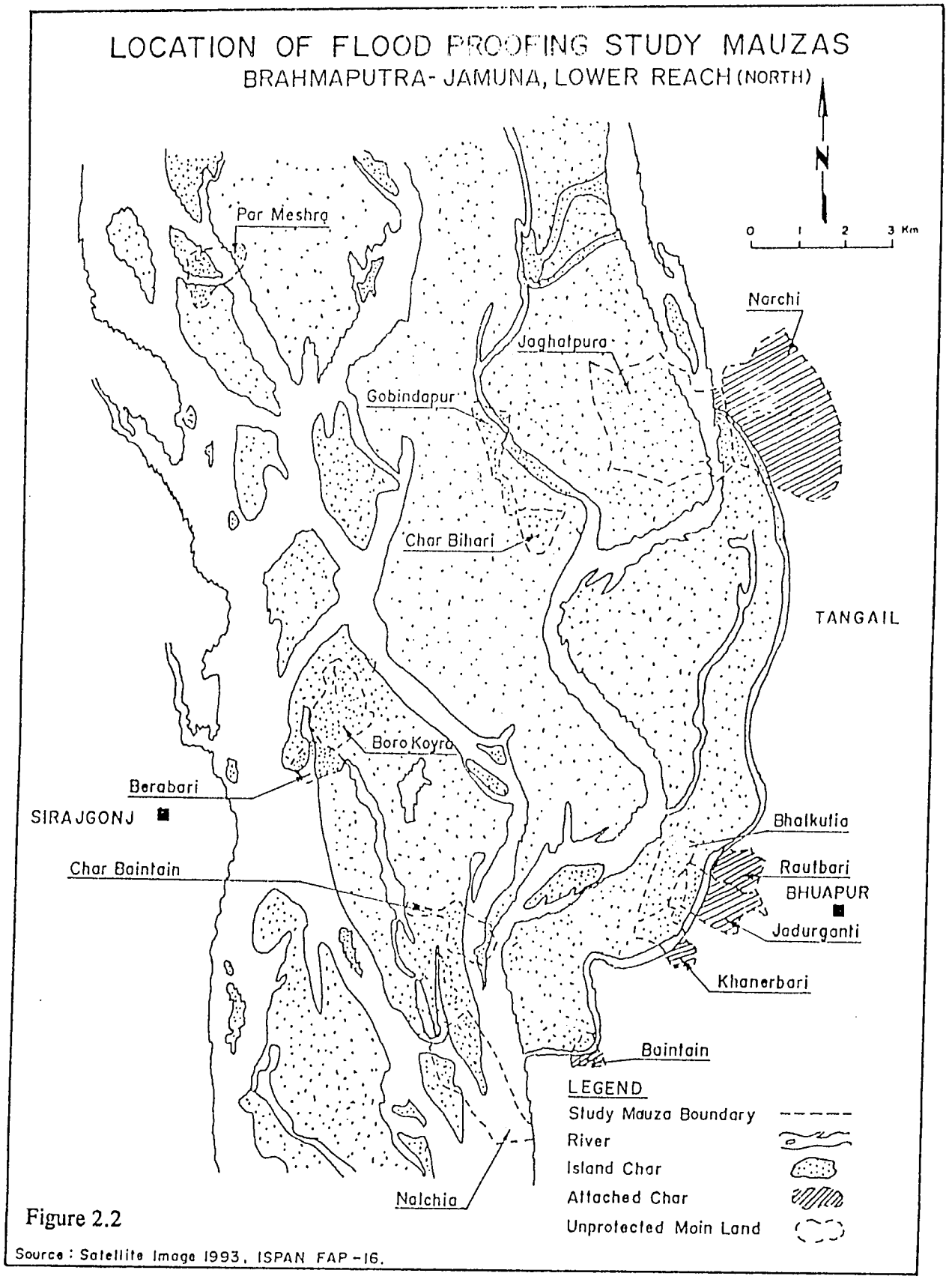


Figure 2.2

Source : Satellite Image 1993, ISPAN FAP-16.

Table 2.3 Availability of Services and Infrastructure: Kurigram (percent)

Service/Infrastructure	Island Char	Attached Char
Health Centers	0	0
Primary School	87	60
Secondary School	7	0
Hat (Market)	0	20
Launch Ghat	0	0
Active NGO	7	10
Mauzas	15	10

Source: Charland Inventory
*Infrastructure data were not collected for unprotected mainland.

No health care facilities are available in the study mauzas (Table 2.3). While there are primary schools in more than half of the mauzas, secondary schools are rare. There are no *hats* or markets on island chars, and NGOs are active only in a few places.

The mauzas selected for the household surveys (Figure 2.1) are distributed throughout the study area, and include several remote mauzas close to the border of Bangladesh. Selection of mauzas for the household survey followed the procedures described in Section 1.4.2.

2.1.3 Features of the Bhuapur Area

island and attached chars are probably due to the significant areas of sand and water within the mauzas, the difficulty of supporting human settlements on unstable land, and the limited availability of employment opportunities. There were an estimated 28,758 households in the study area in 1992.

The Bhuapur study area consists of 148 mauzas located in 10 unions in Bhuapur and Sirajganj thanas of Tangail and Sirajganj districts (Figure 2.2). Of these mauzas, only 84 are inhabited, and of the remainder, five are completely submerged and 59 are mainly water and have only small areas of sandy char during the dry season. The charland

Table 2.4 Population and Land: Bhuapur

	Island Char*	Attached Char	Unprotected Mainland	All
No. of Mauzas	76	29	38	148
Total Area (ha)	19,919	4,607	5,099	29,265
Water (%)	28	18	11	23
Sand (%)	19	11	2	15
Land (%)	53	71	87	62
1981 Population	65,704	26,018	32,636	124,359
1992 Population	80,966	24,699	44,876	150,542
1992 Households	13,106	4,039	7,673	24,818
1981 Persons/km^2	330	565	640	425
1992 Persons/km^2	406	536	880	514
Population Increase 1981-92 (%)	23	-5	36	21

Source: Charland Inventory and FAP 19 image analysis
*Excludes 5 submerged mauzas (total area 360 ha).

18

Table 2.5 Bank Erosion and Accretion: Bhuapur

	Island Char	Attached Char	Unprotected Mainland	All
Total Area (ha)	19,919	4,607	5,099	29,265
Eroded (land → water; %)	4.1	26.7	10.1	8.6
Accreted (water → land; %)	0.4	6.7	11.5	3.3
Channel (water → water; %)	95.1	46.6	9.3	72.7
Land (land → land; %)	.5	20.0	69.1	15.3
Mauzas with Erosion (%)	8.8	8.8	8.1	25.7
Mauzas with Accretion (%)	1.4	6.8	6.8	14.9

Source: FAP 19 image analysis

classification of the study mauzas, as shown in Table 2.4, is: island chars, 68 percent; unprotected mainland, 17 percent; and attached chars, 16 percent.

During the dry season, 23 percent of the total area of the mauzas was water, 62 percent was land with some vegetative cover (including cultivated land, grazing land, etc.), and the remainder (15 percent) was sand. The area of land with vegetative cover ranged from 87 percent on the unprotected mainland to 53 percent on the island chars.

During the period from 1984 and 1992, attached char was subject to bank erosion more than either unprotected mainland or island chars.[3] During that period, about 8.6 percent of the area was eroded and only 3.3 percent of the land was accreted, indicating a net loss of 5.3 percent of land area (Table 2.5).

The population of the mauzas in 1981 was 124,359, of which 53 percent lived on island chars, 21 percent on attached chars, and 26 percent on unprotected mainland (Table 2.4). The population had risen to 150,542 by 1992, with the population increasing mainly on island chars (65 percent) and unprotected mainland (30 percent) and declining on attached chars (17 percent). The decline in the attached char population may have

Table 2.6 Availability of Services and Infrastructure: Bhuapur (percent)

Facility	Number of Inhabited Mauzas Reporting	Percent with Facility	Percent of Mauzas with Facilities, by Type		
			Island Char	Attached Char	Unprotected Mainland
Health Centers	79	29	13	18	71
Primary School	84	60	62	42	64
High School	84	12	10	8	18
Weekly Market (*hat*)	80	25	23	0	43
Launch Ghat	82	7	0	17	18
Active NGO*	84	46	38	50	64

Source: Charland Inventory

*SCI covers 38 percent of island mauzas and 50 percent of attached char mauzas.

been due to the high incidence of erosion and the related loss of land. The growth in population on the island chars was similar to the national average during the same period. Population density on the mainland (880 persons/km^2) is much higher than on the island chars (406 persons/km^2) and attached chars (536 persons/km^2) and slightly higher than average population density of the country (763 persons/km^2). There were an estimated 24,818 households in the Bhuapur study area in 1992.

There are health centers in 29 percent of the mauzas (Table 2.6). Primary schools are adequate in number, but high schools are rare. There are no *hats* or markets on attached chars, and NGOs are active in nearly 50 percent of the mauzas.

The mauzas selected for the household surveys (Figure 2.2) are concentrated on the eastern side of the study area, which is a result of the sampling method based on the probability proportional to (population) size (PPS) random sample. Most of the population lives on the eastern side, as many of the mauzas on the western side of the area are uninhabited river channel. Selection of mauzas for the household survey followed the procedures described in Section 1.4.2.

2.2 Background Data from the Household Survey

2.2.1 The Household Survey

A total of 150 households were interviewed in each of the two study areas. In Bhuapur, 47 percent of the households surveyed lived on island chars, 33 percent on attached chars, and 20 percent on unprotected mainland. In Kurigram, 40 percent lived on island chars, 15 percent on attached chars, and 45 percent on unprotected mainland. The mean size of the households surveyed was 6.45 (±0.33) in Bhuapur and 6.74 (±0.25) in Kurigram.[4]

For the purpose of making overall estimates of flood impacts for the two study areas, households were not segregated since they were chosen from a random sample of households in each mauza. It is important, however, to understand the types of households found in the study area and the sample.

Overall, 23 percent of households were joint families in a broad sense. There were slightly more joint families in Kurigram than in Bhuapur, but the difference was not significant nor did it differ between char types. There are only a few (5 percent) subnuclear families in the study areas, while most joint families are lineal joint.

Several households in both study areas are *uthuli*, settlers who are not expected to pay rent for the lands on which they have built their homesteads because they have no way of doing so. Settlers accepting these conditions appear to have an obligation to perform labor for their hosts in exchange for their temporary settlement rights. The incidence of *uthuli* is higher in the Kurigram area than in Bhuapur (Table 2.7), and it is particularly high in the attached chars of Kurigram (46 percent).

Table 2.7 Distribution of *Uthuli* by Location

Char Type	Sample House-holds	Households Changing *Samaj* When Moved (%)	Households Living as *Uthuli* (%)
		BHUAPUR	
Island Char	70	45.7	24.3
Attached Char	50	20	18
Unprotected Mainland	30	13.3	6.6
		KURIGRAM	
Island Char	60	38.3	16.7
Attached Char	22	27.3	45.5
Unprotected Mainland	68	12	21

Source: Household Flood Proofing Survey

The stability of *samajes* is also indicated by the data in Table 2.7, which shows that households that move are more likely to change their *samaj* on island chars in both study areas. This reflects the more dynamic physical environment of the islands and the breakup of communities when islands are submerged.

2.2.2 Land Ownership

Landholding size is a commonly used indicator of household socioeconomic status. The survey households were categorized according to operated holding as non-farm (no operated farmland owned by the household), farming 1-49 decimals, 50-249 decimals, 250-749 decimals, and more than 750 decimals. The distribution of households by farm size is shown in Table 2.8.

Table 2.8 Land Ownership

Landholding Category	Percentage of Households		Percentage of Joint Families Bhuapur and Kurigram
	Bhuapur	Kurigram	
Landless	29	33	13
Marginal	17	9	15
Small	35	43	22
Medium	15	8	43
Large	3	7	67
All	-	-	23

Source: Household Flood Proofing Survey

The proportion of joint families was found to vary systematically with farm size category; hence, size of landholding is a good indicator of wealth and of social support systems available in times of need. As Table 2.9 indicates, farm size and especially landholding size is more unequal in Kurigram than in Bhuapur. Respondents in Bhuapur said that they owned more submerged land than respondents in Kurigram, which corresponds with the more active charland dynamics in the Lower Jamuna. Table 2.9 also shows that all household types own areas of non-cultivated land. This, plus the homestead, amounts to the land ownership of non-farm households. Households in the largest farm category (>750 decimals) in Bhuapur share-crop in large areas of land (hence their small owned areas). This may again be associated with charland dynamics;

Table 2.9 Land Ownership by Size of Operated Holding

Utilization Category	Non-farm	1-49 Decimals	50-249 Decimals	250-749 Decimals	>750 Decimals
BHUAPUR					
Average land operated (ha)	0.0	0.12	0.54	1.37	2.44
Average land owned (ha)	0.29	0.20	1.21	2.23	2.21
Average not cultivated (ha)	0.14	0.08	0.54	0.64	0.85
Average submerged (ha)	0.32	0.18	0.37	1.32	2.06
KURIGRAM					
Average land operated (ha)	0.00	0.12	0.58	1.36	3.36
Average land owned (ha)	0.19	0.27	0.88	1.87	5.72
Average not cultivated (ha)	0.12	0.19	0.41	0.55	2.23
Average submerged (ha)	0.13	0.10	0.32	0.52	1.32

Source: Household Flood Proofing Survey

Table 2.10 House Construction and Cost

	House Type		
	All *Kutcha*[*]	*Kutcha* Wall, CI[†] Roof	All CI
BHUAPUR			
% of Total Houses	25	54	21
Mean Dimensions (m^2)	14.2	18.6	32
Mean Cost (Tk./house)	1,608	9,490	33,594
Unit Cost (Tk./m^2)	113	510	1,010
KURIGRAM			
% of Total Houses	81	14	5
Mean Dimensions (m^2)	15.7	22.7	33
Mean Cost (Tk./house)	1,742	10,725	27,429
Unit Cost (Tk./m^2)	111	472	831

Source: Household Flood Proofing Survey
[*]*Kutcha* = Straw, leaves, grass, catkin, jute sticks, bamboo.
[†]CI = corrugated iron.

households own land in more than one char and cannot operate all their land at one time, so richer households tend to share-crop land within reach of their homesteads. Overall, very little land in either area was reported to have been permanently lost to erosion in recent years.

The percentage of landless and marginal households in both study areas is lower than the national average, but the data on land ownership is distorted by the fact that significant areas are either submerged or covered by sand, both conditions that make the land unusable. People maintain their rights to eroded or sandy land in the hope that one day it may re-emerge and become productive again. The significance of land ownership in terms of potential production is shown in Table 2.9. Only the small, medium, and large farmers own significant areas of productive land, and even though landless households may own some land, they are functionally landless, as are most marginal households. Given the low quality of much of the charland, the production of many small landholdings will also be extremely limited.

2.2.3 Houses and Buildings

Table 2.10 shows that the quality of housing in Bhuapur is much better than in Kurigram: 81 percent of the houses in Kurigram are *kutcha*[5] compared with only 25 percent in Bhuapur. In Bhuapur, 50 percent of the landless and marginal families have at least CI sheet roofs, while in Kurigram only 2 percent of landless and no marginal families have CI sheet roofs. The high percentages of houses with straw roofs, particularly in Kurigram, indicate that most households are poor. In both study areas, larger landholdings are associated with more permanent houses and use of CI sheet in construction.

Floor areas of *kutcha* houses are slightly larger in Kurigram than in Bhuapur (15.7 m^2 compared with 14.2 m^2), while the floor areas of semi-*pucca* houses (*kutcha* walls and CI roof) are about 20 m^2 in both places. The floor area of *pucca* houses is similar in Kurigram and Bhuapur (32-33 m^2).

Housing construction costs are similar in both locations (Table 2.10). Depending on floor area, a *kutcha* house costs about Tk. 1,600 to Tk. 1,750, which is equivalent to about Tk. 112/m^2 of floor area. Semi-*pucca* houses cost Tk. 9,500 to Tk. 10,750, depending on floor area, or Tk. 500/m^2. *Pucca* houses cost about Tk. 27,500 to Tk. 33,500, or Tk. 920/m^2.

2.2.4 Livestock

Livestock are a major part of the local economy in both areas. In Bhuapur in 1993, there were 28,292 cattle or 1.14 cattle/household. In Kurigram there were 54,832 cattle or 1.91 cattle/household. The availability of cattle in Kurigram is higher than the national average of 1.33 cattle/household,[6] but it is slightly lower than the average in Bhuapur.

The number of cattle have declined significantly since 1988 in both study areas. In Bhuapur, there were 70,814 cattle in 1988; by 1991 there were only 37,392. In Kurigram, there were 77,263 cattle in 1988 and 60,008 cattle in 1991. The decline in cattle seems to indicate that local economies are still adjusting to the losses incurred in the 1987 and 1988 floods.

2.2.5 Ownership of Other Assets

The other large assets owned by char people are shown in Table 2.11. Boats are a major asset during the monsoon, particularly during floods, but few households, even among large landholders, own any kind of boat. This indicates a high level of dependence on the households who own boats and the need for money to hire boats when required.

Radios are owned by several households in all categories, with the exception of landless and marginal households in Kurigram. Many households also own trees, particularly in Kurigram, indicating greater stability of land in that area.

2.2.6 Economic Activities

Agriculture is the main activity for 54 percent of households in Kurigram but only 34 percent in Bhuapur (Table 2.12), indicating a more diversified economy of the Lower Jamuna area. Trade and business/service activities are important activities in Bhuapur. In both locations about 25-30 percent of households depend on laboring. Fishing is the main activity for about 3 percent of households in both study areas. Women have relatively little involvement in paid employment outside the homestead, but some earn income from selling poultry and vegetables.

Agricultural laborers are paid Tk. 15-30/day without meals or Tk. 10-25/day with two meals. Laborers employed for house building or earth-cutting are paid about Tk. 20-25/day without meals or Tk. 15-20/day with two meals. For four or five months a year (during January-May and September-November), many laborers migrate to find work in other districts. Harvesting paddy in other districts can earn Tk. 50-60/day. Laborers travel in groups based on their area, neighborhood, or *samaj*.

2.3 Incidence of Floods and Erosion

2.3.1 Flood Hazard

Table 2.13 shows the estimated return periods for peak water levels during the period 1987-1992 at

Table 2.11 Large Asset Ownership

	Bhuapur					Kurigram				
Asset	Non-farm	1-49 dec.	50-249 dec.	250-749 dec.	>750 dec.	Non-farm	1-49 dec.	50-249 dec.	250-749 dec.	>750 dec.
Small Boat	2	3	0	4	40	2	0	9	8	20
Medium Boat	2	4	4	4	20	2	0	2	8	20
Large Boat	0	0	2	9	0	0	0	2	0	0
Engine Boat	0	0	4	9	0	0	8	2	8	10
Radio	14	19	31	35	40	0	0	26	42	50
Trees	36	5	63	65	40	38	38	49	75	100
Total Households	44	26	52	23	5	50	13	65	12	10

Source: Household Flood Proofing Survey

Table 2.12 Main Occupations and Income Sources (percent)

	Main Source of Income					
	Household		Men		Women	
Occupation	Bhuapur	Kurigram	Bhuapur	Kurigram	Bhuapur	Kurigram
Own Cultivation	18	24	15	22	1	1
Part Sharecropper	15	26	15	26	1	0
Sharecropper	1	4	1	3	0	0
Laborer	26	27	25	30	0	0
Fishing	3	3	3	3	0	0
Transport	7	2	7	2	0	0
Trade*	13	4	13	2	3	1
Service/Business	12	1	14	2	0	1
Paid Domestic Work	1	1	1	1	3	5
Cattle/goats†	1	0	1	0	5	5
Poultry	0	0	0	0	59	55
Other‡	3	7	4	5	13	13
None	0	0	1	3	14	19

Source: Household Flood Proofing Survey

*Trade includes handicrafts.

†Women mainly raise goats, not cattle.

‡Includes beggars and those who raise trees, vegetables, or wild plants; most women in this category get income from vegetables.

Table 2.13 Peak Water Levels and Return Periods

	Chilmari		Kazipur		Sirajganj	
Year	Peak	R.P.*	Peak	R.P.	Peak	R.P.
1987	24.69	19.7	16.2	10.7	14.57	11.7
1988	25.04	85.9	16.7	94.8	15.11	51.6
1989	23.58	1.1	15.7	1.8	13.65	1.2
1990	23.66	1.2	15.51	1.7	13.97	2.2
1991	24.37	5.0	14.94	1.1	13.88	1.8

Source: FAP 25 (1992) and FAP 25 unpublished data

*R.P. = return period; 19.7, for example, indicates a flood that occurs about once every 19.7 years.

Table 2.14 Incidence and Severity of House Flooding 1987-1992

	Households Flooded (%)						Households Building *Machas* (%)					
Char Type	1987	1988	1989	1990	1991	1992	1987	1988	1989	1990	1991	1992
BHUAPUR												
Island	46	99	7	11	41	3	40	91	7	10	33	3
Attached	20	88	6	6	18	0	14	72	4	4	14	0
Unprotected Mainland	3	80	0	0	3	0	3	67	0	0	3	0
Total	29	90	5	7	26	1	24	80	5	6	21	1
KURIGRAM												
Island	23	100	8	13	40	5	22	93	7	12	28	5
Attached	32	100	23	18	41	14	32	86	23	18	32	9
Unprotected Mainland	15	93	9	9	32	4	10	81	9	9	29	4
Total	21	97	11	12	37	6	18	87	10	11	29	5

Source: FAP 19 image analysis

the gauging stations in the Jamuna near the study areas. Chilmari is about 30 km south of the Kurigram area, while Sirajganj is on the western side of the Bhuapur study area. The return period for the 1988 flood varies from 1 in 50 years at Sirajganj in the Lower Jamuna to about 1 in 100 years in Chilmari south of the upper Brahmaputra study area. The difference in water levels for the return periods is small. For example, at Chilmari, there is only 0.67 m difference between the 1-in-5-year peak water level and the 1-in-85.9-year peak water level. At Sirajganj, there is only 0.54 m difference between the 1-in-12-year peak water level and the 1-in-52-year peak water level. The critical factor is that small increases of water level can make a difference between a normal flood, which most char dwellers can accommodate, and a disastrous flood, which causes widespread disruption and suffering.

The significance of small differences in water level is shown in Table 2.14, which reports data on the incidence and severity of household flooding. In 1988, nearly all houses were flooded in both Kurigram and Bhuapur. In 1989, the peak water levels were about 1.5 m less at Chilmari and Sirajganj, and less than 10 percent of the houses were flooded, except in the attached char in Kurigram, where 23 percent of houses were flooded.

In addition to water levels, the rate of rise, duration, and timing of the flood determine the severity of its impact. In 1991, the duration of the flood was long, and in 1993, the rate of rise of flood water was rapid, both factors resulting in very disruptive floods.

Temporary platforms (*machas*) were built in most but not all houses in 1988, particularly in island chars. *Machas* tend to built by most households flooded above floor level, implying that construction of *machas* is seen as a flood response rather than a flood preparation activity.

2.3.2 Erosion Hazard

This study is primarily concerned with flood losses and potential benefits from flood proofing measures, but flooding of land within or adjacent to the river channel cannot be considered in isolation from erosion hazards (Plate 7). Charlands have a

Table 2.15 Incidence of Erosion 1987-1992

Char Type	Households with Land Eroded (%)						Households with Homesteads Eroded (%)					
	1987	1988	1989	1990	1991	1992	1987	1988	1989	1990	1991	1992
BHUAPUR												
Island	50	59	36	36	37	30	13	24	6	13	7	3
Attached	40	58	52	50	50	38	8	14	2	8	4	4
Unprotected Mainland	7	10	3	7	10	7	0	7	0	0	0	0
Total	38	49	35	35	38	28	17	3	9	5	0	3
KURIGRAM												
Island	27	40	27	27	25	18	5	32	7	10	3	3
Attached	27	36	23	28	36	32	5	32	9	14	9	41
Unprotected Mainland	13	18	6	10	7	3	0	16	4	9	2	0
Total	21	30	17	19	19	13	3	25	6	10	3	7

Source: FAP 19 image analysis

high risk of erosion, particularly island and attached chars, and inhabitants of those areas have adjusted their activities to take erosion into account. The differences between floods and erosion should be recognized, however. Erosion is more devastating, especially for those living on mainland, as the loss of land is complete, leaving the owner with nothing. Furthermore, the land is usually lost for an indeterminate period of years, perhaps even decades. With floods, losses are usually temporary, and land can be re-used once the flood recedes.

Erosion is a more widespread problem in Bhuapur than in Kurigram as more households lost land to erosion in the Lower Jamuna during the period 1987-1992 (Table 2.15). Households on attached mainland lost more land to erosion than those on island chars, and households on unprotected mainland lost significantly less land to erosion than either island or attached chars. In Kurigram, land lost to erosion was similar for households on both island and attached chars.

The maximum number of homesteads lost to erosion in both study areas occurred in 1988. Homesteads in Kurigram appear to be just as erosion-prone as those in Bhuapur. It is clear that erosion is an ever-present hazard, which is worse—but not dramatically worse—in high flood years. Overall, there is a high chance of losing agricultural land, which must limit interest in investing in agricultural inputs such as tubewells. The long-term risk of homestead erosion is high in the chars, resulting in lower property values and, hence, lower flood damages in absolute terms, although the impact of flooding may be just as great. The risk is that investments in char infrastructure are unlikely to last for a long time. Measures that are portable or flood and erosion proof (for example, increased income earning opportunities, business developments in boats or cattle, and houses that can be moved) are clearly preferable.

2.3.3 Relationship between Floods and Erosion

Comparison of Tables 2.14 and 2.15 shows that erosion is more prevalent at times of more severe floods. This finding confirms the previous analysis of satellite images and the charland inventory,

which showed that peaks in bank erosion coincided with peak floods (FAP 16/19 1993). Nonetheless, Table 2.15 also indicates that sizable numbers of households can be affected by erosion in years with little or no flooding. In general, erosion peaks are not as accurately recorded as flood peaks.

NOTES

1. These areas are derived from the land cover classification reported in the Jamuna Inventory Report (FAP 16/19 1993) and are based on the 1992 Landsat image.

2. Within-channel erosion and accretion are not included; hence, island chars will be subject to greater erosion/accretion than shown.

3. Within-channel erosion and accretion are not included; hence, island chars may be subject to greater erosion/accretion than shown.

4. All confidence intervals in this and subsequent chapters are 80 percent confidence intervals. For example, there is an 80 percent probability that the actual mean household size for the whole 24,818 households in Bhuapur is between 6.11 and 6.78.

5. *Kutcha* houses are made from vegetative material such as catkin grass, straw, jute sticks, or bamboo.

6. Based on 1983/4 Agriculture and Livestock Census and 1981 Population Census.

Chapter 3

IMPACT OF FLOODS

3.1 Introduction

This chapter documents the direct flooding damage reported by households in the Kurigram and Bhuapur study areas. The sample design (Section 1.4.2) makes it possible to estimate the total losses experienced in the two study areas (along with confidence intervals (Appendix C) and gain some insight into the magnitude of flood losses along the Brahmaputra-Jamuna. Two floods were selected for detailed investigation: 1988 and 1991.

The 1988 flood was the worst in living memory in both areas; respondent's memories of its impacts were still vivid at the time of the survey.

The 1991 monsoon was selected for comparison because flood level data and return period estimates were available and because the inventory had collected basic information on flood extent and duration for that year. The 1991 flood was the most recent flood to cause any notable damage in the two study areas. In Kurigram the flooding was moderate (a 1-in-5-year flood) and in Bhuapur it was nearly normal (a 1-in-2-year flood) according to water level analysis done by FAP 25. The 1991 event, therefore, constitutes a control case of more normal conditions from which minimal flood losses can be estimated. These estimates can then be used to calculate average annual flood proofing benefits (Chapter 5).

This chapter also reports how people coped during these two events: who evacuated, what problems they faced, and what means they found to recover from their losses.

3.2 Impact of the 1988 Flood

A majority of the houses of the sample households were flooded in 1988 (Table 3.1), although the

Table 3.1 Household Flood Depth and Duration, 1988

	Bhuapur		Kurigram	
	% Flooded	Mean	% Flooded	Mean
Flood Depth (m)				
All	87	0.69	97	1.05
Island Char	97	1.13	100	1.34
Attached Char	84	0.80	100	1.82
Unprotected Mainland	70	0.44	93	1.18
Duration (days)	—	14.3	—	14.0

Source: Flood Proofing Household Survey

Table 3.2 Incidence of Evacuation by Flood Depth, 1988

Mean Depth (m)	Bhuapur				Kurigram			
	H/H Member Present at Home	H/H Member Evacuated	% Evacuated	% Not Evacuated	H/H Member Present at Home	H/H member Evacuated	% Evacuated	% Not Evacuated
0	131	10	7.6	92.4	43	—	—	100.0
0.20	129	15	11.6	88.4	43	2	4.6	95.4
0.53	246	40	16.3	83.7	166	70	42.2	57.8
0.83	292	121	41.4	58.6	305	163	53.4	46.6
1.13	182	122	67.0	33.0	164	111	67.7	32.3
1.45	41	36	88.0	12.0	129	92	71.3	28.7
1.6 +	19	19	100.0	0.0	140	127	90.7	9.3

Source: Household Flood Proofing Survey

proportion was lower in Bhuapur, where only 70 percent of unprotected mainland houses were flooded (flooding of houses was defined as flood water entering onto the floor of the house). The average duration of in-house flooding in both study areas was 14 days, but flood depths in Bhuapur were considerably lower than those in Kurigram (0.69 m compared with 1.05 m; Table 3.1). Houses in the attached chars and unprotected mainland of Kurigram were flooded to particularly deep levels. Although the flooding was more severe in Kurigram, it did not last as long.

A majority of people whose houses flooded to depths in excess of about 1 m were found to have evacuated their homes in 1988. Table 3.2 shows that the pattern of evacuation with respect to house flooding depth was broadly the same for both areas. In Kurigram, however, a substantially higher percentage of people evacuated houses flooded to about 0.5 m. This may reflect factors such as weaker house construction (Table 2.10) and a need to move people and cattle to shelter to reduce the risk of loss of life in remote island chars. In general it appears that 73 percent of people in these charlands whose houses are flooded by over 1 m of water will evacuate of their own accord.

An estimated 57 percent of the Kurigram population and 35 percent of the Bhuapur population evacuated their homes in 1988 (Table 3.3; Appendix C, Table 2). This translates into about 93,000-123,000 people taking shelter in the Kurigram study area alone. Although the average cost of

Table 3.3 Evacuation Impacts of 1988 Flood

	Bhuapur Estimate	Kurigram Estimate
Total Population	172,071	189,803
People Moved	60,060	108,322
Percent Moved	35	57
Temporary Shelter (Tk/household)	223	284
Total Cost, Temporary Shelter ('000,000s)	5.5	8.2
Total Cattle	70,814	77,263
Cattle Moved	39,047	55,407
Percent Moved	55	72

Source: Household Flood Proofing Survey

evacuation and temporary shelter was only in the range of approximately Tk. 200-300 per household, spread across the whole population the evacuation costs are quite high: Tk. 8.2 million in Kurigram and Tk. 5.5 million in Bhuapur. By raising house plinths and providing flood shelters within charland villages, this money could be saved.

Cattle evacuation was even more dramatic in the 1988 flood. In Kurigram 72 percent of the livestock was moved, and in Bhuapur 55 percent was relocated (Table 3.3). Despite the evacuation and other attempts to safeguard cattle, livestock losses were the second highest component of reported average homestead damage. Table 3.4 indicates that Bhuapur households averaged considerably more livestock losses than the Kurigram households, despite lower average within-house flood depths and a lower level of cattle ownership. The reasons for this need further investigation before planning appropriate measures to minimize the loss. In general, however, flood shelters are more likely to reduce livestock losses than raising house plinths.

Table 3.4 Mean Household Losses from 1988 Flood (1988 Tk. values)

	Bhuapur Mean	Kurigram Mean
Temporary Shelter	223	283
Livestock	2,142	1,015
Housing	3,238	2,031
Stored Food Grain	433	759
Boat Damage	83	25
Tree Damage	1,295	793
House Contents	385	394
Total Homestead Loss	7,581	5,300
Preventable Loss	218	204
Standing Boro Loss	540	204
Standing Aus Loss	5,014	3,792
Standing Aman Loss	7,332	4,834

Source: Household Flood Proofing Survey

The main component of household losses is damage to housing structures. Such losses appear to have been higher in Bhuapur, but the difference between the two study areas is not significant. Losses to stored food grains, house contents, and boats were all small, probably because these items were raised or moved by households as they are needed even when people move out of their home. Reported damage to trees was higher in Bhuapur than in Kurigram even though tree ownership in 1993 was no higher there. As a result of these differences, overall homestead losses were significantly higher in Bhuapur than in Kurigram (Table 3.4; Appendix C, Table 3) despite less severe flooding. Hence, asset structures, housing values, and people's flood response may be as important as the depth of flooding in determining the value of losses. Few (3-4 percent) of these losses were regarded as preventable by the respondents, so char people lack the means to reduce losses in an extreme flood.

Agricultural losses were estimated as gross losses—the difference between expected output and actual output from respondents' fields in 1988, multiplied by the appropriate harvest price from BBS figures. Clearly the 1988 standing crop losses in the charlands were substantial, and on average they were of much higher value than homestead damage.

Table 3.5 repeats the same loss information in aggregate for the two areas. These data emphasize the magnitude of the direct financial losses due to the flood. In Kurigram (341 km^2 and about 189,000 people), total homestead losses were Tk. 152 million, and the value of harvested crops—compared with expected value in a normal year—was down by Tk. 254 million. The equivalent figures in Bhuapur (293 km^2 and about 172,000 people) were homestead losses of Tk. 188 million and crop losses of Tk. 320 million.

Table 3.5 Total Losses from 1988 Flood by Study Reach (1988 Tk. millions)

	Bhuapur Total	Kurigram Total
Temporary Shelter	5.5	8.1
Livestock	53.2	29.2
Housing	80.3	58.4
Stored Food Grain	10.7	21.8
Boat Damage	2.1	0.7
Tree Damage	32.1	22.8
House Contents	9.5	11.3
Total Homestead Loss	188.2	152.4
Preventable Loss	5.4	5.9
Standing Boro Loss	14.1	5.9
Standing Aus Loss	124.5	109.0
Standing Aman Loss	181.9	139.0

Source: Household Flood Proofing Survey

The overall flood losses in 1988, therefore, were Tk. 2,148 per person, or Tk. 1.2 million per km^2, in the Kurigram charland area, and Tk. 2,953 per person, or Tk. 1.73 million per km^2, in Bhuapur. The Jamuna charlands have a total area of 3,830 km^2 and had a 1988 population of about 1.72 million (ISPAN, Jamuna Inventory, 1993). If the sample survey results were representative of the whole river, this implies total losses in the range of Tk. 3,690 to Tk. 6,630 million for the Brahmaputra-Jamuna charlands, depending on the basis of calculation and which of the two study reaches is more typical of the whole river. These losses compare with an overall estimate of 1988 flood losses in Bangladesh of US$ 1.3 billion (World Bank, 1989), or about Tk. 50 billion. Agricultural losses are largely unavoidable in charlands, but with better warnings, house raising, evacuation improvements, and shelters, a substantial part of the homestead-related losses might be prevented.

House repair costs after flood water recedes, for example, are a major expense for affected households. Table 3.6 shows that in both study areas households spent substantial amounts on repairs (average household monthly income in the chars is on the order of Tk. 2,700 for a household of six persons). The difference between the two areas in the cost of repairing CI sheet houses appears to be because there are few such houses in the Kurigram study area and most of them are located in unprotected mainland where they were less severely flooded. It may also be that some Bhuapur households improved their houses after the flood and counted this as a repair cost.

3.3 Impact of the 1991 Flood

In 1991, less than a third of houses were flooded in the two study areas, but in Kurigram houses in all land types were affected, whereas in Bhuapur only the island and attached char houses were affected. As a consequence, average depths and durations across all households were low: under 0.09 m inside even island char houses in Bhuapur, compared with an average of 0.28 m flooding in Kurigram houses (Table 3.7).

Since flooding was neither extensive nor deep, few people evacuated their homes. An estimated 5 percent moved in Bhuapur (which may have been related to cattle movement rather than house

Table 3.6 House Repair Expenses in 1988 Flood

	Repair Cost/Household (Tk.)	
Type of House	Bhuapur	Kurigram
All *Kutcha*	1,008	1,542
Kutcha walls, CI roof	3,026	1,929
All CI	7,484	986

Source: Household Flood Proofing Survey

Table 3.7 In-House Flood Characteristics (1991)

	Bhuapur		Kurigram	
	% Flooded	Mean	% Flooded	Mean
Flood Depth (m)				
All	19	0.056	31	0.28
Island Char	31	0.09	28	0.22
Attached Char	14	0.04	41	0.30
Unprotected Mainland	0	0.00	29	0.33
Duration (days)	—	1.87	—	2.96

Source: Household Flood Proofing Survey

flooding) and only 1.5 percent moved in Kurigram, despite a higher proportion of cattle being moved (Table 3.8). The reported decline in cattle numbers between 1988 and 1991 in the two study areas is notable (Tables 3.3 and 3.8, see also Section 2.2.4)—and significant in Bhuapur (Appendix C, Tables 2 and 6)—but it is much larger than the estimated direct losses of cattle in 1988 (about 6,000 head).

Livestock losses in 1991 were again reported to be significantly higher in Bhuapur than in Kurigram (Tables 3.9 and 3.10; Appendix C, Tables 7 and 8). The higher homestead losses in Bhuapur were presumably due to the higher value of houses and their contents in Bhuapur, since flooding was less severe there. House repair costs after the 1991 flood were consistent with these lower damage figures, but they were relatively higher in houses with *kutcha* walls than in all-CI houses. It appears that about 20 percent of the 1988 house repair costs are incurred even when there is little homestead flooding.

The higher losses in the Bhuapur area in 1991 imply that potential charland flood proofing benefits might be greater in more economically developed areas where modest losses might be prevented every year. For example, average 1991 homestead loses in Bhuapur were about Tk. 1,080

Table 3.8 Evacuation Impacts of 1991 Flood

	Bhuapur Estimate	Kurigram Estimate
Total Population	158,504	191,528
People Moved	7,445	2,876
Percent Moved	4.7	1.5
Temporary Shelter (Tk/household)	30.0	8.33
Total Cost, Temporary Shelter (Tk '000,000s)	0.74	0.24
Total Cattle	37,392	60,008
Cattle Moved	1,489	4,410
Percent Moved	4.0	7.3

Source: Household Flood Proofing Survey

Table 3.9 Mean Household Losses from 1991 Flood (1991 Tk. values)

	Bhuapur Mean	Kurigram Mean
Temporary Shelter	30.0	8.33
Livestock	214.0	47.0
Housing	514.0	242
Stored Food Grain	3.3	10.0
Boat Damage	200.0	2.67
Tree Damage	95.0	87.3
House Contents	25.5	26.0
Total Homestead Loss	1,082	423
Preventable Loss	21.3	20
Standing Boro Loss	721	360
Standing Aus Loss	1,714	1,320
Standing Aman Loss	2,052	1,823

Source: Household Flood Proofing Survey

Table 3.10 Total Losses From 1991 Flood by Study Reach (1991 Tk. in millions)

	Bhuapur Total	Kurigram Total
Temporary Shelter	0.75	0.24
Livestock	5.3	1.34
Housing	12.8	6.9
Store Food Grain	0.08	0.30
Boat Damage	4.96	0.08
Tree Damage	2.4	2.5
House Contents	0.64	0.75
Total Homestead Loss	26.9	12.2
Preventable Loss	0.53	0.56
Standing Boro Loss*	18.0	10.40
Standing Aus Loss*	42.5	38.00
Standing Aman Loss*	51.3	52.44

Source: Households Survey
*Loss of Boro, Aus and Aman paddy calculated as price of 1990-91 financial year (BBS 1992).

(Table 3.9), and measures such as modest house plinth raising might minimize this loss in a 1-in-2-year event. For that study area homestead flood losses in a more-or-less normal year were about Tk. 27 million.

Even greater crop losses were reported (compared with household losses). While this may be correct, it also indicates that farmers' estimates of their expected outputs may have been over optimistic, so the 1988 losses may be overestimated.

3.4 Problems Faced by Flooded Households

Respondents were asked to name the three greatest problems they faced in each of the 1988 and 1991 floods. This was asked separately of the main respondent (male) and of a female respondent (usually the wife) in the household.

There were few differences between the two areas in 1988 both in terms of the problems faced or in their ranking (Table 3.11). The main problem for men was obtaining transport, followed by finding enough food. Other key problems were finding work, lack of shelter, and obtaining fodder for livestock. Lack of shelter was clearly a greater problem in Kurigram than in Bhuapur, which reflects the greater flood depths and higher level of evacuation experienced there.

Food preparation and cooking were the main problems for women, closely followed by availability of sanitation facilities and getting fuel and food. If flood shelters are promoted, therefore, providing sanitation facili-

Table 3.11 Problems Reported by Men and Women in 1988 and 1991 Floods*

	1988				1991			
	Bhuapur		Kurigram		Bhuapur		Kurigram	
Problem	Men	Women	Men	Women	Men	Women	Men	Women
Obtaining Drinking Water	23.0	18.0	7.0	14.0	9.3	6.0	7.4	1.3
Sanitation Facilities	12.0	66.0	10.0	48.0	6.7	27.5	18.8	34.8
Getting Fuel	8.0	47.4	5.4	46.0	5.3	22.1	4.7	34.8
Getting Food	55.0	32.4	57.3	42.3	28.7	24.1	25.5	30.8
Food Preparation and Cooking	11.4	81.0	11.0	57.0	6.0	38.2	2.7	33.5
Getting Work	42.3	3.0	46.0	4.2	20.0	2.7	22.8	2.0
Lack of Shelter	28.0	12.0	45.0	31.2	5.3	2.0	11.4	3.4
Moving House	7.5	1.2	3.0	3.0	0.7	0.0	0.0	0.7
Transport	62.4	27.0	61.0	32.4	44.7	20.1	50.3	24.8
Fodder	36.3	4.2	35.4	5.4	17.3	3.4	27.5	2.0
Livestock Diseases	5.0	0.6	6.3	1.2	2.7	0.7	2.0	0.7
Human Illness	3.0	3.0	13.2	13.2	4.7	2.0	23.5	14.1
Safety (theft, snakes, etc.)	8.1	5.4	1.2	3.3	2.0	3.4	2.7	9.4

Source: Household Flood Proofing Survey

*Respondents were asked to report the three main problems experienced in the flood. The replies are combined in this table, so each percentage is based on 150 households.

ties and space and facilities for cooking is of great importance since people can be expected to stay in a shelter for more than two weeks during a severe flood.

The same pattern of problems for men and women was reported in 1991 as in 1988, but lower percentages of households reported experiencing each of the problems. The main differences are that lack of shelter was much less of a problem in 1991 than it was in 1988, which reflects the lower water levels and reduced incidence of in-house flooding under moderate flooding conditions. There also was a relatively high incidence of human illness in Kurigram in 1991, particularly among male respondents. The reasons for this may deserve further investigation. Transport is apparently almost as much of a problem in a moderate flood as it is in a severe flood. This may be because of the low incidence of boat ownership in the charlands, which leaves most households dependent on neighbors or on engine boat services even under normal conditions. This may be an unavoidable problem of char life. Apart from the transportation issue, however, flood proofing measures could help reduce the problems that affect life during floods and are not costed as financial or economic losses to households.

3.5 Assessing Household Damage

To estimate potential benefits from flood mitigation measures, and thereby justify expenditure on these measures, some standardized or average data on flood losses is needed. Homestead flood losses depend on many factors, including asset ownership and the characteristics of a flood. Since the main component of household loss is housing damage, this factor has been related with depth of flooding in Table 3.12. Other factors, such as duration of flooding and velocity of flow, are also important

Table 3.12 Depth Damage Data for Houses Flooded in 1988 and 1991 (both study areas; Tk/house, 1991 prices)

Depth (m)	All *Kutcha*		*Kutcha* Walls, CI Roof		All CI	
	Number of Houses	Tk. Value	Number of Houses	Tk. Value	Number of Houses	Tk. Value
.02 - .37	25	548	15	355	8	1,212
.38 -.67	45	853	26	1,144	2	24,860
.68 -.98	68	839	25	1,220	3	1,680
.99 - 1.27	32	1,138	14	2,261	3	1,367
1.30 - 1.59	18	1,221	4	6,654	—	—
1.6 +	17	1,362	4	3,900	—	—

Source: Household Flood Proofing Survey

but did not vary between the sample areas in the 1988 event. The damage data did not show any systematic variation between locations or between the two flood years other than by flood depth; hence, losses from both areas and years have been combined.

Table 3.12 indicates a stepped loss function for all-*kutcha* houses based on damage reported in actual floods. There are jumps in damage between about 0.3 m (Tk. 550) and 0.4 m (Tk. 850), and between just under and just over 1 m (Tk. 850 to Tk. 1,150), thereafter damage increases slowly with depth.

Although sample sizes are smaller for houses with CI sheet roofs, losses are clearly higher than for all-*kutcha* houses. Up to flooding of 1 m, damage is effectively constant at about Tk. 1,200 (presumably the cost of replacing damaged walls, which tend to be larger than those the all-*kutcha* category). When flooding goes above 1 m, average damage more than doubles. The apparent minimal change in the figures for flooding of more than 1 m reflects small sample sizes and, possibly, variations in whether structures collapsed in floods of over 1.3 m. In the absence of more damage data, a constant loss with respect to depth of about Tk. 4,000 per CI-roof house flooded above 1 m is a reasonable approximation.

Samples of all-CI sheet houses experiencing flooding were too small to estimate any function. One exceptional household reported very high damage, but if this case is excluded, damage to all-CI houses appears to be lower than for houses with *kutcha* walls and CI sheet roofs. This indicates that CI sheet walls may be resistant to flooding of up to about 1 m depth, and that their floors tend to be raised, unlike those of many *kutcha* houses.

Considering household damage as a whole, most households estimated that they could have done more to reduce or prevent damage, at least in 1988 (Table 3.13). It appears that more than 75

Table 3.13 Households That Could Have Prevented Damage in 1988 (percent)

Char Type	Bhuapur	Kurigram
Island Char	78.8	76.7
Attached Char	62.5	81.8
Unprotected Mainland	56.7	76.5

Source: Household Flood Proofing Survey

3

Table 3.14 Constraints to Reducing Household Flood Damage in 1988 (percent)

Constraint	Bhuapur			Kurigram		
	Island Char	Attached Char	Unprotected Mainland	Island Char	Attached Char	Unprotected Mainland
Insufficient Warning	74.5	80	88.2	76.1	94.4	88.5
Unexpected Flood	71.2	80	88.2	91.3	94.4	94.2
Lack of Higher Place	84.6	60	58.8	93.5	88.9	88.5
Transport Problem	69.2	63.3	70.6	89.1	100	94.2

Source: Household Flood Proofing Survey

percent of all households in Kurigram and about 60 percent of Bhuapur households thought that they could have reduced damage.

Several factors limited damage reduction. The main factor was that flooding was unexpected, or not expected to the level or severity experienced (Table 3.14). This is closely related to the lack of sufficient warning (although this was regarded as less of a problem in the island chars). Lack of high places to take shelter and transport problems affected almost all Kurigram households in their attempts to cope with flooding, but were not such problems in Bhuapur, particularly in the unprotected mainland (which in this area is adjacent to embankments).

It appears, therefore, that providing shelters and improved transport would especially help the more remote island chars and that flood information and warnings would generally help all the charland inhabitants.

3.6 Evacuation

Since the provision of flood shelters for people and livestock is a major component of proposed flood proofing programs, the evacuation behavior of flood victims in 1988 was investigated in more detail. The main destination of Bhuapur evacuees was nearby embankments (Table 3.15). In Kurigram, where a much higher proportion of households evacuated during the flood, embankments were also the principle destination of households in attached chars and unprotected mainland. Island char households in the Kurigram study area were severely flooded, but fewer of them evacuated, and those that did evacuate experienced problems in moving (Section 3.4). Most of those who evacuated moved to relatives' houses; none moved to public land or buildings (Table 3.15).

The majority of households that evacuated their houses stayed within their village; some moved to adjacent mauzas (Table 3.16). The exception was the Bhuapur island chars where more households left the mauza and many left the union. This probably reflects better availability of transport facilities and of space on embankments fringing the charlands. In Kurigram, by contrast, embankments are fewer and less substantial and travel to them is more difficult. Clearly people prefer to stay within their village or nearby if they have the opportunity.

Table 3.17 shows that the main reason for evacuating was depth of water in the house (as suggested by Table 3.2). Only a few households moved because their house was already destroyed, although some left as flood water rose and their houses may have been effectively destroyed later. Only in Bhuapur did a few people move to safeguard their livestock when they evacuated.

The duration of evacuation was found to correlate with depth of flooding in the house (Table 3.18). Considering the average flood depths, people in

Table 3.15 Evacuation Destination in 1988 Flood (percent of households)

Destination	Bhuapur			Kurigram		
	Island Char	Attached Char	Unprotected Mainland	Island Char	Attached Char	Unprotected Mainland
Relative's House	19	—	13	33	14	12
Neighbor's or Rich Person's House	—	—	—	7	5	3
Embankment	21	26	13	8	32	40
Public Land or Building	4	8	—	—	18	9
Not Evacuated	56	66	74	50	27	34
Total Households (number)	70	50	30	60	22	68

Source: Household Flood Proofing Survey

Table 3.16 Destination of Evacuating Households in 1988 Flood (percent of households)

Distance	Bhuapur			Kurigram		
	Island Char	Attached Char	Unprotected Mainland	Island Char	Attached Char	Unprotected Mainland
Within Mauza	11	24	23	42	32	48
Adjacent Mauza	7	10	—	5	18	12
Within Union	2	—	—	—	9	—
Village Outside Union but in District	13	—	—	3	5	3
Town Outside Union but in District	7	—	3	—	9	3
Outside of District	4	—	—	—	—	—
Households Evacuated	44	34	26	37	50	73
Total Households (number)	70	50	30	60	22	68

Source: Household Flood Proofing Survey

Table 3.17 Reason for Moving in 1988 Flood (percent of households)

Reason for Moving	Bhuapur				Kurigram			
	Island Char	Attached Char	Unprotected Mainland	Total	Island Char	Attached Char	Unprotected Mainland	All
House Destroyed	11	8	—	8	8	9	9	9
High Water Depth	31	26	20	27	42	64	57	52
Save Livestock	2	—	6	2	—	—	—	—
Evacuated from District	44	34	26	37	50	73	66	61
Total Households (number)	70	50	30	150	60	22	68	150

Source: Household Flood Proofing Survey

Table 3.18 Duration of Evacuation and Depth of Flooding in 1988

	Bhuapur			Kurigram		
	Island Char	Attached Char	Unprotected Mainland	Island Char	Attached Char	Unprotected Mainland
Duration of Stay Outside House (days)	35	9	5	14	21	13
Average Depth of Water Above House Plinth Level (m)	1.13	0.80	0.44	1.34	1.82	1.18

Source: Household Flood Proofing Survey

Kurigram evacuated for relatively short periods. The Bhuapur island char evacuees, who travelled farther than most (to mainland embankments), stayed away from home an average of 35 days.

Similar patterns of movement applied to livestock, although cattle were moved to higher ground in much higher proportions. The duration of evacuation was similar to that for people. Evacuation from island chars was about twice the average for other locations, likely due to the cost and difficulty of arranging transport and the lack of grazing land in submerged island chars. Despite the fact that a majority of animals were moved, substantial numbers (Table 3.19) were lost during the flood.

There are potentially high benefits from providing shelters that can safely accommodate livestock and people within the affected islands or mauzas. This would help to save the lives of people and their animals, reduce travel costs, and save some personal possessions.

3.7 Impact on Incomes and Recovery Measures Taken

Analysis so far mainly has concentrated on direct damage and evacuation. Loss of income from charland cultivation clearly also was great, with a high proportion of expected aus and aman production lost. The study also investigated impacts on other income sources in terms of the number of months incomes were affected and the proportion of normal income received. Table 3.20 shows that, in general, incomes in 1991 were little affected by flooding, except that farm laborers had relatively lower incomes than normal in comparison with other occupational groups. Fishermen in Bhuapur reported better than average catches during the 1991 monsoon season.

Fishermen were the only occupation group virtually unaffected by the 1988 flood. Laborers received only about one third of their normal income during the flood period; combined with the damage and

Table 3.19 Movement of Livestock in 1988

	Bhuapur			Kurigram		
	Island Char	Attached Char	Unprotected Mainland	Island Char	Attached Char	Unprotected Mainland
Households Moving Livestock (%)	86	76	73	80	73	74
Duration of Livestock Movement (days)	28	11	11	27	20	10
Number of Large Livestock Lost	2,814	1,951	1,086	840	1,995	1,163

Source: Household Flood Proofing Survey

36

Table 3.20 Percent of Normal Income Received by Household During Flood

Source of Income	Bhuapur				Kurigram			
	1988		1991		1988		1991	
	Mean %	No. H/H	Mean %	No. H/H	Mean %	No. H/H	Mean %	No. H/H
Agriculture Labor	34	42	79	40	28	87	65	85
Fishery	86	7	116	9	85	5	87	4
Non-agricultural Labor	64	39	89	36	40	19	85	25
Domestic Work	41	11	82	6	64	10	84	9
Business/Trade/Craft	47	44	92	43	57	24	82	22
Regular Livestock and Poultry Income	41	122	86	116	34	122	81	119

Source: Household Flood Proofing Survey
Data are for households with that income source.

disruption suffered in the flood, this must have put a severe strain on the finances of these households. Businesses, trades, and non-farm labor lost an average of about 50 percent of their normal incomes, while loss of livestock and household dislocation resulted in regular livestock incomes (as opposed to distress sales) of about a third of the normal level.

Flood-affected households need resources to recover from a flood. The main means of quickly obtaining such resources are: as gifts or relief, by selling assets, by taking a loan, or by finding extra work. Since men and women may take different recovery measures, data on each were collected separately. In some cases men and women may have cited the same measure, but in this way an indication was obtained of who was responsible for the sale of an asset or who took extra work.

Table 3.21 shows that men mainly reported receiving relief (from government or NGOs), but this reached less than 50 percent of all Bhuapur households in 1988 and only 69 percent of Kurigram households; more island char households appear to have received relief. Very few households are helped by rich people, and even though more received help from relatives they were not a major source of recovery assistance. Obtaining extra work outside the area was a major response and was particularly important in Kurigram. While some migration for work normally takes place, leaving the island chars to find work was obviously important for many households. Loans, both formal and informal, were also an important response in all areas, but in the Kurigram island chars credit may have been harder to obtain (perhaps because of remoteness from institutions plus general loss of resources within the charland community) than in the other charland areas.

Sale of assets is collectively the main source of funds to cope in a flood and recover afterwards (to cover living costs and rebuild houses, for example). Selling and mortgaging land was relatively rare in both study areas even in 1988 (under 20 percent of households did so). Livestock were the main asset sold to obtain cash, emphasizing the importance of animals as a store of wealth that can be quickly realized in an emergency. About 40 percent of all households sold livestock; this presumably accounts for the substantial fall in reported cattle numbers in the two study areas between 1988 and 1991. While these sales met an immediate need, they represent a loss that appears not to have been subsequently recovered. This

Table 3.21 Flood Recovery Measures Taken by Men (percent of households)

Char Type	Work Outside	Land Sale	Land Mortgage	Livestock Sale	Loan	Jewelry Sale	Sold Other Goods	Help from Relative	Help from Rich	Govt /NGO Help
BHUAPUR										
Island	46	7	9	43	33	0	17	22	3	57
Attached	28	16	18	42	40	8	18	14	4	42
Unprotected Mainland	30	17	20	27	27	3	33	17	0	27
All	37	12	14	39	34	3	21	19	3	46
KURIGRAM										
Island	52	7	22	52	18	0	10	28	8	73
Attached	46	5	9	41	32	9	14	9	9	77
Unprotected Mainland	43	13	16	35	31	3	21	10	7	62
All	47	9	17	43	26	3	15	17	8	69

Source: Household Flood Proofing Survey

Table 3.22 Flood Recovery Measures Taken by Women (percent of households)

Char Type	Work Outside	Land Sale	Land Mortgage	Livestock Sale	Loan	Jewelry Sale	Sold Other Goods	Help from Relative	Help from Rich	Govt/ NGO Help
BHUAPUR										
Island	3	1	1	19	6	13	10	13	1	43
Attached	4	6	6	10	14	20	10	8	4	32
Unprotected Mainland	10	10	13	7	3	17	17	13	3	30
All	5	5	5	13	8	16	11	11	3	37
KURIGRAM										
Island	18	2	7	17	3	13	8	27	10	55
Attached	46	5	9	41	32	9	14	9	9	77
Unprotected Mainland	43	13	16	35	31	3	21	10	7	62
All	47	9	17	43	26	3	15	17	8	69

Source: Household Flood Proofing Survey

means that in the longer term land preparation may have been handicapped and the grazing resources of the charlands may be under used.

Women were reported to have taken fewer measures than men to recover finances after the 1988 flood, reflecting social constraints on their participating in the wider society and in financial matters. Despite these constraints, women in many households received relief goods (more in Kurigram than in Bhuapur; Table 3.22). More women in Kurigram took work outside the homestead to earn money after the flood. Given the social norms against such work, this presumably reflects relatively higher losses. Some women, who presumably held title to land, sold or mortgaged it, and up to 20 percent sold their jewelry (more than reported by men).

"Traditional" flood proofing measures such as house raising and flood shelters can help to reduce damage and thereby reduce strain on household resources. It will not be possible to prevent all damage, however, and agricultural and income losses may be unavoidable. It is therefore important that charland households receive help in finding paid work so that they can obtain the resources on which to live and rebuild houses following a severe flood.

One way that this could be achieved is through food-for-work or paid work provided to make or restore flood shelters and raise houses following a severe flood. This could be fitted into existing programs that otherwise tend to avoid the charlands because of the high risks and lack of opportunity for the usual earthworks on roads and embankments. In this way incomes would be created at a critical time and future losses would be reduced. Such programs would try to avoid the most erosion-prone locations, but would have to accept that the life of earthworks might not be more than 5-10 years, after that chars would be likely to have eroded, their people moved, and the same type of aid would again be needed.

Chapter 4

APPLICATION OF FLOOD PROOFING

4.1 Introduction

Mitigating flood effects in the charlands is complicated by the innate instability of these areas. Flood protection facilities like embankments and water control structures are neither technically nor economically feasible in the chars because of the high risk of erosion, low value of the land, and low population densities. Therefore, the main options for mitigating flood losses are flood proofing and flood preparedness.

Charland families and communities traditionally have depended on their own initiatives to "flood proof" their livelihoods, properties, and possessions against damage or loss during floods. For example, the floors of houses are usually raised above ground level and the side slopes of homestead areas are planted with grass to protect against erosion by wave action (Plate 2). Such traditional flood proofing efforts, however, have only limited success; even in years of normal flooding households in both study areas suffer significant losses. In 1991, which was close to a normal flood, for example, average homestead losses equalled about one month's agricultural wages and average gross agricultural losses per household equalled about three months' wages (see Table 3.9). In the larger flood of 1988, average homestead losses for both locations equalled about six months' agricultural wages and average gross agricultural losses per household equalled about 12 months' agricultural wages (see Table 3.4). Hence, there is a clear need to mitigate the effects of flooding on people living in char areas.

This chapter discusses flood proofing measures that could be applied to char areas, then presents data on the flood proofing preferences of charland households. This is followed by discussion of issues related to the implementation of flood proofing and the features of specific flood proofing measures. In the next chapter, the possibilities of flood proofing char area communities are investigated using two case studies.

4.2 Possible Flood Proofing Measures

The objective of flood proofing is to avoid loss of human life, reduce the disruption caused by floods, and improve normal social and economic activities during and after a flood. Flood proofing activities find ways for people to live and improve their lives in an environment that frequently floods. Flood proofing measures can be grouped into three categories: (a) measures focused on saving human lives and reducing human suffering; (b) measures focused on reducing the disruption caused by floods, such as measures affecting incomes and livelihood; and (c) measures relating to public utilities, infrastructure, and services. Some flood proofing measures related to each of these groupings are discussed below.

4.2.1 Saving Lives and Reducing Suffering

Floods can exact a toll on human life; cause illness, extreme physical distress, and mental stress, and severely disrupt social and economic activities. Many of the lives lost during floods are the result of drowning; and the disruptions mainly result in people's inability to sustain normal life during and after the flood because of the absence or shortage of such basic necessities as shelter,

food, fuel, and clean drinking water. Damage or loss of peoples' personal property and capital assets also causes considerable suffering.[1] Damage or loss of these necessities and possessions can lead to deterioration of the health and physical condition of those affected and impair their ability to recover and earn wages.

Flood proofing measures that reduce the risk to human life and decrease the suffering caused by floods include:

- raising floor levels of houses above peak flood level to ensure sufficient dry space to carry out normal daily activities;
- placing material around earthen house plinths to protect the soil from erosion by wave action or rainwater;
- planting vegetation (trees, catkin grass, etc.) to protect against erosion and encourage sedimentation;
- constructing community flood shelters;
- providing sanitation and water facilities;
- raising hand tubewells above peak water levels to ensure the availability of clean drinking water throughout a flood;
- providing flood-free areas to store the family's capital assets (by raising floor levels or providing materials for roof-level storage, for example); and
- improving the availability of boats.

Non-structural measures include:

- flood warning system; and
- information on floods during the event.

4.2.2 Incomes and Livelihood

During and after floods, the main hardship suffered by many people results from the disruption of the local economy and consequent shortage of employment opportunities and absence of income. Most poor people have insufficient food or money reserves to survive without a regular income from self-employment or wages, and the lack of income can lead to devastating social and economic losses that can result in severe malnutrition, homelessness, and displacement.

Flood proofing measures that could improve employment in flood-prone areas include:

- improving the yield of such flood-tolerant crops as deep water aman;
- protecting seed and fertilizer storage areas/godowns;
- identifying and supporting alternative employment activities that can continue throughout a flood;
- ensuring access to and protection of commercial facilities and necessary support services so that employment activities are unaffected by flooding;
- making credit available after floods;
- improving returns on dry season cultivation to make farmers less dependent on income from wet season cropping;
- improving access to markets to enable production of cash crops; and
- providing livestock shelters and local veterinary services to improve livestock survival.

The impact of flooding on economic activities should be assessed as an integral part of national, regional, and local development planning.

4.2.3 Infrastructure and Public Services

Public utilities in char areas are limited, mainly consisting of hand tubewells for water supply and, in a few locations, electricity supplies. Infrastructure includes roads, footpaths, ferries, irrigation, and markets. Public services include education and health services, postal and telephone services, and administrative services such as police and land registration. Infrastructure and services available on adjacent mainland may also be important to people living in the chars.

Communities face many problems during and after floods because of the disruption of public utilities and services and damage to public infrastructure either on the char or in the adjacent mainland. Ensuring that essential services and infrastructure remain operable throughout a flood would allow the free flow of materials and information between

flood-affected areas and the rest of the country. Goods and services could still be supplied to affected areas, and markets could still operate to distribute them; scarcity would be avoided and prices would be more stable.

Flood proofing communities involves identifying critical public services and infrastructure. Government agencies would be responsible for ensuring that facilities are designed and constructed to provide consistent and agreed upon standards of usability and accessibility to the public throughout flood events.

4.3 Measures Preferred by Local People

As part of the household survey, respondents were asked to indicate their preferences from among a list of flood proofing measures that could be locally implemented to mitigate the effects of floods and erosion (see Appendix A, Questions 9 and 10).

4.3.1 Flood Proofing Measures

Table 4.1, which contains data from both Kurigram and Bhuapur, indicates that raising house plinth levels, providing boats, raising the ground level of clustered communities, and providing flood shelters were the flood coping options preferred by both male and female respondents. Providing shelters only for cattle was not considered a significant measure. Women indicated a stronger preference for raising house plinths and local relief funds than for such community-based measures as raising the level of clustered communities or building flood shelters.

Table 4.1 Household Preferences for Flood Proofing Measures (percent)

	Most Needed		Next Most Needed		Third Most Needed	
Measure	Male	Female	Male	Female	Male	Female
Flood Shelter	**32.2**	**30.2**	**20.4**	**23.3**	**14.2**	**12.1**
House Raising	**22.1**	**26.3**	5.3	8.1	4.0	4.0
Clustered Settlement Raising	**17.3**	**14.2**	**12.3**	**8.1**	8.0	8.1
Boats in Flood	**9.7**	**9.7**	**29.8**	**19.6**	**11.7**	**19.7**
Strengthen Plinth	4.5	3.8	1.8	3.0	1.8	3.0
Low-interest Loans after Flood	3.1	3.8	**7.7**	**7.8**	**19.3**	**10.6**
Build Bund	2.1	3.5	2.1	4.1	1.8	1.0
Local Relief Fund	1.7	2.8	4.2	7.4	**10.9**	**17.7**
Flood Warning	1.4	1.0	2.1	3.0	3.3	0.5
Grass Barriers	0.3	0.3	-	-	1.5	1.5
Other Barriers	0.7	-	2.5	6.7	4.7	4.5
Brick Mattress	0.3	0.3	0.4	1.1	0.7	-
Plant Trees	-	0.3	1.8	3.0	0.7	2.5
Cattle Shelter	0.3	0.3	4.2	3.0	8.4	5.1
Flood Information	-	0.3	-	0.4	-	0.5

Source: Household Flood Proofing Survey

Table 4.2 Household Preferences for Erosion-coping Measures

Measure	First Preferred Measure		Second Preferred Measure	
	Male	Female	Male	Female
Provide Homestead Plots	48	42	12	14
Arrange Boat for Household	11	12	17	20
Resettlement Loans	6	5	10	5
Resettlement Grants	4	5	13	16
Security of Tenure on Embankments	1	2	2	1
Secure Rights to Eroded Land	10	12	19	10
Allocation of *Khas* Land to Erosion Victims	5	4	11	8
Boats to Help Move House	2	4	3	7
Free Temporary Accommodation	11	14	13	19
Number of Households Reporting Preference	288	287	283	274

Source: Household Flood Proofing Survey

The provision of boats was the second most-mentioned measure overall, but it was more frequently a measure of secondary preference. Similarly, non-structural measures were raised as first preference but were mainly recorded as the next most-needed and third most-needed measures, particularly among men. Of the non-structural measures, credit in the form of low-interest loans was considered to be the most important by men, while women considered local relief funds to be more important.

4.3.2 Erosion Coping Measures

Among the erosion coping measures (Table 4.2) there was a clear preference for the provision of homestead plots, which may reflect the difficulties respondents have finding new plots. Other prominent measures include arranging boats, ensuring rights to eroded land, and providing free temporary accommodation. Lesser measures were providing resettlement loans and grants, allocating *khas* land to those whose land has eroded, and ensuring security of tenure on embankments used for temporary shelter. Female respondents showed a slightly greater preference for the provision of free temporary accommodation and boats and lesser preference for the provision of homestead plots.

Among the large-scale measures to reduce flooding impact (Table 4.3), respondents preferred embankments to protect their land and property (at least among those on unprotected mainland) and the dredging of rivers. Among the large-scale erosion-reducing measures, respondents preferred protecting land by brick mattressing and making changes in river alignment (Table 4.4).

Overall, respondents clearly preferred measures that protect their homesteads and, secondarily, the provision of flood shelters.

4.4 Implementation Issues

4.4.1 Planning

Households are affected by floods in different ways, and peoples' responses to floods and capacity to cope with them depend upon their unique set of physical resources and social support. Effective

Table 4.3 Household Preferences for Large-scale Flood-coping Measures

Measure	First Preferred Measure		Second Preferred Measure	
	Male	Female	Male	Female
Proper Drainage Facilities	6	4	9	9
River Dredging	28	30	52	46
Close Canal Entrance	3	3	3	—
Pucca Embankment	6	10	10	5
Make Embankment along Riverbank	53	48	24	41
Build High Road	3	4	3	—
Provide Free Temporary Shelter	1	1	—	—
Number of Households Reporting Preference	141	95	71	22

Source: Household Flood Proofing Survey

flood proofing is based on overcoming the vulnerabilities of local populations and building on their capacities to cope with the challenges of daily living. Floods and erosions, while major problems, are only two of char dwellers' vulnerabilities, others include inaccessibility, poverty, lack of education, dry season drought, and the predominance of sandy, low-fertility soils. Their social vulnerabilities include domination by large landholders, a feudal social structure, and remoteness from the mainland. All of these vulnerabilities can be exacerbated by flooding and erosion. The capacities of the charland households include relatively low population densities and extensive grazing land. Social capacities include the kinship and support provide by *samaj* and *uthuli* and a willingness to cooperate with one another, particularly in times of need.

The impact of floods needs to be seen in the context of the other community vulnerabilities in order to identify flood proofing measures that are appropriate for, and can be sustained by, individuals or the local community. For example, investment in raising house plinth levels may not be sound if there is a high risk that the whole home-

Table 4.4 Household Preferences for Large-scale Erosion-coping Measures

Measure	First Preferred Measure		Second Preferred Measure	
	Male	Female	Male	Female
Remove Embankments	3	7	6	16
Change River Alignment	33	20	25	13
Brick Mattressing Along Riverbank	47	44	33	29
Plant Catkin Grass	8	18	15	19
Bamboo Fence Along Riverbank	3	4	15	13
Free Passage of Floodwater (no embankments)	6	7	6	10
Number of Households Reporting Preference	66	45	48	31

Source: Household Flood Proofing Survey

stead could be lost to erosion. Indeed, at present, households living on older, more mature chars invest more in flood proofing their homesteads than households on newly accreted chars, where the risk of erosion is much more uncertain.

Appropriate flood proofing measures can be determined through a process of identifying and assessing the vulnerabilities and capacities of households and communities. The process requires the active participation of all community members. Their participation recognizes the ability of people, particularly those who live in rural areas, to identify their own problems and implement sustainable measures that meet their most pressing needs.

A methodology for planning and implementing flood proofing measures needs to be developed and field tested in a number of different flood environments, but the basic process should include:

- the identification of flood characteristics;
- the identification and assessment of local vulnerabilities and capacities;
- the assessment of impact of floods and local needs; and
- the identification of appropriate measures that are technically, socially, and economically viable.

4.4.2 Benefits of Flood Proofing

The quantifiable benefits of flood proofing include preventing the loss or damage of property and physical possessions and avoiding the need for households to evacuate their homesteads. Other factors, such as loss of earning and the related cost of lost opportunities while evacuating, are more difficult to determine, although some of these costs will not be avoided by flood proofing structures since the flooding will affect the availability of work.

Estimates of homestead losses has been determined from information collected in the household survey (see Table 3.12).

The cost of evacuating includes travel expenses, temporary accommodation costs, increased prices for food, fuel, and other essentials in unknown markets, and the expense of returning to and re-establishing the homestead. The cost of each of these items depends upon several factors, among them, the distance traveled, the place of refuge, and the duration and reasons for evacuating.

4.4.3 Institutional Issues

In order to assess possible institutional arrangements for implementing flood proofing, respondents in the household survey were asked who should be responsible for implementing specific measures and who should pay for them.

The measure most preferred by respondents—raising house plinths—was mainly perceived to be a household responsibility, while raising clustered communities was considered a community-based action primarily involving the homestead but also the responsibility of the *samaj* and neighborhood (*para*). Male and female responses were similar.

Flood shelters were seen to be the responsibility of government institutions other than the union parishad or thana. This may reflect the remoteness of local government institutions and the villagers' inability to differentiate between government departments or activities. Likewise, the provision of low-interest loans was seen as the responsiblity of other government agencies. NGOs and the union parishad were considered secondary sources for such loans.

Table 4.5 Willingness of Respondents to Pay for Flood Proofing Measures

Level of Contribution	Male	Female
All Costs	26	30
Part of Cost	48	42
None of Cost	26	28
Number of Households	288	285

Source: Household Flood Proofing Survey

The provision of boats was mainly perceived to be the responsibility of households and government agencies other than those of the union or thana, although union parishads and NGOs were also mentioned as having some responsibility.

NGOs, mentioned also in connection with the provision of flood shelters, were not seen as significant providers of any measures, which probably is due to their lack of activity in many char areas.

Non-structural measures were consistently seen to be the responsibility of other government agencies, and partly the responsibility of the union parishad.

The willingness of respondents to bear the costs of flood proofing measures is shown in Table 4.5. Most respondents were willing to bear all or part of the cost, while only about a quarter were unwilling to bear any of the cost.

4.4.4 Environmental Issues

Flood proofing measures, by definition, are small-scale and therefore will not significantly affect river morphology; "flood-proofed" charland therefore would still be susceptible to the processes of erosion and accretion.

Raising the floor levels of houses and providing shelters will improve the human environment and give those living in the chars more resources that can be invested in productive activities rather than having to use them for recovering from floods.

4.5 Discussion of Some Flood Proofing Measures

4.5.1 Housing

People prefer to stay in their own houses during floods, but to do so, the floor of the house must be above flood level and the house plinth must be protected from erosion. In preparation for a flood householders often construct platforms (*macha*) raised above the floor level. A *macha*, while a low-cost solution to the problem, restricts space for such daily activities as food preparation and sleeping. Raising the floor of a house provides more space, but it is more expensive. A solution combining the features of both—building floors of wood or bamboo slats supported on a timber frame—could also be an option, but villagers prefer the solid earthen floor because the slated floor would be too drafty during the winter.

The main reason people have to move out of their houses is high water levels, although some houses collapse following inundation due to their poor quality (see Table 3.18). Improving the housing stock could be done by:

- raising floor plinth levels to above maximum water level; and
- improving the standard of construction.

Householders in char areas traditionally have constructed their houses on the highest available land, and if the elevation of the land is insufficient to ensure that their houses stay dry during floods, householders have raised the floor or plinth levels or the level of the whole homestead compound. Since floors are made from earth, raising floor levels usually involves placing more soil on the existing floor.

Charland houses are constructed with earthen floors for a variety of reasons including low cost, ready availability of materials, and their ability to prevent entry of cold winds during the winter season. The disadvantage of such floors is their susceptibility to erosion by rain and floods. Although many households provide vegetative protection to the sides of the plinth (Figure 4.1 and Plate 2), this practice could be encouraged further.

Householders limit their investment in raising floor levels because of the risk of losing the whole house to erosion. Houses are designed to be easily dismantled so that they can be moved quickly when erosion is imminent. Householders living on more mature chars have invested more resources in ensuring that their houses are above flood level than those living on recently accreted chars. The

latter group is waiting to see if their homestead sites will be sustainable in the long-term before they invest more in flood proofing.

4.5.2 Flood Shelters

The purpose of a flood shelter is to provide temporary refuge to people whose houses are unable to protect them during floods. Community activities are not strongly developed in Bangladesh, and flood shelters have not been a traditional flood proofing measure.

During the 1988 flood in Bhuapur, about 44 percent of households on island chars evacuated from their homesteads. Of the evacuated households, 43 percent went to nearby relatives' houses, 48 percent sheltered on embankments, and 9 percent took shelter in public land and buildings (see Table 3.15). In contrast, about 34 percent of households on attached chars evacuated. Of these, 76 percent went to embankments and 24 percent went to other public land and buildings. In Kurigram, about 50 percent of households on island chars evacuated 69 percent of whom went to relatives' houses, 15 percent to neighbors' houses, and only 17 percent to embankments. Households on attached mainland in Kurigram were more affected by the flood: 73 percent evacuated; most went to embankments (44 percent), and smaller numbers went to relatives' houses (19 percent) or public buildings and land (25 percent).

In Bhuapur, about 45 percent of the evacuating households moved to another mauza in the same union, while in Kurigram 89 percent of evacuating households stayed within the same union, with the majority moving within the same mauza (see Table 3.16). In both locations, the main reason for evacuating was because the depth of water inside the house was too high (see Table 3.17). Whether households were inhabitable upon return is unknown, although destruction of the house during the flood was not given as a reason for evacuating.

The nearest embankment can be quite distant and the cost of moving high. Average moving costs across all households are given in Table 3.3 for 1988, but not all households moved. The average costs for households that did move were Tk. 637 in Bhuapur and Tk. 498 in Kurigram.

The need for shelters is greater in the island chars than on attached chars or unprotected mainland, as the latter households tend to move within the same mauza where there are nearby embankments and other high ground. In Kurigram, the number of families staying in the mauza is also sizable, which may reflect the remoteness of embankments, a shortage of transport, and an unwillingness to leave houses empty for security reasons. Although embankments provide refuge, social organization tends to break down in the crowded conditions of a shelter, and basic facilities are scarce. Therefore, there may be a need for local flood shelters in most char areas.

In addition to providing refuge for people, flood shelters need to provide refuge for animals, which are a major part of the economy in char areas. There is considerable movement of livestock during floods (see Table 3.19), and local shelter facilities would reduce the cost of moving them. Even though more than 70 percent of the study area households moved livestock for periods of up to 28 days from island chars, 11-20 days on attached chars, and 10-11 days on unprotected mainland, there were still major losses of livestock (see Table 3.19).

Since floods occur only periodically, flood shelters should be designed so they can primarily be used as schools, health centers, or to meet other community needs. The main use of the buildings should dictate their design, but they should be flood proofed and easily adapted for periodic use as shelters. The main features of shelters are:

- dry shelter for families;
- cooking facilities;
- drinking water facilities (hand tubewells);
- sanitation facilities for men and women;
- storage space for fodder, fuel, and food;
- secure storage space for household items

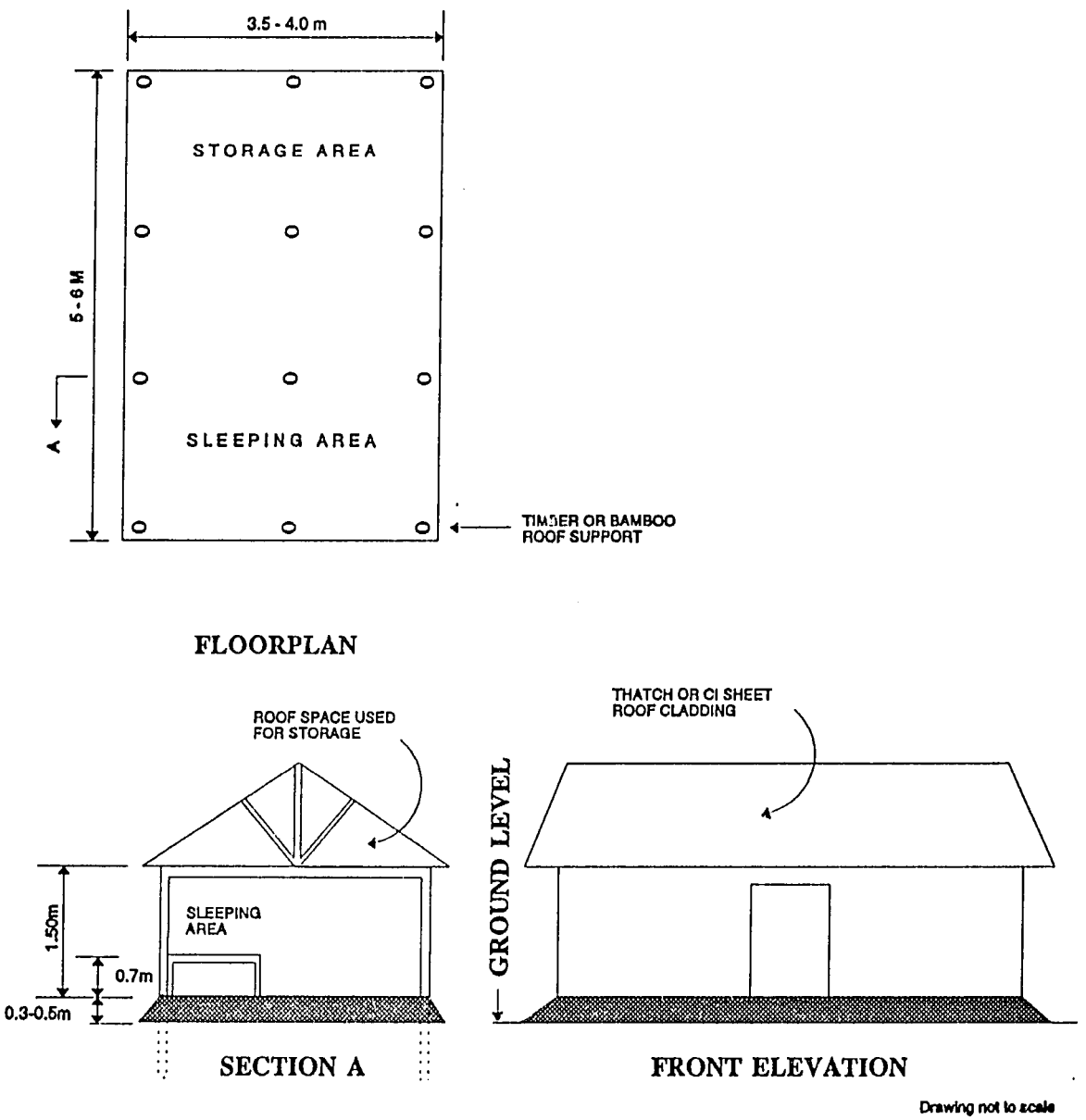


Figure 4.1 Details of a char house

and possessions; and
- storage space for livestock.

Plates 5 and 6 are photographs of a typical flood shelter.

The siting and design of shelters has to take into account a number of factors including: population density; access during flood; land availability; height above flood level; protection from the weather. The duration of the flood event and the likely time that people will need to stay in the shelter after the event and before they are able to return to their homesteads should also be considered.

4.5.3 Boats

Boats are a critical component of char life. Improved access to boats would reduce the cost of inputs and decrease the cost of marketing outputs. During the monsoon season, when river levels are high, boats are the only way people and goods can be moved. In the dry season, when river levels are low and large areas of charland are exposed, transport of goods usually requires a combination of land transport and short crossings of waterways.

The number of boats in Bangladesh has been decreasing over the past 20 years. This trend started to reverse with the introduction of lower cost boats made with timber frames and "tin sheet" paneling. These composite boats last about five years if regularly maintained and are about one-third the cost of wooden boats. In addition to the lower cost of materials, the composite boats take about two to three days to construct versus 20 days for an equivalent wooden boat.

Flood embankments have caused serious problems for boats as many waterways have been blocked and channels have dried up.

Commercialization of country boats lessens the need for individuals to have boats. Commercial boats have carrying capacities of greater than 50 maunds (2,000 kg). Mechanization has made it possible for boats to make more frequent trips, thereby increasing overall transport capacity. For example, a trip that would take three to four days under sail can be made by a mechanized boat about one day. This has improved access to markets for char people, and most island chars are now connected to local markets by engine boat services on market days.

Boat owners are less inclined to use their boats during floods because of the higher risks caused by more turbulent flows.

Country boats are in the informal sector, and as a result tend to be exploited by everyone. If country boats can be institutionalized, some of the problems can be overcome. For example, truck owner's associations pay "advance harassment fees" so that their trucks are not delayed and do not have to pay off police or other parties on the roadside. By contrast, boats moving from the lower Jamuna to the Meghna have to pay numerous parties as they cross different district and thana boundaries.

Most boats are owned by individuals and the requirements for group ownership would be different. The Country Boat Owners Association has been established to improve the conditions for boat owners, although at present it has few members in the Jamuna area.

To improve flood and erosion response, boat owners need to know there is a demand for boat transport so that they can be sure of earning an adequate income and are covered for risks to their boats. Local communities, for instance, could perhaps contract boats based in their own area to help evacuate and be on standby in emergencies in return for a small fee. This could be backed up by group insurance through the government or an NGO to cover the damage to boats employed in official flood/erosion related work.

NOTES

1. Capital assets include houses, homesteads, and commercial and industrial premises. Personal property includes personal possessions (family heirlooms, jewelry, clothes), household furniture and utensils, tools, commercial and industrial equipment (weaving looms, fishing nets), livestock and fodder, agricultural supplies (seeds, fertilizers, etc.), and food grains and other consumable items.

Chapter 5

CASE STUDIES OF FLOOD PROOFING MEASURES IN TWO CHARS

5.1 Introduction

Case studies of two char areas were conducted by the flood proofing study to illustrate the scope for flood proofing measures and determine the technical, social, and economic feasibility of specific flood proofing measures.

Information for the case studies was collected from the flood proofing household surveys, additional rapid rural appraisals (RRAs), and topographic surveys of the selected areas. Where appropriate, the findings of the FAP 16 socioeconomic studies and charland inventory also were used. The approach of the field survey was first to gather information about local flood characteristics and local responses to floods. Then, on the basis of the information collected, a number of specific flood proofing measures were discussed with the villagers. The field surveys were undertaken in June and July 1993 at the same time as the household survey discussed in Chapter 2.

The areas selected for the case studies were Gokulganj Char, in Gabsara mauza of Bhuapur thana, Tangail district, and Jhaukuti mauza, in Nageswari thana, Kurigram district (Figures 2.2 and 2.4, respectively). The cost-benefit estimates cited below are subject to refinement, but the case studies demonstrate a method for performing cost-benefit analyses on flood proofing measures and indicate the likely economic viability of taking such measures.

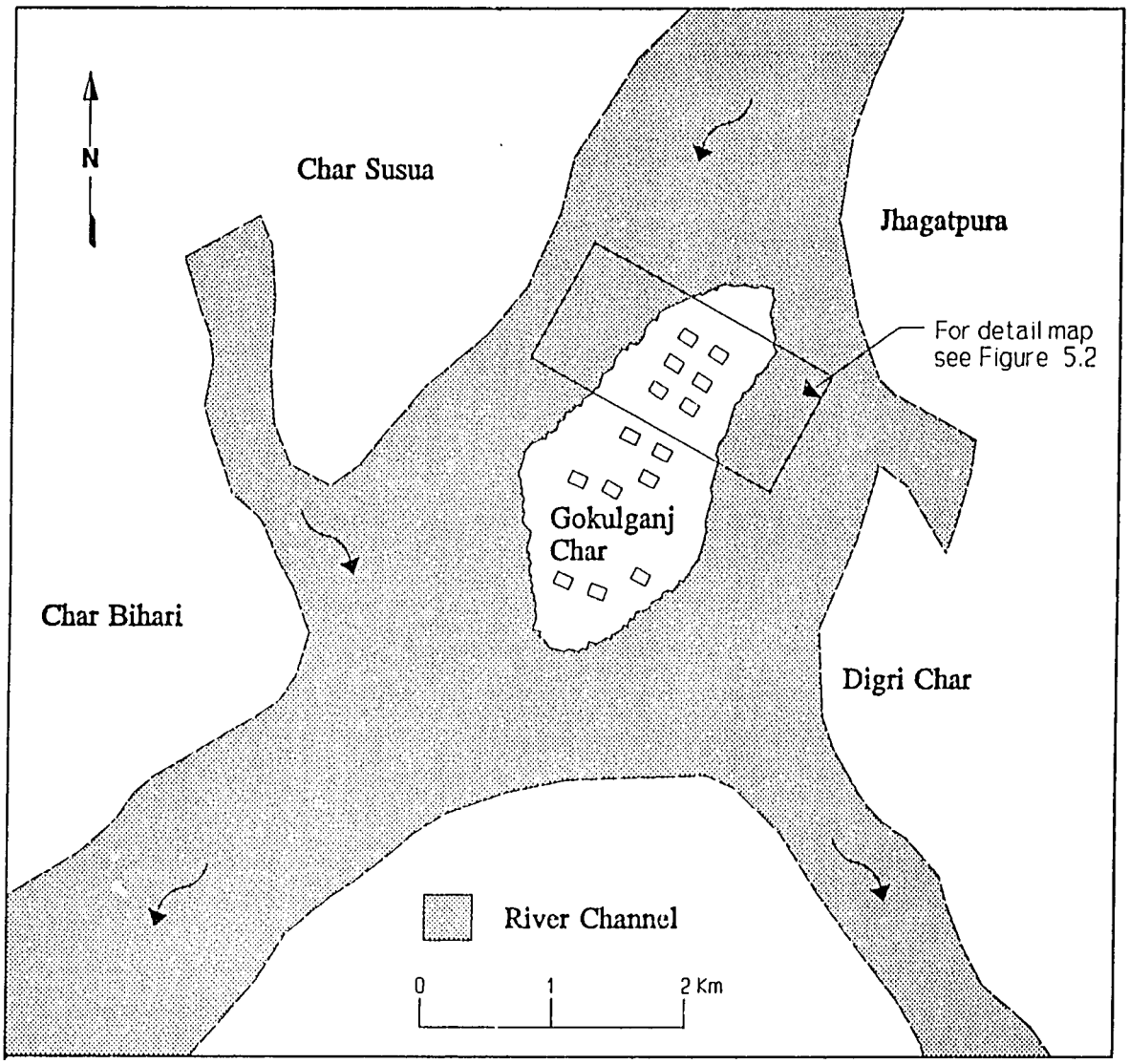
5.2 Case Study 1: Gokulganj Char

5.2.1 Description of Gokulganj Char

Gokulganj Char eroded completely in the 1960s but reappeared about two years ago, and the newly-accreted island char has been occupied since early 1992. Most of the char lies within Gabsara mauza, but a small area on the eastern side of the char is in Jaghatpura mauza. The layout of the char is shown in Figure 5.1, and a more detailed section of the char's northern part is shown in Figure 5.2.

About 45 households are living on the char, 12 of which came from Jaghatpura mauza to the northeast, eight from Digri Char to the south, 15 from Chadro Bari mauza to the east, and 10 from Char Susua to the northwest (Figure 5.1). With the present layout of homesteads on the char, five households are located in Jaghatpura mauza and the remainder are in Gabsara mauza.

The land of the char is about 50 percent lowland, which floods to a depth of 2-3.5 m; 30 percent is medium land, which floods to a depth of about 1-2 m; and 20 percent is highland, which floods to a depth of 0.5-1.5 m. About 50 percent of the char is cultivated, the remainder is either sand or catkin grass. Of the cultivated land, about 40 percent is single cropped, 50 percent is double cropped and, 10 percent is triple cropped. In the first rabi season, the main crops were *khesari*, sweet potato,



Source: Field Observation

Figure 5.1 Layout of Gokulganj Char

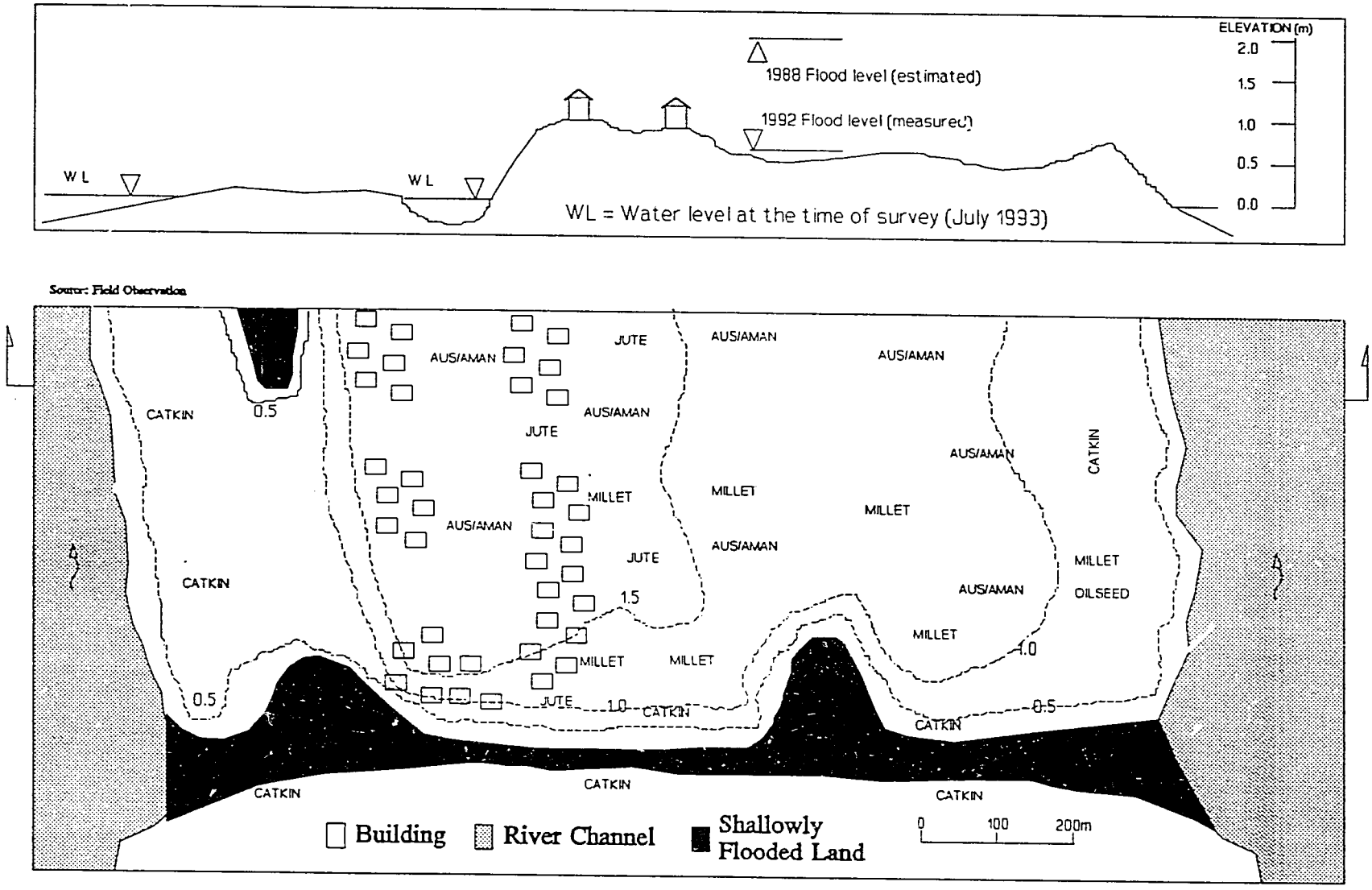


Figure 5.2 Detail aap of Gokulganj Char (early monsoon)

wheat, and mustard. In the following kharif season, the main crops were broadcast aus/aman (55 percent), millet (35 percent), *dhaincha* (5 percent), and jute (5 percent). Figure 5.2 shows the crops being grown on part of the char in June 1993.

The main sources of income for the households of Gokulganj Char are cattle fattening and fishing. Agriculture had started in the year of the survey, but the yields of the main kharif crops were expected to be low because of the new soil and the depth of new deposition during the last flood season. Minor sources of income include selling cow dung, catkin grass, and jute sticks. Many household members also have to work as day laborers.

All households are involved in cattle fattening on a share basis, although some also own cattle. Under the share arrangements, cattle are owned either by people from the mainland, by relatives, or by former neighbors.

Catkin grass grows on the periphery of the char and assists accretion and reduces erosion (Plate 4). Areas of catkin grass are protected from livestock and other villagers to prevent damage to the plants. Catkin is also planted around households to protect buildings from the wave action of floods. When the catkin grass is immersed, villagers harvest the grass by diving underwater.

As with most new chars, bananas are the only fruit trees growing on Gokulganj Char. In addition to providing fruit, the stems of the banana trees are used to make rafts during floods. Other trees take too long to grow and are not planted because the villagers cannot be certain that production will start before the trees are lost to erosion.

Settlers only take loans from local moneylenders because access to both government and nongovernment banks is too difficult. According to survey respondents it is too time consuming to travel to the mainland to process bank loans. Settlers consider it more productive to sell their labor than to take loans. Nongovernment organizations consider char dwellers unsuitable candidates for loans because disruption of their livelihood by floods and erosion would upset the operation of the groups on which most NGO credit schemes are based.

The settlers of Gokulganj Char are in food deficit for about 10 months a year. During *Ashwin/Kartik* (September-November) and *Magh/Falgun* (January-February) it is particularly difficult to find sufficient income to purchase rice. In these months *chapatis* and cakes are made from *kaon* (millet). During *Chaitro* (March/April) people eat less desirable sweet potatoes. Fish is eaten only about twice a week, and *dal* and vegetables are eaten at other times. During the monsoon season, 25 percent of villagers eat three times a day, 35 percent eat two times a day, and 40 percent eat once a day. At other times, 25 percent of villagers eat three times a day; 40 percent eat two times a day; and 20 percent eat rice only once a day and 15 percent eat other grains (mainly millet) once a day.

Buildings on the char have bamboo or timber frames and walls of jute sticks. Roofs are made of thatch or corrugated iron (CI) sheet. In all, there are 67 buildings with catkin or jute stick walls and thatch roofs, 24 with *kutcha* walls and CI sheet roofs, and 4 entirely of CI sheet. Bamboo for construction is purchased from the mainland, and *dhaincha*, the branches of which can be up to 50 mm in diameter, is grown on the char to provide wood for roof trusses. As is typical of chars, homestead buildings are grouped around a central courtyard, and each building has a specific use, such as sleeping and storage, cooking, and cattle. Homesteads generally are arranged linearly along the ridge of higher ground, although some homesteads in the southern part of the char are more scattered.

The majority of the buildings are located along a ridge on the eastern side of the island (Figure 5.2). The plinths of most structures are raised about 0.3-0.5 m above ground level, although a few cattle sheds have floors closer to 1 m above ground level (Plate 3). All households are pre-

pared to construct platforms (*machas*) when required. Gokulganj Char is about 3 km from the BWDB embankment on the left bank of the Brahmaputra. Until 1992 the nearest flood shelter was at Digri Char (Plates 5 and 6), about 1 km to the south; in late 1992 the shelter was lost to erosion.

All households have access to hand tubewells for domestic water, some also have pit latrines.

5.2.2 Impact of Floods and Needs Assessment

Gokulganj Char, as previously noted, recently reaccreted and considerable sedimentation is still taking place. In the settlers' opinions, the char would be stable for a number of years, and several households have constructed buildings with plinths 1 meter above ground level. The northern part of the char is already eroding significantly, however, and the settlers in nearby areas are uncertain how much longer they will be able to stay on the char.

During the first year of char settlement (1992), no houses were flooded. Settlers expect that their houses are likely to be flooded about three out of 10 years, and they estimated that 1988 flood levels would have been about 1.5 m above the 1992 peak flood level. If a 1988 flood occurred under present conditions, all buildings on the char would be flooded to roof level and some low-lying building would be submerged completely. The villagers reported that erosion is worse when water levels are changing rapidly, especially during the early part of the monsoon season.

If floods are severe, householders expect to sell livestock in order to finance rebuilding of their houses. In addition, many will have to migrate to find work. Some will take loans, but interest on these loans tends to be on the order of 20 percent per month.

The settlers are aware of the proposal to construct a bridge across the Jamuna, but they do not know how it will affect them. Some of those interviewed objected to the construction of additional embankments on the mainland because of the potential rise of water levels.

After completion of the bridge and other proposed interventions on the Jamuna, flood levels at Gokulganj Char are expected to increase in a normal year by about 0.20 to 0.28 m, and flood levels of a 1-in-50-year flood are expected to increase by 0.55 to 0.87 m (FAP 25, 1992 and 1993, and Table 3.13 ISPAN 1994). These probable increases in water levels will have significant repercussions on the households of Gokulganj Char since their existing flood proofing measures will be inadequate to protect their properties from even a normal-year flood. Furthermore, the existing 1-in-25-year flood will become close to a 1-in-10-year occurrence, and the present 1-in-10-year flood (that is, the 1987 flood) will become equivalent to a 1-in-5-year flood.

The compensation arrangements made by the Jamuna Multi-Purpose Bridge Authority for people living in charlands affected by the backwater from the bridge are somewhat vague. Under the Revised Settlement Action Plan (JMBA 1993) there is provision for compensation (to be defined) for groups not covered by the Action Plan but found to be adversely affected by the bridge. When and how this may be implemented is unclear, and there is no mention of specific compensation for the confinement effects that have been modeled and predicted by FAP 25.

If households on Gokulganj Char have to cope with the changes themselves, they will incur the cost of raising floor plinth levels to the same return period. For example, flood plinths presently at a 1-in-10-year flood level will need to raised by 0.28 to 0.55 m to retain their present effectiveness, which would cost between Tk. 140 and Tk. 290 per building, depending on the height raised. In addition, cropped land would be adversely affected. Detailed study of cropping patterns at different elevations and the change in normal flood depth and duration plus usual flood risks would be needed to estimate agricultural production losses. This is currently impossible on Gokulganj as the settlers are only in their first year of cultivation.

Many households estimate that it would be possible to keep more cattle on the char than is done at present, but they lack the finances to purchase additional stock.

As in many island chars, villagers consider erosion a greater threat to their livelihoods than flooding as they have adjusted their lifestyles to accommodate normal floods, whereas erosion takes their land and forces them to move to new places.

5.2.3 Assessment of Some Flood Proofing Measures

The problems and losses faced by villagers during floods would be greatly reduced by ensuring that people could stay in their own houses or, alternatively, by providing a community flood shelters within the *para*. The feasibility of these two options is analyzed in detail below.

Housing

At present, house floor plinths are about 0.3 m above ground level, which protects them from the 1-in-1.2-year or normal flood level (that is, the 1989 or 1992 flood level). The 1988 flood level would be about 1.5 m higher, and in such a flood most houses on the char would be flooded to at least the roof level.

To protect at least one building in each homestead against the 1-in-25-year flood, floor plinth levels would have to be raised about 1.1 m (3.6 ft.). Assuming an average floor area of 20 m^2, the cost of raising one building is Tk. 620. The total cost for the 45 households on the char would be Tk. 27,900. The raised plinths would have to be adequately compacted, but it may be necessary to extend the main poles supporting the roof to ensure the stability of house structures.

The main benefits of raising floor plinth levels are:

- saving of evacuation costs including transport, temporary shelter, increased cost of domestic essentials (fuel, food, etc.);
- savings in house damage repair costs; and
- savings of damage to house contents (grain, fuel, personal possessions, etc.)

Table 5.1 Benefits of Raising Floor Plinth Levels: Gokulganj Char*

Benefit (losses avoided)	Return Period†				
	1 in 2	1 in 5	1 in 10	1 in 25	1 in 50
Average Depth of Water in Houses (m)	0.06	0.50	0.80	1.25	1.50
Households Evacuated (%)	0.10	0.16	0.40	0.70	0.88
Savings of Evacuation Costs (Tk.)					
-temporary shelter including transport	1,350	3,375	6,750	7,875	10,035
-increased cost of domestic goods	450	720	1,800	3,150	3,960
Savings from House Damage (Tk.)					
-grass walls/thatch roof	23,130	38,385	37,755	51,210	54,945
Savings of Possessions (Tk.)					
-food grain	148.5	1,350	4,500	9,000	19,485
-personal possessions	1,147.5	4,500	6,750	11,250	17,325
-poultry	2,250	4,500	6,750	9,000	13,500
Total (Tk.)	28,476	52,830	64,305	91,485	119,250

Source: Charland Flood Proofing Study

*Total households = 45

†1988 taken as 1 in 50 year flood; 1991 taken as 1 in 2 year flood

Based on the average costs determined from the household survey and other information gathered during the RRA, these benefits have been quantified and are shown in Table 5.1.

Other, more difficult to quantify benefits include increased well-being of the community as the risk of flood loss and the need for evacuation are reduced.

Economic analysis of raising floor levels is complicated by the risk of losing the investment to erosion and the periodic nature of flooding.

The periodic nature of flooding is taken into account by calculating an annual average benefit, which is the area under the loss-probability curve where losses are in money units and probabilities are the excedence probabilities (reciprocal of return periods) for different events (US Water Resources Council 1979; Penning-Rosewell and Chatterton 1977). Summing the probabilities within each interval in Table 5.1 and multiplying by the average of the pair of losses gives an annual average benefit of house raising of Tk. 29,845 for the 1-in-25-year return period.

The risk of losing the investment to erosion can be determined as the sensitivity of having to replace house plinths at different intervals over a 25-year project period, as shown in Table 5.2a.

This assumes that the household moves nearby and rebuilds at a similar elevation. If it moves to a different location and the life of the investment is curtailed by its loss to erosion (which may be more realistic for Gokulganj) the IRR changes, as indicated in Table 5.2b.

Table 5.2 Risk of Investment Loss

(a)		(b)	
Replacement of House Plinth	IRR (%)	Complete Loss of Plinth in...	IRR (%)
2 years	70	2 years	13
4 years	100	4 years	92
8 years	107	8 years	106

Overall, investment in raising floor plinths to a 1-in-25-year flood level would be a sound investment for settlers if they can stay there for four years. If they stay for only two years, the investment is marginal, which indicates that their present investment of constructing their houses to a 1-in-5-year flood level has a rational basis.

Flood Shelters

If raising house floor plinths is not feasible, providing a communal flood shelter can be a viable alternative. Details of a shelter appropriate for Gokulganj Char are shown in Figure 5.3. The buildings would have CI sheet roofs, timber frames, and walls of jute-stick or similar materials. The buildings would be designed to be easily transported so they could be moved if the land was lost to erosion. It was assumed that land for the shelter would be donated by the community.

The main benefits of flood shelters are:

- saving household evacuation costs;
- reduced livestock losses;
- reduced disruption to cattle fattening schedules; and
- reduced loss of possessions.

Based on average costs determined by the household survey, the benefits in different flood events have been quantified in Table 5.3.

Other benefits, which are more difficult to quantify, include the use of the shelter buildings for schools or other community purposes, improvement of community well-being by reducing flood impacts, vaccination of livestock when they are all gathered in one place. The disadvantage of shelters is that they do nothing to prevent flood damage to homestead buildings.

As with raising floor plinths, economic analysis of shelters is affected by the risk of investment loss to erosion and the periodic nature of flooding.

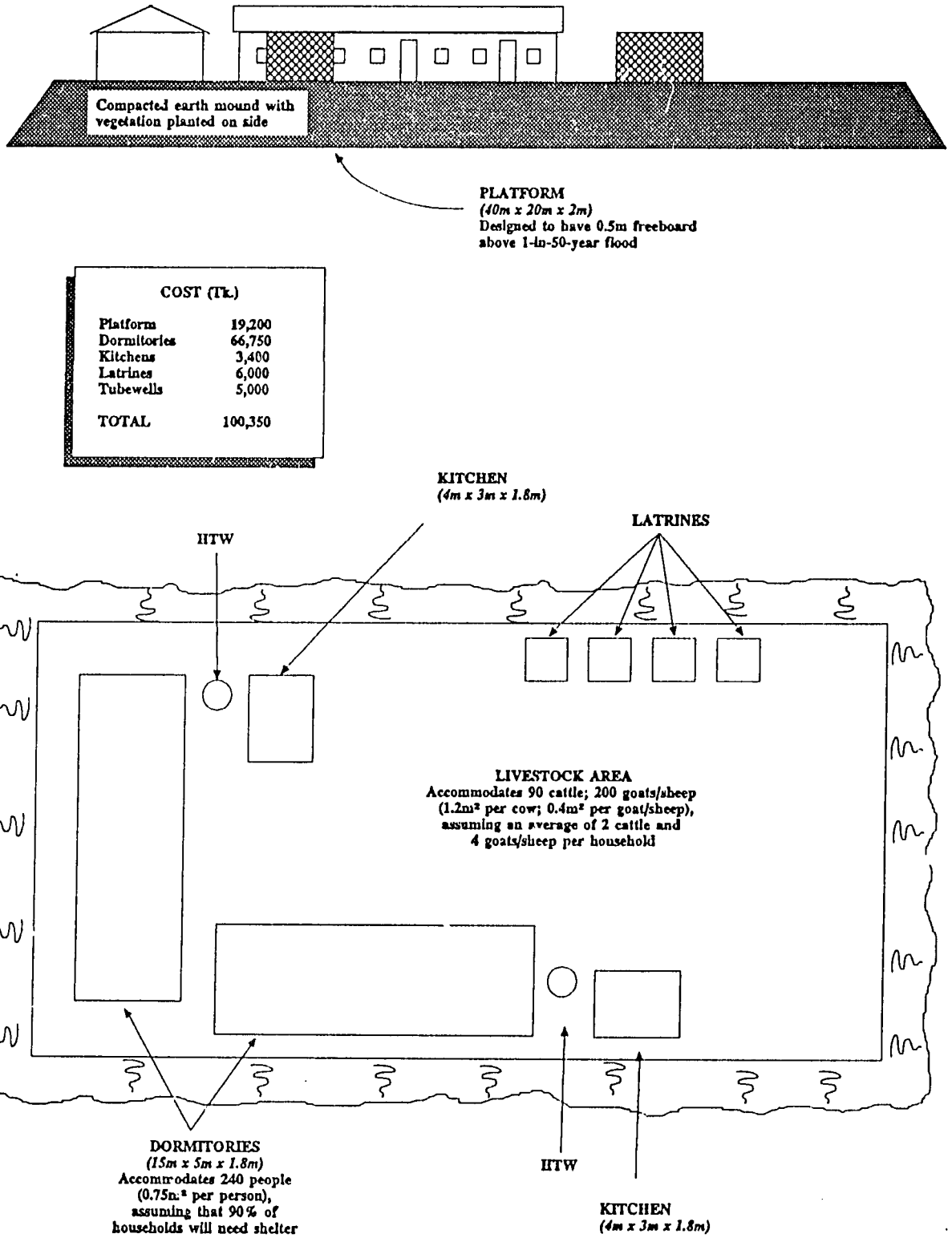


Figure 5.3 Layout and Characteristics of Flood Shelter for Gokulganj Char

Table 5.3 Benefits of Building Flood Shelter: Gokulganj Char*

Benefit (losses avoided)	Return Period†				
	1 in 2	1 in 5	1 in 10	1 in 25	1 in 50
Average Depth of Water in Houses (m)	0.1	0.5	0.8	1.1	1.5
Households Evacuated (%)	0.10	0.16	0.40	0.70	0.88
Number of Cattle	90	90	90	90	90
Number of Sheep/goats	40	40	40	40	40
Cattle Lost (%)	0.01	0.02	0.03	0.05	0.08
Sheep/goats Lost (%)	0.05	0.10	0.15	0.25	0.50
Cattle Evacuated (%)	0.04	0.10	0.20	0.30	0.55
Sheep/goats Evacuated (%)	0.01	0.05	0.10	0.15	0.30
Savings of Evacuation Costs (Tk.)					
-temporary shelter including transport	1,350	3,375	6,750	7,875	10,035
-increased cost of domestic goods	450	720	1,800	3,150	3,960
-travel costs for livestock	144	360	720	1,080	1,980
Subtotal (Tk.)	1,944	4,455	9,270	12,105	15,975
Savings from Livestock (Tk.)					
-cattle losses	2,700	5,400	8,100	13,500	21,600
-sheep/goat losses	900	1,800	2,700	4,500	9,000
-improved well-being from less disruption	1,080	2,700	5,400	8,100	14,850
Subtotal (Tk.)	4,680	9,900	16,200	26,100	45,450
Savings of Possessions (Tk.)					
-food grain	149	1,350	4,500	9,000	19,485
-personal possessions	1,148	4,500	6,750	11,250	17,325
-poultry	2,250	4,500	6,750	9,000	13,500
Subtotal (Tk.)	3,546	10,350	18,000	29,250	50,310
Total (Tk.)	**10,170**	**24,705**	**43,470**	**67,455**	**111,735**

Source: Charland Flood Proofing Study

*Total households = 45

†1988 taken as 1 in 50 year flood; 1991 taken as 1 in 2 year flood

Table 5.4 Influence of Economic Factors on Shelter Loss

Factors	IRR (%)
Allocate all costs (including buildings, kitchen, latrines, and HTW)	
-replace building every 16 years/earthworks every 4 years	10
-replace buildings every 8 years/earthworks every 4 years	0
Allocate earthworks costs plus some relocation costs only and assign the building costs to education, community health, etc.	
-replace every 4 years	53
-replace every 8 years	64
Construct only refuge for livestock	
-replace every 4 years	14
-replace every 8 years	30
Construct only refuge for livestock	
-complete loss after 4 years	14
-complete loss after 8 years	29

Source: Charland Flood Proofing Study

The periodic nature of flooding has been taken into account by calculating an annual average benefit in the same way as was done for the raising of house plinth levels. Based on the benefits shown in Table 5.3, the average annual benefit is Tk. 14,510 for a 1-in-25-year flood and Tk. 16,302 for 1-in-50-year flood. A shelter for livestock only has an average annual benefit of Tk. 5,931 for a 1-in-25-year flood and Tk. 6,646 for a 1-in-50-year flood.

Assuming a 25-year project life, the risk of losing the shelter to erosion is determined by the influence of various economic factors as shown in Table 5.4.

Overall, flood shelters are economically feasible if they are used for multiple purposes. Single-purpose livestock shelters also are economically feasible if they do not have to be replaced often.

Other Measures

Other measures that would be beneficial during or after floods include:

- raising the level of hand tubewells;
- improving the availability of boats;
- improving agricultural production in the dry season; and
- providing credit to purchase livestock.

The costs and benefits of these measures are difficult to clearly identify as they would improve the resources available to households and have benefits beyond their usefulness during floods.

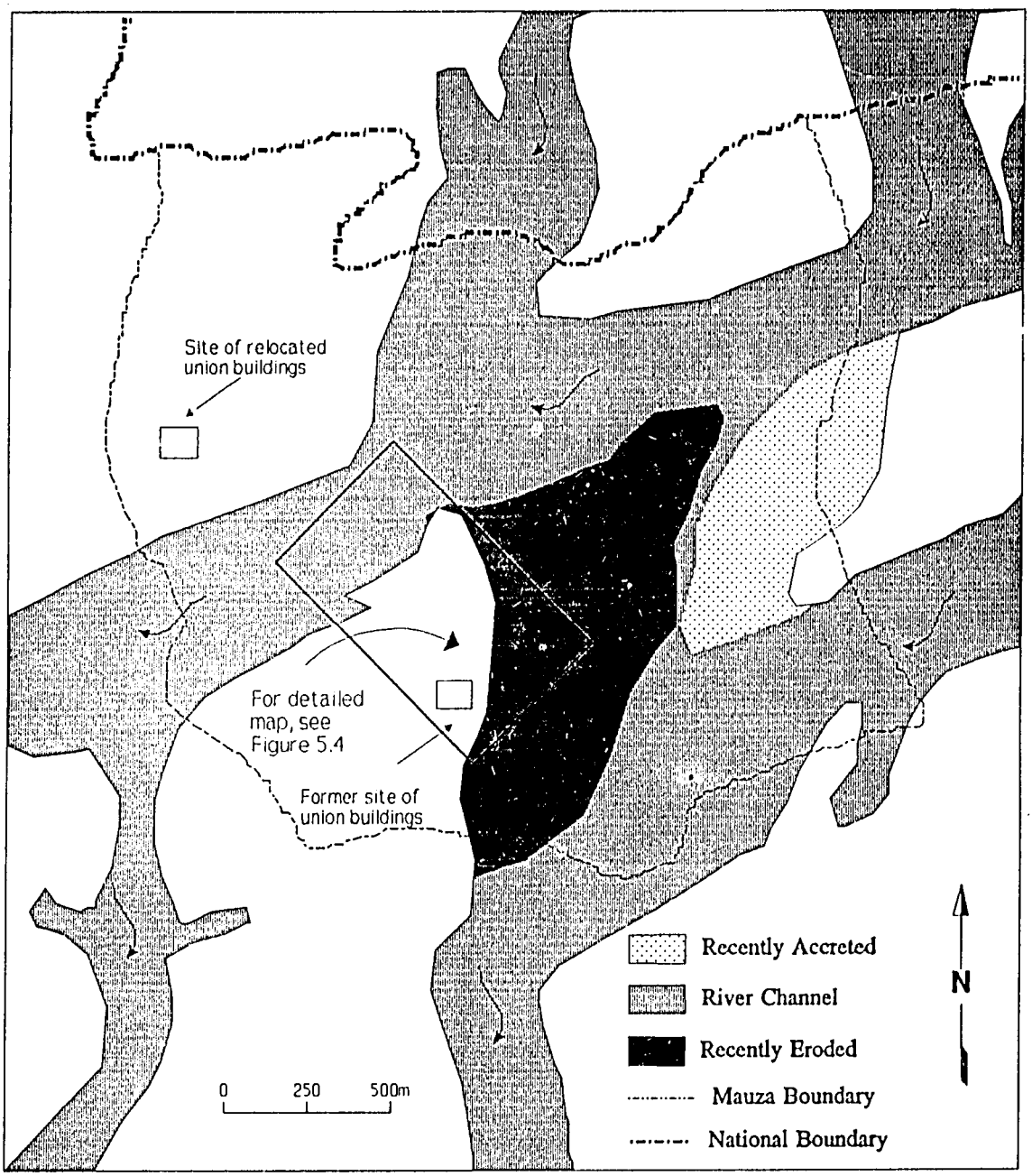
5.3 Case Study 2: Jhaukuti, Kurigram

5.3.1 Description of Jhaukuti Mauza

Jhaukuti mauza in Narayanpur union has been inhabited for more than 100 years. River channels divide the mauza into three *paras* (Figure 5.4). A significant portion of the central part of the mauza has been lost to erosion during the past decade, and about 95 percent of the mauza's land is 5 to 10 years old; the remaining 5 percent is as much as 40 years old.

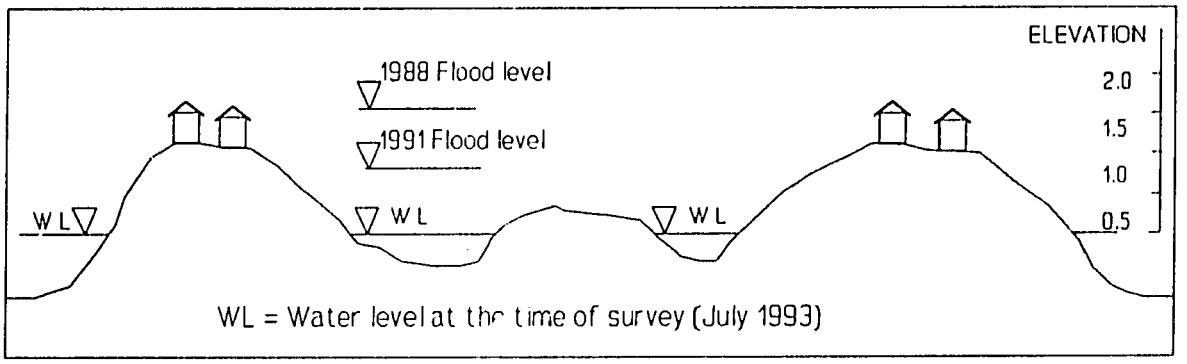
In 1992, there were 170 households and three *samajes* in the mauza. During the 1970s an estimated 350 households lived in the mauza. In the southern part, which was surveyed for this case study, there are 70 households and one *samaj*.

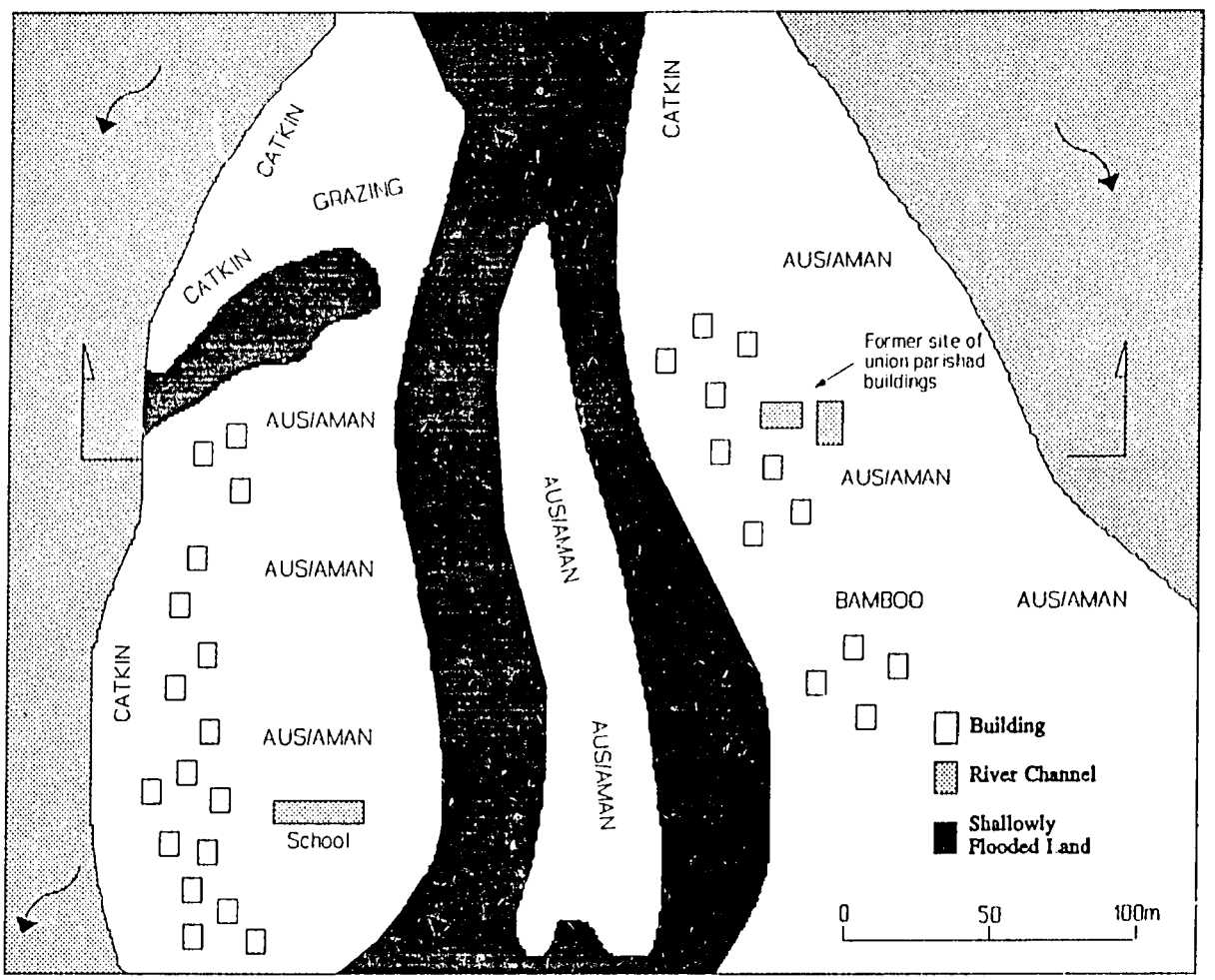
62



Source: Field Observation

Figure 5.3 Layout of Jhaukuti Mauza





Source: Field Observation

Figure 5.5 Detail Maps of Jhaukuti Mauza

Jhaukuti mauza land is 50 percent uncultivated, 20 percent cultivated, and 5 percent homestead. About 20 percent of the land is underwater. Of the cultivated land, about 20 percent is lowland that floods to a depth of 2 to 3 m; 60 percent is medium land that floods to a depth of 1 to 2 m, and 20 percent is highland that floods to 0.5 to 1 m. About 60 percent of the land is single cropped, 20 percent is double cropped, and 15 percent is triple cropped. The main rabi crops are wheat, sweet potato, millet, and pulses. The main kharif crops are broadcast aus/aman (Figure 5.5). The only recent change in the area's cropping pattern is that jute has been phased out because of its low price.

As in Gokulganj and other island chars, catkin grows on the river banks and assists in accretion and reduces erosion. Catkin flowers in late monsoon and the seeds are spread by wind and water. All catkin grass has been established naturally, yields about 1,000 bundle/ha, and is sold for Tk. 30-40/bundle.

The main sources of income in Jhaukuti are agriculture, labor, and cattle fattening. About 85 percent of the resident households are laborers, 80 percent of whom migrate to find work for one to three months during the monsoon season. Since 1977/79, when erosion became a problem in the mauza, many more men have migrated to find work. About 15 percent of households are farmers (that is, their main income is directly from agriculture), and about 75 percent of households are involved in sharecropping. Local wage rates for day labor are Tk. 20-25 per day plus three meals. Fishing is also an important source of income.

There are an estimated 330 cattle in the mauza, or about 1.94 cattle per household. The cattle density, therefore, is higher than the national average (1.33 cattle/household). There also are about 250 goats, 75 sheep, and three buffalo. The main constraint on the number of cattle in the mauza seems to be lack of resources to purchase more stock. Fodder, such as grass or catkin, is available throughout the year except in times of severe floods. During the monsoon, animals are fed straw. Fallow fields also provide ample grazing.

The main markets are at Jatrapur (10 miles distant) for cattle and Madarganj (3.5 miles) for household goods. The cost of boat transportation to Jatrapur is Tk. 20-30 per cow and Tk. 10 per person. Forty to fifty people can fit in one boat. In some areas people pay an annual charge to ferry operators, which gives them use the ferry service throughout the year. In Jhaukuti, only one family owns an engine boat.

For the past two years, two engine boats have come weekly from other villages to take villagers to market on the mainland. The boats do not follow a fixed schedule but tend to come sometime in the morning and return in the evening. In the dry season it takes villagers 2 to 2.5 hours to reach Madarganj as they have to travel by a combination of walking across island chars and taking ferries across river channels. In the monsoon season, villagers can travel directly to Madarganj by boat, which takes about an hour.

Fuel for cooking is readily available, and hay and dung are used throughout the year except during monsoon season when driftwood and straw are used. Surplus fuel is sold in local markets.

In an average year, 5 percent of households eat three meals a day, the remaining 95 percent eat two meals a day. Most households do not eat vegetables except for spinach.

Building construction consists of bamboo or timber frames with walls of catkin grass or jute sticks and roofs of thatch. Only a few buildings have CI sheet roofs or walls. In the mauza's southern *para* there are 32 buildings with catkin grass or jute stick walls and thatch roofs, 10 with catkin or jute walls and CI roofs, and two buildings entirely of CI sheet.

The construction cost of a house with catkin walls and thatch roof is Tk. 2,000; and for CI sheet roof and walls Tk. 10,000. The cost of a plinth 0.5 m high is Tk. 200-250. Householders often first fill the courtyard and then make the plinths on top of the raised courtyard. The dimensions of courtyards are about 18 m^2 and cost about Tk. 1,500-2,000 to

construct (earth filling costs about Tk. 5/m^3). Floor plinths generally are about 0.3 to 0.5 m above ground level, but householders do not raise the floor levels of their houses since they consider the investment too risky.

Most homesteads consist of several buildings grouped around a central courtyard. Buildings are used for sleeping and storage, cooking, and cattle. The settlement pattern is mainly linear, although there are some scattered or outlying homesteads.

When water levels rise 0.3 to 0.7 m (1 to 2 ft.) inside a house, beds are raised on bamboo poles. If the water level continues to rise, platforms (*machas*) are constructed. A *macha* is built to roof level and one house wall is removed to provide access. The lower portions of the other walls are removed to prevent them from being washed away by flood water. Platforms where cattle can stand are made by forming mounds of catkin grass and banana stems. If households have to move because of erosion, lineage mates (*gushti*) move together and *samajes* are not involved in the moving arrangements.

There are five hand tubewells in the mauza, and 25 percent of the households drink tubewell water, the rest drink river water. Tubewell water is not used for cooking because the iron content of the water gives rice an unappetizing color. All wells are submerged during floods, but until they are completely submerged, water is collected from them by raft. During floods, water adjacent to the riverbank is muddy so water is collected from farther out in the channel.

The union parishad building, once located in the southern *para* (Figure 5.5), has been shifted to western *para* because of the threat of erosion (Figure 5.4). A flood shelter (with dimensions 140 m by 45 m by 1.8 m high) has been constructed at the new site, on land donated by the union parishad chairman, with 1,300 maunds of wheat. On the mound there is a building with a floor area of 9 m by 3 m, a CI sheet roof, and catkin grass walls. The building is used as a *madrasa*.

5.3.2 Impact of Floods and Needs Assessment

During the past five years, floods have occurred in 1987, 1988, and 1991. The worst flood, in 1988, lasted from early August to mid-September. Usually floods occur from mid-June to mid-August and last for about two months.

In 1988, villagers heard no news of the coming flood on the radio, and there was little news in the markets. Villagers generally forecast floods based on winds from the south carrying rain clouds north, but they were unable to predict the severity of the 1988 flood.

During the flood, all houses were flooded and all but five were inundated above roof level. Seventy-five percent of the houses were destroyed or washed away. About 50 percent of households took shelter on a BWDB embankment about 10 km distant, where they remained for about 20 days. The transportation costs of those who went to the embankment were paid by the village relief committee. Whole families went to the embankment, but in each case one member returned periodically to check on what was happening in the village. The round trip from the embankment to the village and back cost about Tk. 60, and individual families had to pay this themselves.

About 500 people stayed in two large boats anchored next to the union parishad office (Figure 5.5). Livestock were moved to the mounds on the union parishad grounds. Cooking was done in rotation, and the roofs of houses were used as fuel. The tubewell at the union parishad office broke after a few days and people had to resort to using river water. Generally, the better-off households moved either to relatives' homes or to the mainland embankment; poorer households had no option but to stay on the char. During the flood, the union parishad distributed rice and flour for four days and then the upazila parishad distributed rice and flour for about 20 days. The villagers considered the provided service satisfactory under the circumstances.

In 1988, all crops and poultry were lost, along with 50 percent of the goats and 30 percent of the cattle. Banana leaves and water hyacinth were used for fodder for the animals that did survive. All field crops were lost as were kitchen gardens (chilies, sweet potatoes, etc.).

Since the 1988 flood, 13 households have moved away and no new households have moved into the mauza. The economy took about two years to recover to its previous level of activity. Families had to sell livestock to pay for immediate needs, and many men migrated to urban areas for work.

The main problem during floods is the lack of boats, and high demand for transportation results in an acute shortage of boats. The cost of transportation increases during the monsoon, but as the flood levels worsen, demand rises and costs increase. During higher floods, the small boats used within the village become unsafe in the high currents and turbulent water. When erosion threatens and buildings have to be moved, families negotiate with boat owners to move the construction materials at a fixed price, which is on the order of Tk. 500 to move two or three buildings.

During severe floods, livestock care becomes a problem, especially if cattle sheds become inundated. At such times, fodder becomes scarce or unavailable, and animal become sick if they stand in water for too long.

Other problems villagers experienced during floods were:

- no place to store grain when houses were flooded above roof level; and
- no place to process rice.

Waves generally are not a problem, except in 1991 when high winds accompanied the high water levels.

Villagers expressed an interest in receiving flood warnings and suggested that the union parishad could organize warnings to be broadcast locally by loudspeakers and drums.

5.3.3 Assessment of Flood Proofing Measures

As with Gokulganj Char, the problems and losses faced by villagers in Jhaukuti during floods would be greatly reduced by ensuring that people could stay in their own houses or, alternatively, by providing a community flood shelter within the *para*. The feasibility of these two options are analyzed in detail below.

Housing

House floor plinths are presently about 0.3 m above ground level, which provides protection from the normal flood level (that is, the 1989 or 1992 flood levels). The 1988 flood level was about 1.25 m higher, so most houses on the char would have been flooded to at least the roof level.

To protect at least one building in each homestead against the 1-in-25-year flood, floor plinth levels would have to be raised about 0.9 m. Assuming an average floor area of 20 m^2, the cost of raising one building is Tk. 500. The total cost for the 70 households of the southern *para* would be Tk. 35,000. The raised plinths would have to be adequately compacted, although for some houses it may be necessary to extend the main poles supporting the roof to ensure stability of the house structure.

The main benefits of raising floor plinth levels are:

- saving of evacuation costs, including transport, temporary shelter, increased cost of domestic essentials (fuel, food, etc.);
- savings in house damage repair costs; and
- savings of damage to house contents (grain, fuel, personal possessions, etc.)

Based on the average costs determined from the household survey, these benefits are quantified in Table 5.5.

Other benefits, which are more difficult to quantify, include the increased well-being of the commu-

Table 5.5 Benefits of Raising House Plinths: Jhaukuti Mauza*

Benefit	Return Period†					
	1 in 2	1 in 5	1 in 10	1 in 25	1 in 50	1 in 86
Number of Hc -cholds	70	70	70	70	70	70
Average Depth of Water in Houses	0.1	0.3	0.5	0.9	1.1	1.25
Households Evacuated (%)	0.10	0.16	0.40	0.60	0.75	0.90
Number of Cattle	90	90	90	90	90	140
Number of Sheep/goats	40	40	40	40	40	91
Cattle Lost (%)	0.01	0.02	0.03	0.05	0.08	0.12
Sheep/goats Lost (%)	0.05	0.10	0.15	0.25	0.50	0.50
Cattle Evacuated (%)	0.04	0.10	0.20	0.30	0.55	0.75
Sheep/goats Evacuated (%)	0.01	0.05	0.10	0.15	0.30	0.40
Savings of Evacuation Costs (Tk.)						
-temporary shelter including transport	2,100	5,250	10,500	12,250	15,610	19,810
-increased cost of domestic goods	700	1,120	2,800	4,200	5,250	6,300
-travel costs for livestock	144	360	720	1,080	1,980	4,200
Subtotal (Tk.)	2,944	6,730	14,020	17,530	22,840	30,310
Savings from Livestock (Tk.)						
-cattle losses	2,700	5,400	8,100	13,500	21,600	50,400
-sheep/goats losses	900	1,800	2,700	4,500	9,000	20,475
-improved well-being from less disruption	1,080	2,700	5,400	8,100	14,850	31,500
Subtotal (Tk.)	4,680	9,900	16,200	26,100	45,450	102,375
Savings of Possessions (Tk.)						
-food grain	231	2,100	7,000	14,000	30,310	53,130
-personal possessions	1,785	7,000	10,500	17,500	26,950	27,580
-poultry	2,250	4,500	6,750	9,000	13,500	202,500
Subtotal (Tk.)	4,266	13,600	24,250	40,500	70,760	283,210
Total (Tk.)	**11,890**	**30,230**	**54,470**	**84,130**	**139,050**	**415,895**

Source: Charland Flood Proofing Study

*Total households = 45

†1988 taken as 1 in 50 year flood; 1991 taken as 1 in 2 year flood

nity as the risk of flooding and the need for evacuation are reduced.

Economic analysis of raising floor levels is complicated by the risk of losing the investment to erosion and the periodic nature of flooding.

The periodic nature of flooding is taken into account by calculating an annual average benefit in the same way as for raising of house plinth levels in Gokulganj (Section 5.2.3). Based on the benefits shown in Table 5.5, the average annual benefit of raising house plinths is Tk. 21,657 for a 1-in-25-year flood. The benefits from flood proofing measures are lower in Jhaukuti than in Gokulganj because the people in Jhaukuti are poorer and therefore have less to loose from floods.

The risk of losing the investment to erosion is determined by calculating the sensitivity of having to replace house plinths at different intervals as shown in Table 5.6a.

Although Jhaukuti has been a settled community for many years, it may not be possible for villagers to remain within the mauza in future if the present rate of erosion continues (Figure 5.4). Should erosion continue, the investment in raising floor plinths levels would be lost, and the IRR would be as shown in Table 5.6b.

Overall, raising house floor plinths would be a sound investment as long as the houses remain for at least four years after the work has been carried out. Even though the southern *para* of Jhaukuti continues to erode, the houses that remain would still benefit from having their floor plinths raised as long as they were there for at least four years.

Table 5.6 Risk of Investment Loss

(a)		(b)	
Replacement of House Plinth	IRR (%)	Complete Loss of Plinth in...	IRR (%)
2 years	<0	2 years	<0
4 years	49	4 years	39
8 years	60	8 years	55

Flood Shelters

Provision of a communal flood shelter is an alternative to raising house floor plinths if the latter are not feasible. Details of a shelter appropriate for Gokulganj Char are shown in Figure 5.6. The buildings would have CI sheet roofs, timber frames, and walls of jute-sticks or similar materials. The buildings would be designed to be easily transported so they could be moved if the land was lost to erosion. It was assumed that land for the shelter would be donated by the community.

The main benefits of flood shelters are:

- savings of evacuation costs of households;
- reduced livestock losses;
- reduced disruption of cattle fattening schedules; and
- reduced loss of possessions.

Based on average costs determined by the household survey and other information gathered during the RRA the benefits can be quantified as shown in Table 5.7.

Other, less quantifiable, benefits, include using the shelter buildings for schools or other community purposes, improvement of community well-being by reducing flood risk, and the opportunity to vaccinate livestock when they are all in one place. The disadvantage of shelters is that they do nothing to prevent flood damage to homesteads.

As with the raising of flood plinths, economic analysis of shelters is complicated by the risk of losing the investment to erosion and the periodic nature of flooding.

The periodic nature of flooding is taken into account by calculating an annual average benefit in the same way as for raising of house plinth levels. Based on these benefits in Table 5.7, the average annual benefit is Tk. 17,635 for a 1-in-25-year

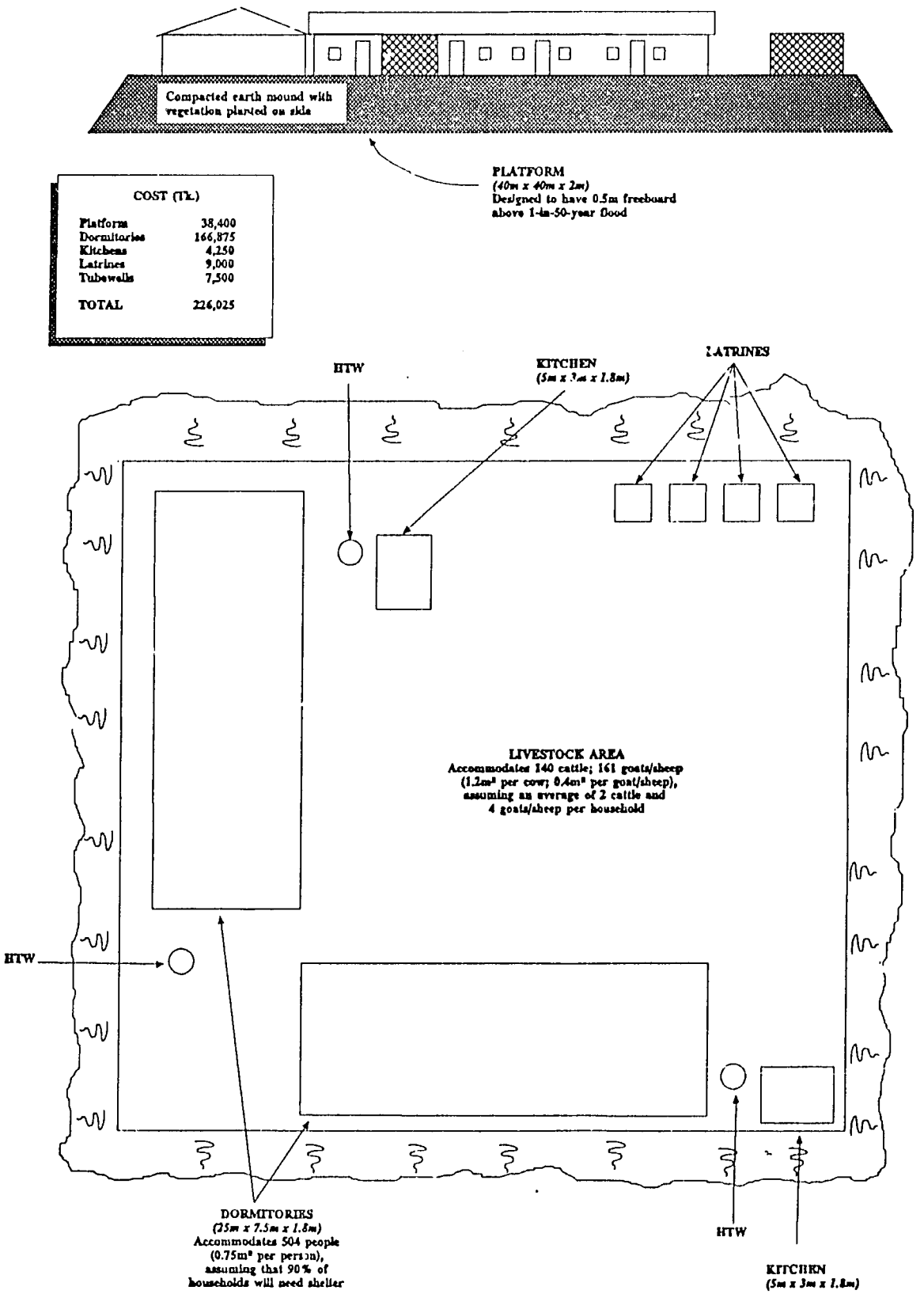


Figure 5.6 Layout and Characteristics of Flood Shelter for Jhaukuti Mauza

Table 5.7 Benefits of Building Flood Shelter: Jhaukuti Mauza*

Benefit (losses avoided)	Return Period†					
	1 in 2	1 in 5	1 in 10	1 in 25	1 in 50	1 in 86
Number of Households	70	70	70	70	70	70
Average Depth of Water in Houses	0.1	0.3	0.5	0.9	1.1	1.25
Households Evacuated (%)	0.10	0.16	0.40	0.60	0.75	0.90
Number of Cattle	140	140	140	140	140	140
Number of Sheep/goats	91	91	91	91	91	91
Cattle Lost (%)	0.01	0.02	0.03	0.05	0.08	0.12
Sheep/goats Lost (%)	0.05	0.10	0.15	0.25	0.35	0.50
Cattle Evacuated (%)	0.04	0.10	0.20	0.45	0.65	0.75
Sheep/goats Evacuated (%)	0.01	0.05	0.10	0.15	0.30	0.40
Savings of Evacuation Costs (Tk.)						
-temporary shelter including transport	350	700	3,500	7,350	12,250	19,810
-increased cost of domestic goods	700	1,120	2,800	4,200	5,250	6,300
-travel costs for livestock	224	560	1,120	2,520	3,640	4,200
Subtotal (Tk.)	1,274	2,380	7,420	14,070	21,140	30,310
Savings from Livestock (Tk.)						
-cattle losses	4,200	8,400	12,600	21,000	33,600	50,400
-sheep/goats losses	2,048	4,095	6,143	10,238	14,333	20,475
-improved well-being from less disruption	1,680	4,200	8,400	18,900	27,300	31,500
Subtotal (Tk.)	7,928	16,695	27,143	50,138	75,233	102,375
Savings of Possessions (Tk.)						
-food grain	231	700	7,000	14,000	28,000	53,130
-personal possessions	1,050	1,820	7,000	10,500	19,250	27,580
-poultry	2,250	4,500	6,750	7,875	13,500	202,500
Subtotal (Tk.)	3,531	7,020	20,750	32,375	60,750	283,210
Total (Tk.)	**12,733**	**26,095**	**55,313**	**96,583**	**157,123**	**415,895**

Source: Charland Flood Proofing Study

*Total households = 70

†1988 taken as 1 in 86 year flood; 1991 taken as 1 in 2 year flood

Table 5.8 Influence of Economic Factors on Shelter Loss

Factors	IRR (%)
Allocate all costs (including buildings, kitchen, latrines, and HTW)	
-replace earthworks every 4 years	4
-replace earthworks every 8 years	6
-complete loss after 4 years	<0
-complete loss after 8 years	<0
Allocate earthworks costs plus some relocation costs only and assign the construction costs to education, community health, etc.	
-replace every 4 years	34
-replace every 8 years	47
-complete loss after 4 years	22
-complete loss after 8 years	40
Construct only refuge for livestock	
-replace every 4 years	9
-replace every 8 years	26
-complete loss after 4 years	1
-complete loss after 8 years	21

Source: Charland Flood Proofing Study

flood and Tk. 20,172 for a 1-in-50-year event. The average annual benefits related to livestock are Tk. 10,645 for the 1-in-25-year flood and Tk. 13,100 for the 1-in-50-year flood.

The risk of losing the shelter to erosion is determined by calculating the influence of various factors on the economics as shown in Table 5.8. Overall, flood shelters are economically feasible if they are used for multiple purposes. Livestock shelters also are economically feasible if they are safe from erosion for more than four years.

Other Measures

Other measures that could be considered are:

- raising of the level of hand tubewells;
- improving the availability of boats;
- improving agricultural production in the dry season;
- providing credit to purchase more livestock;
- improving the flood warning systems.

The costs and benefits of these measures are difficult to identify clearly, but they would improve the resources available to households and have benefits in addition to those associated with floods. Improved flood warnings and improved availability of boats would complement the flood proofing of housing and construction of flood shelters by ensuring that household possessions were moved and that people and livestock moved to the shelter in time.

5.4 Conclusions from the Case Studies

People living on island chars suffer significant flood losses in most years. Investment in flood proofing measures would be economically sound and contribute toward improving the standard of living of char dwellers.

Chapter 6

DISCUSSION AND RECOMMENDATIONS

6.1 Discussion

The mitigation of flood effects in char areas is complicated by the high risk of erosion, which makes flood protection facilities, such as embankments and water control structures, technically and economically unsound. In addition, the poor fertility and low value of the land and low population densities make structural solutions undesirable. Therefore, the main options for mitigating flood losses in char areas are flood proofing and flood preparedness measures.

Char families and communities traditionally have depended on their own initiatives to "flood proof" their livelihoods, property, and possessions from damage or loss during floods. For example, floor levels of houses are usually raised above ground level and side slopes of homesteads are planted with grass to protect against destructive wave action (Plate 2). Traditional flood proofing efforts, however, have met with limited success since many households in both study areas lack both the resources and the time horizon to carry them out and therefore suffer significant losses even in years of normal floods. For example, in 1991, a close to a normal flood year, average homestead losses were equivalent to about one month's agricultural wages, and average gross agricultural losses per household were equivalent to about three months' wages (Tables 3.9). In the larger flood of 1988, average homestead losses for both locations were equivalent to about six months' agricultural wages, and average gross agricultural losses per household were equivalent to about a year's agricultural wages (Table 3.4). The rates of return presented are based on financial costs, but economic costs are likely to yield similar results as there are no crop benefits and mainly local materials are used for housing.

People in the chars have adjusted their lifestyles to accommodate flood levels within a specific range. Even small increases in water level, therefore, can seriously disrupt their way of life. The impact of all interventions affecting water levels and flows in the major rivers should be determined and programs developed and implemented to avoid adverse affects on people in char areas. For example, it is estimated that a Jamuna left embankment and the Jamuna Multipurpose Bridge would increase the water level at Sirajganj in a repeat of the 1988 flood by about 0.83m (FAP 15, 1993; FAP 16/19, 1993). This will seriously affect char dwellers upstream of the bridge. Moreover, the increase in flow velocities near the bridge will elevate erosion risks; as a result, char people may have to move their homesteads even more frequently than they already do.

The continuing vulnerability of char households to floods and erosion leaves most families unable to make significant improvements to their lives as they continually have to use available resources to recover from the affects of flood and erosion. Livestock, for example, are a main economic activity, yet the number of livestock in the char areas has decreased significantly since the 1988 flood. Some of the reduction may be due to losses during the flood of 1988 and subsequent floods, but most of the decline seems to be due to distress sales as people have sold cattle to raise money for

other, more pressing, needs. Easier access to credit would alleviate the need for such distress sales and contribute to more rapid recovery of local economies after floods.

The problems faced by people in char areas during floods would be greatly reduced by ensuring that people could stay in their own houses or, alternatively, by providing community flood shelters. Analysis undertaken in the two case studies shows clearly that two particular measures (raising house floor plinth levels and constructing flood shelters) give good economic returns for the investment. Raising plinth levels of houses costs about Tk. 500-650 per house and gives an IRR of 39 percent in Kurigram and 92 percent in Bhuapur. Flood shelters cost between Tk. 100,000 and Tk. 250,000, depending on the size of the community served and the facilities provided. The shelters have rates of return of 34-64 percent if facilities are used for multiple purposes and the shelter is not lost to erosion within four years. Actual costs and returns may differ from these estimates depending on the communities and flood risks in a particular location.

One of the difficulties in implementing flood proofing programs is that most of them are based on local initiatives leading to individual or community actions. This is contrary to the central planning tendency that is typical of most government agencies. To ameliorate this, a significant change will be required in the internal culture of many of these agencies before they can support flood proofing programs based on community participation.

To increase local accountability for flood proofing programs, ways to get local people to contribute to their cost need to be investigated. One possibility would be cost sharing, which would use public resources to construct a shelter on condition that local people raise the floor plinth levels of their homesteads. Such a public investment would be justified as the reduction of losses would enable household to use available resources for productive purposes rather than for recovering from floods. The amount that floor plinth levels should be increased at a particular location will depend on local circumstances and the reaction of local people.

These flood proofing measures would have significant social effects, as they would benefit all income groups. At present, poorer families are particularly vulnerable and often have to evacuate their houses and travel considerable distances to seek refuge. Local relief committees may pay some of their evacuation costs, but households have to bear most of the costs, as well as the costs of rehabilitation once the flood has receded.

For comparison, of the 17 FCD/I projects studied in FAP 12 (only two of which had irrigation components), only nine gave rates of return of more than 22 percent, and the "best" project gave a rate of return of 90 percent. Furthermore, the investment on the 17 projects analyzed ranged from Tk. 3,720 to Tk. 43,302 per household (the highest figure being a project with an irrigation component), with average being about Tk. 6,000 per household. Therefore, investment in flood proofing can give similar if not better rates of return than investment in FCD schemes at a much lower cost per household. Another consideration is that investment in FCD schemes would mainly benefit landowners and farmers, while flood proofing would benefit all households, including the most vulnerable groups in a community.

A major advantage of flood proofing measures is that they are small in scale and environmentally benign. Since they do not affect river morphology, flood proofed charland would still be susceptible to the processes of erosion and accretion, however. Flood proofing programs need to plan with this in mind.

6.2 Recommendations

The study establishes that flood proofing is an effective and cost-efficient way of reducing charland people's vulnerability to flooding and therefore improve the social and economic conditions in which they live. The FPCO may now include

among the list of projects due to emanate from the FAP process a project to flood proof the char-lands. Such a project would not only implement flood proofing but also make specific proposals to reduce the impact on char dwellers of major interventions that will increase the water levels in rivers with inhabited chars. The detailed design and implementation of such a project will call for BWDB's collaboration with the LGED, local government bodies, and NGOs.

Based on the discussion in Section 6.1, flood proofing programs might address some or all of the following issues:

- providing flood shelters;
- raising homestead floor plinth levels;
- improving access to credit; and
- improving access to boats.

Any project undertaken at or near the grassroots level, as would be the case with most flood proofing programs, requires ensuring a high degree of local accountability.

Flood proofing programs in char areas should be developed and implemented in a manner that equitably distributes public funds allocated to rural development activities. At present, char areas tend to be missed by government rural development programs, and few government services are available in char areas. NGO services are also not available at the level of need.

Flood proofing programs should initially focus on reducing losses to homesteads and livestock as both are preventable. In the short term, increasing house flood plinth levels and providing shelters are financially sound investments. In the longer term, general development programs that include the provision of credit should be implemented. Initially, pilot programs lasting two to three years are required to develop the institutional arrangements for implementing flood proofing measures. Longer-term general development programs should give the people in char areas the resources to undertake their own flood proofing measures. Since flood proofing does not alter the effects of erosion, alternative development strategies may be required for char areas that are subject to greater frequency of erosion.

In planning flood shelters, the particular needs of women should be taken into account. This study found that food preparation and cooking were the main problems for women during floods, closely followed by the availability of santitation facilities and getting fuel and food. If flood shelters are to be promoted, then the provision of sanitation facilities and space and facilities for cooking is of great importance.

Boats are critical to char people, but the relatively high cost of the large boats that can operate when river levels are high, combined with the seasonal demand for such boats, result in their scarcity during floods. The utilization of boats in the chars should be studied further to identify ways to increase the availability of boats during the monsoon season.

Flood proofing programs should be implemented with the active participation of all sections of local communities to assess the feasibility and suitability of different measures, and the process of implementing the program should be used to strengthen communities and improve the linkage between people in char areas and local and central government staff and services. Ways to move government agencies away from centralized planning and into community planning should be identified and developed. Flood proofing programs would provide an opportunity to facilitate this process.

Potential users of this report include:

- water project planners in the MOWR, BWDB, FPCO, and WARPO;
- FAP 3.1—the next phase of the Jamalpur Priority Project includes a flood proofing component;
- LGED/CARE, who are undertaking a flood proofing program;
- agencies, such as WFP, that implementing food-assisted development programs;
- local government and thana offices having

responsibility for thanas that include charland areas;

- the Disaster Management Bureau of the Ministry of Relief and Disaster Management;
- the Public Health Engineering Department;
- the Primary Education Directorate and Facilities Department for the planning, location, and design of primary schools and other educational institutions;
- the Directorate of Health Services;
- the Rural Development Division and BRDB;
- the Jamuna Multipurpose Bridge Authority; and
- NGOs currently active in charlands and those that may do so in the future.

The FAP regional studies have previously identified areas where major structural flood protection measures are not feasible, and these areas were earmarked for flood proofing activities. Prior to the regional studies, no study was made of potential flood proofing measures and their costs and benefits. Given the evidence of the Charland Flood Proofing Study, flood proofing is technically and economically feasible even in the charlands, where there are high erosion risks. Flood proofing may also be appropriate in other unprotected flood-prone areas. Flood proofing has been proposed before, but it has not been given serious attention by the public sector for riverine areas (unlike cyclone shelters in the coastal belt). There is an urgent need now for a government agency to take up, at least on a pilot basis, a flood proofing program before another major flood occurs and people in the unprotected floodplain again suffer severe losses. A small investment in labor-intensive minor structural works would help millions of people cope with severe floods. Flood proofing would be the initial step in reducing vulnerability to flooding, once its success has been demonstrated, other measures or economic development could be added.

REFERENCES

Penning-Rosewell, E.C. and Chatterton, J.B. (1977). *The Benefits of Flood Alleviation: A Manual of Assessment Techniques.* Gower Technical Press, Aldershot, United Kingdom.

US Water Resources Council. 1979. Procedures for Evaluation of National Economic Benefits (NEB) and Costs on Water Resources Planning: Final Rule. Washington D.C.

FAP 14. 1992. *Draft Final Report—Flood Response Study.* Dhaka: Flood Plan Coordination Organisation, Ministry of Irrigation, Water Development and Flood Control. (Report prepared by Irrigation Support Project for Asia and the Near East).

FAP 16. 1993. *Socioeconomic Study Summary Report.* Dhaka: Flood Plan Coordination Organisation, Ministry of Irrigation, Water Development and Flood Control. (Report prepared by Irrigation Support Project for Asia and the Near East).

FAP 16/19. 1993. *The Dynamic Physical and Human Environment of Riverine Charlands* (Reports on Brahmaputra-Jamuna, Ganges, Meghna, and Padma Rivers). Dhaka: Flood Plan Coordination Organisation, Ministry of Irrigation, Water Development and Flood Control. (Report prepared by Irrigation Support Project for Asia and the Near East).

FAP 25. 1993. *Flood Hydrology Study, Annex 2 - Flood Modelling and Management.* Dhaka: Flood Plan Coordination Organisation, Ministry of Irrigation, Water Development and Flood Control. (Report prepared by KrügerConsult in association with BCEOM).

JMBA. 1993. *Revised Resettlement Action Plan.* Dhaka: Jamuna Multipurpose Bridge Authority.

PLATE 1: Island char homestead. Note the raised courtyard and buildings.

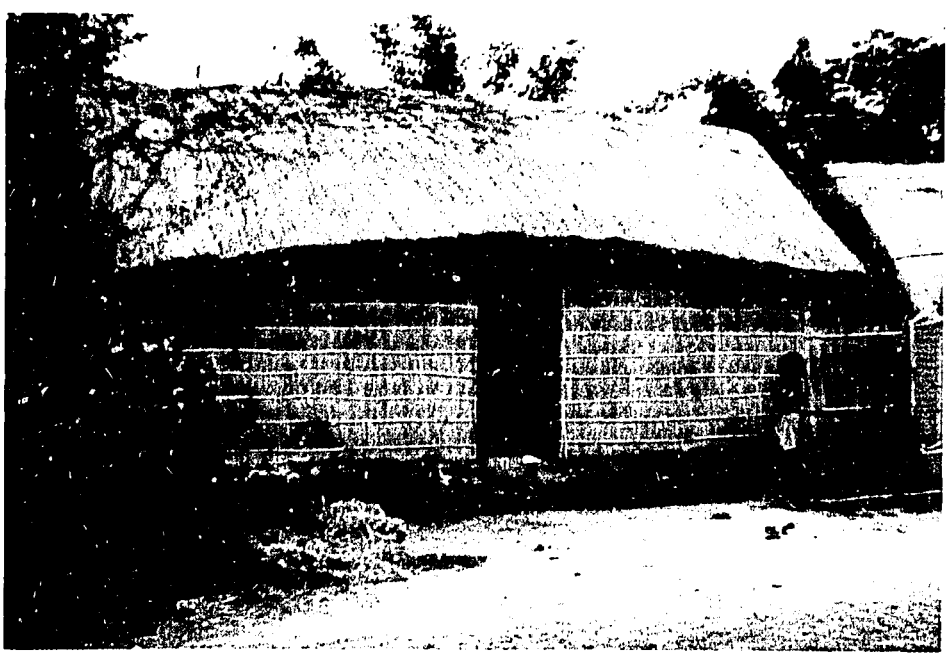


PLATE 2: Homestead living quarters. The raised floor plinth is a typical precaution against flooding, and the grass planted on the plinth protects its side slopes from wave action and rain.

PLATE 3: Homestead cattle shelter. Note that the floor plinth is raised above the level of adjacent houses.

PLATE 4: Charland settlement. The catkin grass along the riverbank protects the homesteads from wave action and erosion.

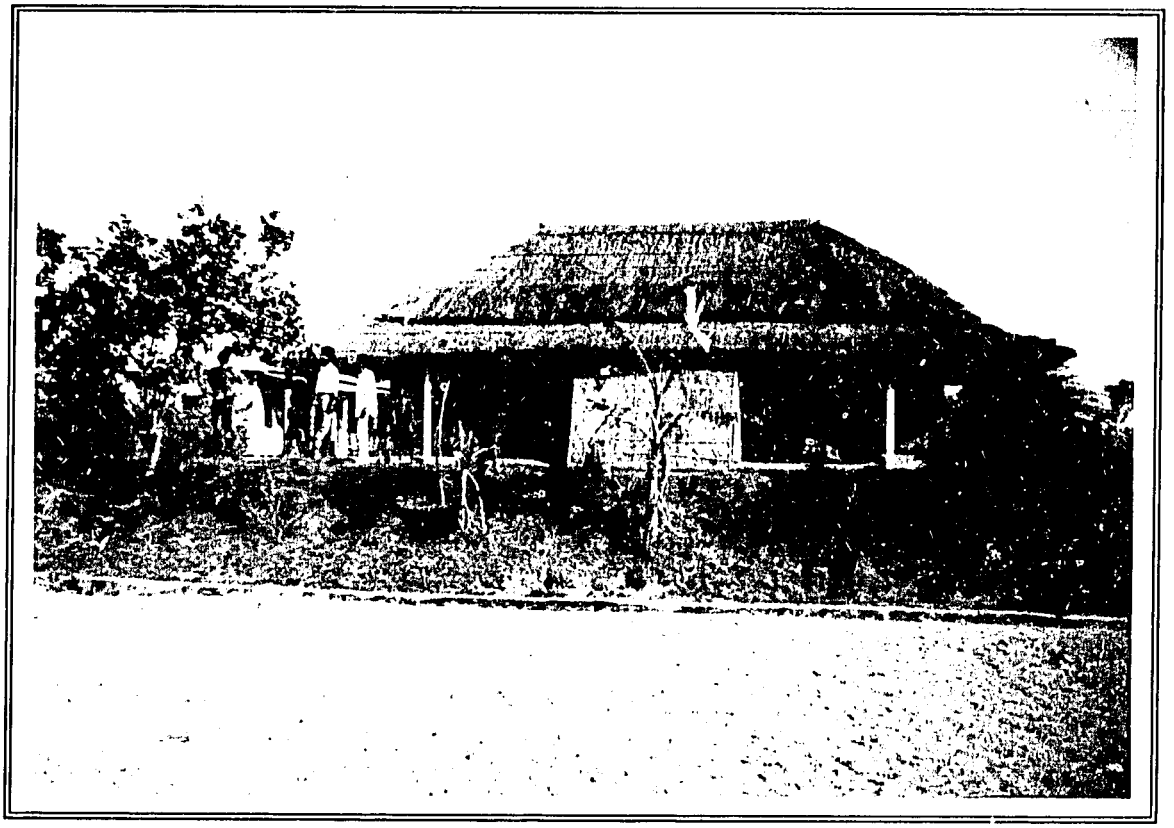


PLATE 5: Digri Char flood shelter. This community building and its raised platform were constructed by Service Civil International (SCI), an NGO active in the Bhuapur chars.

PLATE 6: Digri Char flood shelter (right). The houses adjacent to the shelter, clearly constructed at a lower level than the shelter, were partly flooded in 1992. In 1993, the homesteads and shelter were all lost to erosion.

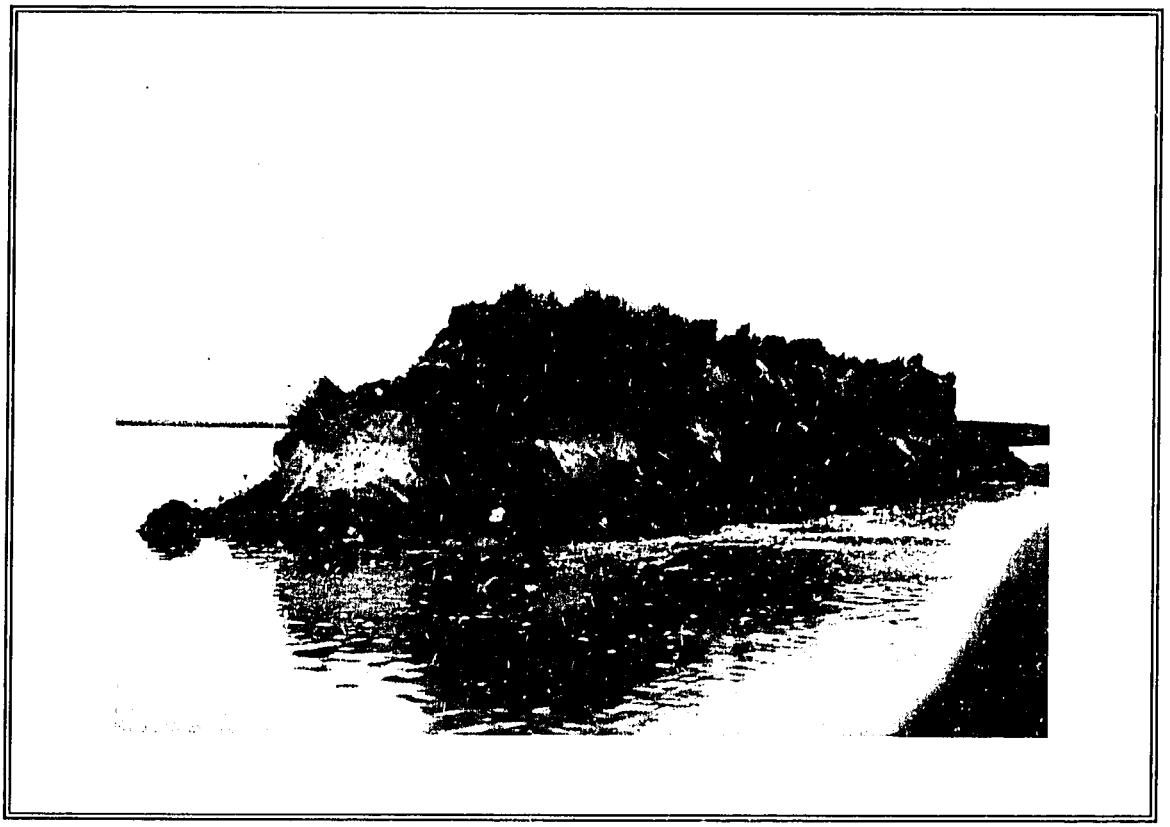


PLATE 7: Char erosion. Erosion is a constant threat to all land in and along active river channels. A community once lived here and cultivated this island char.

PLATE 8: Charland livestock. Cattle rearing and fattening are important economic activities in the charlands, especially in the upper Jamuna, where large herds are found.

PLATE 9: New charland homestead. This homestead, typical of those on newly settled chars has several recently planted banana trees and no other vegetation.

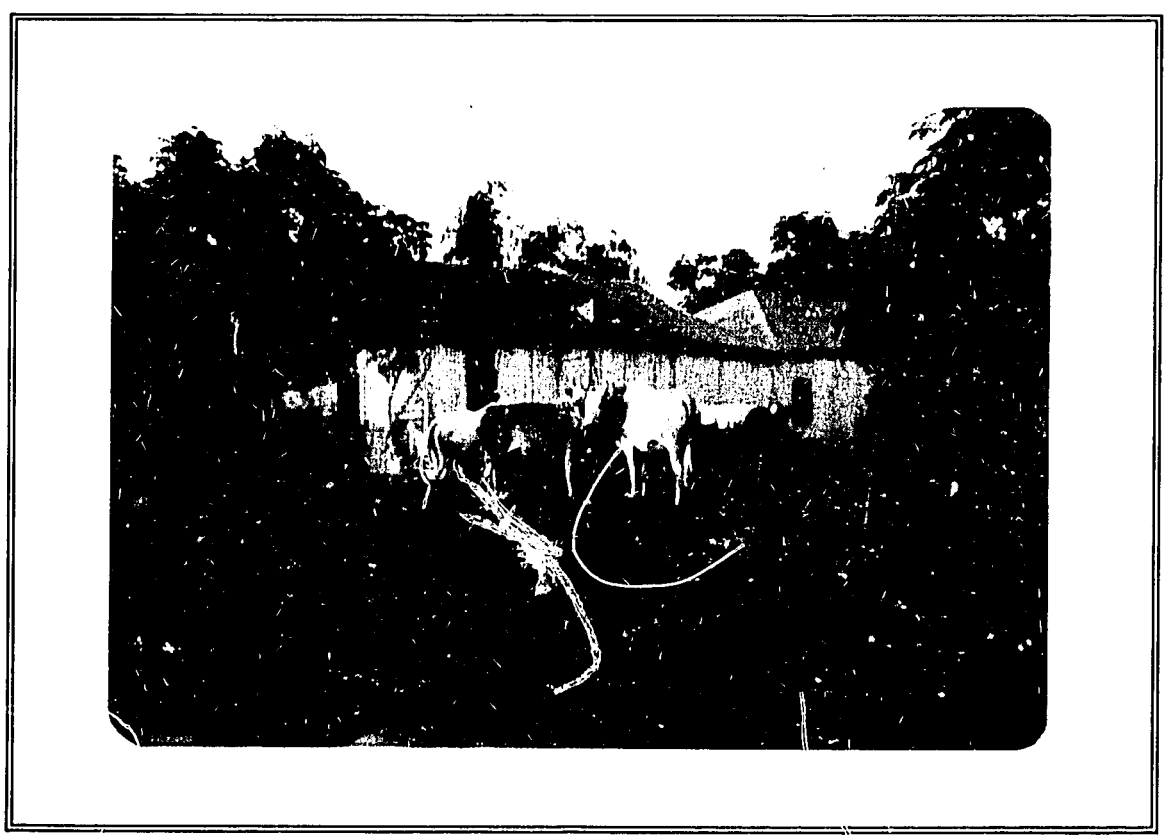


PLATE 10: Established charland homestead. This homestead on a mature char has more permanent buildings, as well as mature trees and dense vegetation.

APPENDIX A

SURVEY QUESTIONNAIRE

Checklist C - 21.6.1993

BBS CODE : |_|_|_|_|_|_|_|_|
Household sl. no : |_|_|_|_|

BANGLADESH FLOOD ACTION PLAN
FAP- 16 ENVIRONMENTAL STUDY

SOCIO-ECONOMIC STUDIES OF CHAR LANDS

CHARLAND FLOOD IMPACT AND LOSS SURVEY

1 **Identification details**

Mauza name .....
Village name ..... |_|_|_|_|
Thana name .....
Char name ..... |_|_|_|
Name of Household head .....
number of years education ..... |_|
Name of respondent if different .....
Father's name .....

2 **Household members/occupations**

a Number of people in household (chula) ..... |_|_|
Number of people living away and sending income ..... |_|_|
How many of the following people live in this household?
(All relationships are to the household head.)

Male head ..... |_|
Female head ..... |_|
Wife ..... |_|
Husband ..... |_|
Mother ..... |_|
Father ..... |_|
Father's brother ..... |_|
Son ..... |_|
Daughter ..... |_|
Son's wife ..... |_|
Daughter's husband ..... |_|
Brother ..... |_|
Sister ..... |_|
Brother's wife ..... |_|
Sister's husband ..... |_|
Others ..... |_|

Do people of your sharik or gusti live in the next bari? Y/N. |_|_|

b For this household (chula):

How many people contribute income ..... |_|

What is the: main source of household livelihood (codes) |_|_|

Main source of livelihood of men ..... |_|_|

Second source of livelihood of men ..... |_|_|

Main source of livelihood of women ..... |_|_|

Second source of livelihood of women ..... |_|_|

[Livelihood codes: 1-farmer (own land); 2-farmer (own and sharecropped in land); 3-farmer (sharecropped in land only); 4-agricultural day labouring; 5-other day labouring; 6-fishing; 7-boat; 8-other transport, 9-handcrafts; 10-petty trade/business; 11-larger business; 12-service; 13-paid homestead work; 14-cattle rearing; 15-goat/sheep rearing; 16-poultry; 17-harvesting grasses/wild plants; 18-own tree products; 19-vegetable production; 20-rental income (land or other); 21-remittances from outside; 22-other (details)]

c How many (if any) members of the household move away for work for part of every year? ..... |_|

From which month ..... |_|_|

To which month .... |_|_|

[Month codes: 1-Baishak, 2-Jaistho; 3-Ashar, 4-Shrabon, 5-Bhadro, 6-Ashin, 7-Kartik, 8-Agrahan, 9-Poush, 10-Magh, 11-Falgon, 12-Chaitro]

3 Land

[Areas may be noted in local units, but these must be converted to decimals later for the coding boxes, based on the number of decimals per bigha/kani etc reported in that village.]

a Area of own homestead land .....dec |_|_|_|_|

b Area of land owned and cultivated last year by household dec |_|_|_|_|

c Area of land cultivated last year but owned by others (share/rent in) .....dec |_|_|_|_|

Percentage of operated land (b and c) which is on this char (access by land from homestead).....% |_|_|_|

d Area of land owned but cultivated last year by others (share/rent out) .....dec |_|_|_|_|

Percentage of this land (d) which is on this char ...% |_|_|_|

e Area of non-cultivated land (land during dry season) which household owns or has exclusive use rights over (eg land too sandy to cultivate, used for grazing).....dec |_|_|_|_|

Percentage of this land (e) which is on this char ...% |_|_|_|

f Area which household has claim to (for example pays land tax) but which is under water all year .....dec |_|_|_|_|

Percentage of this land (f) which is on this char ...% |_|_|_|

g Area of own land which household lost permanently to erosion in last five years (ie not paying land tax on this area).dec |_|_|_|_|

Percentage of this land (g) which is on this char ...% |_|_|_|

h How did you obtain access to the land you farm?

- inherited .....dec |_|_|_|_|
- bought .....dec |_|_|_|_|
- settled new land with help of others.....dec |_|_|_|_|
- settled new land by self .....dec |_|_|_|_|

4 Homestead

a Materials of main house: wall ..... |_|_|
roof ..... |_|_|
frame ..... |_|_|

[House material codes: 1-straw/leaves; 2-grass sticks; 3-jutesticks; 4-bamboo; 5-wood; 6-tin; 7-earth; 8-brick; 9-tiles; 10-concrete. Code main material where more than one used, if materials are in equal amounts code higher quality material]

b Number of rooms in main house ..... |_|

Dimensions of main house: length (longer wall)..ft |_|_|

width (shorter wall)..ft |_|_|

Height of roof above floor .....ft |_|_|

Total cost of building such a house now.....Tk |_|_|_|_|_|_|

c Number of other buildings owned by household within this village/char and occupied by this household ..... |_|

d Number of other buildings on this household's land in this village but occupied by other households ..... |_|

e Number of buildings owned by household but located outside this village/char ..... |_|

f Number of following owned by household:

small boats (up to 10 maunds) ..... |_|
medium boats (11-50 maunds) ..... |_|
large boats (greater than 50 maunds) ..... |_|
boat engines ..... |_|
trees ..... |_|_|
radio ..... |_|

Number of following livestock owned by household and number being raised on a share basis (loaned by others):

	own	share
cattle and buffaloes	|_|_|	|_|_|
goats and sheep	|_|_|	|_|_|
ducks and chickens	|_|_|	|_|_|

5 Food security

For how many days in a week in the last dry season could your household eat:
3 meals a day?..... |_|_|
only 2 meals a day?..... |_|_|
only 1 meal a day?..... |_|_|

For how many days in a week in the last monsoon could your household eat:
3 meals a day?..... |_|_|
only 2 meals a day?..... |_|_|
only 1 meal a day?..... |_|_|

6 **Flood and erosion years**

In the last 6 years did any of the following affect your household, and in which years?:

- lose your homestead due to erosion/have to move *[no. times]*
- lose some of your land due to erosion *[0-no; 1-yes]*
- homestead flooded *[0-not flooded, 1-above house floor; 2-above roof]*
- family built macha to shelter from flood *[0-no; 1-yes]*

Year	homestead eroded	land eroded	house flooded	built macha
1992				
1991				
1990				
1989				
1988				
1987				

7 **Severe flood impact - in 1988**

a What was:

Maximum depth of water in main house .....inches |_|_|_|

Duration of house flooding .....days |_|_|_|

How long before water entered homestead did you start preparing for this flood, if at all? .....days |_|_|

Did you get any advance warning? .....Y/N |_|

How were you warned? ..... |_|

[Warning: 0-none; 1-own observations/experience; 2-told by someone from village; 3-told by outsider; 4-told by official; 5-radio/TV; 6-mike system or drum beating]

b How many household members were present at that time? |_|_|

How many moved because of flood (if any) ..... |_|_|

If any moved, where did they go to (location codes)? |_|

(status/relationship codes) ..... |_|

main reason for moving (codes)..... |_|

how long did they stay away .....days |_|_|_|

what extra costs did you face in moving and in getting temporary shelter .....Tk |_|_|_|_|_|

[Location codes: 1-within mauza; 2-an adjacent mauza; 3-elsewhere within Union; 4-village outside Union inside District; 5-town outside Union inside District; 6-outside District.
Status/relationship codes: 1-relative's house; 2-neighbour's house; 3-rich person's house; 4-flood shelter; 5-embankment; 6-other public land; 7-public building; 8-other.
Reason codes: 1-house destroyed; 2-water too high/safety although house standing; 3-to safeguard livestock; 4-to find work; 5-other.]

c How many livestock did you have (own or on share basis) at that time? How many did you move because of the flood? total moved

large stock (cattle and buffalo ..... |_|_| |_|_|

medium stock (goats and sheep) ..... |_|_| |_|_|

when were stock moved? ..... |_|

[1-before flood, 2-during flood, 3-after flood]

number of days moved ..... |_|_|_|

what was the main reason? ..... |_|

[Reasons: 1-for safety above flood water, 2-for safety from theft, 3-to find fodder/grazing, 4-to sell, 5-other]

Number of cattle and buffalos (if any) lost due to flood |_|_|

Number of goats and sheep (if any) lost due to flood |_|_|

Total value of livestock lost due to flood .....Tk |_|_|_|_|_|

d Main house at time of 1988 flood: wall ..... |_|

roof ..... |_|

[House material codes: 1-straw/leaves/jutesticks/bamboo; 2-tin; 3-earth; 4-brick; 5-tiles; 6-concrete. Code main material where more than one used, if materials are in equal amounts code higher quality material]

Number of houses damaged in flood ..... |_|_|

cost of repairs to existing house(s).....Tk |_|_|_|_|_|

cost of replacing destroyed house(s) if any.....Tk |_|_|_|_|_|

Value of damage (if any) to other buildings (cattlesheds, outh uses etc).....Tk |_|_|_|_|_|

e Quantity of foodgrains in store just before flood ...mds |_|_|

Quantity of foodgrains lost in flood (if any).....mds |_|_|

Value of lost foodgrains (if any) .....Tk |_|_|_|_|_|

f Value of damage to boats (if any) due to flood .....Tk |_|_|_|_|_|

Value of any damage to trees and kitchen garden .....Tk |_|_|_|_|_|

Value of damage to other assets (agricultural implements furniture, household utensils, personal posessions, etc) due to flood .....Tk |_|_|_|_|_|

What percentage of these assets could you save? .....% |_|_|_|

g Could you have prevented more of this damage from happening? |_|

If yes, why couldn't you do this? not enough warning.. |_|

didn't expect flood. |_|

no higher place .... |_|

[0-no; 1-yes.] transport problem .. |_|

h Crop areas and losses/gains (if any):

Area of **Boro** paddy in 1988 .....dec |_|_|_|_|

expected yield md/____ ..... md/acre |_|_|_|

actual yield md/____ ..... md/acre |_|_|_|

Area of **Aus** paddy in 1988 .....dec |_|_|_|_|

expected yield md/____ ..... md/acre |_|_|_|

actual yield md/____ ..... md/acre |_|_|_|

Area of **Aman** paddy in 1988 .....dec |_|_|_|_|

expected yield md/____ ..... md/acre |_|_|_|

actual yield md/____ ..... md/acre |_|_|_|

Area of **millet** in **next season** (winter 1989/89).....dec |_|_|_|_|

Was production more (1), same (2), or less (3) than normal? ..... |_|

Area of other rabi crops **next season** .....dec |_|_|_|_|

Was production more (1), same (2), or less (3) than normal? ..... |_|

[Area=0 if not grown, yield=0 if lost whole crop.]

i Income impacts. If the household obtains income in cash or kind from the following sources, how was it affected by the 1988 flood:

i agricultural labour: no months affected ..... |_|_|

during these months % of normal income received.% |_|_|_|

ii fishing: no months affected ..... |_|_|

during these months % of normal income received.% |_|_|_|

iii other labouring: no months affected ..... |_|_|

during these months % of normal income received.% |_|_|_|

iv domestic work: no months affected ..... |_|_|

during these months % of normal income received.% |_|_|_|

v business/trade/crafts: no months affected ..... |_|_|

during these months % of normal income received.% |_|_|_|

vi regular livestock income (eggs, milk): no months. |_|_|

during these months % of normal income received.% |_|_|_|

[Note 100% = normal income; 10% more income code as 110% of normal; 20% less income code as 80% of normal; 0=no income; -8 = Not Applicable household does not receive any income from this source normally]

j What were the biggest problems during the 1988 flood:

- for men? 1st problem ..... |_|_|

2nd problem ..... |_|_|

3rd problem ..... |_|_|

- for women? 1st problem ..... |_|_|

2nd problem ..... |_|_|

3rd problem ..... |_|_|

[Ask women separately from men, make notes and code later for additional problems: 1-obtaining drinking water; 2-toilet facilities; 3-getting fuel; 4-getting food; 5-preparing food; 6-cooking; 7-getting work; 8-safety; 9-theft; 10-moving house; 11-transport; 12-lack of shelter, 13-feeding livestock; 14-livestock disease; 15-human illness;...]

k What actions did your household take to cope with these losses and recover from them immediately after the 1988 flood? Did men or women or both take these actions? What were the main uses of these funds?

	M	W	Use
- sought work outside village	|_|	|_|	|_|
- sold land	|_|	|_|	|_|
- mortgaged land	|_|	|_|	|_|
- sold livestock	|_|	|_|	|_|
- took loan in own name.....	|_|	|_|	|_|
- sold jewellery	|_|	|_|	|_|
- sold other assets	|_|	|_|	|_|
- received help/gift from relatives	|_|	|_|	|_|
- received help from rich person	|_|	|_|	|_|
- received relief from government or NGO ...	|_|	|_|	|_|

[Men and women: 0-No; 1-Yes.
Use codes: 1-obtain food; 2-rebuild house; 3-replace livestock; 4-for agricultural inputs; 5-to replace other assets; 6-to pay for health care; 7-other; 8-not applicable.]

l Did your household help any of the following during or after the 1988 flood? *[0-no; 1-yes]*

relatives from same bari	|_|
relatives from another bari	|_|
others from same gusti	|_|
others from same samaj	|_|
unrelated people	|_|

What type of help did you give? *[0-no; 1-yes]*

moving people or goods	|_|
treating sick and ill	|_|
providing shelter in your home	|_|
providing food	|_|
providing cooking facilities	|_|
giving relief	|_|
giving financial help	|_|
others	|_|

8 Moderate flood impact - in 1991

a What was:

Maximum depth of water in main house .....inches	|_|_|_|
Duration of house flooding .....days	|_|_|_|
How long before water entered homestead did you start preparing for this flood, if at all? .....days	|_|_|
Did you get any advance warning? .....Y/N	|_|
How were you warned?	|_|

[Warning: 0-none; 1-own observations/experience; 2-told by someone from village; 3-told by outsider; 4-told by official; 5-radio/TV; 6-mike system or drum beating]

b How many household members were present at that time? |_|_|
How many moved because of flood (if any) ..... |_|_|
If any moved, where did they go to (location codes)? |_|
(status/relationship codes) ..... |_|
main reason for moving (codes)..... |_|
how long did they stay away .....days |_|_|_|
what extra costs did you face in moving and
in getting temporary shelter .....Tk |_|_|_|_|_|

[Location codes: 1-within mauza; 2-an adjacent mauza; 3-elsewhere within Union; 4-village outside Union inside District; 5-town outside Union inside District; 6-outside District.
Status/relationship codes: 1-relative's house; 2-neighbour's house; 3-rich person's house; 4-flood shelter; 5-embankment; 6-other public land; 7-public building; 8-other.
Reason codes: 1-house destroyed; 2-water too high/safety although house standing; 3-to safeguard livestock; 4-to find work; 5-other.]

c How many livestock did you have (own or on share basis) at that time? How many did you move because of the flood? total moved

large stock (cattle and buffalo)..... |_|_| |_|_|
medium stock (goats and sheep) ..... |_|_| |_|_|
when were stock moved? ..... |_|

[1-before flood, 2-during flood, 3-after flood]

number of days moved ..... |_|_|_|
what was the main reason? ..... |_|

[Reasons: 1-for safety above flood water, 2-for safety from theft, 3-to find fodder/grazing, 4-to sell, 5-other]

Number of cattle and buffalos (if any) lost due to flood |_|_|
Number of goats and sheep (if any) lost due to flood |_|_|
Total value of livestock lost due to flood .....Tk |_|_|_|_|_|

d Main house at time of 1991 flood: wall ..... |_|
roof ..... |_|

[House material codes: 1-straw/leaves/jutesticks/bamboo; 2-tin; 3-earth; 4-brick; 5-tiles; 6-concrete. Code main material where more than one used, if materials are in equal amounts code higher quality material]

Number of houses damaged in flood ..... |_|_|
cost of repairs to existing house(s).....Tk |_|_|_|_|_|
cost of replacing destroyed house(s) if any.....Tk |_|_|_|_|_|
Value of damage (if any) to other buildings (cattlesheds, outhouses etc).....Tk |_|_|_|_|_|

e Quantity of foodgrains in store just before flood ...mds |_|_|
Quantity of foodgrains lost in flood (if any).....mds |_|_|
Value of lost foodgrains (if any) .....Tk |_|_|_|_|_|

f Value of damage to boats (if any) due to flood .....Tk |_|_|_|_|_|
Value of any damage to trees and kitchen garden .....Tk |_|_|_|_|_|

j What were the biggest problems during the 1991 flood:

- for men? 1st problem ..... |_|_|
  2nd problem ..... |_|_|
  3rd problem ..... |_|_|
- for women? 1st problem ..... |_|_|
  2nd problem ..... |_|_|
  3rd problem ..... |_|_|

[Ask women separately from men, make notes and code later for additional problems: 1-obtaining drinking water; 2-toilet facilities; 3-getting fuel; 4-getting food; 5-preparing food; 6-cooking; 7-getting work; 8-safety; 9-theft; 10-moving house; 11-transport; 12-lack of shelter, 13-feeding livestock; 14-livestock disease; 15-human illness;...]

k What actions did your household take to cope with these losses and recover from them immediately after the 1991 flood? Did men or women or both take these actions? What were the main uses of these funds?

	M	W	Use
- sought work outside village	|_|	|_|	|_|
- sold land	|_|	|_|	|_|
- mortgaged land	|_|	|_|	|_|
- sold livestock	|_|	|_|	|_|
- took loan in own name.....	|_|	|_|	|_|
- sold jewellery	|_|	|_|	|_|
- sold other assets	|_|	|_|	|_|
- received help/gift from relatives	|_|	|_|	|_|
- received help from rich person	|_|	|_|	|_|
- received relief from government or NGO ...	|_|	|_|	|_|

[Men and women: 0-No; 1-Yes.
Use codes: 1-obtain food; 2-rebuild house; 3-replace livestock; 4-for agricultural inputs; 5-to replace other assets; 6-to pay for health care; 7-other.]

l Did your household help any of the following during or after the 1991 flood? *[0-no; 1-yes]*

relatives from same bari ..... |_|
relatives from another bari ..... |_|
others from same gusti ..... |_|
others from same samaj ..... |_|
unrelated people ..... |_|

What type of help did you give? *[0-no; 1-yes]*

moving people or goods ..... |_|
treating sick and ill ..... |_|
providing shelter in your home ..... |_|
providing food ..... |_|
providing cooking facilities ..... |_|
giving relief ..... |_|
giving financial help ..... |_|
others ..... |_|

Value of damage to other assets (agricultural implements furniture, household utensils, personal posessions, etc) due to flood .....Tk |_|_|_|_|_|

What percentage of these assets could you save? .....% |_|_|_|

g Could you have prevented more of this damage from happening? |_|

If yes, why couldn't you do this? not enough warning |_|

didn't expect flood |_|

no higher place |_|

[0-no; 1-yes.] transport problem |_|

h Crop areas and losses/gains (if any):

Area of Boro paddy in 1991 .....dec |_|_|_|_|

expected yield md/____ ..... md/acre |_|_|_|

actual yield md/____ ..... md/acre |_|_|_|

Area of Aus paddy in 1991 .....dec |_|_|_|_|

expected yield md/____ ..... md/acre |_|_|_|

actual yield md/____ ..... md/acre |_|_|_|

Area of Aman paddy in 1991 .....dec |_|_|_|_|

expected yield md/____ ..... md/acre |_|_|_|

actual yield md/____ ..... md/acre |_|_|_|

Area of millet in next season (winter 1991/92).....dec |_|_|_|_|

Was production more (1), same (2), or less (3) than normal? ..... |_|

Area of other rabi crops next season .....dec |_|_|_|_|

Was production more (1), same (2), or less (3) than normal? ..... |_|

[Area=0 if not grown, yield=0 if lost whole crop.]

i Income impacts. If the household obtains income in cash or kind from the following sources, how was it affected by the 1991 flood:

i agricultural labour: no months affected ..... |_|_|

during these months % of normal income received.% |_|_|_|

ii fishing: no months affected ..... |_|_|

during these months % of normal income received.% |_|_|_|

iii other labouring: no months affected ..... |_|_|

during these months % of normal income received.% |_|_|_|

iv domestic work: no months affected ..... |_|_|

during these months % of normal income received.% |_|_|_|

v business/trade/crafts: no months affected ..... |_|_|

during these months % of normal income received.% |_|_|_|

vi regular livestock income (eggs, milk): no months. |_|_|

during these months % of normal income received.% |_|_|_|

[Note 100% = normal income; 10% more income code as 110% of normal; 20% less income code as 80% of normal; 0=no income; -8 = Not Applicable household does not receive any income from this source normally]

9 **Homestead protection**

a Height of plinth of main house above ground level. inches |_|_|_|

How much do you spend each year on normal repair and maintenance of your main house? .....Tk |_|_|_|_|_|_|

How often in 10 years do you expect your house to be flooded above floor level? ..... |_|_|

b What actions has this household taken (if any) to protect the homestead?

make barrier	once every ..... years	|_|_|
	last year done	|_|_|_|_|
	cost .....Tk	|_|_|_|_|_|
raise plinth	once every ..... years	|_|_|
	last year done	|_|_|_|_|
	cost .....Tk	|_|_|_|_|_|
main other action	once every ..... years	|_|_|
	last year done	|_|_|_|_|
	cost .....Tk	|_|_|_|_|_|

[Actions: note action taken, codes: 1-plant trees/bushes; 2-strengthen house plinth; 3-turf plinth; 4-build bund; 5-raise homestead area; others post-code ...] |_|_|

10 **Erosion**

When did you last move homestead because of erosion? Year |_|_|_|_|
[0-never]
Where from (name) ..... |_|

[1-Another char in another mauza; 2-Another char within this mauza; 3-This char but another mauza; 4-This char same mauza]

Where did you first move to? Location (name)

..... |_|

[1-Homestead presently living in; 2-This char same mauza; 3-This char but another mauza; 4-Another char within this mauza; 5-Another char in another mauza]

Type of place first moved to ..... |_|_|

[1-own land already owned; 2-bought land; 3-relative's house; 4-neighbour's house; 5-rich person's house; 6-flood shelter; 7-embankment; 8-other public land; 9-public building; 10-other]

What was your reason for choosing your present homestead .....location? |_|

[1-near own land; 2-near relatives; 3-near samaj; others - note and post code]

Did you change samaj when moving? *[0-no, 1-yes]* |_|

Are you living here on an uthuli basis? *[0-no, 1-yes]* |_|

11 Preferences

[This question should be asked separately of the household head/senior male and senior female/household head. Column "M" is for men's opinions, column "W" is for women's opinions]

a What local measures could be taken to help reduce your household's suffering in future floods? Who should do each thing suggested?

	M	W
Most needed local measure	|_|_|	|_|_|
Who	|_|_|	|_|_|
Next most needed local measure	|_|_|	|_|_|
Who	|_|_|	|_|_|
Third most needed local measure	|_|_|	|_|_|
Who	|_|_|	|_|_|

[Measures: 1-house raising; 2-grass barriers; 3-other barrier (eg daincha, bamboo etc); 4-brick mattress; 5-plant trees; 6-strengthen plinth; 7-build bund; 8-flood shelter; 9-cattle shelters; 10-clustered settlement raising; 11-boats in flood; 12-flood warning; 13-flood information; 14-low interest loans after flood; 15-local relief fund; 16-help for dry season agriculture;
...
Who: 1-individual households of their own initiative; 2-bari; 3-gusti; 4-samaj; 5-para; 6-village; 7-other local community group; 8-cooperative societies; 9-NGO groups; 10-Union Parishad; 11-Thana; 13-District; 14-Other government agency; 15-NGO .... (add codes as necessary)]

b Measures such as these cost money. Would you be willing to pay in cash or kind:

	M	W
all of your share of the costs (1),	|_|	|_|
part of your share of the costs (2), or	|_|	|_|
none of the costs (3)	|_|	|_|

c Are there other local measures which could help you cope if erosion cannot be reduced? What?

	M	W
Preferred measure	|_|_|	|_|_|
Second needed measure	|_|_|	|_|_|

[Measures: 1-provide homestead plots; 2-assistance for house boats; 3-resettlement loans; 4-resettlement grants; 5-security of tenure on embankments; 6-secure rights over eroded land; 7-allocation of khas land to erosion victims; 8-boats to help when moving; 9-free temporary accommodation .....]

d Are there any other major interventions which you think should be made to help against floods and erosion here?

[Open question, write answer in space, to be coded later]

1st intervention	|_|	|_|
2nd intervention	|_|	|_|

....
Checked Interviewer

চেকলিষ্ট গ – ৩১.৫.১৯৯৩

বি.বি.এস কোড
খানার ক্রমিক নং

বাংলাদেশ ফ্লাড এ্যাকশন প্ল্যান
ফ্যাপ–১৬ এনভায়রনমেন্টাল ষ্টাডি

চরাঞ্চলের আর্থ–সামাজিক অবস্থার সমীক্ষা
চরাঞ্চলে বন্যার প্রভাব এবং ক্ষয়ক্ষতির জরীপ

১. **খানার বিস্তারিত পরিচয়**

মৌজার নাম_____

গ্রামের নাম_____

থানার নাম _____

চরের নাম_____

খানা প্রধানের নাম _____

খানা প্রধান কত ক্লাস পর্যন্ত লেখাপড়া করেছেন_____

উত্তরদাতার নাম (খানা প্রধানের অবর্তমানে)_____

উত্তরদাতার পিতার নাম_____

থানা প্রধানের সাথে উত্তরদাতার সম্পর্ক_____

২. **খানার সদস্য এবং তাদের পেশা বিষয়ক প্রশ্ন**

ক. খানায় (এক চুলায়) মোট সদস্য সংখ্যা কত জন_____

কতজন সদস্য অন্যত্র বসবাস করেন এবং সংসারের জন্য টাকা পাঠান_____

খানা প্রধানের সাথে সম্পর্কযুক্ত নিচে উল্লেখিত শ্রেণীর কতজন লোক এই খানায় বসবাস করেন?

প্রধান পুরুষ_____
প্রধান মহিলা_____
স্ত্রী _____
স্বামী _____
মাতা _____
পিতা _____
চাচা _____
পুত্র _____
কন্যা _____
পুত্রবধূ _____
মেয়ের জামাই_____
ভাই _____
বোন_____
ভাই-বৌ _____
বোন-জামাই _____
অন্যান্য _____

আপনার গোষ্ঠীর বা শরীকের কোন লোক কি আপনার পাশের বাড়ীতে থাকেন? হ্যাঁ / না

খ. সংসারের কত জন সদস্য উপার্জন করেন? _____

উপার্জনের প্রধান উৎস কি কি (কোড ব্যবহার করুন) _____

পুরুষের উপার্জনের প্রধান উৎস কি _____

পুরুষের উপার্জনের দ্বিতীয় উৎস কি _____

মহিলাদের উপার্জনের প্রধান উৎস কি _____

মহিলাদের উপার্জনের দ্বিতীয় উৎস কি _____

উপার্জনের উৎস বিষয়ক কোড: ১. কৃষক (নিজের জমি), ২. কৃষক (নিজস্ব এবং বর্গা জমি), ৩. কৃষক (শুধুমাত্র বর্গা জমি), ৪. কৃষি শ্রমিক বা কামলা, ৫. অকৃষি দিন মজুর, ৬. মাছ ধরা, ৭. নৌকা, ৮. অন্য যানবাহন, ৯. কুটির বা হস্তশিল্প, ১০. ক্ষুদ্রপুজির ব্যবসা, ১১. বড় পুজির ব্যবসা, ১২. চাকুরি, ১৩. বেতনভুগ গৃহস্থালীর কর্ম, ১৪. গবাদীপশু পালন, ১৫. ছাগল/ভেড়া পালন, ১৬. হাঁস-মুরগী পোষা, ১৭. ঘাস কাটা, ১৮. নিজস্ব বৃক্ষের বা বৃক্ষের উৎপাদিত ফল, ১৯. শাকসব্জি উৎপাদন, ২০. ভূমি বা অন্য কিছু ভাড়া দেওয়া, ২১. বিদেশ থেকে আয়, ২২. অন্যান্য (উল্লেখ করুন)

গ খানায় এমন কত জন সদস্য আছেন যারা প্রত্যেক বৎসরেই কোন না কোন সময়ে দূরে কোথাও কাজ করেন

কোন মাস থেকে সেখানে থাকেন (কোড ব্যবহার করুন) _____

কোন মাস পর্যন্ত সেখানে থাকেন (কোড ব্যবহার করুন) _____

[মাসের কোড : ১. বৈশাখ, ২. জ্যৈষ্ঠ, ৩. আষাঢ়, ৪. শ্রাবণ, ৫. ভাদ্র, ৬. আশ্বিন, ৭. কার্তিক, ৮. অগ্রহায়ণ, ৯. পৌষ, ১০. মাঘ, ১১. ফাল্গুন, ১২. চৈত্র]

৩. ভূমি বিষয়ক প্রশ্ন :

[ভূমির পরিমাণ উত্তরদাতা যেভাবেই বলুন না কেন সেটাকে ডেসিমেলে পরিবর্তন করে ডান দিকের ঘরে বসাতে হবে]

ক. খানার আওতাভূক্ত নিজস্ব বাড়ীর জমি _____ ডেসিমেল

খ. খানার নিজস্ব জমি যাহা গত বৎসর চাষ করেছেন _____ ডেসিমেল

গ. অন্যের জমি কিন্তু বর্গা/চুক্তি/মেদি/ভাড়া নিয়ে গত বৎসর চাষ করেছেন _____ ডেসিমেল

খ এবং গ তে উল্লেখিত জমির শতকরা কত অংশ এই চরে অবস্থিত _____ %

ঘ. নিজস্ব জমি কিন্তু গত বৎসর চাষের জন্য বর্গা/চুক্তি/মেদি/ভাড়া দেয়া হয়েছে ___ ডেসিমেল

এই জমির শতকরা কত অংশ এই চরে অবস্থিত _____ %

ঙ. শুকনা মৌসুমে শুধু বালি থাকে বা গোচারণ ভূমি হিসাবে ব্যবহৃত হয় এই ধরণের নিজস্ব জমির পরিমাণ কত _____ ডেসিমেল

এই জমির শতকরা কত অংশ এই চরে অবস্থিত _____ %

চ. খানার নিজস্ব হিসাবে দাবীকৃত (খাজনা দেয়া হচ্ছে) কিন্তু সারা বৎসর পানির নিচে থাকে এমন জমির পরিমাণ কত _____ ডেসিমেল

এই জমির শতকরা কত অংশ এই চরে অবস্থিত _____ %

ছ. গত ৫ বৎসরে যে সমস্ত জমি নদীতে ভেঙ্গে গেছে এবং যার খাজনাও দেয়া হচ্ছে না এমন নিজস্ব জমির পরিমাণ কত _____ ডেসিমেল

এই জমির শতকরা কত অংশ এই চরে অবস্থিত _____ %

জ. যে সমস্ত জমি আপনার দখলে আছে তার দখল সূত্র কি? এবং কতটুকু জমি?

– পৈত্রিক সূত্রে প্রাপ্ত _____ ডেসিমেল

– ক্রয়কৃত _____ ডেসিমেল

– অন্যের দ্বারা নতুনভাবে বন্দবস্তকৃত _____ ডেসিমেল

– নিজেই নতুন জমি বন্দবস্ত নিয়েছেন _____ ডেসিমেল

৪. বসতবাড়ীর তথ্য ঃ

ক. প্রধান/থাকার গৃহের নির্মাণ সামগ্রীর বিবরণ ঃ

ঘরের বেড়া কিসের তৈরী (কোড ব্যবহার করুন) _____ ☐☐

ঘরের চাল কিসের তৈরী (কোড ব্যবহার করুন) _____ ☐☐

ঘরের ফ্রেম কিসের তৈরী (কোড ব্যবহার করুন) _____ ☐☐

[গৃহ নির্মাণ সামগ্রীর কোড ঃ ১. খড়/পাতা, ২. বাস ডাটা/হন, ৩. পাটকাঠি, ৪. বাঁশ, ৫. কাঠ, ৬. টিন, ৭. মাটি, ৮. ইট, ৯. টাইলস, ১০. কংক্রীট। যদি বিভিন্ন দ্রব্য একই পরিমাণ ব্যবহৃত হয়ে থাকে তবে এদের মধ্যে উৎকৃষ্ট দ্রব্যের কোড ব্যবহার করুন এবং যেখানে একাধিক দ্রব্য ব্যবহৃত সেখানে মূল দ্রব্যের কোড ব্যবহার করুন]

খ. প্রধান ঘরে রুমের সংখ্যা কতটি? _____ ☐☐

প্রধান ঘরের আয়তন

লম্বায় কত ফুট _____ ফিট ☐☐

প্রস্থে কত ফুট _____ ফিট ☐☐

ঘরের মেঝে/ডোয়া থেকে চালের উচ্চতা কত ফুট _____ ফিট ☐☐

বর্তমানে এর নির্মাণ খরচ কত হতে পারে _____ টাকা ☐☐☐☐☐

গ. এই গ্রামে/চরে খানার নিজস্ব আর কতগুলো ঘর আছে _____ টি ☐☐

ঘ. এই গ্রামে এই খানার জায়গার উপর অন্য কেউ বাড়ী করেছে এমন ঘরের সংখ্যা কত? টি ☐☐

ঙ. এই খানার নিজস্ব ঘর যাহা অন্য চরে/গ্রামে অবস্থিত তাহার সংখ্যা কত? ____ টি ☐☐

চ. নিচে উল্লেখিত দ্রব্যাদির কি পরিমাণ এই পরিবারের আওতাধীন আছে?

ছোট নৌকা (১০ মণ বোঝা নিতে পারে এমন) _____ টি ☐☐

মাঝারী নৌকা (১১-৫০ মণ বোঝা নিতে পারে এমন) _____ টি ☐☐

বড় নৌকা (৫০ মণের অধিক) _____ টি ☐☐

যন্ত্রচালিত নৌকা _____ টি ☐☐

বৃক্ষ _____ টি ☐☐

রেডিও _____ টি ☐☐

খানার নিজস্ব এবং বর্গাকৃত গরু/মহিষের পরিমাণ ঃ	নিজের	বর্গা
গরু এবং মহিষ্ _____	☐☐	☐☐
ছাগল/ভেড়া _____	☐☐	☐☐
হাঁস-মুরগী _____	☐☐	☐☐

৫. খাদ্য বিষয়ক প্রশ্ন ঃ

গত বৎসর শীত মৌসুমে সপ্তাহে কত দিন আপনারা

৩ বেলা খায়েছেন _____ দিন ☐☐

২ বেলা খায়েছেন _____ দিন ☐☐

১ বেলা খায়েছেন _____ দিন ☐☐

গত বৎসর বর্ষা মৌসুমে সপ্তাহে কত দিন আপনারা

৩ বেলা খায়েছেন _____ দিন ☐☐

২ বেলা খায়েছেন _____ দিন ☐☐

১ বেলা খায়েছেন _____ দিন ☐☐

৬. বন্যা এবং নদী ভাঙ্গা বিষয়ক প্রশ্ন ঃ

ক. গত ৬ বৎসরের মধ্যে আপনি কি নিম্নে উল্লেখিত সমস্যার সম্মুখীন হয়েছেন? এবং কোন বৎসর?

- নদী কি আপনার বাড়ী ভেঙ্গেছিল এবং অন্যত্র সরে গিয়েছিলেন? [কতবার –]
- আপনার কিছু জমি ভেঙ্গেছিল কি? *[০=না, ১= হ্যাঁ]*
- বাড়ী প্লাবিত হয়েছিল কি? *[০=প্লাবিত হয়নি, ১=মেঝের উপর পানি উঠেছিল, ২=চালের উপর পানি উঠেছিল]*
- বন্যার সময় থাকার জন্য বাড়ীতে কি মাচা বানিয়েছিলেন? *[০=না, ১=হ্যাঁ]*

বৎসর	বাড়ী ভেঙ্গেছিল	জমি ভেঙ্গেছিল	বাড়ী প্লাবিত হয়েছিল	মাচা তৈরী করা হয়েছিল
১৯৯২				
১৯৯১				
১৯৯০				
১৯৮৯				
১৯৮৮				
১৯৮৭				

৭. ভয়াবহ বন্যার প্রভাব – ১৯৮৮

ক. প্রধান/বড় ঘরে কতটুকু পানি উঠেছিল _____ ইঞ্চি ☐☐☐

বাড়ীর ঘরগুলোতে কতদিন পর্যন্ত পানি ছিল _____ দিন ☐☐☐

বাড়ীতে পানি প্রবেশের কতদিন আগে থেকে আপনি বন্যা মোকাবেলার জন্য প্রস্তুতি নিয়েছিলেন _____ দিন ☐☐

আপনি কি বন্যার কোন আগাম সংকেত পেয়েছিলেন _____ হ্যাঁ / না ☐

পেয়ে থাকলে কোথা থেকে পেয়েছিলেন (কোড ব্যবহার করুন) _____ ☐

[সংকেত কোড ঃ ০. মোটেই না, ১. নিজস্ব অভিজ্ঞতা/অবস্থাদৃষ্টে, ২. গ্রামের অন্যদের কাছ থেকে, ৩. বাহিরের লোকের কাছ থেকে, ৪. চাকুরীজীবীদের কাছ থেকে সংবাদের মাধ্যমে, ৫. রেডিও/টিভি, ৬. মাইক/ঢোল বাজানো]

খ. ঐ সময় পরিবারের কত জন সদস্য বর্তমান ছিলেন? _____ ☐☐

বন্যার জন্য কত জন বাড়ী ত্যাগ করেন (যদি করে থাকেন) _____ ☐☐

যদি বাড়ী ত্যাগ করে থাকেন তবে কোথায় আশ্রয় নিয়েছিলেন?

- o আশ্রয়স্থলের কোড ব্যবহার করুন _____ ☐
- o আশ্রয়দাতার সাথে সম্পর্কের কোড ব্যবহার করুন _____ ☐
- o অন্যত্র আশ্রয় নেয়ার মূল কারণ কি? (কোড ব্যবহার করুন) _____ ☐
- o কতদিন আশ্রয়স্থলে থাকতে হয়েছে? _____ দিন ☐☐☐
- o অস্থায়ী আশ্রয় এবং যাতায়াতের জন্য কি পরিমাণ অতিরিক্ত খরচ হয়েছে _____ টাকা ☐☐☐☐

[আশ্রয়স্থলের কোড ঃ ১. মৌজার ভেতর, ২. পার্শ্ববর্তী মৌজা, ৩. এই ইউনিয়নের ভেতর অন্য কোথাও, ৪. এই ইউনিয়নের বাহিরের কোন গ্রাম কিন্তু এই জেলার ভেতর, ৫. এই ইউনিয়নের বাহিরের কোন শহর কিন্তু এই জেলার ভেতর, ৬. জেলার বাহিরে]

[আশ্রয়দাতার সাথের সম্পর্কের কোড ঃ ১. আত্মীয়ের বাড়ী, ২. প্রতিবেশীর বাড়ী, ৩. ধনীব্যক্তির বাড়ী, ৪. বন্যা আশ্রয় কেন্দ্র, ৫. বাঁধ/রাস্তা, ৬. সরকারী জমি, ৭. সরকারী ইমারত, ৮. অন্যান্য]

[আশ্রয় নেয়ার কারণ কোড ঃ ১. বাড়ী ধ্বংস হয়ে যায়, ২. অত্যধিক পানি থাকাতে এবং ঘরে নিরাপত্তাহীনতার কারণে, ৩. গবাদিপশুর নিরাপত্তাহীনতার কারণে, ৪. কাজের সন্ধানে, ৫. অন্যান্য]

গ ঐ সময় আপনার নিজস্ব এবং বর্গা হিসাবে কতগুলো গবাদীপশু ছিল? এবং বন্যার কারণে কতগুলো স্থানান্তরিত করেন

	মোট	স্থানান্তরীত
গরু/মহিষ _____	☐☐	☐☐
ছাগল/ভেড়া _____	☐☐	☐☐
কখন স্থানান্তরিত করেন _____		☐

[১. বন্যার পূর্বে, ২. বন্যার সময়, ৩. বন্যার পর]

আশ্রয়স্থলে কতদিন ছিল _____ দিন ☐☐☐

গবাদিপশু স্থানান্তরের মূল কারণ কি (কোড ব্যবহার করুন) _____ ☐

[স্থানান্তরের কারণ: ১. বন্যার পানি থেকে নিরাপদে রাখা, ২. চুরি থেকে নিরাপদে রাখা, ৩. গবাদিপশুর খাদ্য সহজলভ্যতার জন্য, ৪. বিক্রির জন্য, ৫. অন্যান্য]

বন্যার জন্য কতগুলো গরু এবং মহিষের ক্ষতি এবং মৃত্যু হয় _____ ☐☐

বন্যার জন্য কতগুলো ছাগল এবং ভেড়ার ক্ষতি/মৃত্যু হয় _____ ☐☐

ক্ষতির পরিমাণ কত টাকা _____ টাকা ☐☐☐☐☐

ঘ. ১৯৮৮ সালের বন্যার সময় বাড়ী/ঘরের অবস্থা সম্বন্ধে প্রশ্ন :

১৯৮৮ সালে ঘরের বেড়া কিসের তৈরী ছিল (কোড ব্যবহার করুন) _____ ☐

১৯৮৮ সালে ঘরের চাল কিসের তৈরী ছিল (কোড ব্যবহার করুন) _____ ☐

[গৃহনির্মাণ সরঞ্জামাদির কোড : ১. খড়/পাতা/পোলা/বাঁশ, ২. টিন, ৩. মাটি, ৪. ইট, ৫. টাইলস্, ৬. কংক্রিট; যদি বিভিন্ন দ্রব্য ব্যবহৃত হয় তবে বেশী প্রয়োজনীয় দ্রব্যের কোড ব্যবহার করুন, যদি বিভিন্ন দ্রব্য একই পরিমাণে ব্যবহৃত হয়ে থাকে তবে এদের মধ্যে উৎকৃষ্ট দ্রব্যের কোড ব্যবহার করুন]

বন্যায় কতটি ঘর ক্ষতিগ্রস্থ হয় _____ ☐☐

- বন্যার পর উপস্থিত ক্ষতিগ্রস্থ ঘরগুলোকে মেরামত করার জন্য কত টাকা খরচ করতে হয়েছিল _____ টাকা ☐☐☐☐☐
- বন্যার সময় যে সমস্ত ঘর সম্পূর্ণ ধ্বংস হয়ে যায় সে স্থানে পুনরায় ঘর তৈরী করতে কত টাকা খরচ করতে হয়েছে _____ টাকা ☐☐☐☐☐
- অন্য কোন ঘর (গরুর ঘর, কাচারী ঘর, ইত্যাদি) ক্ষতি হয়ে থাকলে তাহার পরিমাণ কত টাকা _____ টাকা ☐☐☐☐☐

ঙ. বন্যার পূর্বে আপনার সঞ্চয়ে কি পরিমাণ খাবার (ধান, চাউল ইত্যাদি) ছিল _____ মণ ☐☐

বন্যায় কি পরিমাণ নষ্ট হয়েছিল _____ মণ ☐☐

ক্ষতির পরিমাণ কত টাকা _____ টাকা ☐☐☐☐☐

চ. বন্যার সময় নৌকার (যদি থাকে) কি পরিমাণ ক্ষয়ক্ষতি হয়েছিল _____ টাকা ☐☐☐☐☐

কত টাকার গাছপালা ও তরিতরকারীর ক্ষতি হয় _____ টাকা ☐☐☐☐☐

বন্যার জন্য অন্যান্য জিনিস কত টাকার ক্ষতি হয় (যেমন কৃষি সরঞ্জামাদি, আসবাবপত্র, থালাবাসন, নিজস্ব দ্রব্যাদি ইত্যাদি) _____ টাকা ☐☐☐☐☐

এই সমস্ত দ্রব্যের শতকরা কত অংশ রক্ষা করা সম্ভব হয়েছিল _____ % ☐☐☐

ছ. আপনি কি মনে করেন এই ক্ষয়ক্ষতির পরিমাণ কমানো সম্ভব ছিল? হ্যাঁ / না

যদি হ্যাঁ হয়, তবে কি জন্য ক্ষয়ক্ষতি কমানো সম্ভব হয়নি?

- যথাযথ পূর্বাভাসের অভাবের কারণে _____ ☐
- বন্যার ভয়াবহতা অনুমান করা যায়নি _____ ☐
- আশ্রয় নেয়ার মত উঁচু স্থানের অভাব _____ ☐
- যানবাহনের অভাব _____ ☐

[০. না, ১. হ্যাঁ]

জ. শস্য ক্ষেতের উৎপাদন এবং লাভ/ক্ষতি বিষয়ক তথ্য:

১৯৮৮ সালে বোরো ধান চাষাধীন জমির পরিমাণ _____ ডেসিমেল ☐☐☐☐

আশান্বিত উৎপাদন (মণ) _____ মণ/একর ☐☐☐☐

সত্যিকার উৎপাদন (মণ) _____ মণ/একর ☐☐☐☐

১৯৮৮ সালে আউস ধানের চাষাধীন জমির পরিমাণ _____ ডেসিমেল ☐☐☐☐

আশান্বিত উৎপাদন (মণ) _____ মণ/একর ☐☐☐☐

সত্যিকার উৎপাদন (মণ) _____ মণ/একর ☐☐☐☐

১৯৮৮ সালে আমন ধান চাষাধীন জমির পরিমাণ _____ _____ ডেসিমেল ☐☐☐☐

আশান্বিত উৎপাদন (মণ) _____ মণ/একর ☐☐☐☐

সত্যিকার উৎপাদন (মণ) _____ মণ/একর ☐☐☐☐

পরবর্তী মৌসুমে কতটুকু জমিতে কাউন/চীনা ইত্যাদি করা হয় _____ ডেসিমেল ☐☐☐☐

উৎপাদন কি স্বাভাবিকের চাইতে বেশী (১), সমান (২) বা কম (৩) হয়েছিল? ☐

পরবর্তী মৌসুমে অন্যান্য রবি ফসল করা হয় _____ ডেসিমেল ☐☐☐☐

উৎপাদন কি স্বাভাবিকের চাইতে বেশী (১), সমান (২) বা কম (৩) হয়েছিল?

[জমি=০ যদি আবাদ না করা হয়; উৎপাদন=০ যদি সমস্ত ফসল ক্ষতিগ্রস্থ হয়]

ঝ. আয় এবং ইহার উপর বন্যার প্রভাব : ১৯৮৮ সালের বন্যা পরিবারের সদ্যদের উপার্জনের উপর কি বিরূপ পতিক্রিয়া সৃষ্টি করে সে বিষয়ে প্রশ্ন :

১. কৃষি মজুরী :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

২. জেলে বা মৎস্য ব্যবসায়ী :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

৩. অন্যান্য শ্রমিক :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

৪. গৃহকর্ম :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

৫. ব্যবসা/বাণিজ্য/হস্তশিল্প/কুটিরশিল্প :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

৬. হাঁসমুরগীর উৎপাদন (ডিম, দুধ) :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

[নোট : ১০০% = স্বাভাবিক সময়ের আয়, ১০% বেশি অর্থাৎ স্বাভাবিক সময়ের চাইতে ১০% বেশি বা ১১০% এবং ২০% কম অর্থাৎ স্বাভাবিক সময়ের চাইতে ২০% কম বা ৮০% আয়, ০ = কোন আয় হয় না, -৮ প্রযোজ্য নয়, অর্থাৎ উল্লেখিত উৎস থেকে খানায় কোন আয় হয় না।]

ঞ. ১৯৮৮ সালের বন্যার সময় কি কি সমস্যাগুলো সবচাইতে মারাত্মক ছিল?

- পুরুষ মানুষের সমস্যা (কোড দিতে পারেন) ১ নং সমস্যা _____ ☐☐
  ২ নং সমস্যা _____ ☐☐
  ৩ নং সমস্যা _____ ☐☐
- স্ত্রী লোকের সমস্যা (কোড দিতে পারেন) ১ নং সমস্যা _____ ☐☐
  ২ নং সমস্যা _____ ☐☐
  ৩ নং সমস্যা _____ ☐☐

[স্ত্রী লোকদের আলাদাভাবে জিজ্ঞাসা করতে হবে, যদি উত্তর দিতে সমস্যা হয় তখন কোড এবং নোট ব্যবহার করা যাবে; ১. পানিয় জলের অভাব, ২. টয়লেটের সমস্যা, ৩. জ্বালানীর সমস্যা, ৪. খাদ্য সমস্যা, ৫. খাদ্য প্রস্তুতের সমস্যা, ৬. রান্নাবান্নার সমস্যা, ৭. কর্মের অভাব, ৮. নিরাপত্তা, ৯. চুরি, ১০. বাড়ি সরানো, ১১. যাতায়াত, ১২. আশ্রায়স্থলের অভাব, ১৩. গো-খাদ্যের অভাব, ১৪. গবাদিপশুর রোগ, ১৫. মানুষের রোগ ... ...]

ট. বন্যার ক্ষয়ক্ষতি কাটিয়ে উঠার ব্যাপারে ঘটনার পর পরই আপনারা কি কি পদক্ষেপ গ্রহণ করেছিলেন এবং সেই সমস্ত ব্যবস্থা কি শুধু পরিবারের পুরুষ বা মহিলা বা উভয়েই সম্মিলিতভাবে গ্রহণ করেছিলেন? সে বিষয়ে তথ্য: এবং সেই সমস্ত পদক্ষেপ থেকে উপার্জিত আয় মূলত: কোন কাজে ব্যয় হয় (কোড ব্যবহার করুন)

পদক্ষেপসমূহ:	পুরুষ	মহিলা	ব্যবহার
- অন্যত্র কাজ করে উপার্জন করতে হয় _____	☐	☐	☐
- জমি বিক্রয় করতে হয় _____	☐	☐	☐
- জমি বন্ধক দিতে হয় _____	☐	☐	☐
- গবাদিপশু বিক্রয় করতে হয় _____	☐	☐	☐
- নিজস্ব নামে ঋণ নিতে হয় _____	☐	☐	☐
- গহনা বিক্রয় করতে হয় _____	☐	☐	☐
- অন্যান্য সম্পদ বিক্রয় করতে হয় _____	☐	☐	☐
- আত্মীয়-স্বজনের কাছ থেকে সাহায্য/উপহার পাওয়া গেছে _____	☐	☐	☐
- ধনী ব্যক্তির সাহায্য পাওয়া গেছে _____	☐	☐	☐
- সরকারী বা বেসরকারী প্রতিষ্ঠান থেকে রিলিফ পাওয়া গেছে _____	☐	☐	☐

[পুরুষ এবং মহিলা : ০ - না, ১ - হাঁ]

[ব্যবহার কোড : ১. খাবারের জন্য, ২. ঘর তৈরীর জন্য, ৩. গবাদিপশু সংগ্রহের জন্য, ৪. কৃষি সরঞ্জাম ক্রয়ের জন্য, ৫. অন্য সম্পদের ঘাটতি পূরণের জন্য, ৬. চিকিৎসার জন্য, ৭. অন্যান্য, -৮. প্রযোজ্য নয়]

ঠ. আপনার পরিবারের লোকজন কি ১৯৮৮ সালের বন্যার সময় বা পরে নিচে উল্লেখিত লোকদেরকে সাহায্য/সহযোগিতা করেছেন? *[০-না,১-হাঁ]*

- আত্মীয় এবং একই ভিটায় থাকে _____ ☐
- আত্মীয় কিন্তু অন্য বাড়ী/ভিটায় থাকে _____ ☐
- একই গোষ্ঠীর অন্য সদস্য _____ ☐
- একই সমাজের অন্য সদস্য _____ ☐
- অনাত্মীয় _____ ☐

আপনি কি ধরনের সহযোগিতা করেছিলেন *[০-না,১-হাঁ]*

- মানুষ এবং দ্রব্যাতি সরাতে সাহায্য করেন _____ ☐
- অসুস্থের সেবা করেন _____ ☐
- আপনার বাড়ীতে আশ্রয় দিয়েছিলেন _____ ☐
- খাবার ব্যবস্থা করেছিলেন _____ ☐
- রান্নার ব্যবস্থা করেন _____ ☐
- রিলিফ বিতরণ করেন _____ ☐
- আর্থিক সাহায্য করেন _____ ☐
- অন্যান্য _____ ☐

৮. ১৯৯১ সালের স্বাভাবিক বন্যার প্রভাব

ক. প্রধান/বড় ঘরে কতটুকু পানি উঠেছিল _____ ইঞ্চি ☐☐☐

বাড়ীর ঘরগুলোতে কতদিন পর্যন্ত পানি ছিল _____ দিন ☐☐☐

বাড়ীতে পানি প্রবেশের কতদিন আগে থেকে আপনি বন্যা মোকাবেলার জন্য প্রস্তুতি নিয়েছিলেন _____ দিন ☐☐

আপনি কি বন্যার কোন আগাম সংকেত পেয়েছিলেন _____ হ্যাঁ / না ☐

পেয়ে থাকলে কোথা থেকে পেয়েছিলেন (কোড ব্যবহার করুন) ☐

[সংকেত কোড : ০. মোটেই না, ১. নিজস্ব অভিজ্ঞতা/অবস্থাদৃষ্টে, ২. গ্রামের অন্যদের কাছ থেকে, ৩. বাহিরের লোকের কাছ থেকে, ৪. চাকুরীজীবীদের কাছ থেকে সংবাদের মাধ্যমে, ৫. রেডিও/টিভি, ৬. মাইক/ঢোল বাজানো]

খ. ঐ সময় পরিবারের কত জন সদস্য বর্তমান ছিলেন? _____ ☐☐

বন্যার জন্য কত জন বাড়ী ত্যাগ করেন (যদি করে থাকেন) _____ ☐☐

যদি বাড়ী ত্যাগ করে থাকেন তবে কোথায় আশ্রয় নিয়েছিলেন?

- আশ্রয়স্থলের কোড ব্যবহার করুন _____ ☐
- আশ্রয়দাতার সাথে সম্পর্কের কোড ব্যবহার করুন _____ ☐
- অন্যত্র আশ্রয় নেয়ার মূল কারণ কি? (কোড ব্যবহার করুন) _____ ☐
- কতদিন আশ্রয়স্থলে থাকতে হয়েছে? _____ দিন ☐☐☐
- অস্থায়ী আশ্রয় এবং যাতায়াতের জন্য কি পরিমাণ অতিরিক্ত খরচ হয়েছে ____ টাকা ☐☐☐☐☐

[আশ্রয়স্থলের কোড : ১. মৌজার ভেতর, ২. পার্শ্ববর্তী মৌজা, ৩. এই ইউনিয়নের ভেতর অন্য কোথাও, ৪. এই ইউনিয়নের বাহিরের কোন গ্রাম কিন্তু এই জেলার ভেতর, ৫. এই ইউনিয়নের বাহিরের কোন শহর কিন্তু এই জেলার ভেতর, ৬. জেলার বাহিরে]

[আশ্রয়দাতার সাথের সম্পর্কের কোড : ১. আত্মীয়ের বাড়ী, ২. প্রতিবেশীর বাড়ী, ৩. ধনীব্যক্তির বাড়ী, ৪. বন্যা আশ্রয় কেন্দ্র, ৫. বাঁধ/রাস্তা, ৬. সরকারী জমি, ৭. সরকারী ইমারত, ৮. অন্যান্য]

[আশ্রয় নেয়ার কারণ কোড : ১. বাড়ী ধ্বংস হয়ে যায়, ২. অত্যধিক পানি থাকাতে এবং ঘরে নিরাপত্তাহীনতার কারণে, ৩. গবাদিপশুর নিরাপত্তাহীনতার কারণে, ৪. কাজের সন্ধানে, ৫. অন্যান্য]

গ ঐ সময় আপনার নিজস্ব এবং বর্গা হিসাবে কতগুলো গবাদীপশু ছিল? এবং বন্যার কারণে কতগুলো স্থানান্তরিত করেন

	মোট	স্থানান্তরীত
গরু/মহিষ _____	☐☐	☐☐
ছাগল/ভেড়া _____	☐☐	☐☐
কখন স্থানান্তরিত করেন _____		☐

[১. বন্যার পূর্বে, ২. বন্যার সময়, ৩. বন্যার পর]

আশ্রয়স্থলে কতদিন ছিল _____ দিন ☐☐☐

গবাদিপশু স্থানান্তরের মূল কারণ কি (কোড ব্যবহার করুন) _____ ☐

[স্থানান্তরের কারণ : ১. বন্যার পানি থেকে নিরাপদে রাখা, ২. চুরি থেকে নিরাপদে রাখা, ৩. গবাদিপশুর খাদ্য সহজলভ্যতার জন্য, ৪. বিক্রির জন্য, ৫. অন্যান্য]

বন্যার জন্য কতগুলো গরু এবং মহিষের ক্ষতি এবং মৃত্যু হয় _____ ☐☐

বন্যার জন্য কতগুলো ছাগল এবং ভেড়ার ক্ষতি/মৃত্যু হয় _____ ☐☐

ক্ষতির পরিমাণ কত টাকা _____ টাকা ☐☐☐☐☐

ঘ. ১৯৯১ সালের বন্যার সময় বাড়ী/ঘরের অবস্থা সম্বন্ধে প্রশ্ন :

১৯৯১ সালে ঘরের বেড়া কিসের তৈরী ছিল (কোড ব্যবহার করুন) _____ ☐

১৯৯১ সালে ঘরের চাল কিসের তৈরী ছিল (কোড ব্যবহার করুন) _____ ☐

[গৃহনির্মাণ সরঞ্জামাদির কোড : ১. খড়/পাতা/শোলা/বাঁশ, ২. টিন, ৩. মাটি, ৪. ইট, ৫. টাইলস্, ৬. কংক্রিট; যদি বিভিন্ন দ্রব্য ব্যবহৃত হয় তবে বেশী প্রয়োজনীয় দ্রব্যের কোড ব্যবহার করুন, যদি বিভিন্ন দ্রব্য একই পরিমাণে ব্যবহৃত হয়ে থাকে তবে এদের মধ্যে উৎকৃষ্ট দ্রব্যের কোড ব্যবহার করুন]

বন্যায় কতটি ঘর ক্ষতিগ্রস্থ হয় _____ ☐☐

- বন্যার পর উপস্থিত ক্ষতিগ্রস্থ ঘরগুলোকে মেরামত করার জন্য কত টাকা খরচ করতে হয়েছিল _____ টাকা ☐☐☐☐☐
- বন্যার সময় যে সমস্ত ঘর সম্পূর্ণ ধ্বংস হয়ে যায় সে স্থানে পুনরায় ঘর তৈরী করতে কত টাকা খরচ করতে হয়েছে _____ টাকা ☐☐☐☐☐
- অন্য কোন ঘর (গরুর ঘর, কাচারী ঘর, ইত্যাদি) ক্ষতি হয়ে থাকলে তাহার পরিমাণ কত টাকা _____ টাকা ☐☐☐☐☐

ঙ. বন্যার পূর্বে আপনার সঞ্চয়ে কি পরিমাণ খাবার (ধান, চাউল ইত্যাদি) ছিল _____ মণ ☐☐

বন্যায় কি পরিমাণ নষ্ট হয়েছিল _____ মণ ☐☐

ক্ষতির পরিমাণ কত টাকা _____ টাকা ☐☐☐☐☐

চ. বন্যার সময় নৌকার (যদি থাকে) কি পরিমাণ ক্ষয়ক্ষতি হয়েছিল _____ টাকা ☐☐☐☐☐

কত টাকার গাছপালা ও তরিতরকারীর ক্ষতি হয় _____ টাকা ☐☐☐☐☐

বন্যার জন্য অন্যান্য জিনিস কত টাকার ক্ষতি হয় (যেমন কৃষি সরঞ্জামাদি, আসবাবপত্র, থালাবাসন, নিজস্ব দ্রব্যাদি ইত্যাদি) _____ টাকা ☐☐☐☐☐

এই সমস্ত দ্রব্যের শতকরা কত অংশ রক্ষা করা সম্ভব হয়েছিল _____ % ☐☐☐

ছ. আপনি কি মনে করেন এই ক্ষয়ক্ষতির পরিমাণ কমানো সম্ভব ছিল? _____ হ্যাঁ / না ☐

যদি হ্যাঁ হয়, তবে কি জন্য ক্ষয়ক্ষতি কমানো সম্ভব হয়নি?

- যথাযথ পূর্বাভাসের অভাবের কারণে _____ ☐
- বন্যার ভয়াবহতা অনুমান করা যায়নি _____ ☐
- আশ্রয় নেয়ার মত উঁচু স্থানের অভাব _____ ☐
- যানবাহনের অভাব _____ ☐

[০. না, ১. হ্যাঁ]

জ. শস্য ক্ষেতের উৎপাদন এবং লাভ/ক্ষতি বিষয়ক তথ্য:

১৯৯১ সালে বোরো ধান চাষাধীন জমির পরিমাণ _____ ডেসিমেল ☐☐☐☐

আশান্বিত উৎপাদন (মণ) _____ মণ/একর ☐☐☐

সত্যিকার উৎপাদন (মণ) _____ মণ/একর ☐☐☐

১৯৯১ সালে আউস ধানের চাষাধীন জমির পরিমাণ _____ ডেসিমেল ☐☐☐☐

আশান্বিত উৎপাদন (মণ) _____ মণ/একর ☐☐☐

সত্যিকার উৎপাদন (মণ) _____ মণ/একর ☐☐☐

১৯৯১ সালে আমন ধান চাষাধীন জমির পরিমাণ _____ ডেসিমেল ☐☐☐☐

আশান্বিত উৎপাদন (মণ) _____ মণ/একর ☐☐☐

সত্যিকার উৎপাদন (মণ) _____ মণ/একর ☐☐☐

পরবর্তী মৌসুমে কতটুকু জমিতে কাউন/চীনা ইত্যাদি করা হয় _____ ডেসিমেল ☐☐☐☐

উৎপাদন কি স্বাভাবিকের চাইতে বেশী (১), সমান (২) বা কম (৩) হয়েছিল? ☐

পরবর্তী মৌসুমে অন্যান্য রবি ফসল করা হয় _____ ডেসিমেল ☐☐☐☐

উৎপাদন কি স্বাভাবিকের চাইতে বেশী (১), সমান (২) বা কম (৩) হয়েছিল? ☐

[জমি=০ যদি আবাদ না করা হয়; উৎপাদন=০ যদি সমস্ত ফসল ক্ষতিগ্রস্থ হয়]

ঝ. আয় এবং ইহার উপর বন্যার প্রভাব : ১৯৯১ সালের বন্যা পরিবারের সদ্যদের উপার্জনের উপর কি বিরূপ পতিক্রিয়া সৃষ্টি করে সে বিষয়ে প্রশ্ন :

১. কৃষি মজুরী :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

২. জেলে বা মৎস্য ব্যবসায়ী :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

৩. অন্যান্য শ্রমিক :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

৪. গৃহকর্ম :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

৫. ব্যবসা/বাণিজ্য/হস্তশিল্প/কুটিরশিল্প :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয় শতকরা কত অংশ আয় হয় _____ % ☐☐☐

৬. হাঁসমুরগীর উৎপাদন (ডিম, দুধ) :

- কত মাস ক্ষতি হয় _____ ☐☐
- স্বাভাবিক সময়ের আয়ের শতকরা কত অংশ আয় হয় _____ % ☐☐☐

[নোট : ১০০% = স্বাভাবিক সময়ের আয়, ১০% বেশি অর্থাৎ স্বাভাবিক সময়ের চাইতে ১০% বেশি বা ১১০% এবং ২০% কম অর্থাৎ স্বাভাবিক সময়ের চাইতে ২০% কম বা ৮০% আয়, ০ = কোন আয় হয় না, -৮ প্রযোজ্য নয়, অর্থাৎ উল্লেখিত উৎস থেকে খানায় কোন আয় হয় না।]

ঞ. ১৯৯১ সালের বন্যার সময় কি কি সমস্যাগুলো সবচাইতে মারাত্মক ছিল?

- পুরুষ মানুষের সমস্যা (কোড দিতে পারেন)
  - ১ নং সমস্যা _____ ☐☐
  - ২ নং সমস্যা _____ ☐☐
  - ৩ নং সমস্যা _____ ☐☐
- স্ত্রী লোকের সমস্যা (কোড দিতে পারেন)
  - ১ নং সমস্যা _____ ☐☐
  - ২ নং সমস্যা _____ ☐☐
  - ৩ নং সমস্যা _____ ☐☐

[স্ত্রী লোকদের আলাদাভাবে জিজ্ঞাসা করতে হবে, যদি উত্তর দিতে সমস্যা হয় তখন কোড এবং নোট ব্যবহার করা যাবে; ১. পানিয় জলের অভাব, ২. টয়লেটের সমস্যা, ৩. জ্বালানীর সমস্যা, ৪. খাদ্য সমস্যা, ৫. খাদ্য প্রস্তুতের সমস্যা, ৬. রান্নাবান্নার সমস্যা, ৭. কর্মের অভাব, ৮. নিরাপত্তা, ৯. চুরি, ১০. বাড়ি সরানো, ১১. যাতায়াত, ১২. আশ্রায়স্থলের অভাব, ১৩. গো-খাদ্যের অভাব, ১৪. গবাদিপশুর রোগ, ১৫. মানুষের রোগ ... ...]

৮. বন্যার ক্ষয়ক্ষতি কাটিয়ে উঠার ব্যাপারে ঘটনার পর পরই আপনারা কি কি পদক্ষেপ গ্রহণ করেছিলেন এবং সেই সমস্ত ব্যবস্থা কি শুধু পরিবারের পুরুষ বা মহিলা বা উভয়েই সম্মিলিতভাবে গ্রহণ করেছিলেন? সে বিষয়ে তথ্য: এবং সেই সমস্ত পদক্ষেপ থেকে উপার্জিত আয় মূলত: কোন কাজে ব্যয় হয় (কোড ব্যবহার করুন)

পদক্ষেপসমূহ:	পুরুষ	মহিলা	ব্যবহার
– অন্যত্র কাজ করে উপার্জন করতে হয়	☐	☐	☐
– জমি বিক্রয় করতে হয়	☐	☐	☐
– জমি বন্ধক দিতে হয়	☐	☐	☐
– গবাদিপশু বিক্রয় করতে হয়	☐	☐	☐
– নিজস্ব নামে ঋণ নিতে হয়	☐	☐	☐
– গহনা বিক্রয় করতে হয়	☐	☐	☐
– অন্যান্য সম্পদ বিক্রয় করতে হয়	☐	☐	☐
– আত্মীয়-স্বজনের কাছ থেকে সাহায্য/উপহার পাওয়া গেছে	☐	☐	☐
– ধনী ব্যক্তির সাহায্য পাওয়া গেছে	☐	☐	☐
– সরকারী বা বেসরকারী প্রতিষ্ঠান থেকে রিলিফ পাওয়া গেছে	☐	☐	☐

[পুরুষ এবং মহিলা : ০ – না, ১ – হ্যাঁ]

[ব্যবহার কোড: ১. খাবারের জন্য, ২. ঘর তৈরীর জন্য, ৩. গবাদিপশু সংগ্রহের জন্য, ৪. কৃষি সরঞ্জাম ক্রয়ের জন্য, ৫. অন্য সম্পদের ঘাটতি পূরণের জন্য, ৬. চিকিৎসার জন্য, ৭. অন্যান্য, –৮. প্রযোজ্য নয়]

৯. আপনার পরিবারের লোকজন কি ১৯৯১ সালের বন্যার সময় বা পরে নিচে উল্লেখিত লোকদেরকে সাহায্য/সহযোগিতা করেছেন? *[০-না,১-হ্যাঁ]*

– আত্মীয় এবং একই ভিটায় থাকে	☐
– আত্মীয় কিন্তু অন্য বাড়ী/ভিটায় থাকে	☐
– একই গোষ্ঠীর অন্য সদস্য	☐
– একই সমাজের অন্য সদস্য	☐
– অনাত্মীয়	☐

আপনি কি ধরনের সহযোগিতা করেছিলেন *[০-না,১-হ্যাঁ]*

– মানুষ এবং দ্রব্যাদি সরাতে সাহায্য করেন	☐
– অসুস্থের সেবা করেন	☐
– আপনার বাড়ীতে আশ্রয় দিয়েছিলেন	☐
– খাবার ব্যবস্থা করেছিলেন	☐
– রান্নার ব্যবস্থা করেন	☐
– রিলিফ বিতরণ করেন	☐
– আর্থিক সাহায্য করেন	☐
– অন্যান্য	☐

৯. বাড়ী রক্ষার ব্যবস্থা বিষয়ক প্রশ্ন :

ক. উঠান থেকে বড়/প্রধান ঘরের মেঝের উচ্চতা কত? _____ ইঞ্চি ☐☐☐

বড় ঘরের স্বাভাবিক মেরামতের জন্য প্রত্যেক বৎসর আপনাকে কত টাকা খরচ করতে হয়? _____ টাকা ☐☐☐☐☐

আগামী ১০ বৎসরে আপনার ঘরের মেঝের উপর কতবার পানি উঠার সম্ভাবনা আছে বলে মনে করেন? _____ ☐☐

খ. বাড়ী রক্ষার জন্য এই পরিবার কি কি ব্যবস্থা (যদি নিয়ে থাকেন) নিয়েছেন?

বাড়ীর চারিদিকে বাধ	প্রতি _____ বৎসরে ১ বার	☐☐
	গত বৎসর _____ বার	☐☐☐☐
	খরচ _____ টাকা	☐☐☐☐☐
ঘরের ভিটা উঁচুকরণ	প্রতি _____ বৎসরে ১ বার	☐☐
	গত বৎসর _____ বার	☐☐☐☐
	খরচ _____ টাকা	☐☐☐☐☐
অন্য কোন গুরুত্বপূর্ণ ব্যবস্থা	প্রতি _____ বৎসরে ১ বার	☐☐
	গত বৎসর _____ বার	☐☐☐☐
	খরচ _____ টাকা	☐☐☐☐☐

[ব্যবস্থা কোড : ১. বৃক্ষরোপন/ঝোপঝাড় বৃদ্ধি, ২. ঘরের ডোমা বা মেঝে শক্ত করা, ৩. মেঝের বাইরে ঘাস বা অন্য কিছুর আচ্ছাদন, ৪.বাড়ীর/ঘরের চতুর্দিকে বাধ নির্মাণ করা, ৫. বাড়ীর ভিটি উঁচু করা, ৬. অন্যান উল্লেখ করুন ... ...] ☐☐

১০. নদী ভাঙ্গন সংক্রান্ত প্রশ্নাবলী :

- নদী ভাঙ্গার কারণে শেষ কত বৎসর আগে আপনি বাড়ী স্থানান্তর করেন *[০-কখনোই না]* ☐☐☐☐
- তখন যে এলাকায় আপনার বাড়ী ছিল সেই এলাকার নাম এবং এলাকার পরিচয় দিন (কোড ব্যবহার করুন)

  গ্রাম/মৌজার নাম _____ কোড ☐

  [কোড: ১. অন্য মৌজার অন্য চর, ২. এই মৌজাই কিন্তু অন্য চর, ৩. এই চরই কিন্তু অন্য মৌজা, ৪. এই চর এবং এই মৌজা]
- শেষবার নদী ভাঙ্গার কারণে কোথায় প্রথম আশ্রয় নেন? _____ (কোড) ☐

  [আশ্রয়স্থলেরকোড: ১. বর্তমানে যে বাড়ীতে বসবাসরত, ২. এই চর এবং এই মৌজা, ৩. এই চর কিন্তু অন্য মৌজা, ৪. অন্য চর কিন্তু এই মৌজা, ৫. অন্য চরে অন্য মৌজা]
- যে স্থানে আশ্রয় নিয়েছিলেন সেই স্থানের মালিকানাস্বত্বের ধরণ কেমন ছিল (কোড ব্যবহার করুন) ☐☐

  [মালিকানাস্বত্বের কোড : ১. স্বত্বাধিকারভুক্ত নিজ সম্পত্তি, ২. ক্রয়কৃত জায়গা, ৩. আত্মীয়-স্বজনের বাড়ী, ৪. প্রতিবেশীর বাড়ী, ৫. ধনী লোকের বাড়ী, ৬. বন্যা আশ্রয় কেন্দ্র, ৭. বাঁধ/রাস্তা, ৮. সরকারী কোন স্থান, ৯. সরকারী ইমারত, ১০. অন্যান্য .. ..]
- এই বাড়ী/ভিটা পছন্দ করার কি কারণ (কোড ব্যবহার করুন) _____ ☐

  স্থানের নাম _____

  [পছন্দের কোড : ১. নিজের জায়গার নিকট বলে, ২. আত্মীয়-স্বজনের কাছাকাছি, ৩. সমাজের অন্যদের কাছাকাছি, ...]
- স্থানান্তরের সময় কি সমাজ পরিবর্তন করেছিলেন? _____ *[০-না,১-হাঁ]* ☐
- এখানে কি আপনি উঠুলী হিসাবে আছেন? _____ *[০-না, ১-হাঁ]* ☐

১১. অগ্রাধিকার ভিত্তিক প্রতিকার/প্রতিরোধসমূহ :

[নিচের প্রশ্নগুলি পুরুষ খানা প্রধান/বয়স্ক পুরুষ এবং বয়স্ক মহিলা/খানা প্রধানকে আলাদা আলাদাভাবে জিজ্ঞাসা করতে হবে। কলাম 'পুরুষ' হচ্ছে পুরুষের মতামত এবং কলাম 'মহিলা' হচ্ছে মহিলাদের মতামত।]

ক. কি ধরনের স্থানীয় ব্যবস্থাদী গ্রহণ করা হলে ভবিষ্যতে বন্যা বা দূর্যোগের সময় আপনার পরিবারের ক্ষতি অনেকাংশে কম হবে এবং কে বা কারা এই সমস্ত ব্যবস্থা নিতে পারেন বলে আপনার ধারণা? (কোড ব্যবহার করুন)

	পুরুষ	মহিলা
খুবই প্রয়োজনীয় স্থানীয় ব্যবস্থা _____	☐☐	☐☐
কে বা কারা এই ব্যবস্থা নিবে _____	☐☐	☐☐
দ্বিতীয় গুরুত্বপূর্ণ স্থানীয় ব্যবস্থা _____	☐☐	☐☐
কে বা কারা এই ব্যবস্থা নিবে _____	☐☐	☐☐
তৃতীয় গুরুত্বপূর্ণ স্থানীয় ব্যবস্থা _____	☐☐	☐☐
কে বা কারা এই ব্যবস্থা নিবে _____	☐☐	☐☐

[ব্যবস্থা কোড : ১. ঘর উঁচু করা, ২. ঘাসের বেড়া, ৩. অন্যান্য বেড়া (যেমন ধইঞ্চা, বাঁশের ইত্যাদি), ৪. ইটের মেটেসিং, ৫. বৃক্ষরোপণ, ৬. মেঝে/ভিটা শক্তকরণ, ৭. বাড়ীর চারদিকে বাঁধ নির্মাণ, ৮. বন্যা আশ্রয় কেন্দ্র, ৯. গবাদি পশুর আশ্রয়স্থল, ১০. যৌথভাবে বাড়ীর ভিটা উঁচু করা, ১১. নৌকার ব্যবস্থা করা, ১২. বন্যার পূর্বাভাস, ১৩. বন্যার তথ্য, ১৪. বন্যার পর সহজ শর্তে ঋণ, ১৫. স্থানীয় ত্রাণভান্ডার, ১৬. শুষ্ক মৌসুমে কৃষি সাহায্য

কারা ব্যবস্থা নিবে : ১. নিজস্ব উদ্যোগে প্রত্যেক পরিবার আলাদাভাবে, ২. বাড়ীভিত্তিক, ৩. গোষ্ঠীভিত্তিক, ৪. সমাজ, ৫. পারা, ৬. গ্রাম, ৭. স্থানীয় সামাজিক সংগঠন, ৮. সমবায় সংগঠন, ৯. বেসরকারী সংগঠন (এনজিও), ১০. ইউনিয়ন পরিষদ, ১১. থানা, ১২. জেলা, ১৩. বিভিন্ন সরকারী প্রতিষ্ঠান, ১৪. অন্যান্য (উল্লেখ করুন)]

খ. আপনি কি এই সমস্ত ব্যবস্থা প্রয়োগের জন্য টাকা বা বস্তু দ্বারা সহযোগিতা করতে রাজী আছেন?

	পুরুষ	মহিলা
আপনার অংশের/ভাগের সম্পূর্ণ খরচ _____	☐	☐
আপনার অংশের/ভাগের আংশিক খরচ _____	☐	☐
কোন রকম খরচ করতে রাজী নন _____	☐	☐

গ. যখন নদী ভাঙ্গা প্রতিরোধ করা সম্ভব হয় না তখন স্থানীয় পর্যায়ে কি ব্যবস্থা নেয়া হলে আপনাদের উপকারে আসতে পারে বলে মনে করেন? এবং সে ব্যবস্থাগুলো কি?

	পুরুষ	মহিলা
খুবই গুরত্বপূর্ণ ব্যবস্থা _____	☐☐	☐☐
দ্বিতীয় গুরুত্বপূর্ণ ব্যবস্থা _____	☐☐	☐☐

[ব্যবস্থা কোড : ১. বাড়ীর জন্য স্থান করে দেয়া, ২. পরিবারের জন্য নৌকার ব্যবস্থা, ৩. পুনর্বাসনের জন্য ঋণ, ৪. পুনর্বাসনের জন্য অনুদান, ৫. বাধে আশ্রয়কারীদের নিরাপত্তা, ৬. নদী ভাঙ্গার পরও জমির উপর দখল বহাল থাকার নিশ্চয়তা, ৭. নদী ভাঙ্গায় ক্ষতিগ্রস্তদের মধ্যে খাস জমি বরাদ্দের ব্যবস্থা, ৮. বাড়ী ভেঙ্গে বহন করার সময় নৌকার ব্যবস্থা, ৯. বিনা ব্যয়ে অস্থায়ী নিবাস]

ঘ. আরও এমন কোন গুরুত্বপূর্ণ ব্যবস্থা আছে কি যেটা বন্যা এবং নদী ভাঙ্গার বিরুদ্ধে খুবই কার্যকর বলে আপনার ধারণা?
[খোলা প্রশ্ন, খালি জায়গায় লিখে পরে কোড করতে হবে]

প্রথম ব্যবস্থা ☐ ☐

দ্বিতীয় ব্যবস্থা ☐ ☐

_____ _____

পরীক্ষিত সাক্ষাতকার গ্রহণকারীর নাম

APPENDIX B

VARIANCE CALCULATIONS FOR 2-STAGE PPS/SRS SAMPLE

This Appendix is derived from the FAP 12 (1992) Final Report.

As described in Chapter 1 the survey used a two-stage sample design, in order to avoid the need for compiling final-stage sample frames covering the entire population in each project. The first-stage sample units, the mauzas (revenue villages), were selected with probability proportional to size (PPS), and the second (final) stage sample units, households, were selected by simple linear random sampling (SRS) within the selected first-stage units.

The variance algorithms supplied as standard with proprietary statistical analysis packages assume a single-stage simple random sample (SSRS) design and therefore are inappropriate for a two-stage design, where it is necessary to take account of the relative contributions of the variance arising from variation within, and variation between, the first-stage sample units.

The variance algorithms used in this study for results presented in Chapter 3 are given in equations 2 and 4 below. They are derived from Cochrane (1983), Section 11.8, and are given in their present form in Poate and Daplyn (1990), Appendix 1.

For calculating variances using these algorithms, it is necessary to obtain the subtotals of the variable(s) being analyzed, for the first-stage sample units. These subtotals are indicated in equations 2, and 4 by:

$$\sum y_{ij}$$

and

$$\sum x_{ij}$$

Since the number of first-stage units is quite small, it was easiest to operationalize the variance algorithms by extra ing the relevant subtotals for the first-stage units using SPSS or dBase, and then to enter them into a spreadsheet for variance calculation.

APPENDIX B
STATISTICS FOR 2-STAGE PPS/SRS SAMPLE

EQUATION 1: POPULATION TOTAL OF A VARIABLE

$$Y=\frac{H}{mn}\sum_{n}^{i-1}\sum_{m}^{j-1}y_{ij}$$

EQUATION 2: VARIANCE OF TOTAL

$$var(Y)=\frac{H^2}{n(n-1)m^2}\left(\sum_{n}^{i-1}\left(\sum_{m}^{j-1}y_{ij}\right)^2-\frac{1}{n}\left(\sum_{n}^{i-1}\sum_{m}^{j-1}y_{ij}\right)^2\right)$$

Definitions of variables:

Variable	Definition	Value/Source
Y	Estimated population total for numerator	Computed-Eq.1
X	Estimated population total for denominator	Computed-Eq.1
H	Total households in sampled population	Derived from inventory data
n	Number of clusters in sample	15
m	Cluster size	10
Y_{ij}	Value of Y for j^{th} household of i^{th} cluster	Original household data
X_{ij}	Value of X for j^{th} cluster	Original household data

APPENDIX C Confidence Limit Tables

Table 1 Household Flood Depth and Duration, 1988

	Bhuapur			Kurigram		
	% Flooded	Mean	80% CI	% Flooded	Mean	80% CI
Flood Depth (m)						
All	87	0.69	0.60-0.77	97	1.05	0.95-1.14
Island Char	97	1.13	na	100	1.34	na
Attached Char	84	0.80	na	100	1.82	na
Unprotected Mainland	70	0.44	na	93	1.18	na
Duration (days)	—	14.3	12.4-16.2	—	14.0	12.8-15.2

Source: Flood Proofing Household Survey

Table 2 Evacuation Impacts of 1988 Flood

	Bhuapur		Kurigram	
	Estimate	80% CI	Estimate	80% CI
Total Population	172,071	160,432-183,711	189,803	179,764-199,842
People Moved	60,060	48,144-71,975	108,322	93,274-123,369
Percent Moved	35	—	57	—
Temporary Shelter (Tk/household)	223	162-285	284	234-334
Total Cost, Temporary Shelter ('000,000s)	5.5	4.0-7.1	8.2	6.7-9.6
Total Cattle	70,814	55,570-86,058	77,263	65,398-89,128
Cattle Moved	39,047	27,086-51,008	55,407	43,988-66,826
Percent Moved	55	—	72	—

Source: Household Flood Proofing Survey

Table 3 Mean Household Losses from 1988 Flood (1988 Tk. values)

	Bhuapur		Kurigram	
	Mean	80% CI	Mean	80% CI
Temporary Shelter	223	161-285	283	234-334
Livestock	2,142	1,482-2,802	1,015	787-1,242
Housing	3,238	2,145-4,332	2,031	1,838-2,223
Stored Food Grain	433	270-596	759	543-975
Boat Damage	83	36-130	25	2-47
Tree Damage	1,295	1,025-1,565	793	646-939
House Contents	385	292-475	394	325-464
Total Homestead Loss	7,581	5,980-9,182	5,300	4,732-5,869
Preventable Loss	218	164-271	204	169-240
Standing Boro Loss	540	329-754	204	112-295
Standing Aus Loss	5,014	3,834-6,197	3,792	2,801-4,786
Standing Aman Loss	7,332	6,090-8,572	4,834	3,617-6,049

Source: Household Flood Proofing Survey

Table 4 Total Losses from 1988 Flood by Study Reach (1988 Tk. millions)

	Bhuapur		Kurigram	
	Total	80% CI	Total	80% CI
Temporary Shelter	5.5	4.0-7.1	8.1	6.7-9.6
Livestock	53.2	36.8-69.5	29.2	22.6-35.7
Housing	80.3	53.2-107.5	58.4	52.8-63.9
Stored Food Grain	10.7	6.7-14.8	21.8	15.6-28.0
Boat Damage	2.1	0.9-3.2	0.7	0.06-1.35
Tree Damage	32.1	25.5-38.8	22.8	18.6-27.0
House Contents	9.5	7.2-11.8	11.3	9.4-13.4
Total Homestead Loss	188.2	148.4-227.8	152.4	136-168.8
Preventable Loss	5.4	4.1-6.7	5.9	4.9-6.9
Standing Boro Loss	14.1	6.6-21.5	5.9	3.22-8.5
Standing Aus Loss	124.5	95.2-153.8	109.0	80.6-137.6
Standing Aman Loss	181.9	151.1-212.8	139.0	104-174.0

Source: Household Flood Proofing Survey

Table 5 In-House Flood Characteristics (1991)

	Bhuapur			Kurigram		
	% Flooded	Mean	80% CI	% Flooded	Mean	80% CI
Flood Depth (m)						
All	19	0.056	0.04-0.073	31	0.28	0.16-0.33
Island Char	31	0.09	na	28	0.22	na
Attached Char	14	0.04	na	41	0.30	na
Unprotected Mainland	0	0.00	na	29	0.33	na
Duration (days)	—	1.87	1.03-2.17	—	2.96	2.14-3.50

Source: Household Flood Proofing Survey

Table 6 Evacuation Impacts of 1991 Flood

	Bhuapur		Kurigram	
	Estimate	80% CI	Estimate	80% CI
Total Population	158,504	149,483-167,526	191,528	184,319-198,738
People Moved	7,445	2,221-12,670	2,876	0-6,069*
Percent Moved	4.7	—	1.5	—
Temporary Shelter (Tk/household)	30.0	6-54	8.33	0.74-16.0
Total Cost, Temporary Shelter (Tk '000,000s)	0.74	0.14-1.34	0.24	0.02-0.46
Total Cattle	37,392	32,645-42,139	60,008	49,754-70,263
Cattle Moved	1,489	623-2,355	4,410	929-7,890
Percent Moved	4.0	—	7.3	—

Source: Household Flood Proofing Survey

*Lower confidence limits that were estimated as negative numbers have been truncated and set to zero in the tables.

Table 7 Mean Household Losses from 1991 Flood (1991 Tk. values)

	Bhuapur		Kurigram	
	Mean	80% CI	Mean	80% CI
Temporary Shelter	30.0	6-54	8.33	0.75-16.0
Livestock	214.0	99-329	47.0	21-73
Housing	514.0	234-793	242	203-280
Stored Food Grain	3.3	0-7.6*	10.0	0-20.4*
Boat Damage	200.0	0-456*	2.67	0-6.1*
Tree Damage	95.0	61-129	87.3	58.5-116
House Contents	25.5	15-36	26.0	18.6-33.4
Total Homestead Loss	1,082	694-1,469	423	356-490
Preventable Loss	21.3	12-30	20	14.4-24.7
Standing Boro Loss	721	343-1,103	360	147-577
Standing Aus Loss	1,714	1,284-2,140	1,320	834-1,798
Standing Aman Loss	2,052	1,448-2,656	1,823	1,352-2,293

Source: Household Flood Proofing Survey

*Lower confidence limits that were estimated as negative numbers have been truncated and set to zero in the tables.

Table 8 Total Losses From 1991 Flood by Study Reach (1991 Tk. in millions)

	Bhuapur		Kurigram	
	Total	80% CI	Total	80% CI
Temporary Shelter	0.75	0.14-1.4	0.24	0.02-0.46
Livestock	5.3	2.5-8.2	1.34	0.59-2.10
Housing	12.8	5.8-19.7	6.9	5.8-8.10
Store Food Grain	0.08	0-1.9*	0.30	0-0.6*
Boat Damage	4.96	0-11.3*	0.08	0-0.17*
Tree Damage	2.4	1.5-3.2	2.5	1.7-3.3
House Contents	0.64	0.36-0.91	0.75	0.53-0.96
Total Homestead Loss	26.9	17.2-36.5	12.2	10.2-14.1
Preventable Loss	0.53	0.31-0.75	0.56	0.41-0.71
Standing Boro Loss†	18.0	8.45-27.36	10.40	4.23-16.55
Standing Aus Loss†	42.5	31.78-53.27	38.00	24.3-51.70
Standing Aman Loss†	51.3	36.41-66.17	52.44	38.62-66.26

Source: Households Survey

*Lower confidence limits that were estimated as negative numbers have been truncated and set as zero in the tables.

†Loss of Boro, Aus and Aman paddy calculated as price of 1990-91 financial year (BBS 1992).