



**CDMP EC – Funded Component 3d Support for
Livelihood Security-Hazard Awareness**

Development of Hazard Zoning Maps using CRA Process



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CDMP EC – Funded Component 3d
Support for Livelihood Security-Hazard Awareness

Draft Report
Development of Hazard Zoning Maps using CRA Process

Submitted to
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Executive Summary

Development of Hazard Zoning Maps using CRA Process of CDMP is one of the activities under the EC funded Component 3d: Support for Livelihood Security- Hazard Awareness.

CDMP selected seven pilot districts for their study, such as Lalmonirhat, Rajshahi, Sirajganj, Sunamganj, Cox's bazaar, Faridpur and Satkhira. As part of the study process CDMP prepared Community Risk Assessment (CRA) guidelines and implemented the CRA process in those seven pilot districts to assess the risks from different natural hazards using services of several local NGOs.

To make the study and hazard management process more scientific and organized CDMP assigned CEGIS to prepare Multi-Hazard Zoning Maps of 64 unions and 3 paurashavas under 7 vulnerable upazilas namely Hatibandha, Godagari, Chouhali, Sadarpur, Dharampasha, Assasuni, Moheshkahli, in 7 pilot districts. It was envisaged that the Multi- hazard Zoning Maps would be easy, meaningful, scientific, user-friendly, value added output of the CRA process using sophisticated GIS techniques.

To build the Multi-Hazard Zoning Maps the CRA reports have been thoroughly reviewed and information regarding natural hazards occurring in respective areas were extracted. The CRAs have been validated in the field through FGDs in all the 67 unions/paurashavas. Additional features (settlement, roads, rivers, water bodies, educational institutes, local government institutes etc) have been extracted from SOB Topo sheet, FINNMAP and field investigation. All these information have been fed into the GIS system. Weightage has been assigned for each hazard according to their intensity, recurrence and affects. Then the analysis was done using GIS overlay techniques to compute the resource elements exposed under different hazard conditions.

An Atlas has been prepared which consists of several maps for each 67 unions/paurashavas. The maps are mainly (i) Base Map, (ii) Multi-hazard Map and (iii) Livelihood Map.

The Hazard Zoning Maps would be helpful for the local community, planners, disaster managers and decision makers for disaster management and risk related activities.

Acronyms

A.D	Anno Domini (After the birth of Jesus Christ)
AHP	Analytical Hierarchical Process
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorological Department
BWDB	Bangladesh Water Development Board
CCD	Common Core of Data
CDMP	Comprehensive Disaster Management Programme
CEGIS	Center for Environmental and Geographic Information Services
CRA	Community Risk Assessment
CYSMIS	Cyclone Shelter Management Information System
DEM	Digital Elevation Model
DMB	Digital Multimedia Broadcasting/Disaster Management Bureau
DU	University of Dhaka
EC	European Commission
ENVI	Is the premier software solution to quickly, easily, and accurately extract information from geospatial imagery
EROS	Extremely Reliable Operating System
FGD	Focus Group Discussion
FHI	Flood Hazard Index
GIS	Geographic Information Systems
GMLC	Gateway Mobile Location Centre
GPS	Global Positioning System
GRDB	Geo-referenced database
ICRD	Integrated Coastal Resources Database
ICRRP	International Commission on Radiological Protection
ILWIS	Integrated Land and Water Information System is a PC-based GIS & Remote Sensing software
IMD	Indian Meteorological Department
IRS	Indian Remote Sensing
LISS	Live Internet Seismic Server
NATMO	National Atlas & Thematic Mapping Organization
NDVI	Normalized Difference Vegetation Index
NGO	Non-Government Organization
NWRD	National Water Resources Database
RIW	Relative Importance Weights
SOB	Survey of Bangladesh
SSHS	Saffir-Simpson Hurricane Scale
ToR	Terms of Reference
UDMC	Union Disaster Management Committee
UNO	Upazila Nirbahi Officer

Chapter 1

Introduction

1.1 Background

Bangladesh, due to its location, is one of the most natural hazard prone countries of the world. It experiences tropical cyclones, storm surges, floods, riverbank erosion, drought and many more. Floods and local seasonal storms are annual events, which cause loss of lives and properties. The amount of loss is aggravated with increasing population density. People are forced to live in those places that were not used before i.e. slopes, areas with risk of flood/cyclone, unstable soils, chars and many other vulnerable areas. Any specific location may experience only one hazard or more than one (multi hazard). The hazard management planners/disaster managers must understand the characteristics, location, frequency and magnitude of hazards and their potential impacts on life and property.

For adopting effective measures the managers should have effective planning data, tools and mechanisms. The nature of hazard, its occurrence, magnitude and its effects varies with local and regional climatic, physiographic and social settings. The hazard management should be customized to the spatial extent, magnitude, seasonality and local context. Proper disaster/hazard management including preparedness, prevention and post hazard relief/rehabilitation, planning and operation can be achieved through understanding and anticipating future hazard events, which can minimize the risks of loss of life and properties.

It is also very important to build the capacity of the local people to cope with the different types of hazards. In this regard Hazard Zoning Maps containing spatial and temporal extent of the hazards can be most effective starting tool for planning of hazard management activities. In order to prioritize the populations that are facing higher threats by various natural hazards can be mapped at the local levels, which could be a useful tool for decision makers. Thus disaster management can involve stakeholders from the community level to the planning level.

In this regard Comprehensive Disaster Management Programme (CDMP) has been designed to strengthen the Bangladesh disaster management system by adopting a holistic approach, embracing processes of hazard identification and mitigation, community preparedness and integrated response efforts considering the relief and recovery activities under an all-risk management framework. CDMP seeks to raise the capacities of at-risk communities by lowering their vulnerability for each and every specific hazard.

This assignment, “Development of Hazard Zoning Maps using CRA Process”, of CDMP falls under the EC funded Component 3d: Support for Livelihood Security- Hazard Awareness. CDMP has prepared Community Risk Assessment (CRA) guidelines and implemented the CRA process in 7 pilot districts in Bangladesh. To continue the studies of CDMP, a set of hazard zone maps are required which would be meaningful, scientific, user-friendly to add value to the outputs of the CRA process. This would be helpful for the local community, planners, disaster managers and decision makers for disaster management and risk related activities. CDMP has assigned CEGIS to prepare Multi-hazard

Zoning Maps using CRA outputs prepared by NGOs for 7 pilot districts of Bangladesh such as Lalmonirhat, Rajshahi, Sirajganj, Sunamganj, Cox's Bazar, Faridpur and Satkhira.

1.2 Objective and rationales

The objective of this study is to develop Hazard Zoning Maps for all natural events using CRA processes and products of selected seven upazilas in seven districts of Bangladesh.

CRA is a participatory process for assessing local hazards, vulnerabilities, risks, ability to cope, preparing coping strategy and finally preparing a risk reduction options implemented by the local community.

The hazard information were collected through CRA process by NGOs assigned by CDMP in all 67 unions/purashavas in seven upazilas of seven districts. During the CRA the knowledge of the vulnerable communities and other local stakeholder were obtained through participatory appraisals and those were presented in individual reports. The CRA information was the main input to this assignment. This information was fed into the GIS system to produce the outputs in the form of high quality GIS datasets reflecting natural hazard scenarios in the local contexts.

The Hazard Zoning Maps have been developed to serve the following rationales:

- ❑ CRA outputs are more participatory than scientific; to make the CRA outputs scientific and user-friendlier the Maps has to be developed by using sophisticated GIS techniques.
- ❑ The CRA outputs are hand drawn maps which are not geographically positioned and not in proper scale and shapes. Hazard Zoning Maps should be developed using GIS techniques and to make it geographically positioned with a proper coordinate system.
- ❑ To make the CRA outputs useful for scientific analysis using overlay techniques GIS based Hazard Zoning Maps are essential .
- ❑ Settlements and other infrastructures were absent or poorly represented in CRA reports, but hazard management analysis requires considering those elements which will help to identify the vulnerable settlements and infrastructure.
- ❑ Hazards are not static phenomenon and hazard risk exposure changes over time. One should keep into account the future changes in hazard risk over a period of time. The CRA outputs do not consider the future hazard risk in a particular area. The climate change, morphological change, flooding and inundation may have significant effects on the patterns and trends of the natural hazards, which need to be reflected in the Maps by using the prediction model results.

1.3 Scope of works and activities

The scopes of work under this contract are described as follows:

Activity –1: Inception Report Preparation

The followings are the tasks under Activity – 1.

- Literature review
- Describe the scope of work, tasks and methodology,
- Focus the resources to be utilized
- Highlight the outputs and
- Present the schedule of the assignment for developing the Hazard Zoning Maps.

Activity –2: CRA report collection and data extraction The followings are the tasks under Activity – 2.

- Collect CRA reports from CDMP
- Extract information regarding hazard from the Community Risk Assessment (CRA) reports provided by CDMP as per ToR through comprehensive review
- Validate the social maps, hazard maps, risk maps, risk analysis information included in the CRA reports to identify the need for information content, enlist hazard, identify the tasks for hazard zoning.
- Generate data layers from the extracted information from the CRA reports

Activity –3: Identification of natural events using CRA processes and products

The followings are the tasks under Activity – 3.

- Select the survey locations based on frequency of hazard, vulnerability to multifarious hazard, geographical location, population density, available resources etc.
- Prepare Base Maps prior to field visits. The Base Maps contained all the individual hazard information in addition to administrative boundaries, rivers, roads, settlements, public and private institutes and other relevant information of the specific area.
- Conduct field visits through Focus Group Discussion to validate the CRA reports focusing on the hazard (major & minor), its spatial extent, magnitude (intensity and frequency) and their seasonality.
- Validation of the number of hazard (from CRA reports) through FGDs. Marking the range of relative severity of the hazard and the affected areas on the Base Maps.
- Development of Hazard seasonality matrix.
- Identification of settlements from the satellite images and categorization from the FGDs.
- Taking photographs of the actual damage (if present at the time of FGD) caused by a specific hazard for visual evidence.
-

Activity –4: Addressing risk

The followings are the tasks under Activity – 4

- Collection of secondary historical information on hazard from the concerned locality.
- Collection of additional secondary information on hazard.
- Use of NWRD, ICRD, CYSMIS, ICRRP, CCD and BBS data for preparing different data layers
- Extraction of settlement, roads from IKONOS and QUICKBIRD satellite images
- Use of prediction model results, for predicting riverbank erosion and flooding in floodplain to generate Hazard Maps for a prediction magnitude or for a recurrence period (1:2 yr, 1:5 yr, 1:10 yr etc) in the study areas
- Generation of risk data by considering the CRA outputs and current risk from different types of prevailing hazard from FGDs

- Generation of risk data by applying the prediction models of CEGIS on riverbank erosion and flood

Activity –5: Develop maps reflecting major risks

Tasks: The followings are tasks under Activity – 5

- Preparation of risk zone maps by overlaying the climate change effects (if available) or adding up the prediction model results or statistical analysis using different GIS techniques.

Activity –6: Develop Draft Hazard Maps

Tasks: The followings are the tasks under Activity – 6

- Hazard analysis using GIS techniques for different hazard condition
- Overlaying the information which were extracted from satellite images
- Application of GIS techniques to combine all secondary information collected from different sources
- Development of Multi-Hazard-Zoning Maps by assigning weightage and preferences derived from FGDs.

Activity –7: Develop Final Hazard Maps

Tasks: The followings are the tasks under Activity – 7

- Finalization of the Hazard Zoning Maps after considering the comments and feedbacks from CDMP
- Preparation of Final Atlas with maps, photographs and local ideas.
- Documentation

1.4 Community Risk Assessment (CRA) of CDMP

As mentioned before, CRA is a participatory process for assessing local hazards, vulnerabilities, risks, ability to cope, preparing coping strategy and finally preparing a risk reduction options implemented by the local community.

Under this study a total of 67 unions/paurashavas under 7 pilot districts has been undertaken for development of Hazard Zoning Maps using CRA reports and FGDs. CDMP contracted several local NGOs for conducting CRA in these areas. Table 1.4.1 shows the name of the local NGOs and the assigned areas where they worked. They prepared detail CRA report and submitted to CDMP. CEGIS collected the CRA reports from CDMP and extracted information on natural hazards prevailing in the respective areas from these reports, which was the primary source of information for developing the unionwise Hazard Zoning Maps.

Table 1.4.1: Locations and NGOs involved to conduct the CRAs

District	Upazila	No.	CDMP listed unions	No.	Pourashava	Local NGOs
			Name		Name	
Faridpur	Sadarpur	9	Dheukhali, Akterchar, Bhashanchar, Charbishnopur, Charmanair, Charnasirpur, Narikelbaria, Sadarpur, Krishnapur,			Samata
Cox's Bazaar	Moheshkhali	8	Kalarmarchahara, Dhalghata, Matarbari, Saplapur, Hoanak, Bara Moheshkhali, Kutubjome, Chhoto Moheshkhali	1	Moheshkhali	Ananda
Sirajganj	Chowhali	7	Gharjan, Sthal, Umarpur, Sadiachadpur, Khashkaulia, Khashpukuria, Bhaghutia			Bangladesh Disaster Preparedness Center (BDPC)
Rajshahi	Godagari	9	Basudevpur, Deupara, Gogram, Matikata, Mohonpur, Pakri, Rhishikul, Godagari, Char Ashariadaha	2	Godagari, Kakonhat	Village Education Resource Center (VERC)
Satkhira	Assasuni	11	Anulia, Assasuni, Baradal, Budhhata, Dargapur, Khajra, Kulla, Pratapnagar, Sobhnali, Seeula, Kadakati			Area Development Organization
Sunamganj	Dharmapasha	10	Selobrash, Dakshin Bangshikunda, Uttar Bangshikunda, Madhyanagar, Chamardani, Paikarati, Dharmapasha, Joysree, Uttar Sukhair Rajapur, Dakshin Sukhair Rajapur			Institute for Environment and Development
Lalmonirhat	Hatibandha	10	Barakhata, Bhelaguri, Dauabari, Goddimai, Gotamari, Nowdabash, Patikapara, Singimari, Sinduhurna, Tongbangha			People's Oriented Program Implementation (POPI)
Total		64		3		

1.5 Study area

The study area is spread over Bangladesh on seven districts in different locations. They were selected by CDMP with intention to cover different types of natural hazards. From the seven districts seven upazilas were selected based on hazards coverage which are presented in Table 1.4.1 and Figure 1.4.1. Entire area of each Upazila was covered to produce the Multi-Hazard Zoning Maps. The locations are presented individually with details in Figures 1.4.2 - 1.4.8. The maps has a backdrop of satellite images varying from year 2003 to 2008 based on availability at CEGIS archive. The satellite images gives more ground information which will help to visualize the topography. Table 1.4.1 gives a list of images used as a backdrop.

Table 1.4.1: List of satellite images used as backdrop

Upazila name	Image description
Sadarpur	IRS LISS3 image of 16 January 2008
Moheshkhali	IRS LISS3 image of 01 February 2005
Chauhali	Aster, 15 meter, January 2007
Godagari	IRS LISS3 image 16 January 2008
Assasuni	IRS LISS3 image of 10 February 2005
Dharampasha	Landsat ETM7 image of 03 January 2003
Hatibandha	IRS Pan 6 meter, 06 January 2003

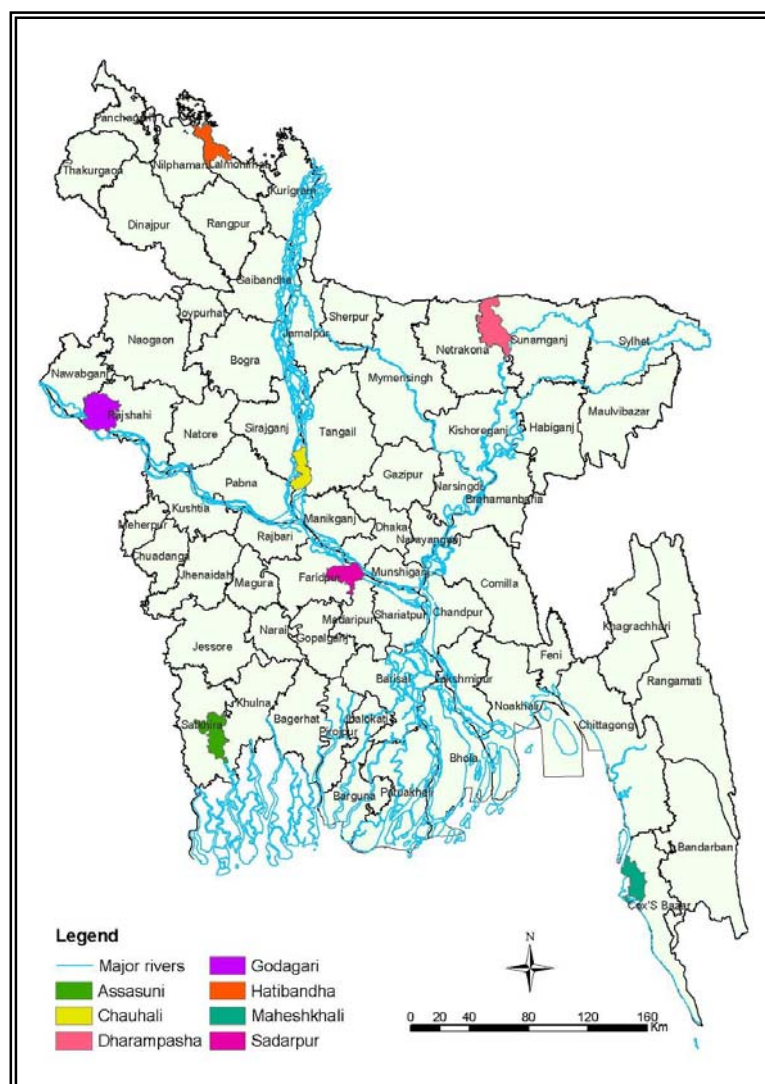


Figure 1.4.1: Study areas for developing Hazard Zoning Maps

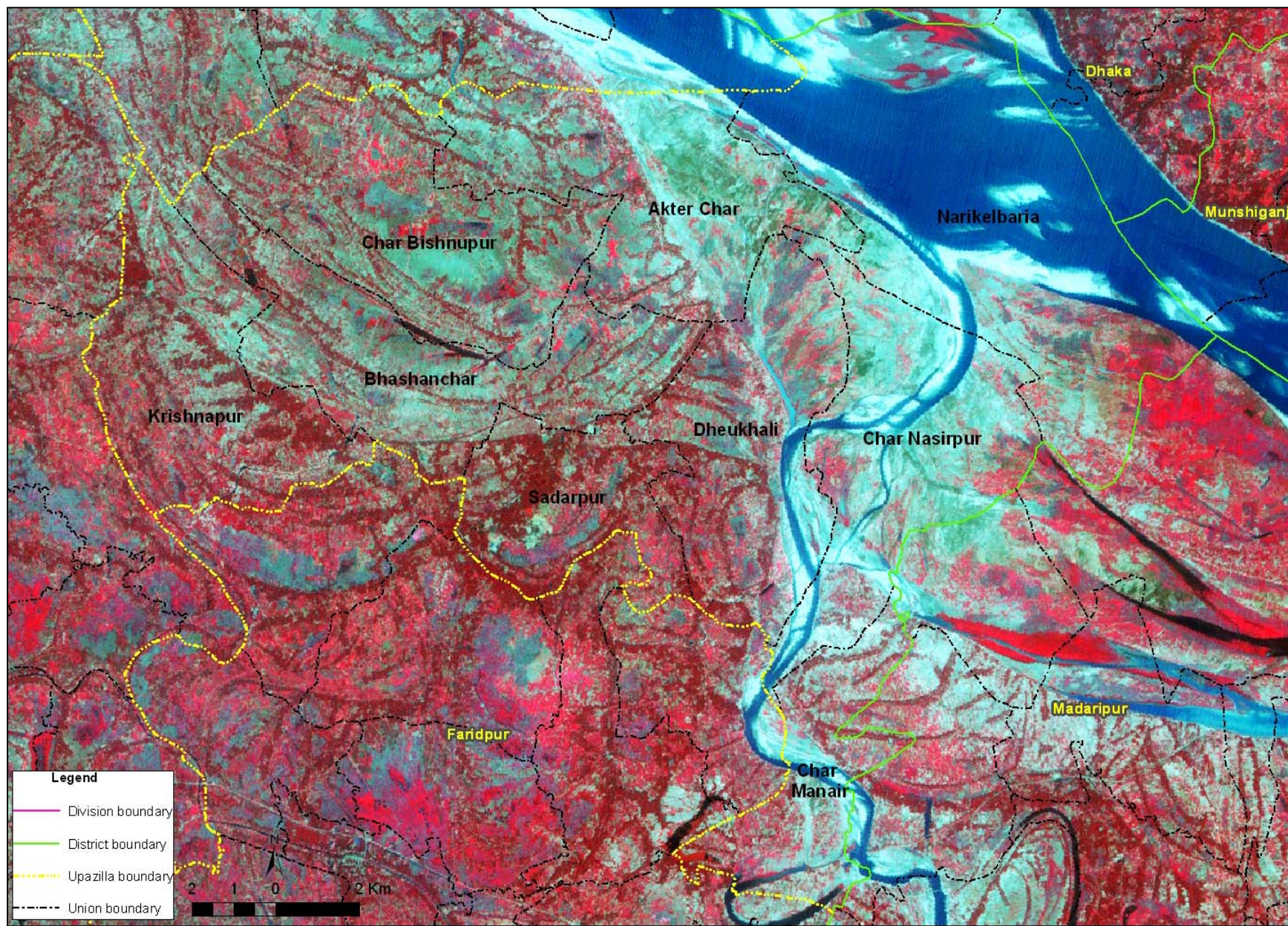


Figure 1.4.2: Unions of Sadarpur upazila (backdrop IRS LISS 3 image 16 Jan 2008)



Figure 1.4.3: Unions of Moheshkhali upazila (backdrop IRS LISS3 image 01 Feb 2005)

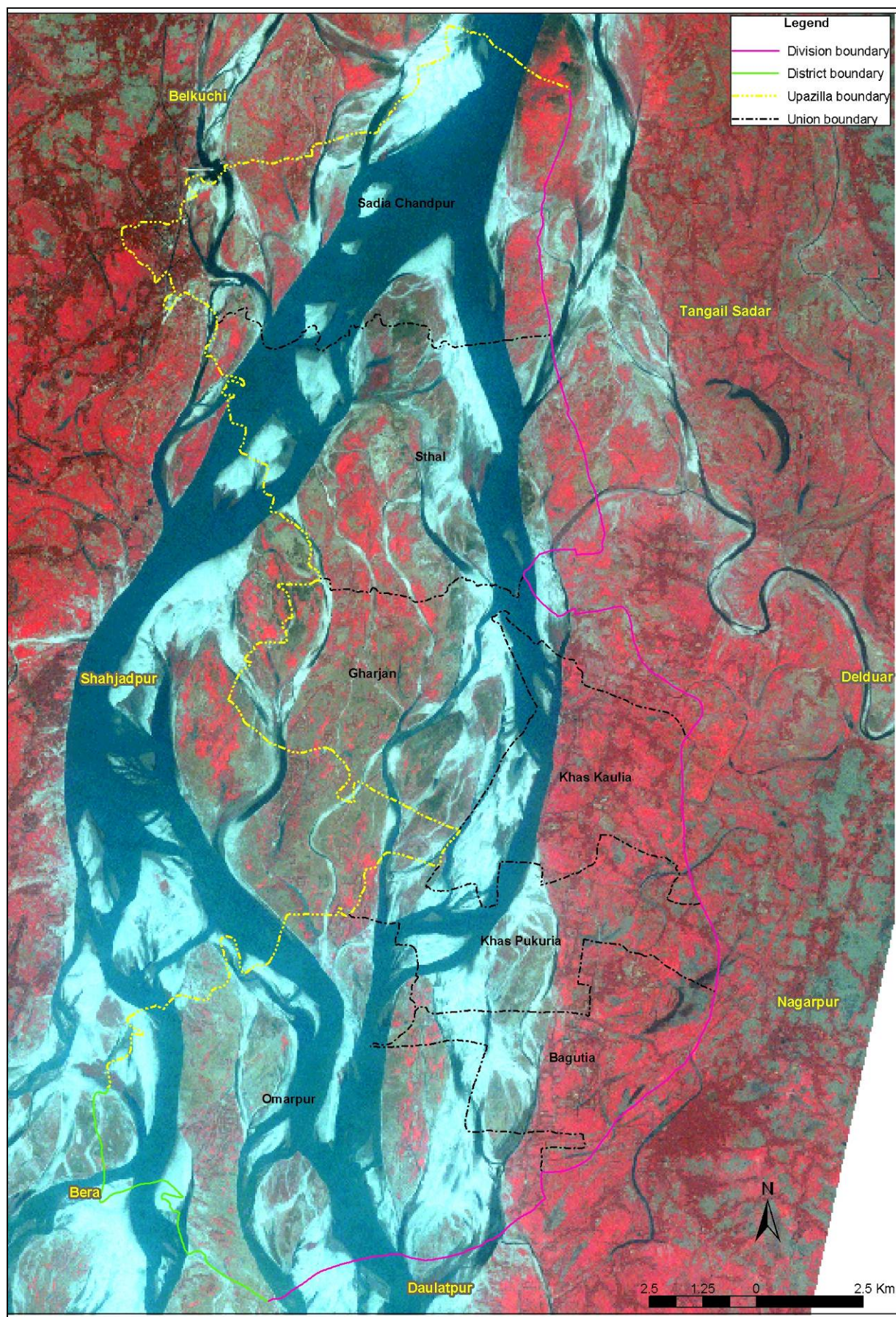


Figure 1.4.4: Unions of Chowhali upazila (backdrop Aster image of Jan 2007)

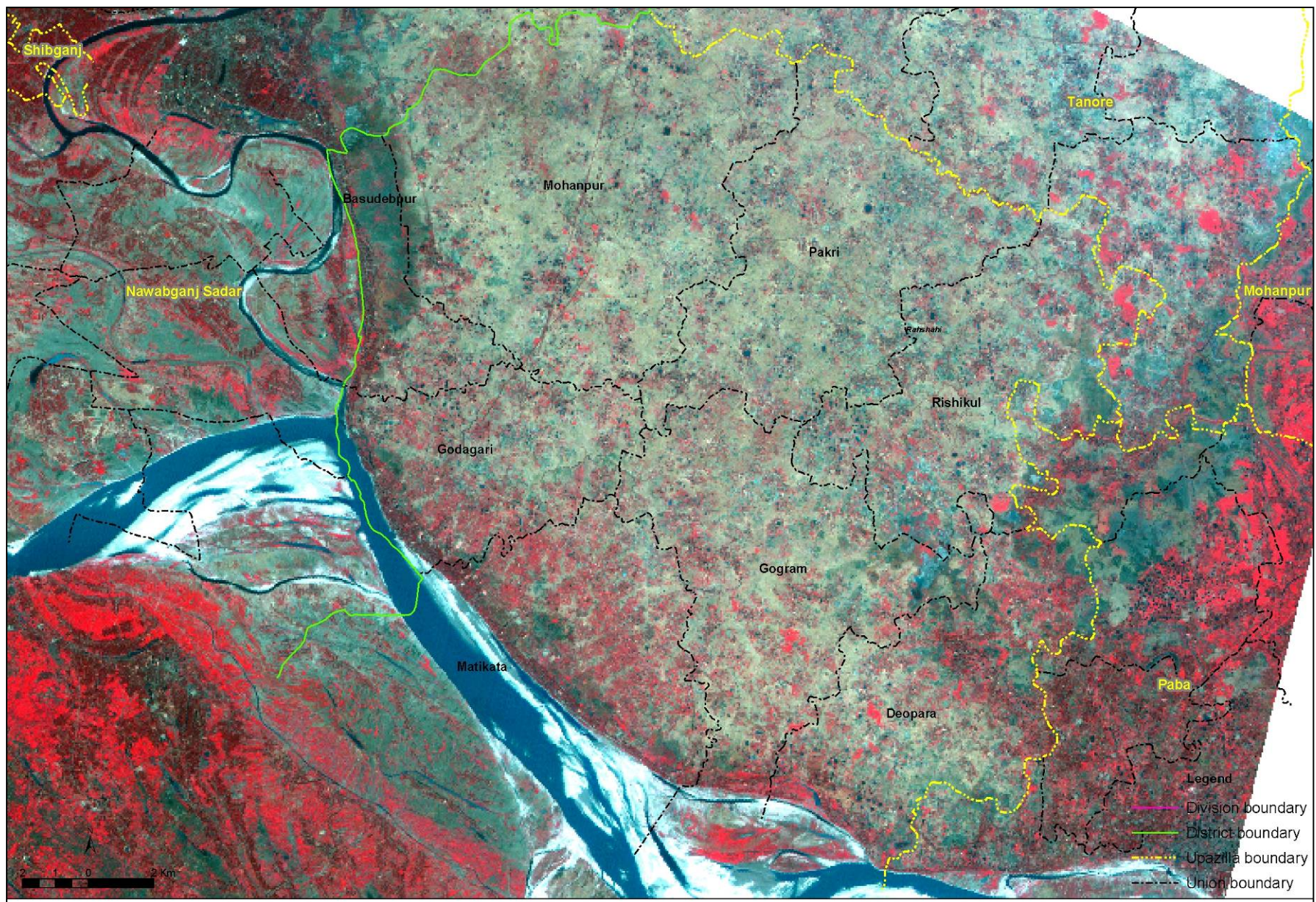


Figure 1.4.5: Unions of Godagari upazila (backdrop IRS LISS3 image of 16 Jan 2008)

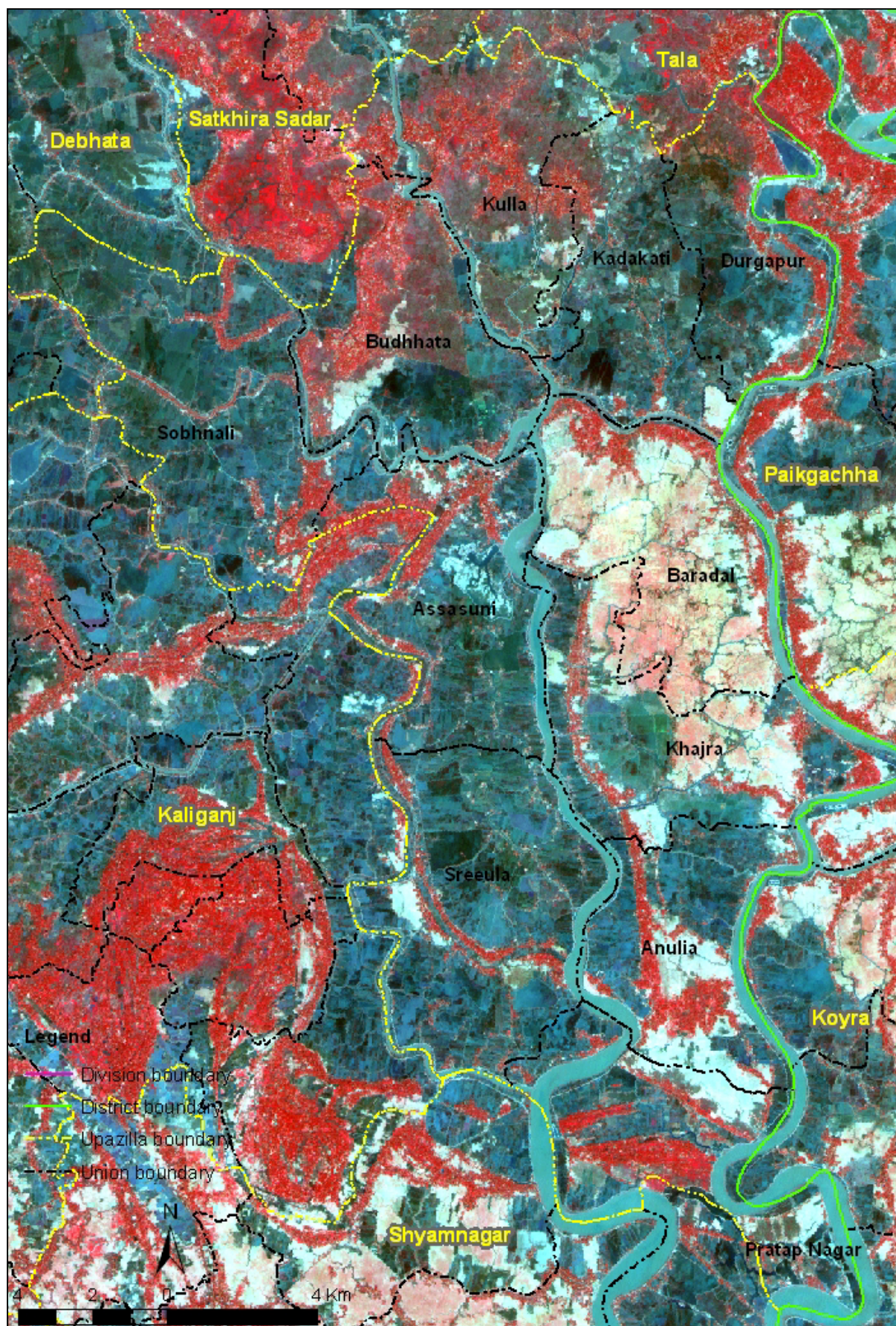


Figure 1.4.6: Unions of Assasuni upazila (backdrop IRS LISS image of 10 Feb 2005)

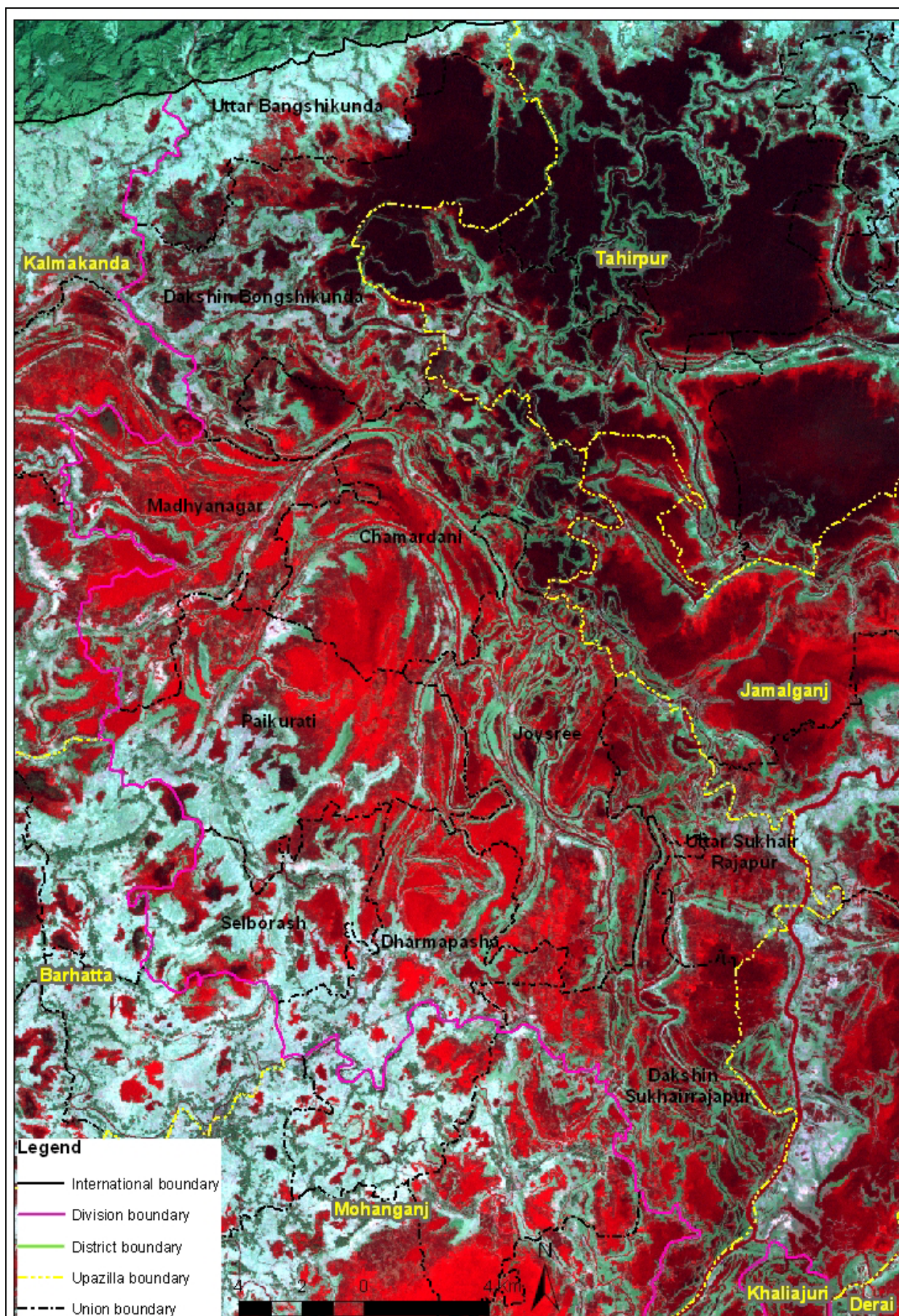


Figure 1.4.7: Unions of Dharampasha upazila (backdrop Landsat ETM7 image 03 Jan 2003)

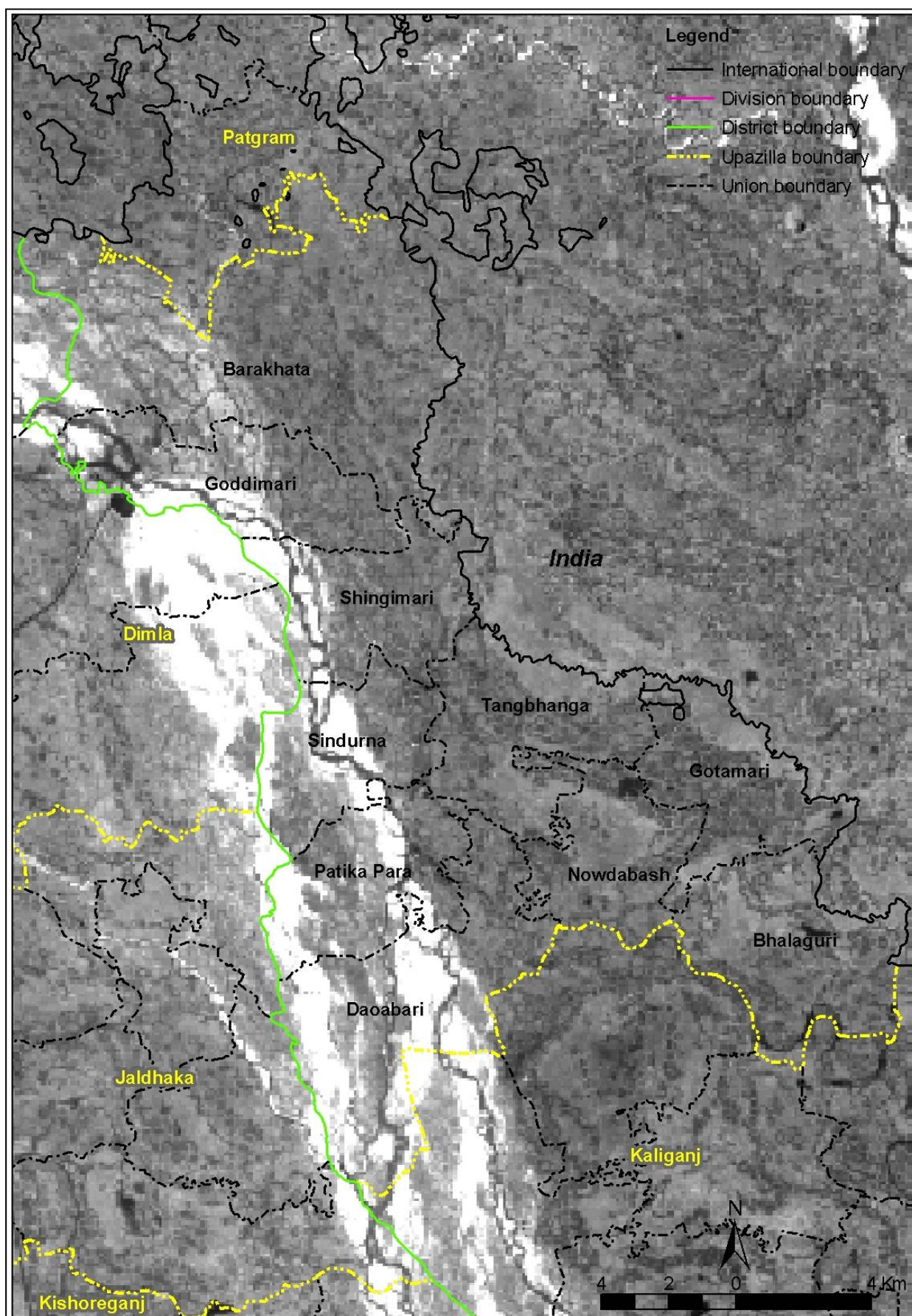


Figure 1.4.8: Unions of Hatibandha upazila (backdrop IRS Pan image 6 Jan 2003)

1.6 Deliverables

The following deliverables were planned to produce for CDMP from this assignment:

- ❑ Hazard Zoning Maps in the form of an Atlas
- ❑ Report focusing on the methodology, outputs from the study

Chapter 2

Literature Review

Many reports and documents on hazards of Bangladesh are available in different organizations and Internet, several of which are studied to assess the severity, recurrence, pattern, impacts and locality. Brief descriptions of the hazards extracted from the reviewed literatures are presented below.

2.1 Major Natural Hazards in Bangladesh

The location of Bangladesh has made it more disaster prone. Bangladesh is part of the humid tropical zone with Himalayan mountain range on the north and the Bay of Bengal on the south. The funnel-shaped coast in the south meets the Bay of Bengal. This peculiar characteristics brings monsoon, cyclones, norwesters, floods and many natural disasters. Among the most severe natural hazards cyclone, flood, riverbank erosion are very much devastating. The Bay of Bengal is an ideal breeding ground for tropical cyclones. Cyclones are often accompanied with storm surge which worsens the situation. The low-lying islands of the coastal areas are highly affected by the severity of the cyclones. Many of the cyclones form in the Indian Ocean goes over Bangladesh as shown in Figure 2.1.1.

Three large rivers Ganges, Brahmaputra and Meghna flow over Bangladesh into the Bay of Bengal carrying runoffs of 1.72 million km² area of which only 8% lies within Bangladesh (Figure 2.1.2).

For earthquake many fault line passes through Bangladesh and it is also very near to the Shilong Plate (Figure 2.1.3 and Figure 2.1.4). Riverbank erosion is also another threatening natural hazard in Bangladesh. Riverbank erosion mainly occurs along the banks of Brahmaputra, Ganges-Padma and Meghna rivers. But it also occurs along the other rivers in Bangladesh.

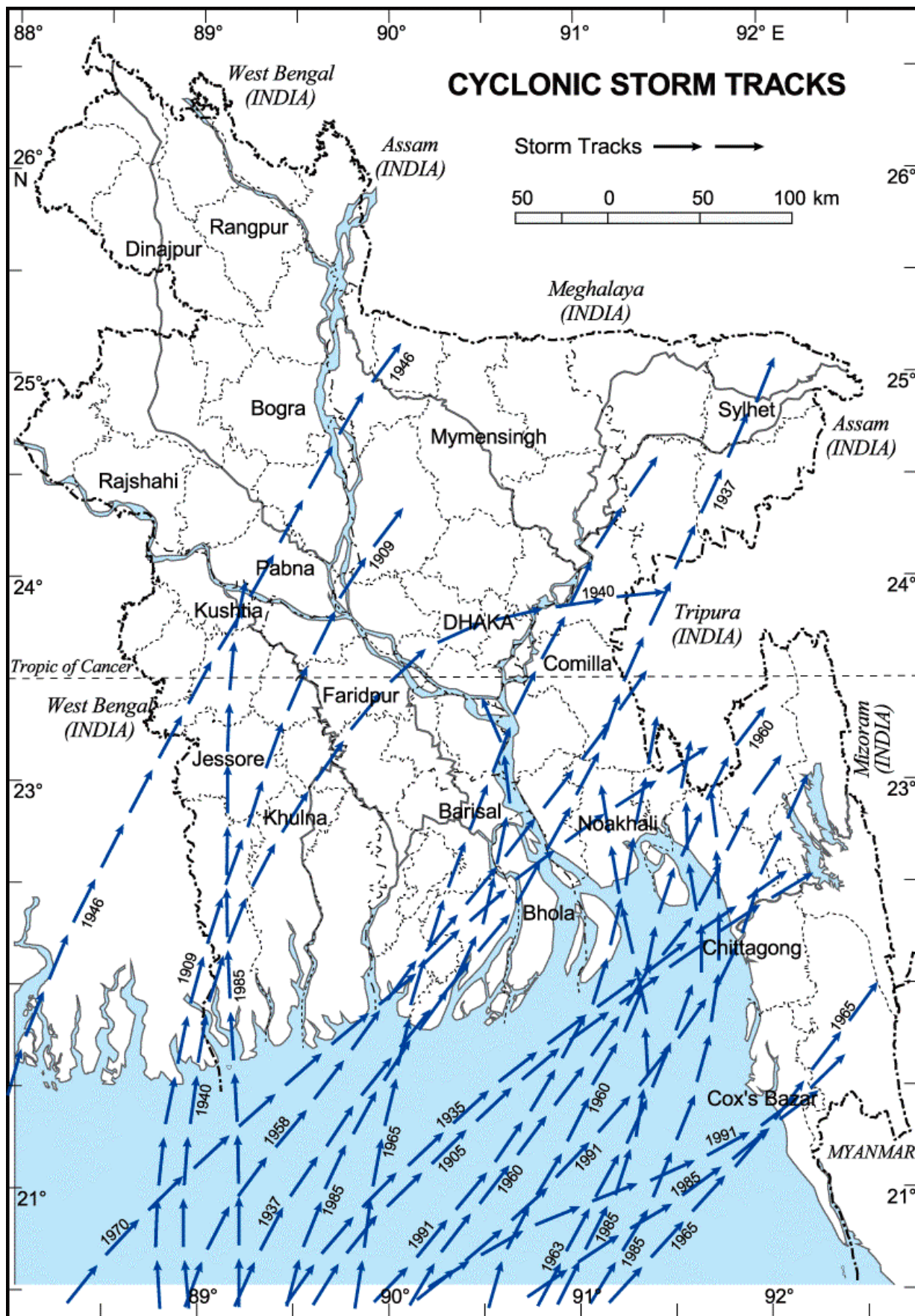


Figure 2.1.1: Cyclone tracks over Bangladesh (source: Banglapedia)

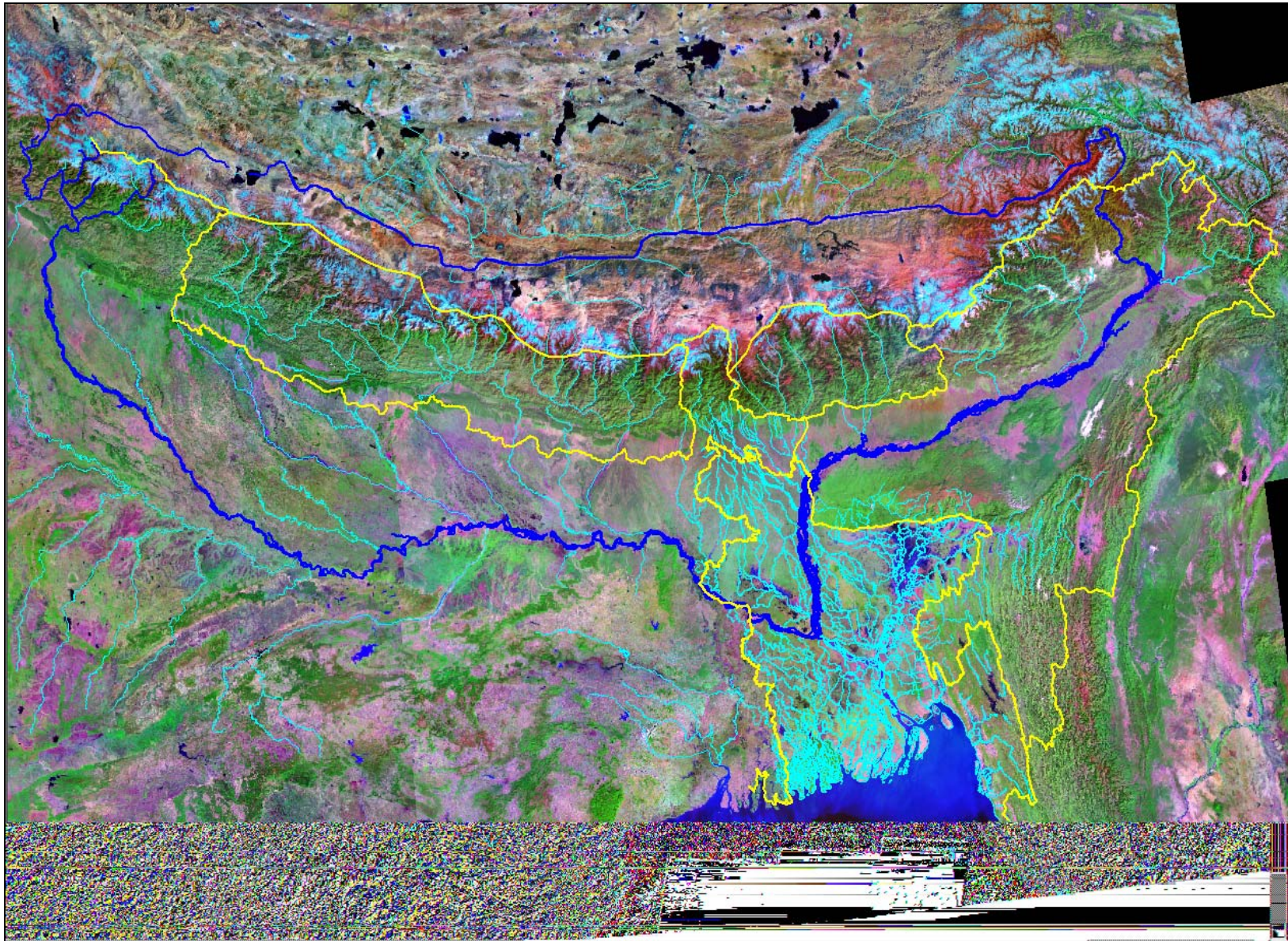


Figure 2.1.2: Major rivers flowing through Bangladesh (backdrop Landsat ETM, 2000)

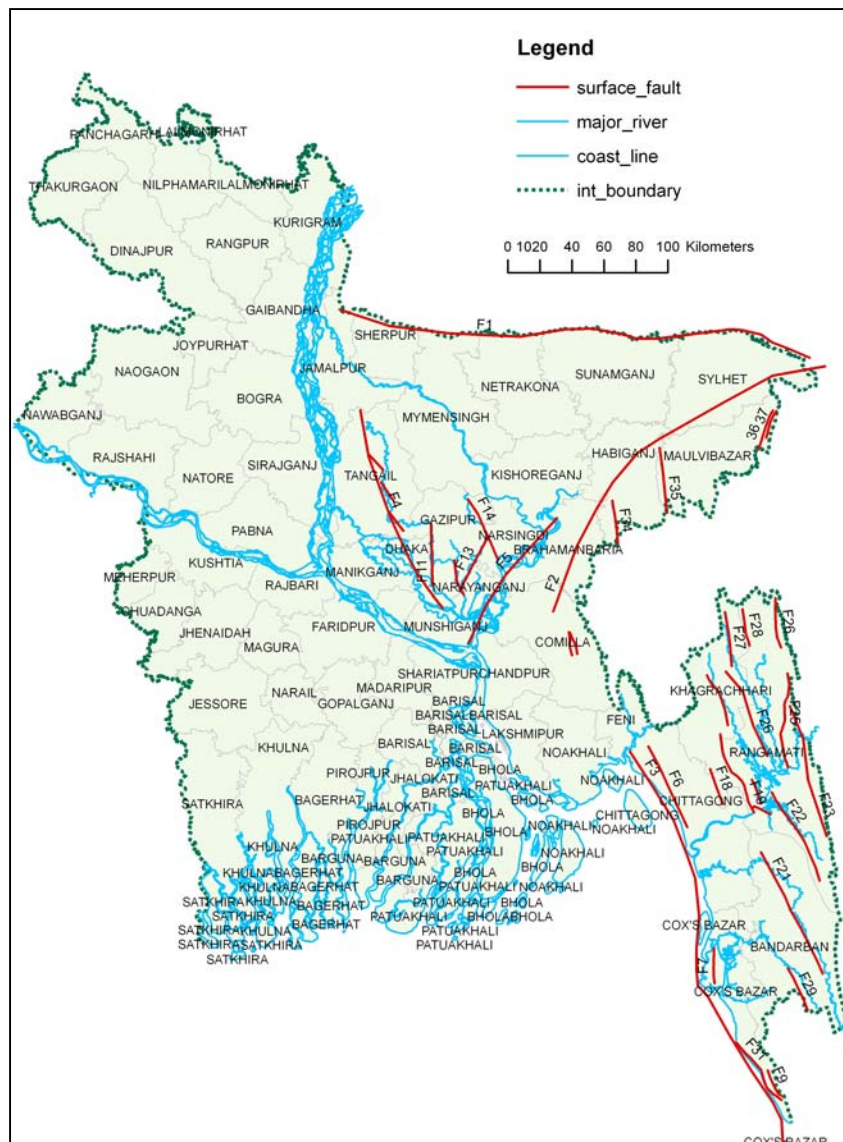


Figure 2.1.3: Fault lines (Geology Dept. DU)

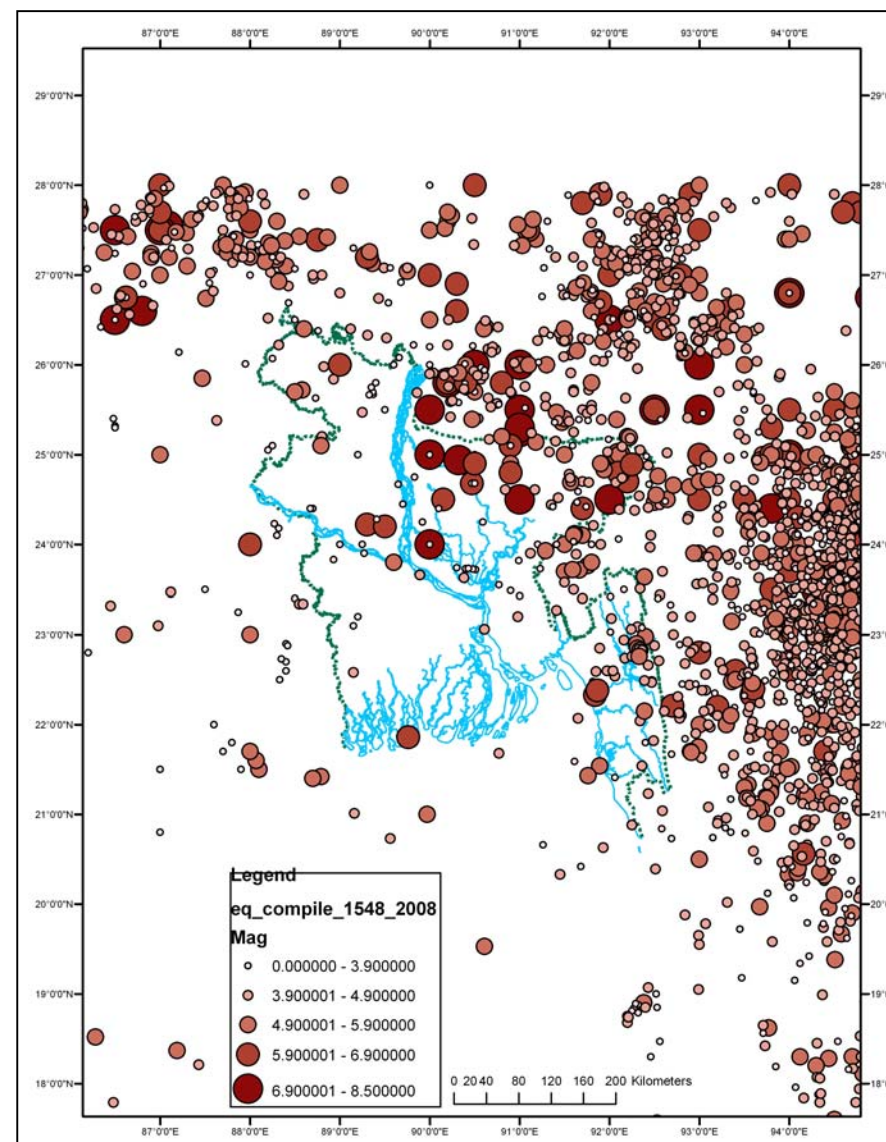


Figure 2.1.4: Magnitude of earthquake (1548 – 2008), (Geology Dept, DU)

Cyclone: Some of the cyclones in the Bay of Bengal, which had affected Bangladesh, compiled from various sources are as follows.

- ❑ October 1872: Cyclonic storm hit the coast of Cox's Bazar (*Source Banglapedia*)
- ❑ 29 October to 1 November 1876: Severe cyclonic storm with a core of hurricane winds crossed the coast of Bakerganj (present Barisal) near Meghna estuary with a maximum win of 220 km/hr, surge height 10 to 45 feet. The storm caused epidemic, famine and vast property damage (*Source BMD, Hurricane Storms and tornadoes- by D.V. Nalivkin, 1982, pp. 68, Tracks of Storms and Depressions in the Bay of Bengal and the Arabian Sea, 1877-1970, IMD, 1979*)
- ❑ Bhola cyclone, 1970. Low-lying islands were inundated; entire villages were wiped out on 12.11.70 when the cyclone and 20 foot high storm surge swept over the coast. Crops were destroyed. Estimated death toll was 150,000 to 550,000 (Figure 2.1.5)



Figure 2.1.5: Children in Bhola wading through floodwater after the tropical cyclone and tidal wave of 13.11.70.

- ❑ Cyclone 02B (Category 5, SSHS) struck Chittagong district on 29th April, 1991 with winds around 155 mph. The storm forced a 6-meter (20 feet) storm surge over a wide area, the death toll was 140,000 and 10 million was homeless ([www. 123exp-history.com](http://www.123exp-history.com)). Some of the photos are shown in Figures 2.1.6-8.



Figure 2.1.6: Visible satellite image from 06:23 UTC on April 29, 1991. The cyclone was Category 4 strength and intensifying rapidly when the image was taken (Wikipedia)



Figure 2.1.7: Storm path (Wikipaida)



Figure 2.1.8: Flooding done by the cyclone

- Cyclone Sidr, 15 Nov 2008: The hardest hit area was Barguna, Patuakhali, Jhalokati with winds of 215 km/h and storm surge of over 16 feet. The damage was extensive, including tin shacks flattened, houses and schools blown away and enormous tree damage. Some local officials have described the damage as being even worse than that from the 1991 cyclone. The Sidr track and a photo of Sidr effect is presented in Figures 2.1.9-10.

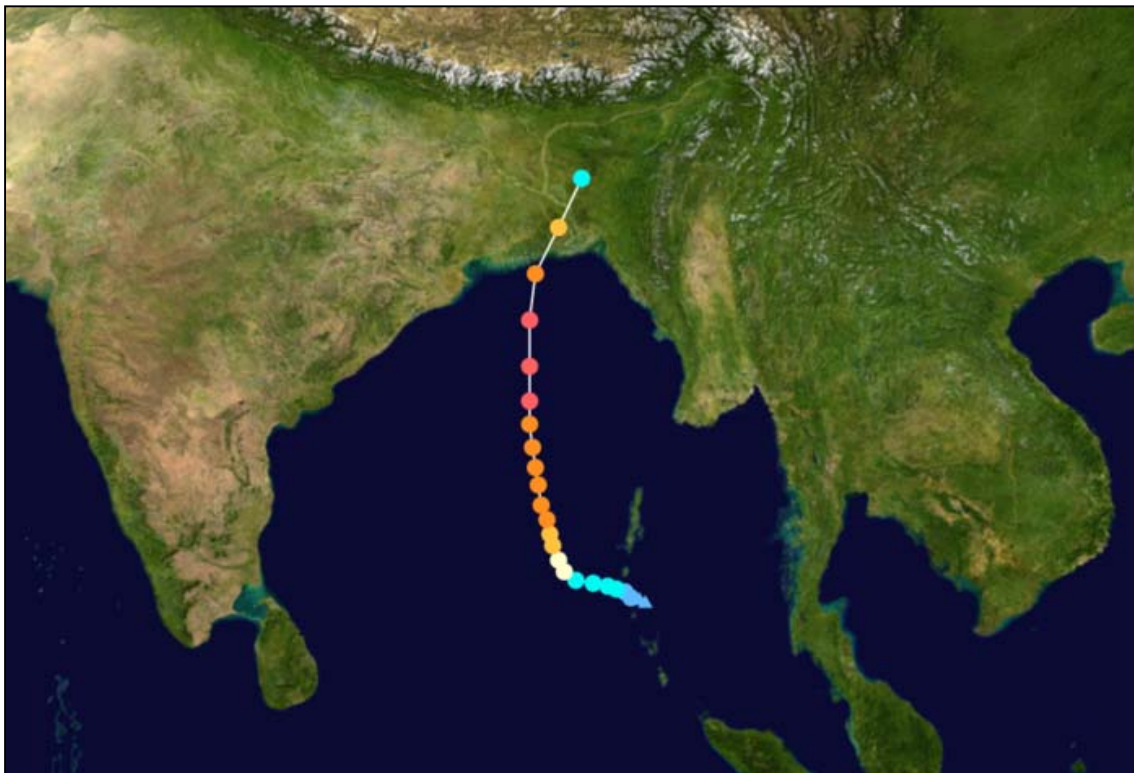


Figure 2.1.9: Cyclone Sidr path (Wikipedia)



Figure 2.1.10: Signs of Sidr photo taken by CEGIS

Flood: Flood is most recurring natural hazard in Bangladesh. Almost every year flooding occurs. But frequently it becomes devastating. Floods in Bangladesh falls under three major categories (i) Monsoon flood- seen in the floodplain, it is seasonal, increases slowly and decreases slowly, inundates vast areas and causes huge loss of life and property. (ii) Flash flood- seen in the hilly areas, water increases and decreases suddenly (iii) Tidal flood from the Bay of Bengal– mainly associated with cyclone. History of floods cannot be separated from the history of the land. Recurrent floods between 1787 and 1830 changed the old course of the Brahmaputra. Recent major flood occurred in 1987, 1988, 1991, 1998, 2000, 2004 and 2007. In normal flood 25-30% of Bangladesh goes under water and about 60-70% area is vulnerable to high flood.

2.2 Hazard Mapping

Investigation shows that hardly any hazard zoning map has been prepared in Bangladesh with similar objectives that CDMP targets. There exist many flood and some cyclone maps prepared by BWDB, DMB and BMD. But multi-hazard zone mapping is almost newly started approach in Bangladesh.

A total of 67 CRA reports were collected and studied to understand the process and hazards in respective localities.

Alongside some other literature which described the process and data layers used in different countries for hazard zone maps are also studied. Short descriptions of some of the reviews are presented in following sections.

2.2.1 CRA Report: Community Risk Identification and Risk Reduction Work Planning in Ghospur Union, Boalmari, Faridpur

Ghospur union of Boalmari Upazila under Faridpur district has been undertaken for conducting the Community Risk Assessment and Risk Reduction Action Plan, which is situated in the northwest corner of the Boalmari Upazila.

Ghospur Union are exposed by various hazards like drought, heavy Rainfall flood, river erosion, river-canal siltation, water logging, arsenic, storm (Tornado), hailstorm, water pollution, cold spell, dense fog, thunderbolt, heat wave etc. So peoples of this union are very much vulnerable by these multiple hazards which drew attention to be taken into consideration for Community Risk Assessment (CRA).

Under this study the hazards were identified through consultation with local peoples and other relevant stakeholders. The main reason of the vulnerability of this area is the presence of Madhumati

River that cause erosion, silted up Chandana Barasia River, silted up canals, etc. The identified hazards were marked on the maps according to their vulnerable areas. The map shows that most of the events strike northwest, west and south west of the Ghoshpur Union. Base map, social map, arsenic map, tornado map and drought maps were prepared for this area using the CDMP CRA process. Finally a Multi-Hazard Zoning Map was prepared by combining all the hazard layers. The maps prepared under this project are shown in Figure 2.2.1 - 2.2.6.

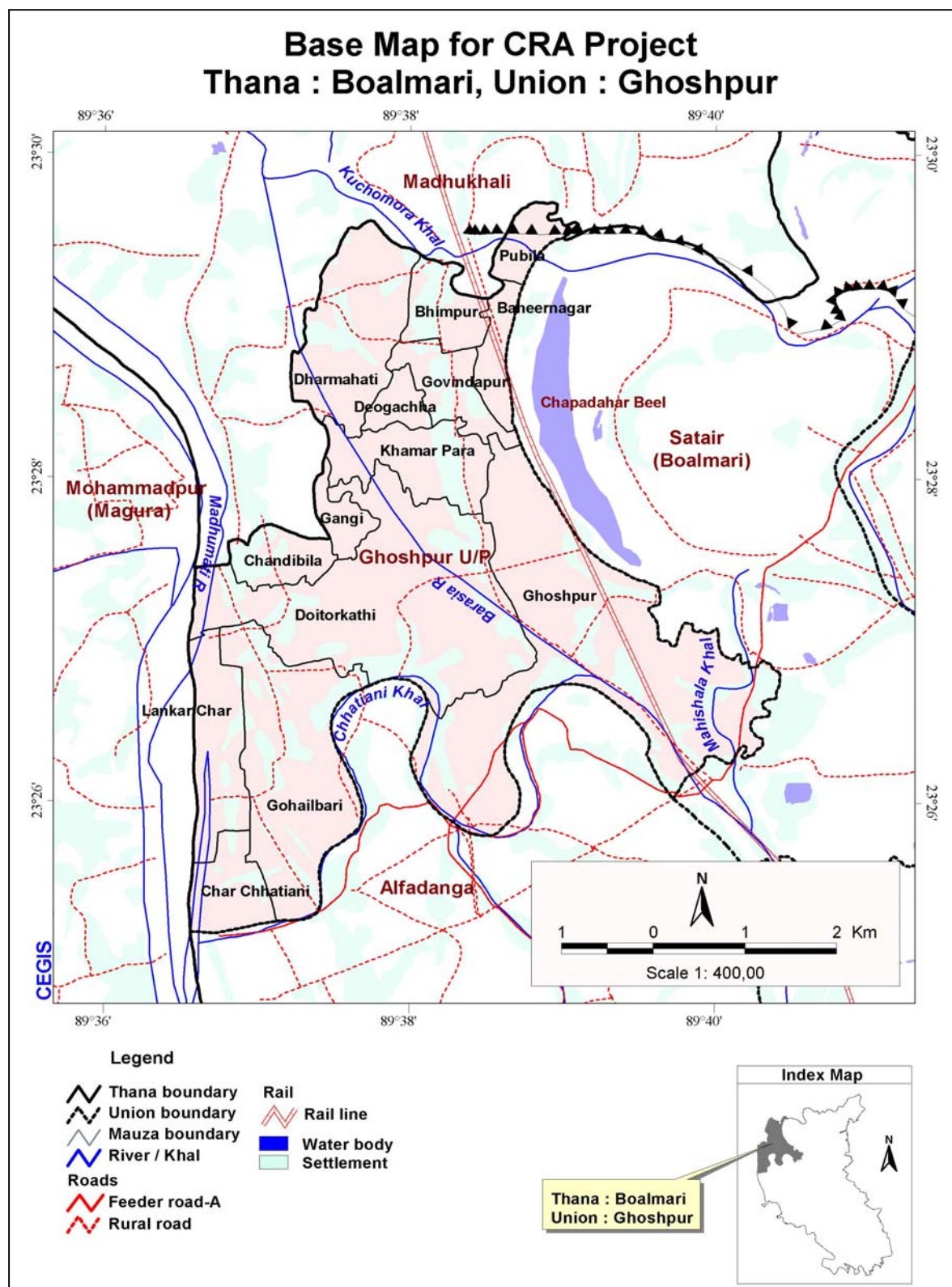


Figure 2.2.1: Base map of Ghoshpur union

SOCIAL MAP

Union: Ghoshpur, Upazila: Boalmari

Legend

Thana boundary	NGO office
Union boundary	Eidgah
Mauza boundary	Hat / Bazaar
River / Khal	Club
Roads	Playground
Feeder road-A	Post Office
Rural road	Snoshan
Rail	Graveyard
Rail line	Temple
Rail station	Mosque
Water body	Madrasa
Settlement	High School
	Primary School

Index Map

Thana : Boalmari
Union : Ghoshpur

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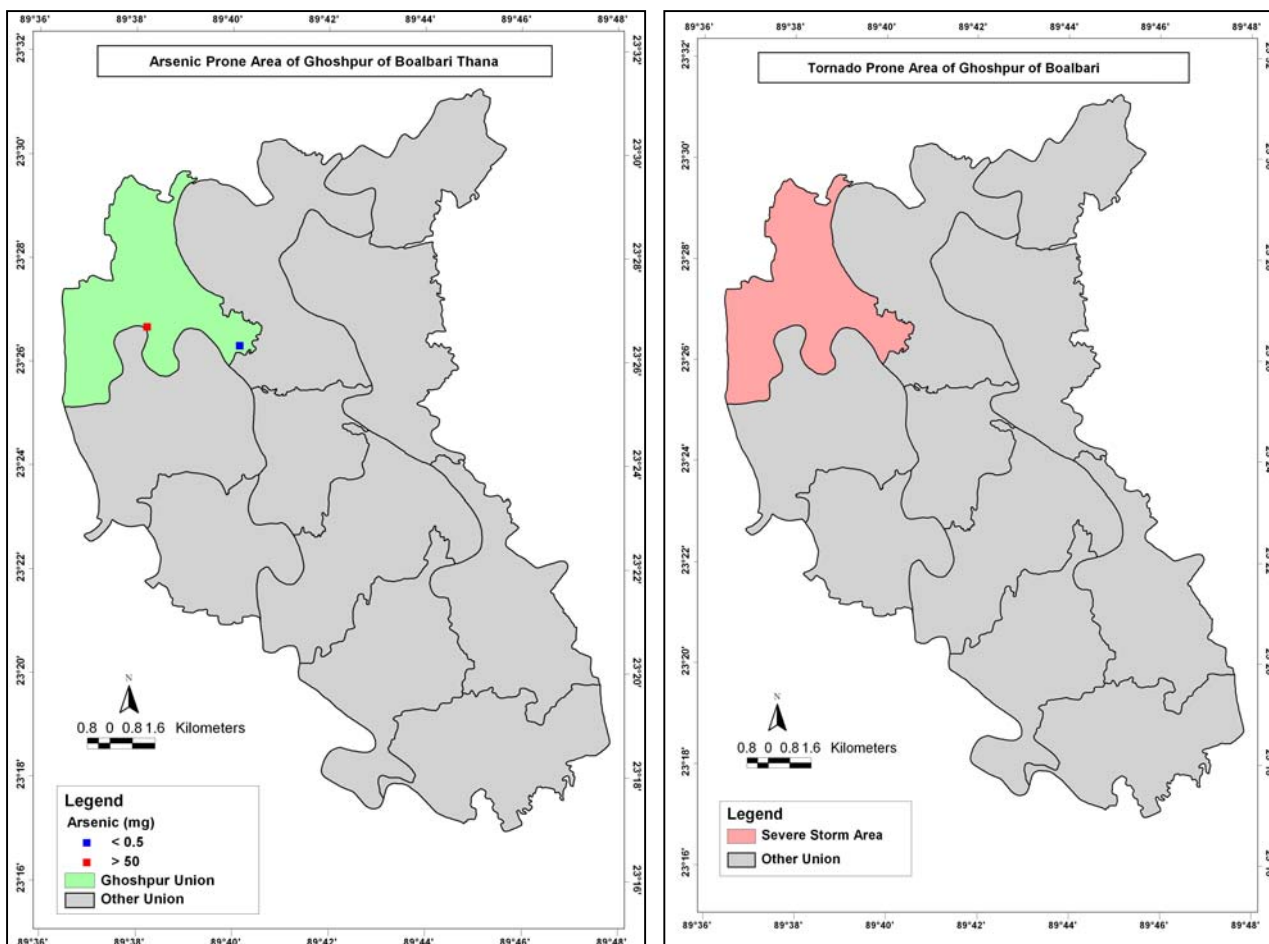


Figure 2.2.3: Arsenic map (left), Tornado map (right)

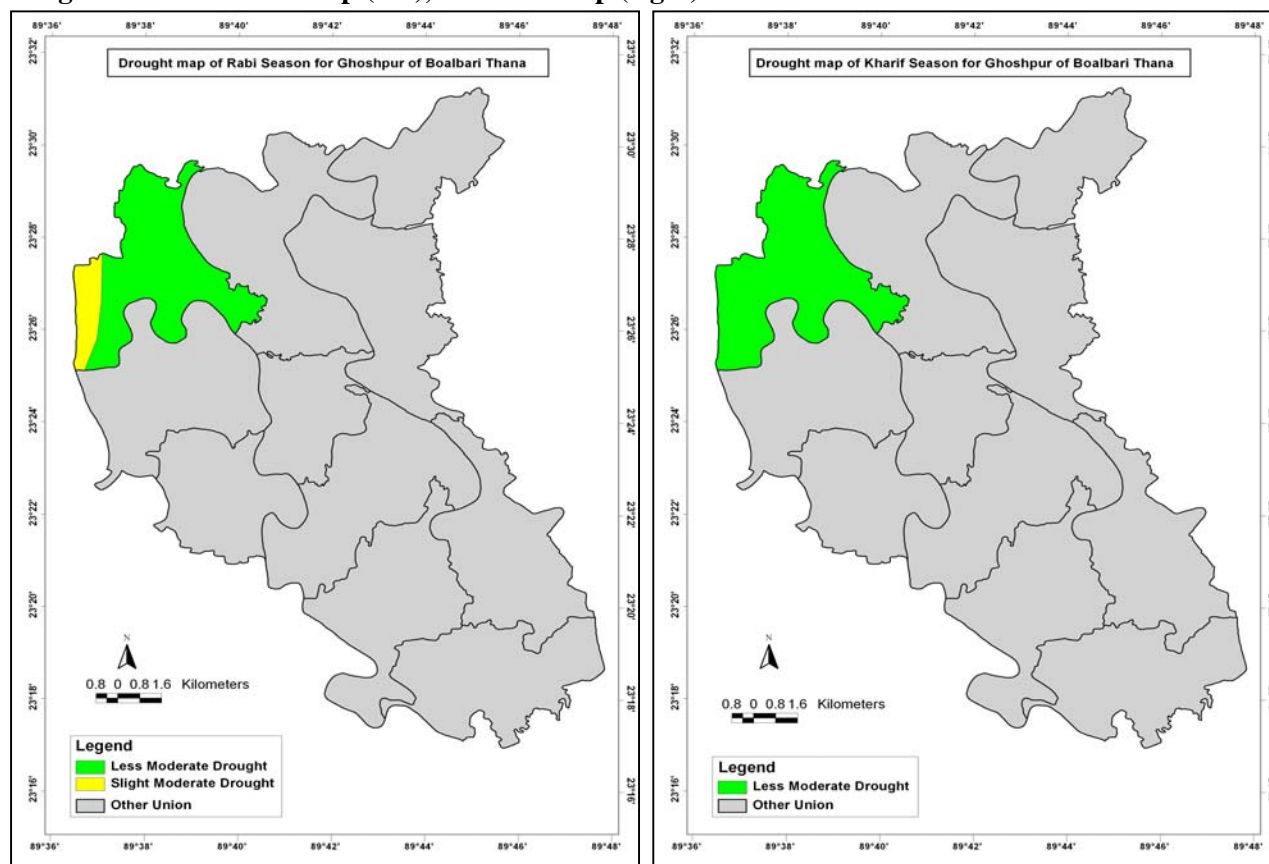


Figure 2.2.4: Drought maps--Rabi (left), Kharif (right)

Hazard Map

Union: Ghoshpur, Upazila: Boalmari

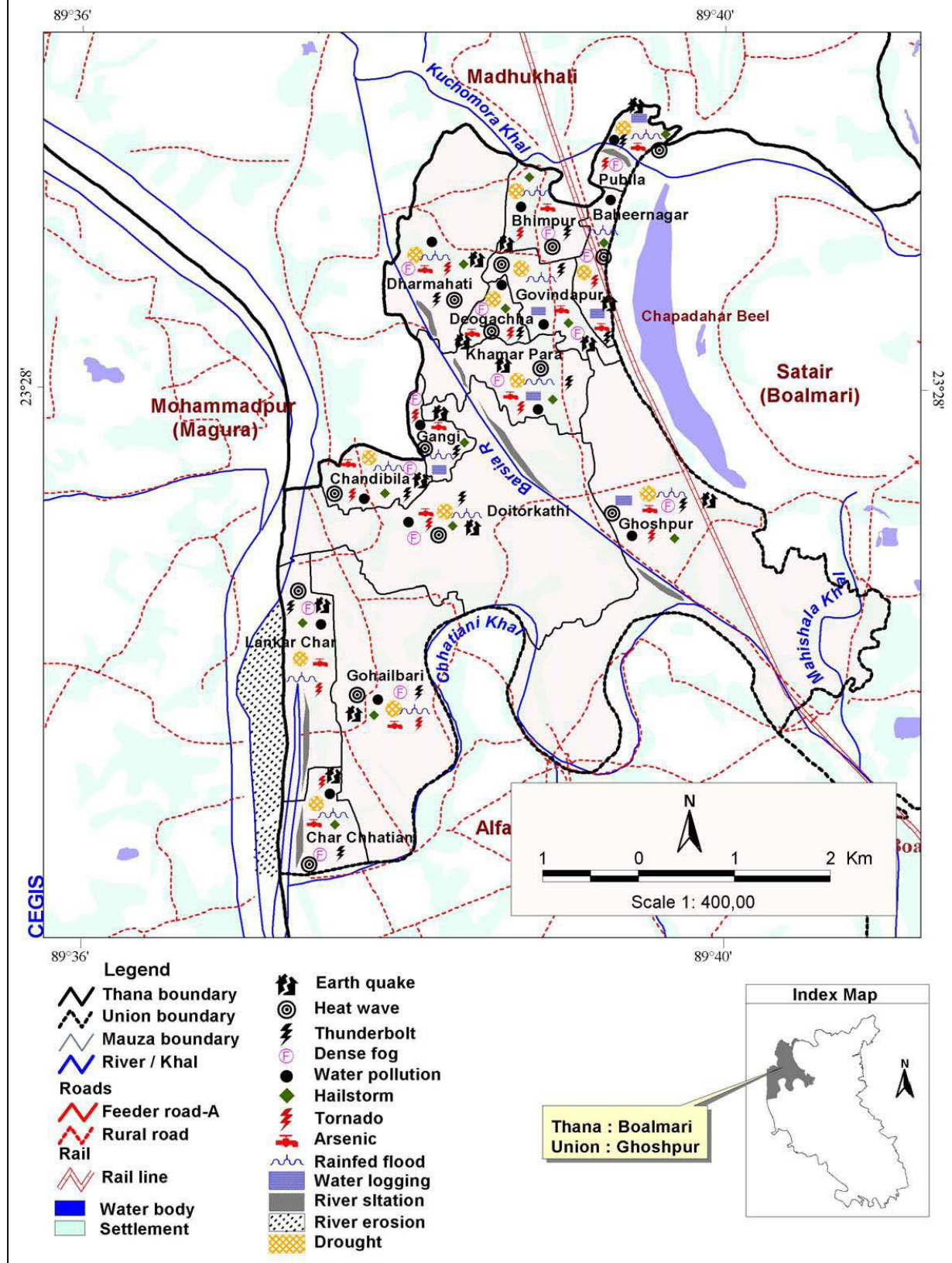


Figure 2.2.5: Hazard map

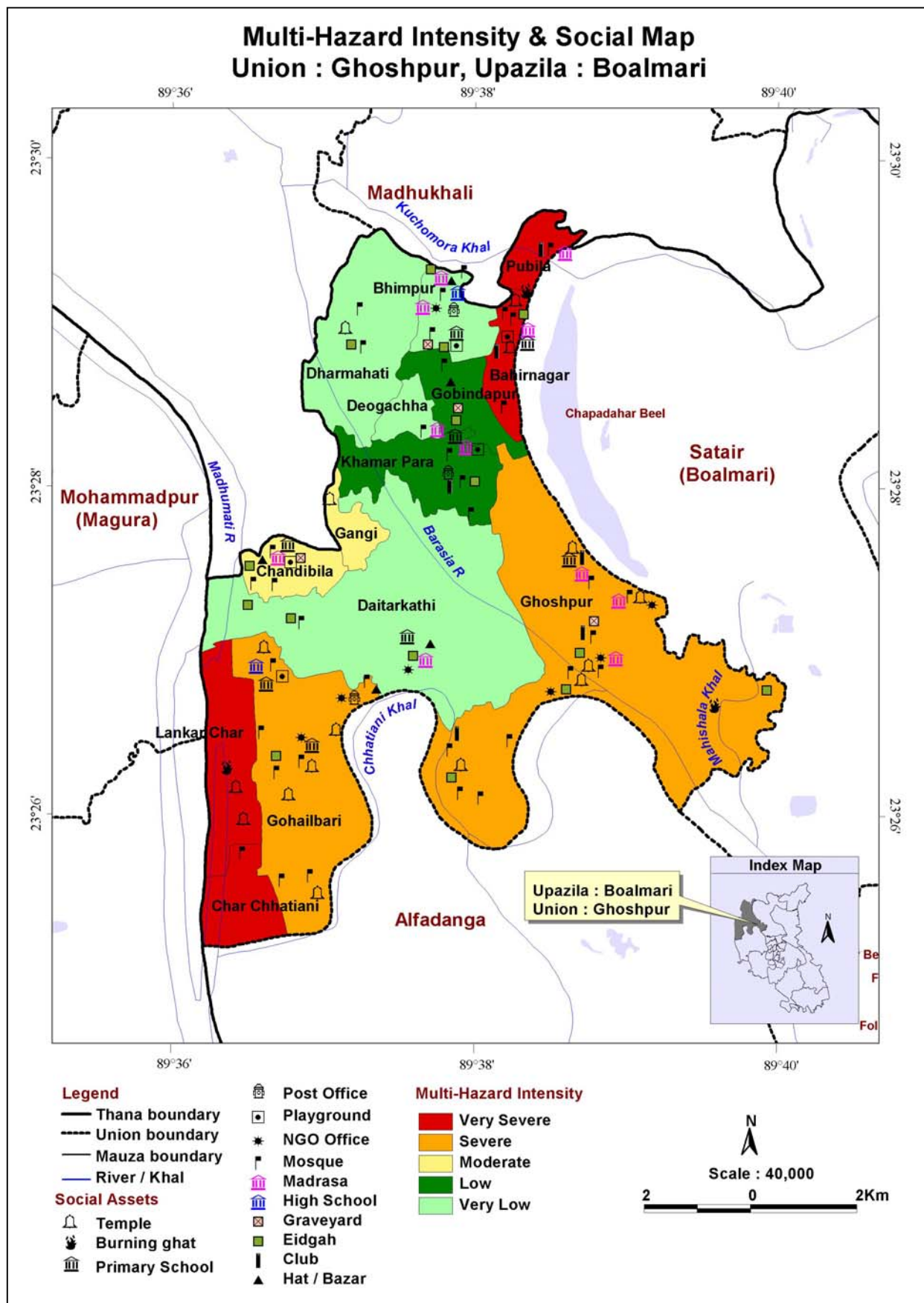


Figure 2.2.6: Multi-hazard intensity and social map

A total of 12 CRA reports of this kind were collected of which Ghosepur is one.. The other 11 CRA followed same process of mapping. The list of studied 12 CRA reports of Boalmari Upazila under Faridpur district is presented in Table 2.2.1 below.

Table 2.2.1: List of reviewed CRA reports of Boalmari

Sl No.	Union	Report
1	Boalmari	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Boalmari Union, Boalmari, Faridpur
2	Chandpur	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Chandpur Union, Boalmari, Faridpur
3	Chatul	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Chatul Union, Boalmari, Faridpur
4	Dadpur	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Dadpur Union, Boalmari, Faridpur
5	Gunbaha	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Gunbaha Union, Boalmari, Faridpur
6	Moyna	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Moyna Union, Boalmari, Faridpur
7	Parameshwardi	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Parameshwardi Union, Boalmari, Faridpur
8	Rupapath	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Rupapath Union, Boalmari, Faridpur
9	Satair	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Satair Union, Boalmari, Faridpur
10	Shekhar	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Shekhar Union, Boalmari, Faridpur
11	Boalmari Pourashava	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Boalmari Pourashava, Boalmari, Faridpur
12	Ghospur	CRA Report: Community Risk Identification and Risk Reduction Work Planning in Ghospur Union, Boalmari, Faridpur

2.2.2 Framework of mapping of natural hazards at local levels

Department of Regional Development and Environment Executive Secretariat for Economic and Social Affairs Organization of American States prepared a report titled “Primer on Natural Hazard Management in Integrated Regional Development Planning” with support from the Office of Foreign Disaster Assistance United States Agency for International Development, Washington, D.C. in 1991.

It says, a geo-referenced database (GRDB) combines data management with map display, allowing planners and emergency managers to graphically display hazard impact areas, and relate them to people and property at risk. GRDB uses points, lines, and polygonal symbols to represent data that can represent hazards. With overlaying capabilities to manage and combine large databases with map display, text relating displayed elements (hazard impact areas, location of shelters, health centers, fire stations, police stations, etc.) to their respective descriptive information, makes it suitable for emergency planning and post-disaster rehabilitation and reconstruction work.

The study presented a framework of the mapping of natural hazards management at the local level as shown in Table 2.2.2 below.

Table 2.2.2: Framework of mapping of natural hazards at local levels

Function	Potential Applications	Examples
Data display	- Aid in the analysis of spatial distribution of socio-economic infrastructure and natural hazard phenomena	- What lifeline elements lie in high-risk areas?
	- Use of thematic maps to enhance reports and/or presentations	- What population could be affected?
	- Link with other databases for more specific information	- Where are the closest hospitals or relief centers in case of an event?
Land Information Storage and Retrieval	- Filing, maintaining, and updating land-related data (land ownership, previous records of natural events, permissible uses, etc.)	- Display all parcels that have had flood problems in the past
		- Display all non-conforming uses in this residential area
Zone and District Management	- Maintain and update district maps, such as zoning maps or floodplain maps	- List the names of all parcel owners of areas within 30 m of a river or fault line
	- Determine and enforce adequate land-use regulation and building codes	- What parcels lie in high and extreme landslide hazard areas?
Site Selection	- Identification of potential sites for particular uses	- Where are the hazard-free vacant parcels of at least x ha lying at least y in from a major road, which have at least z bed-hospitals within 10 km radius?
Hazard Impact Assessment	- Identification of geographically determined hazard impacts	- What units of this residential area will be affected by a 20-year flood?
Development/Land Suitability Modeling	- Analysis of the suitability of particular parcels for development	- Considering slope, soil type, altitude, drainage, and proximity to development, what areas are more likely to be prioritized for development? What potential problems could arise?

Source: Adapted from Levine J., and Landis, J. "Geographic Information Systems for Local Planning" in *Journal of the American Planning Association* (Spring, 1989), pp. 209-220.

The organization of American states/department of regional development and environment applied GIS in hazard assessment and development planning using a different framework, example of use of that framework is presented in Table 2.2.3. This is a summary to be used for mapping of natural hazards at local level presented in *Journal of the American Planning Association* (Spring, 1989).

Table 2.2.3: Framework of mapping of natural hazards at local levels

Location	Scale	Objectives	Data used	Results
Colombia Puerto Bogota, Department of Cundinamarca	1,3,000 (16.81 m2 per cell)	Identification of hazard-free urban areas suitable for the relocation of 34 families presently under high landslide risk.	- Base map - Urban perimeter map - Urban census map - Geologic map - Natural hazards map	Identification of possible relocation sites for 34 families. Sites in question had to comply with the following requirements: not in hazardous zone, 100m. away from the river,

Location	Scale	Objectives	Data used	Results
			<ul style="list-style-type: none"> - Risk zones map - Land use information - Population density 	within urban limits, and in unoccupied areas or with low population density.
Ecuador: Agricultural Sector Vulnerability Study	1:2,000,000 (1 km per cell)	Determination of the vulnerability of the agricultural sector in terms of income, employment, foreign exchange earnings, and food possible mitigation strategies.	<ul style="list-style-type: none"> - Political map - Road network and storage facilities map - Flood, erosion, drought, landslide, seismic, and volcanic hazard map - Crop producing areas (26 cultivation systems) - Socio economic data 	49 possible critical events selected for further study and/or profile level mitigation strategy formulation. Follow-up institutional support delineated.
Honduras: Jesús de Otoro Valley, Department of Intibuca	1:50,000 (2.08 ha per cell)	Identification of flood- and erosion-prone areas for the selection of agricultural production projects.	<ul style="list-style-type: none"> - Present land use - Projected land use - Soils - Human settlements - Floodplains 	66 percent of the land presently occupied or planned for irrigated agriculture investment was found to be in flood-susceptible areas.
Paraguay: Southwestern section of the Paraguayan Chaco	1:500,000 (208 ha per cell)	Identification of hazardous areas for landuse capability definition and agricultural project selection.	<ul style="list-style-type: none"> - Soils map - Forest tipology - Alternative forest uses - Agricultural zones - Landuse capability 	Identification and quantification of areas under varying degrees of limitations or restrictions in areas previously recognized as best suited for their respective production
Saint Lucia Mabouya Valley Project	1:10,000 (2.1 ha per cell)	Identification of current and proposed land uses in conflict with land capabilities and/or erosion risks; selection and distribution of farming resettlement sites.	<ul style="list-style-type: none"> - Human settlements - Land capability - Present land use - Erosion risk - Water resources - Life zones - Ecology - Development strategy 	99 percent of the land occupied by small farms was classified as severely restricted or unsuited for cultivation. 2 percent of the land for commercial agriculture vs. 30 percent of the land for small farms was affected by severe or critical erosion hazard.

Source: Adapted from Levine J., and Landis, J. "Geographic Information Systems for Local Planning" in *Journal of the American Planning Association* (Spring, 1989)

2.2.3 GIS in Flood Hazard Mapping: a case study of Kosi River Basin, India

This paper presented an efficient methodology to delineate the flood-hazard areas in the Kosi River Basin, North Bihar, India in a GIS environment. The approach used multi-criteria decision-making techniques, Analytical Hierarchical Process (AHP) which provides a systematic approach for assessing and integrating the impact of various factors involving several levels of dependent and independent, qualitative and quantitative information. All data are integrated in a GIS environment to prepare a final Flood Hazard map. This flood hazard index computed from AHP method considers susceptibility of each area to be inundated and takes into account the factors that are inherently related to flood emergency management.

The Kosi River, one of the major tributaries of the Ganga River, is well-known in India for rapid and frequent avulsions of its course and the extensive flood damages it causes almost every year. The problem of river flooding is getting more and more acute due to human intervention in the flood plain at an ever-increasing scale.

This document presents a multi-parametric analysis to compute a composite index of flood hazard and to produce a Flood Hazard map. This diagram (Figure 2.2.5) is the overall process of the methodology adopted by the study done in the Koshi River Basin in India for flood hazard mapping.

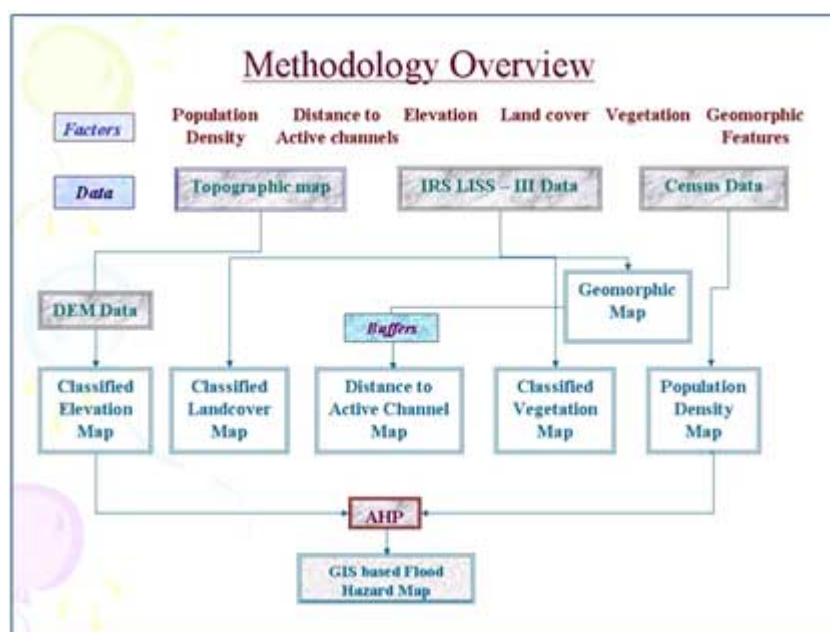


Figure 2.2.5: Methodology followed for flood hazard mapping in Koshi River Basin, India

Chapter 3

Study Approach and Methodology

3.1 Introduction

Hazard Zoning Map could be very effective tool for planning and decision-making for hazard management. Based on ToR, literature review, other recent exercise on preparation of Hazard Zoning Maps using CRA process a comprehensive methodology has been prepared and implemented for developing the Hazard Zoning Maps. The overall methodology is graphically presented in Figure 3.1.1.

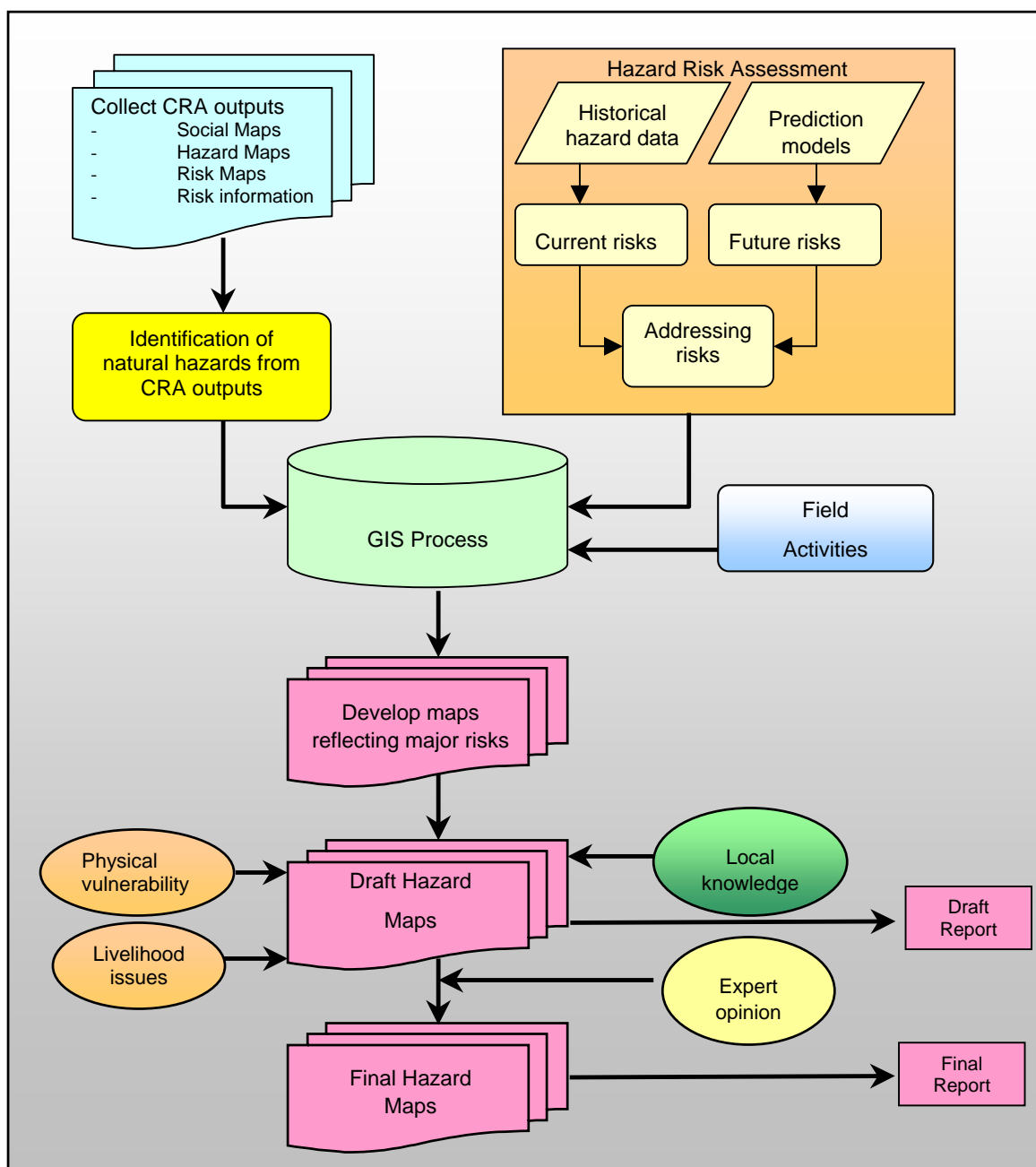


Figure 3.1.1: Comprehensive methodology for developing Hazard Zoning Maps

3.2 Collect CRA outputs

As mentioned before, CDMP contracted different local NGOs for conducting CRA in the study areas (see Table 1.3.1). CEGIS collected 67 CRA reports from CDMP and reviewed them all. During the review it revealed that the reports did not contain any Social Maps, Hazard Maps, Risk Maps. But it contained risk analysis of the natural hazards in the respective area. All the relevant information was extracted from the CRA report.

3.3 Identification of natural hazards

From the review of the CRA reports, the hazard related information for each area were identified and a list was prepared. These information were used to generate data layers. Table 3.3.1 to Table 3.3.7. shows the identified hazards in selected upazilas extracted from the CRA outputs.

Table 3.3.1: Hazards identified from CRA Report, Sadarpur

Union Hazards	Dhue khali	Akter char	Char Manair	Narikelbaria	Char Nasirpur	Sadarpur	Bhashan Char	Char Bishnupur	Krishnapur
Flood	√	√	√	√	√	√	√	√	√
Nor wester	√								
Riverbank erosion	√	√	√	√	√				
Hail storm	√	√	√			√	√	√	√
Drought	√	√	√	√	√	√	√	√	√
Fog	√	√	√	√	√	√	√	√	√
Excess rain	√	√	√	√	√	√	√	√	√
Fire	√		√	√	√				
Scarcity of rain	√		√	√	√		√	√	√
Cyclone		√	√	√	√	√	√	√	√
Mouse attack			√	√					
Water logging						√	√		√
Boat capsize			√	√					
Cold			√	√	√	√			
No monsoon									√
Insect attack		√					√		

Table 3.3.2: Hazards identified from CRA Report, Moheshkhali

Union Hazards	Kalaramchara	Dhalghata	Matarbari	Kutubjom	Bara Maheshkhali	Chhota Maheshkhali	Saflapur	Hoanok	Paurashava
Cyclone	√	√	√	√	√	√	√	√	√
Pahari dhol	√				√	√	√	√	
Tidal water	√	√	√	√		√	√	√	√
Tidal surge	√	√	√	√		√	√	√	√
Norwester	√	√	√	√	√	√	√	√	√
Landslide	√				√	√	√	√	
Earthquake	√		√	√		√		√	
Water		√	√	√			√		

Union Hazards	Kalaram rchara	Dhalgha ta	Matarb ari	Kutub jom	Bara Maheshkh ali	Chhota Maheshk hali	Saflapur	Hoanok	Pauras hava
logging									
Salinity		√	√	√		√			
Bank erosion		√	√						
Tornado			√	√					
Tsunami				√					
Insect attack of paddy					√				
Insect attack of Pan					√	√	√		

Table 3.3.3: Hazards identified from CRA Report, Chowhali

Union Hazards	Gharjan	Sthal	Sadia Chandpur	Omarpur	Khas Pukuria	Khas Kaulia	Baghutia
Flood	√	√	√	√	√	√	√
Norwester	√	√	√	√	√	√	√
Riverbank erosion	√	√	√	√	√	√	√
Hail storm	√	√		√	√		√
Drought	√	√	√	√	√	√	√
Excess rain	√	√	√	√	√	√	√
Morok						√	
Cyclone						√	
Water logging					√	√	√
Cold wave	√	√		√	√	√	√
Insect attack	√	√				√	√

Table 3.3.4: Hazards identified from CRA Report, Godagari

Union Hazards	Pakri	Basudebp ur	Gogram	Rishikul	Godagari	Deopara	Godagari PSA	Mohonpur	Char Ashariadaha	Kakonhat PSA	Matikata
Flood	√	√	√	√		√	√	√	√		√
Riverbank erosion			√			√	√		√		√
Drought	√	√	√	√	√	√	√	√	√	√	√
Morok	√	√			√			√		√	√
Norwester	√	√	√	√	√	√	√	√	√	√	√
Scarcity of rain	√	√		√	√		√	√	√	√	
Excess rainfall	√	√	√	√	√	√	√	√	√	√	√
Fog	√	√	√	√	√	√	√	√	√	√	√
Recession of ground water	√	√		√	√	√		√		√	
Pest attack			√								
Water logging			√	√		√	√	√	√	√	√

Union	Pakri	Basudebpur	Gogram	Rishikul	Godagari	Deopara	Godagari PSA	Mohonpur	Char Ashariadaha	Kakonhat PSA	Matikata
Hazards											
Cold spell				√		√			√		
Abrupt rainfall										√	
Hail storm	√	√	√	√	√	√	√	√	√	√	√

Table 3.3.5: Hazards identified from CRA Report, Assasuni

Union	Anulia	Khajra	Budhhata	Sreeula	Sobhnali	Daragpur	Kadakati	Pratapnagar	Bradal	Assasuni	Kulla
Hazards											
Flood	√	√	√	√	√	√		√	√	√	√
Riverbank erosion	√	√	√	√	√		√	√	√	√	√
Drought					√						
Water logging			√	√	√	√	√			√	√
Cyclone	√	√	√	√	√		√	√	√		√
Arsenic	√	√	√	√	√		√		√	√	√
Virus	√	√	√	√	√	√	√	√	√	√	√
Siltation						√					
Salinity	√		√	√	√					√	√

Table 3.3.6: Hazards identified from CRA Report, Dharampasha

Union	Selobras h	Uttar Sukhair Rajapur	Dakshin Sukhair Rajapur	Dharmapas ha	Joysree	Uttar Bangshikunda	Dakshin Bangshikunda	Paikurati	Chamrdani	Madhyana gar
Hazards										
Flood	√	√	√	√	√	√	√	√	√	√
Norweste r				√	√	√	√			
Riverban k erosion		√		√						
Hailstorm	√	√	√	√	√	√	√	√	√	√
Drought	√	√	√	√	√	√	√	√	√	√
Sanitatio n		√			√				√	√
Early flood	√	√	√	√	√	√	√	√	√	√
Cyclone	√							√	√	√
Insect attack		√		√	√	√	√		√	
Arsenic	√	√	√	√	√	√	√	√	√	√
Sickness		√				√	√			
Flash flood/ pahari dhol						√				
Silta tion				√		√				√
Excess rain				√						
Wave		√	√	√	√	√	√	√	√	√

Table 3.3.7: Hazards identified from CRA Report, Hatibandha

Union Hazards	Barakha ta	Dawaba ri	Shingim ari	Sindu rna	Gotama ry	Nowdab ash	Goddim ari	Pati ka Para	Tong bhang a	Vhala guri
Flood	√	√	√	√			√		√	
Riverbank erosion	√	√	√	√			√	√		
Drought	√	√	√	√	√	√	√	√	√	√
Norwest er		√				√				
Cyclone	√	√	√	√	√	√	√	√	√	√
Excess rain	√	√	√	√	√	√	√	√	√	√
Cold spell	√	√	√	√	√	√	√	√	√	√
Water logging	√									√
Hailstorm	√	√	√	√	√	√	√	√	√	√

3.4 Hazard Risk Assessment

After the identification of hazards from the CRA reports, the secondary historical information on hazards in the concerned locality was collected, analyzed and those were verified in the field during the FGDs. Some statistical analysis were done to predict the hazards in the study area for different recurrence period (1:2 yr, 1:5 yr, 1:10 yr etc.). For estimating the flooding and inundation area the digital elevation model was used along with the predicted water surface generated using GIS models.

By consulting the CRA outputs, FGDs and prediction models results the current risk from different types of prevailing hazard were assessed. Similarly, the prediction model of CEGIS on riverbank erosion was used in Chouhali to prepare erosion risk maps.

3.5 Field activities

Field preparation: According to the ToR, CRA outputs were validated through field visits to all 67 study area locations. Figure 3.5.1 presents various steps related to field activities.

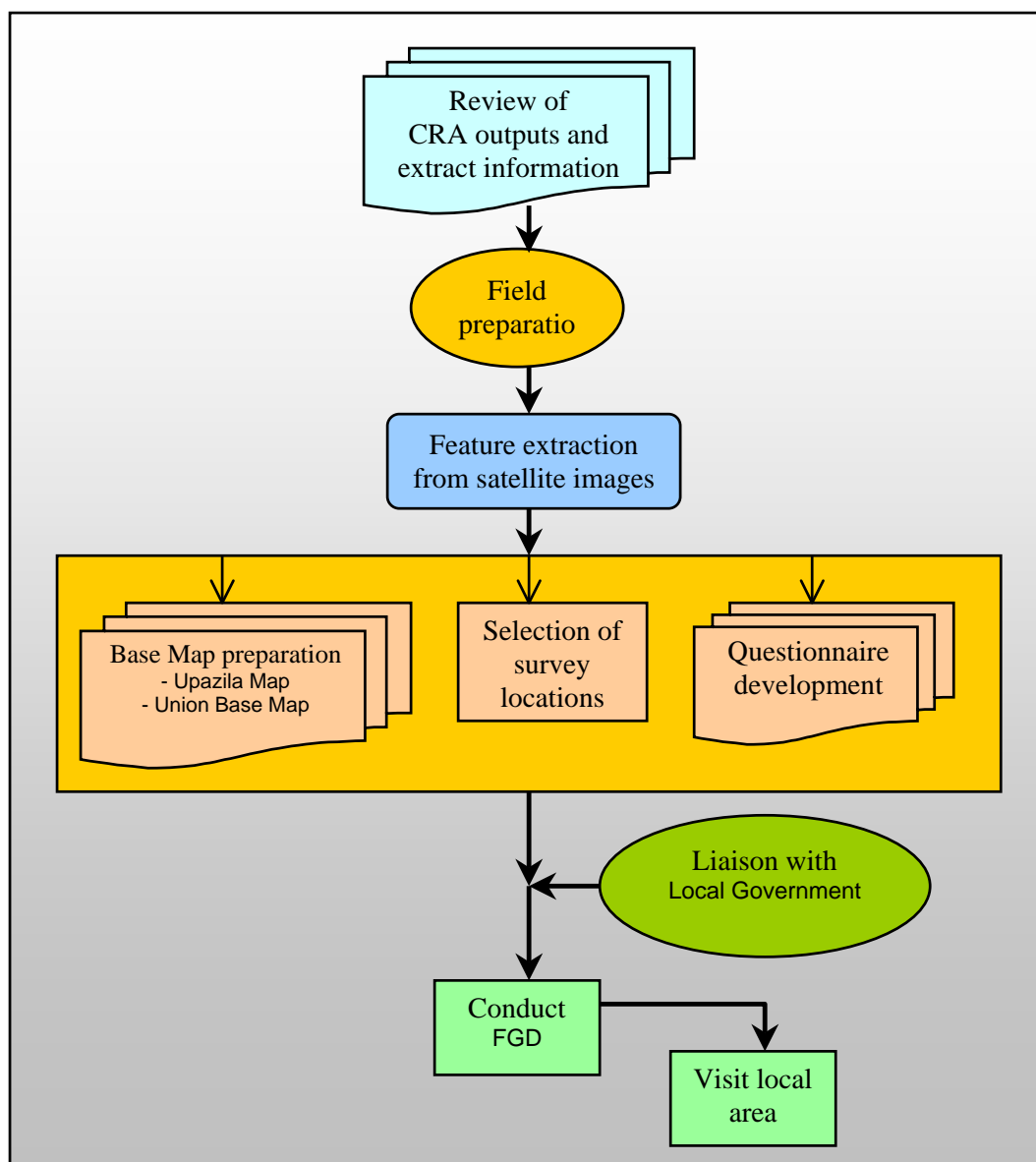


Figure 3.5.1: Detail field activities

Feature extraction from satellite images: Using remote sensing techniques settlements, railways, rivers, ponds were identified from satellite images and these were extracted and stored in a spatial database. These features were extracted from IRS Panchromatic images with 6-meter resolution, IRS LISS images with 24-meter resolution. The date of the satellite images ranges from the year 2003 to 2008. The used images were of dry season to avoid cloud covers. The multi-spectral LANDSAT ETM7 image of 30-meter resolution of year 2003 has been used as guideline and as supporting image when the features were difficult to identify in IRS images. Figure 3.5.2 shows an example of settlement and railway database extracted from satellite images. Names of the settlements have been added from the field.

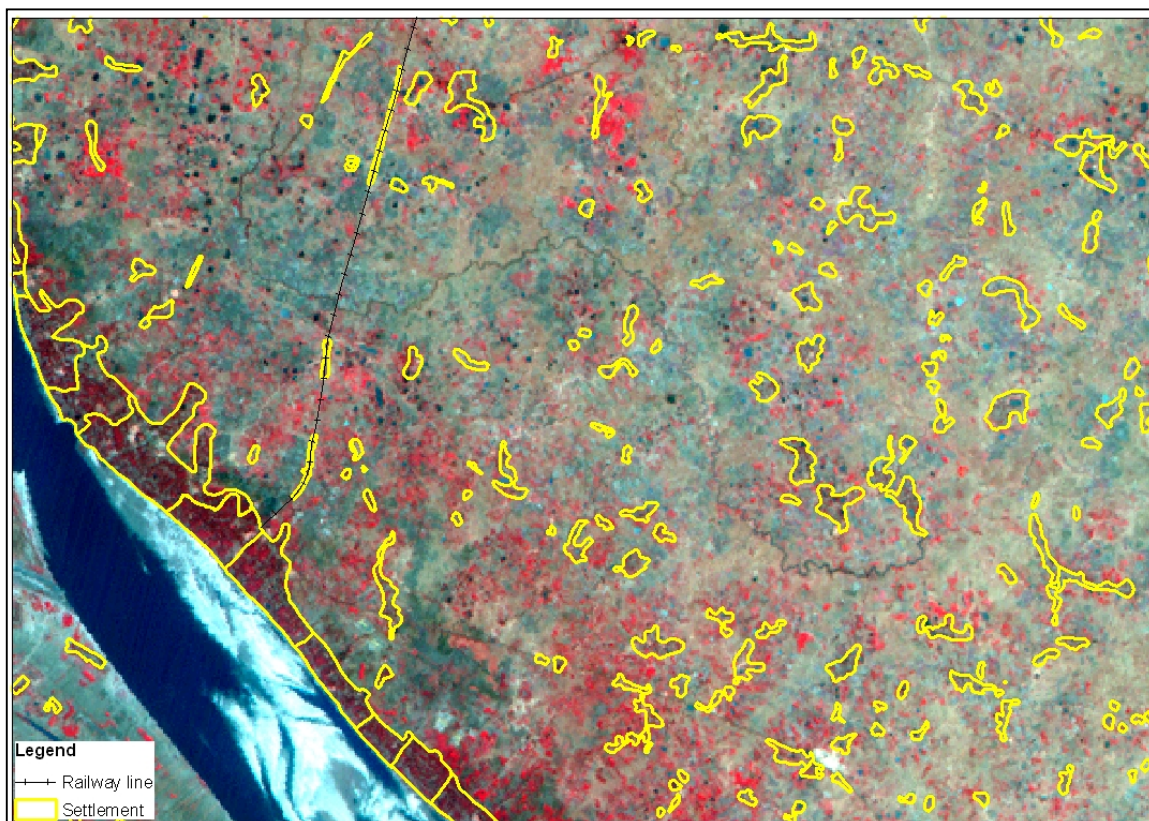


Figure 3.5.2: Settlements, railway line extracted from satellite images (Godagari)

Figure 3.5.3 shows the rivers extracted from satellite images in Chauhali upazila.

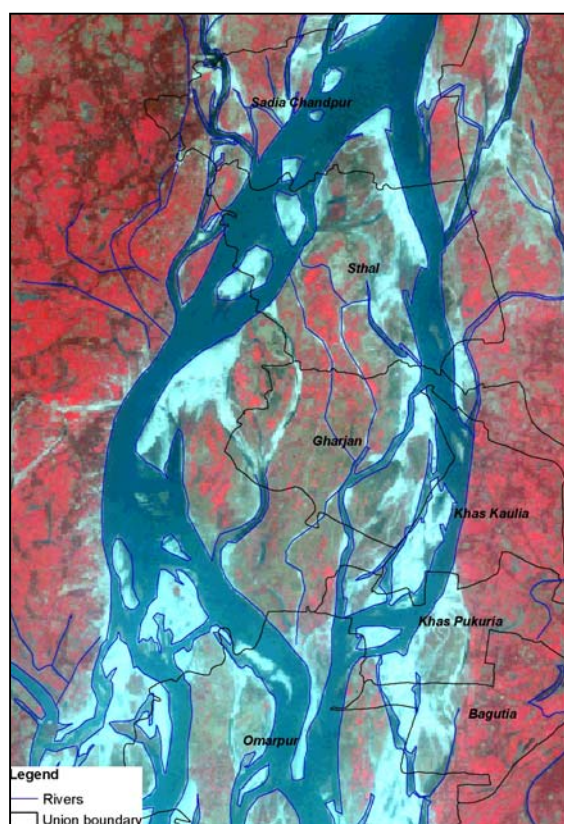


Figure 3.5.3: Rivers extracted from satellite images in Chauhali upazila

Ponds and water bodies have also been extracted from satellite images. An example is shown in Figure 3.5.4

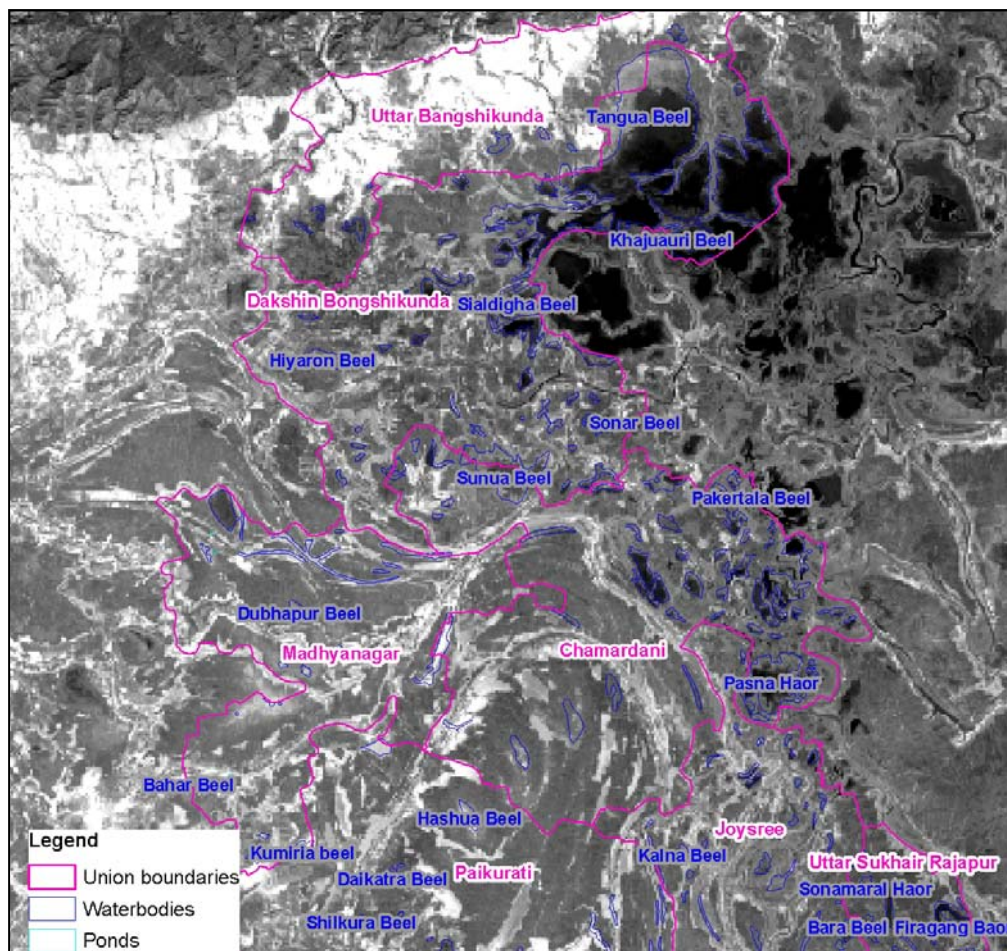


Figure 3.5.4: Ponds, waterbodies in Dharampasha union

Feature extraction from FINNMAP and Topo Map: For further references, important place names and other features has been extracted to make the maps more informative. These additional extracted features are post office, hospital, dispensary, hat/bazaar, mosque, church, temple, tomb, ferry ghat/launch station, railway station, idgah, educational institutes, madrasas and others as found. For Assasuni and Moheshkhali upazila FINNMAP has been used which is latest available topographic map in Bangladesh. In other upazilas (Sadarpur, Chouhali, Godagari, Dharampasha, Hatibandha) SOB Topo Maps were used. An example is shown in Figure 3.5.5. These features are stored in spatial database for future use.

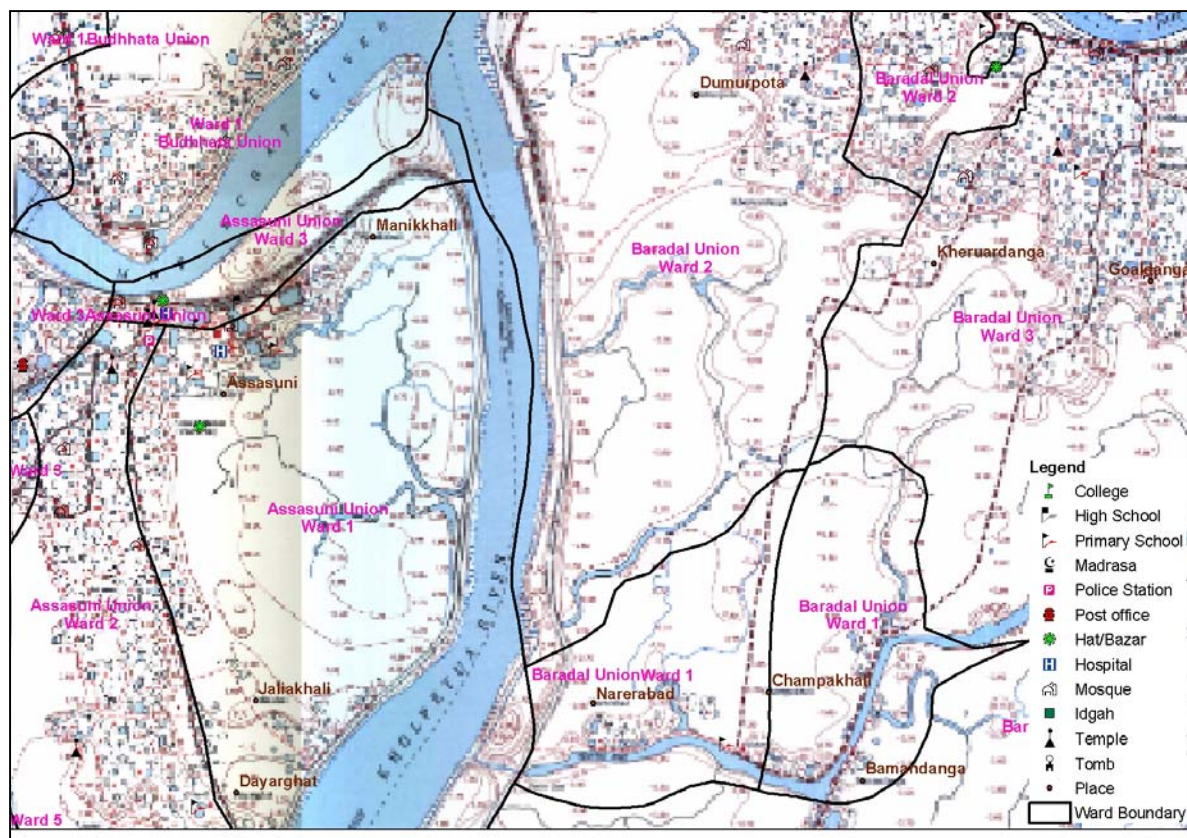


Figure 3.5.5: Extracted features from FINNMAP, Assasuni upazila

Ward boundary: Ward boundaries were traced out from the hand drawn Map as available in Union Parishad offices (Figure 3.6.2). These maps were drawn on tracing paper. The ward boundaries were also drawn on the Union Base Maps (see Figure 3.5.6). In addition, village names and water body names were also identified on the Union Base Maps. Member of each wards and local knowledgeable persons helped in doing this work. All these were incorporated in the spatial database using GIS tools.

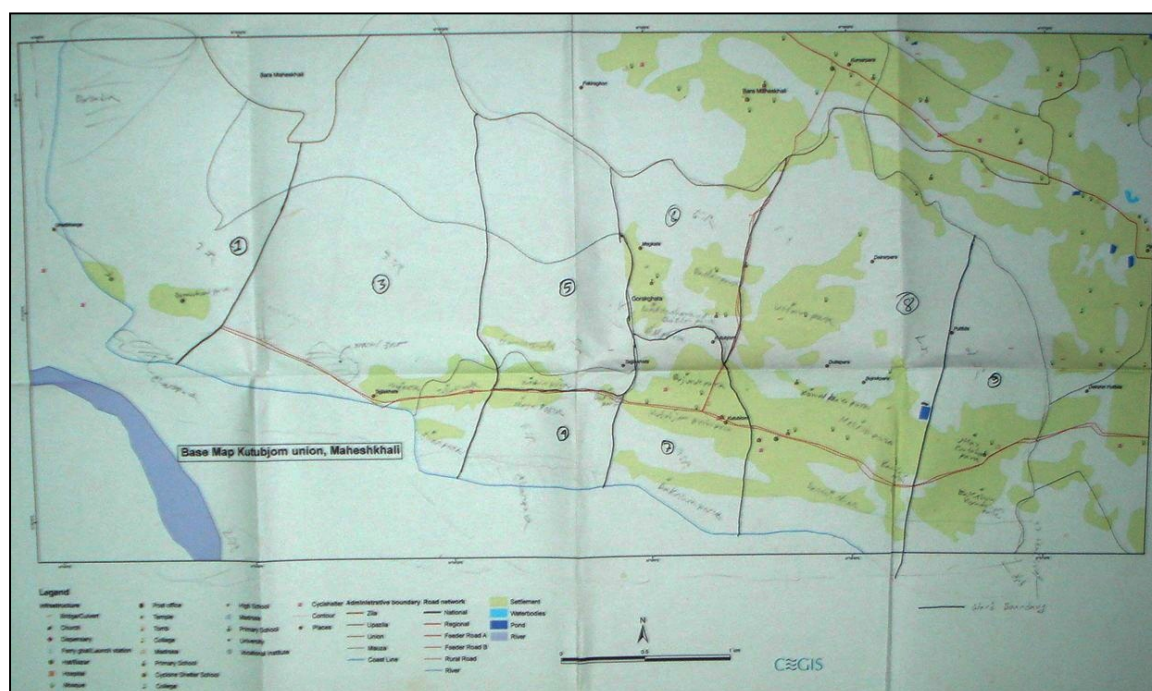


Figure 3.5.6: Ward boundaries drawn on the Union Base map, Moheshkhali upazila

The preliminary survey locations were selected based on some criteria mainly based on CRA reports. The criteria by which the survey locations have been selected are as follows:

- ❑ **Multiple hazards occurring in one location:** If a location is subjected to more than one hazard (e.g. river bank erosion, flood, drought etc.).
- ❑ **Exceptional hazard:** If any place has an exceptional hazard which is not present in any other place. For example, landslide, insect attack, virus on shrimp etc.
- ❑ **Hazard impact on high population density:** If the hazard has an impact on a highly populated area.
- ❑ **Frequency of hazard:** If the frequency of occurring of a specific hazard in a certain area is high.
- ❑ **Severity of hazard:** The severity of a particular hazard will also be considered for selecting the location. For example, high flood or a cyclone-hit area.

Apart from the above-mentioned criteria, the Upazila Nirbahi Officer (UNO), Union Parishad Chairman, Secretary, ward members, and local elites consulted while selecting the survey locations. A report on Survey Locations has already been submitted separately on April 2008.

Afterwards, questionnaires were developed to validate the hazards indicated in CRA reports. At this stage list of hazards for each union was developed as shown in Table 3.5.1. A sample of the developed questionnaire is presented in Table 3.5.2 which shows the union wise hazard information collecting process through FGDs.

Table 3.5.1: Union wise hazard list

Development of Hazard Zoning Maps using CRA (List of Hazard)

Name of key informant: Saidur Rahman _____ Date: 17.01.08 _____
Ragib Ahmad _____
 Union: Sadarpur Union Upazila: Sadarpur District: Faridpur

Sl No	Hazards
1	Riverine flood
2	Heavy rainfall flood
3	Water logging
4	Dense fog
5	Drought
6	Cyclone
7	Hail storm
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Table 3.5.2: Union wise hazard information

Development of Hazard Zoning Maps using CRA (Hazard information)					Questionnaire-
Name of key informant: <u>Saidur Rahman</u> <u>Ragib Ahmad</u>			Date: <u>17.01.08</u>		
Union: <u>Sadarpur Union</u> Upazila: <u>Sadarpur</u>			District: <u>Faridpur</u>		
Table Stakeholder wise Hazard identification (Use ✓)					
Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
Flash flood					
Heavy rainfall flood	Mid June to August	✓	✓		
Riverine flood	Mid June June to Mid August	✓	✓	Imam	
Drought	Mid March to Mid May	✓	✓		
Hail storm	Mid March to Mid Apr.	✓	✓		
Cold spell/fog	Mid Nov. to January	✓	✓		
Cyclone/Noxwester	Mid March to Mid Apr. and Mid May.	✓	✓	Teacher	
Excess rainfall					
Water logging	September to Mid December	✓	✓		
Excess rainfall					
River bank erosion					
Fire					
Insect attack					
Earthquake					
Mosquito attack					

Weights and preferences were assigned for the different hazard through another questionnaire shown in Table 3.5.3. Weights (low, medium, high) and frequency (in terms of last 3 subsequent occurrence) were also noted down during the FGDs. The information were collected ward by ward (9 no.).

Table 3.5.3: Ward wise multi hazard intensity and frequency information

Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

Questionnaire 2

Name of key informant: Saidur Rahman Date: 17.01.09
Ragib Ahmad
 Union: Sadarpur Upazila: Sadarpur District: Faridpur

Table Mouza wise Hazard intensity and frequency information

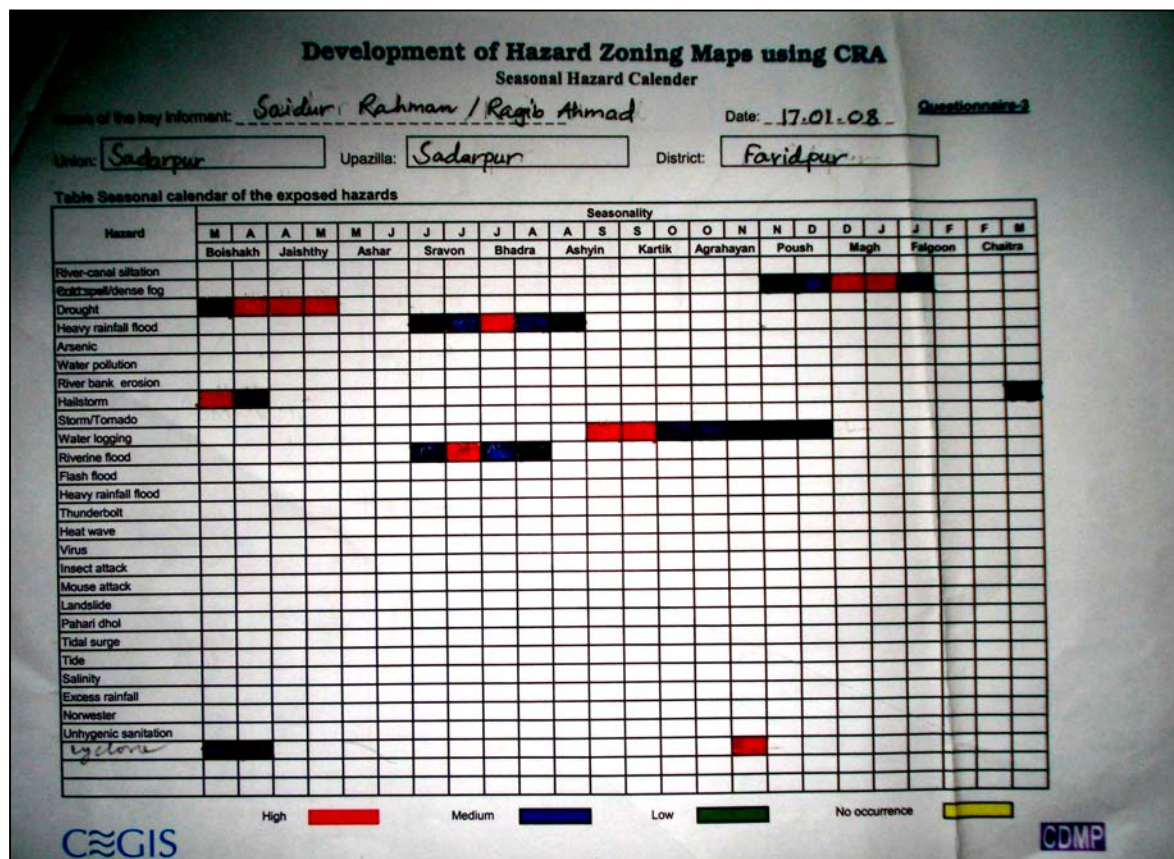
Mouza/ Ward	Parameter	Riverine Flood	Heavy rainfall flood	Water logging	Dense fog	Drought	Cyclone	Hail storm
Ward-1	Intensity	M	H	H	L	L	M	M
		L	M	-	H	M	-	H
		L	H	-	H	H	-	-
Ward-2	Yr of Occu	1988	2005	1997	2006	2004	2007	2002
		1998	2006	-	2007	2005	-	2007
		2007	2007	-	2005	2007	-	-
Ward-3	Intensity	M	L	-	L	L	M	M
		L	-	-	H	M	-	H
		L	L	-	H	H	-	-
Ward-4	Yr of Occu	1988	2005	-	2006	2004	2007	2002
		1998	2006	-	2007	2005	-	2007
		2007	2007	-	2005	2007	-	-
Ward-5	Intensity	M	H	M	L	L	M	M
		L	M	-	H	M	-	H
		L	M	-	H	H	-	-
Ward-6	Yr of Occu	1988	2005	-	2006	2004	2007	2002
		1998	2006	-	2007	2005	-	2007
		2007	2007	-	2005	2007	-	-
Ward-7	Intensity	H	-	-	L	L	M	M
		M	-	-	H	M	-	H
		M	-	-	H	H	-	-
Ward-8	Yr of Occu	1988	2005	-	2006	2004	2007	2002
		1998	2006	-	2007	2005	-	2007
		2007	2007	-	2005	2007	-	-
Ward-9	Intensity	H	M	-	L	L	M	M
		M	L	-	H	M	-	H
		M	M	-	H	H	-	-
Ward-10	Yr of Occu	1988	2005	-	2006	2004	2007	2002
		1998	2006	-	2007	2005	-	2007
		2007	2007	-	2005	2007	-	-

Note: Intensity- H=High; M=Medium; L=Low; Blank=No occurrence
 Frequency in terms of yr. of occurrence- Year of last three subsequent events

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Union hazard seasonality matrix were developed as shown in Table 3.5.4. For this, the seasonal calendar of each hazard has been collected according to the Bengali calendar year. Different color has been used to show the seasonal characteristics of high, medium and low categories of each hazard.

Table 3.5.4: Hazard seasonality index



For conduct the field activities two types of Maps were developed: (i) The Upazila Maps and (ii) Union Base Maps.

The Upazila Maps

Maps of 7 upazilas under the study area were developed by CEGIS. An example is shown in Figure 3.5.7. This map contained the administrative boundaries (upto mauza), roads, the union names and the mauza names. This was used as a reference for the whole upazila. The maps had satellite image as a background.

Union Base Maps

A total of 67 numbers of Union Base Maps were prepared. These maps contained detailed information of the respective union, such as, administrative boundaries (upto mauzas), detailed roads, settlements, water bodies, rivers, infrastructures (educational institutes, growth centers, haat/bazaars, religious centers, place names and many more) etc.. Figure 3.5.8 shows an example of the Union Base Maps.

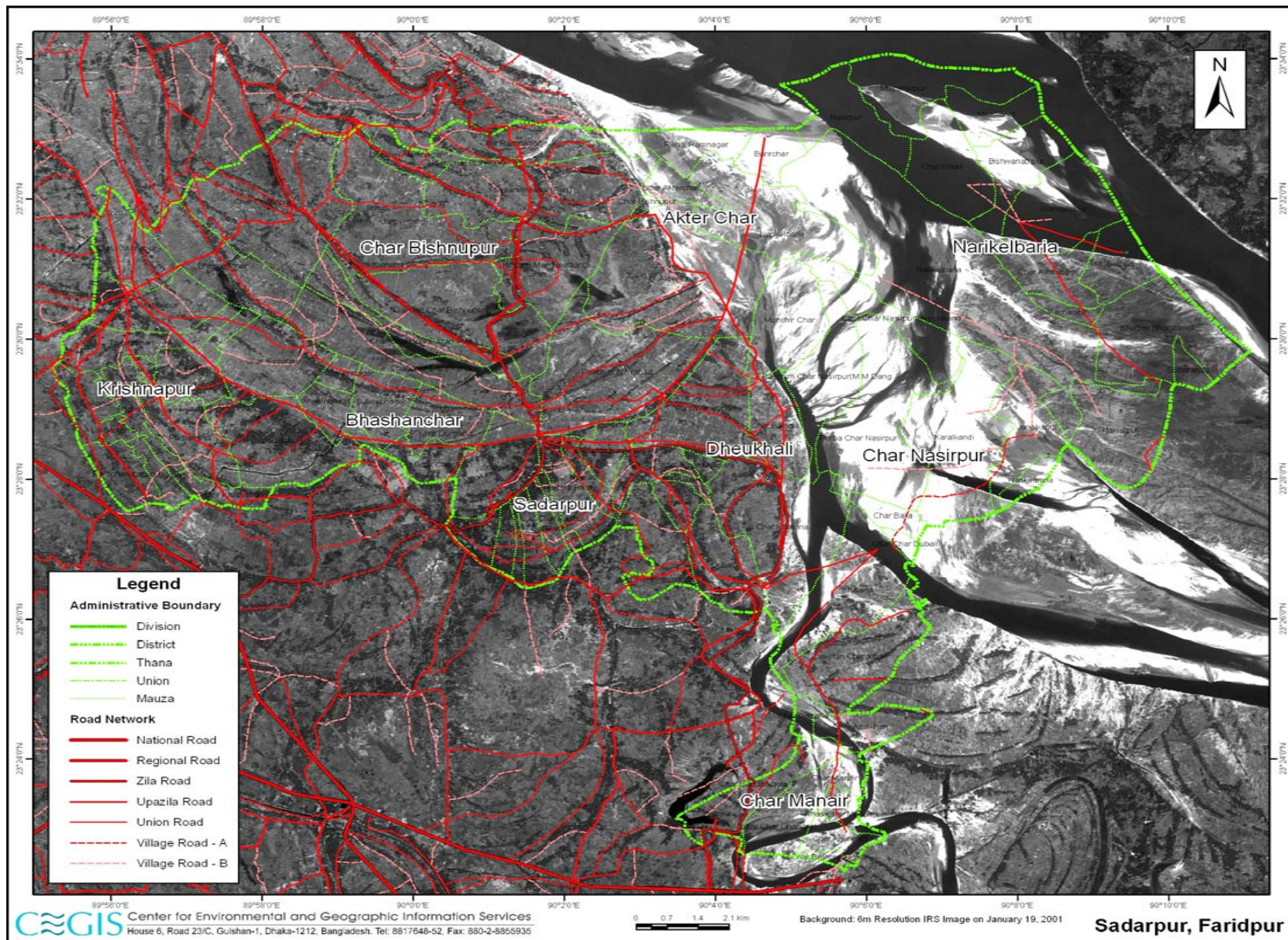
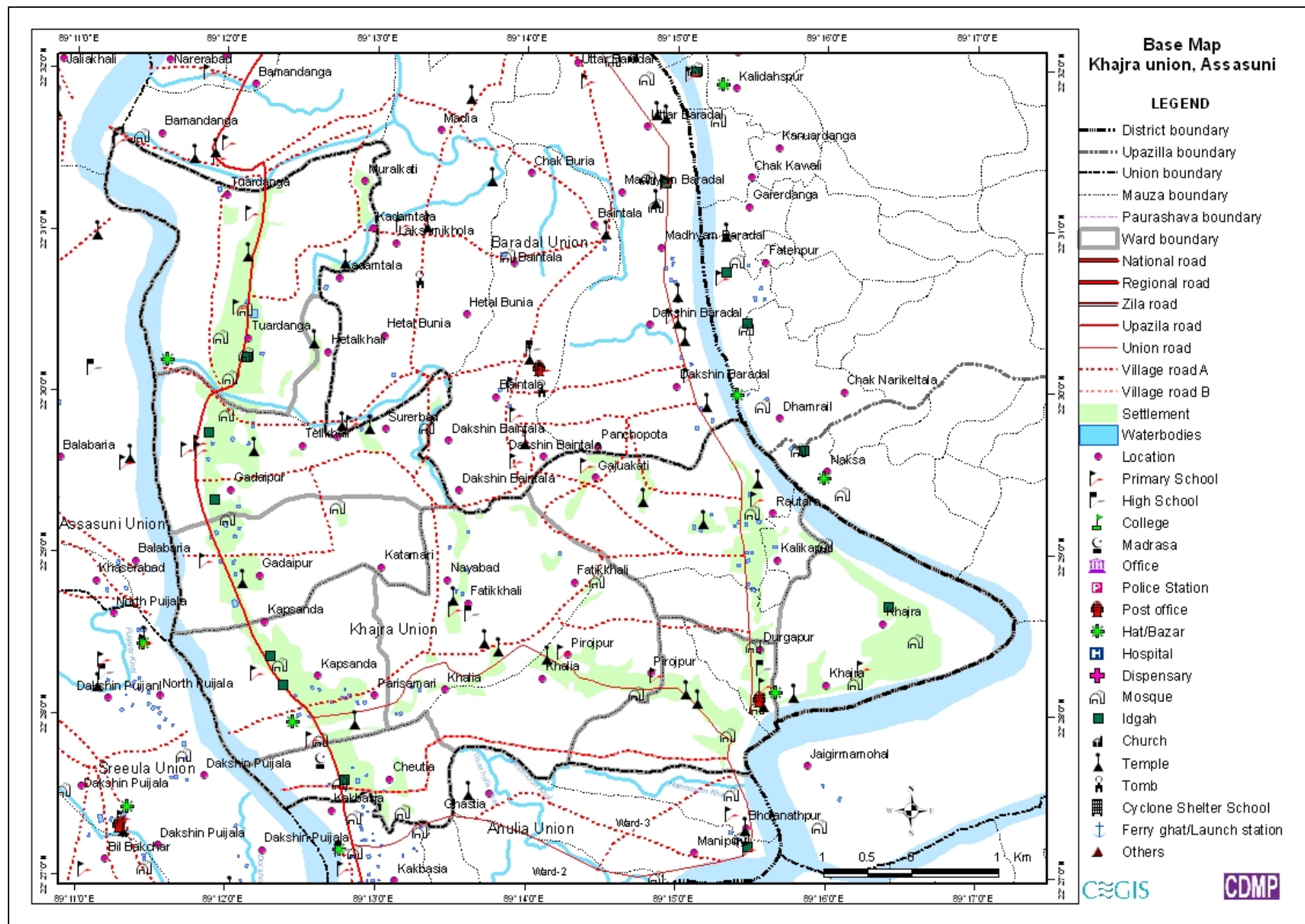


Figure 3.5.7 : Upazila Base Map, Sadarpur upazila, Faridpur



3.6 Conduct FGD and field activities

All the prepared maps, questionnaire and CRA information were taken to the field for conducting the FGDs and field investigations. Five numbers of field teams with 3 persons in each team with a total of 15 persons conducted the field activities.

The field activities were conducted in different stages. The first FGD was conducted at Sadarpur union where the field staff got on-hand training. Experts from CEGIS and the field team participated in the FGD. Then separate FGDs were conducted in other unions of Sadarpur upazila in following days. The local administration was involved in this process including the Upaizlla Nirbahi Officer (UNO) (see Figure 3.6.1).



Figure 3.6.1 : CEGIS team discussing with Sadarpur UNO

Union wise FGD's were conducted with the help of the respective Union Parishad Chairman and the Union Parishad Secretary. The detail of the FGD's in seven upazilas are given in Annex- A.

The FGDs were carried out in the following manner:

Stakeholder selection: Stakeholders were selected by discussing with the Union Parishad Chairman and Secretary. Some criteria were used during stakeholder selection.

- ❑ Affected people by the major natural hazard (Riverbank erosion) of that union, 3 people from 3 old wards
- ❑ Major occupational group (farmer/fishermen) of that union, 3 people from 3 old wards
- ❑ Local elites (school teacher, imam etc)
- ❑ Union Parishad chairman, secretary, ward members and female members
- ❑ NGO workers or government officers (if available)

FGD and Field investigation: The enlisted hazard from the CRA report (see Table 3.5.1) were reviewed and verified in the field through FGDs.

During FGDs, discussion was done to identify the time of occurrence for each hazard. The respondent groups (UDMC, farmer, Shrimp farmer, local elite) were also recorded (see Table 3.5.2) for future use.

Multi Hazard information was collected using Table 3.5.3 for:

- ❑ High affected wards.
- ❑ Medium affected wards.
- ❑ Low affected wards.

For each enlisted hazard the intensity and years of occurrence were collected.

Seasonal Hazard Calendar (Table 3.5.4) was used to collect seasonality of the enlisted hazards; in this regard following information was collected according to Bengali calendar:

- ❑ Time of hazard
- ❑ Extent of the enlisted specific hazard (monthly)
- ❑ Intensity of hazard within the time (day/ month)
- ❑ Extent of intensity according to day/ month

Various colors were used for showing the hazard intensity as follows:

- ❑ Red – High intensity
- ❑ Blue - Medium intensity
- ❑ Green - Low intensity
- ❑ Yellow – No occurrence

Ward boundary demarcation and feature identification: The hand drawn ward boundary maps were collected from the Union Parishad offices (Figure 3.6.2 and 3.6.3). Location and feature names were identified and marked on the Union Base Maps with the help of local peoples.



Figure 3.6.2: Ward map at Union Parishad



Figure 3.6.3 : Ward map being traced

Field investigations: In addition to FGDs, extensive physical investigation around each union was also done. During the field visit hazard information was collected, photo (Figure 3.6.4 to 3.6.7) was taken and GPS reading was collected from each union. Each study team prepared a field report on the whole investigation. An example of such report is attached in Annex B.



Figure 3.6.4: Riverbank erosion in Khas Pukuria Chowhali



Figure 3.6.5: Landslide in Bara Union, Moheshkhali union, Moheshkhali

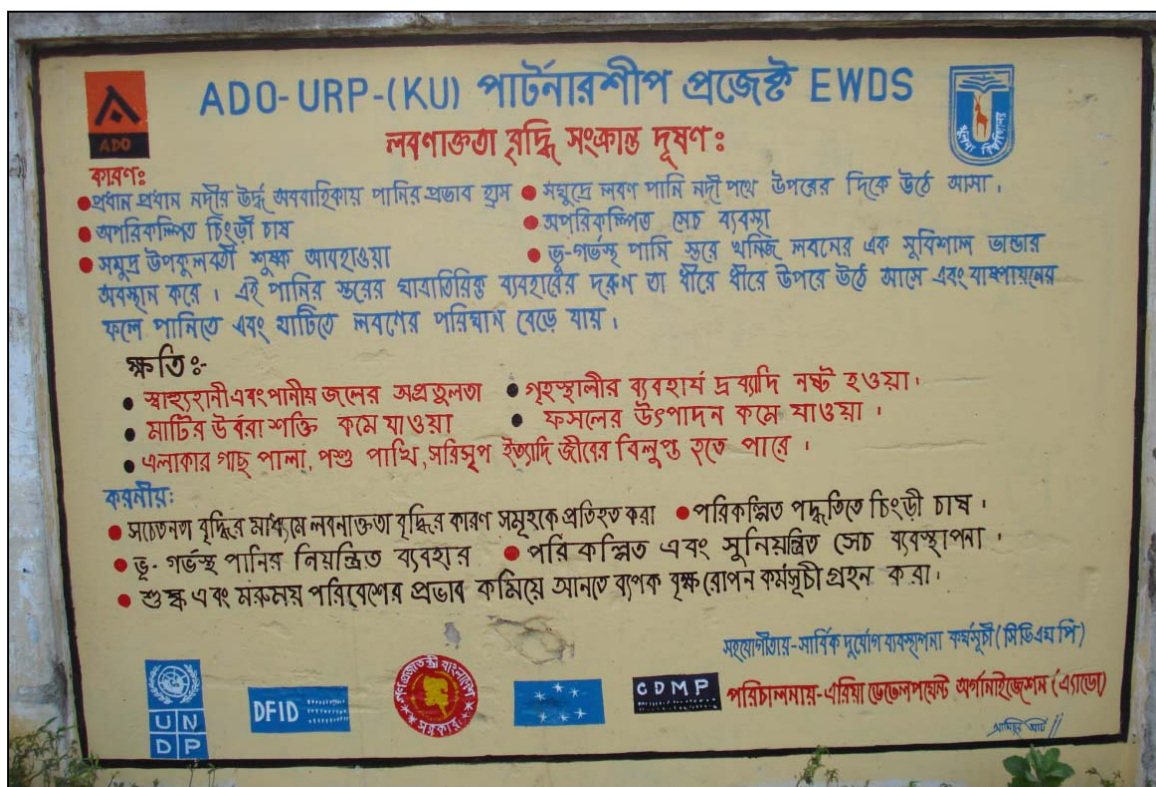


Figure 3.6.6: Salinity awareness campaign in Assasuni union, Assasuni



Figure 3.6.7: Information collection apart from FGD, Bradal union, Assasuni

3.7 Outputs

An Atlas on Multi-hazard zone information has been developed as an output from this activity. The Atlas focuses on upazilawise maps and unionwise maps. The upazilawise maps contain Base Map, Multi-hazard Zone Map, Livelihood Map, Major Livelihood Group information, Flood Map, Climate Change Impact: Impact of Sealevel Rise (Figure 3.7.6) of the whole upazila. The upazilawise maps also includes Earthquake Prone Areas, Cyclone Prone Areas, Drought Map of Kharif and Rabi season and Arsenic Contamination Map of the respective upazilas. Some examples are given below where Figure 3.7.1 shows the multi-hazard zone map of Moheshkhali upazila, Figure 3.7.2 and Figure 3.7.3 shows earthquake prone areas and cyclone prone areas of whole Bangladesh focusing on Moheshkhali upazila respectively. Figure 3.7.4 and Figure 3.7.5 shows the drought of kharif and rabi season of whole Bangladesh focusing on Hatibandha and Godagri upazila respectively. Figure 3.7.6 shows the arsenic contaminated areas of whole Bangladesh focusing on Dharampasha upazila.

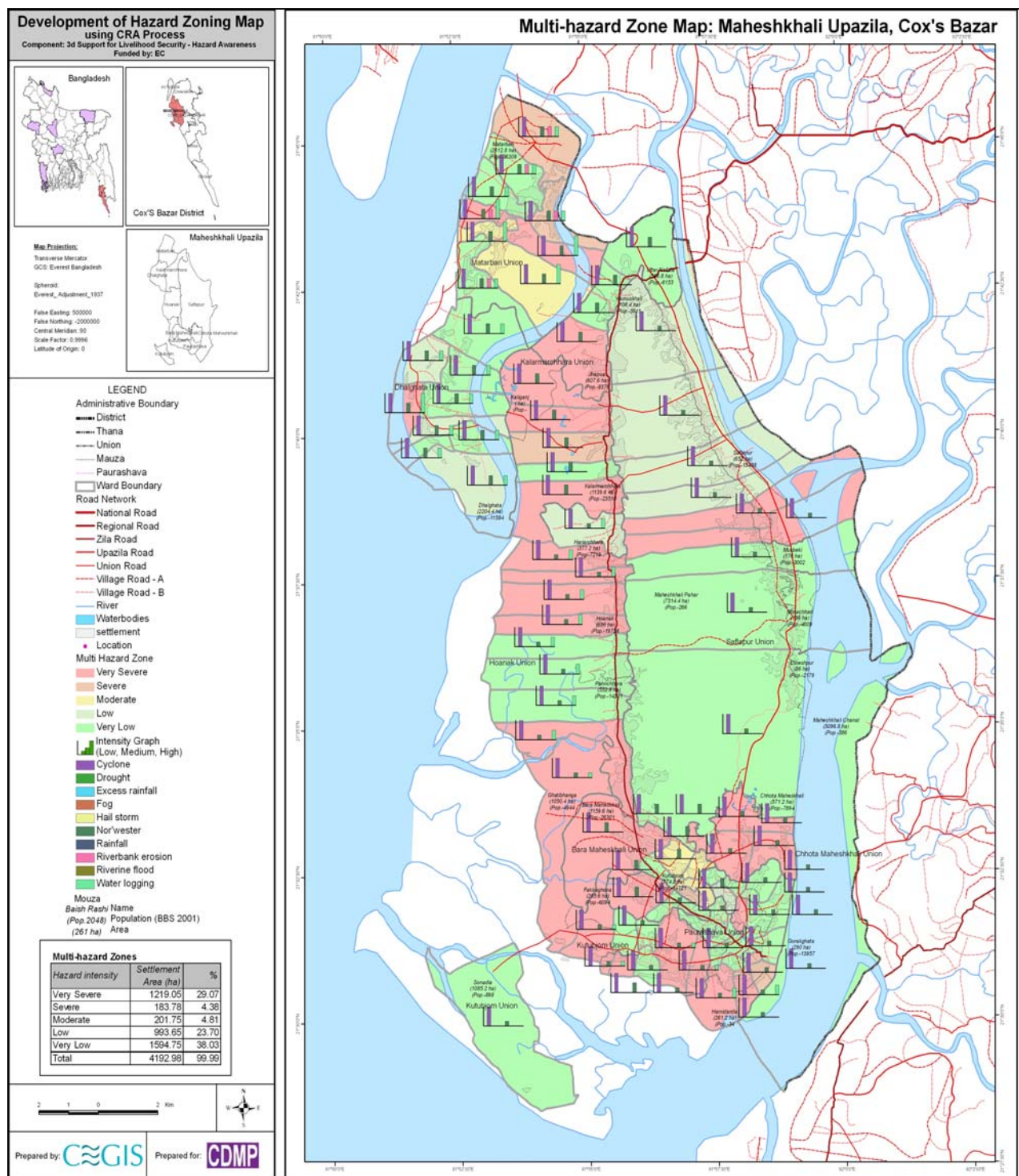


Figure 3.7.1: Multi-hazard Zone Map, Mosheshkhali upazila.

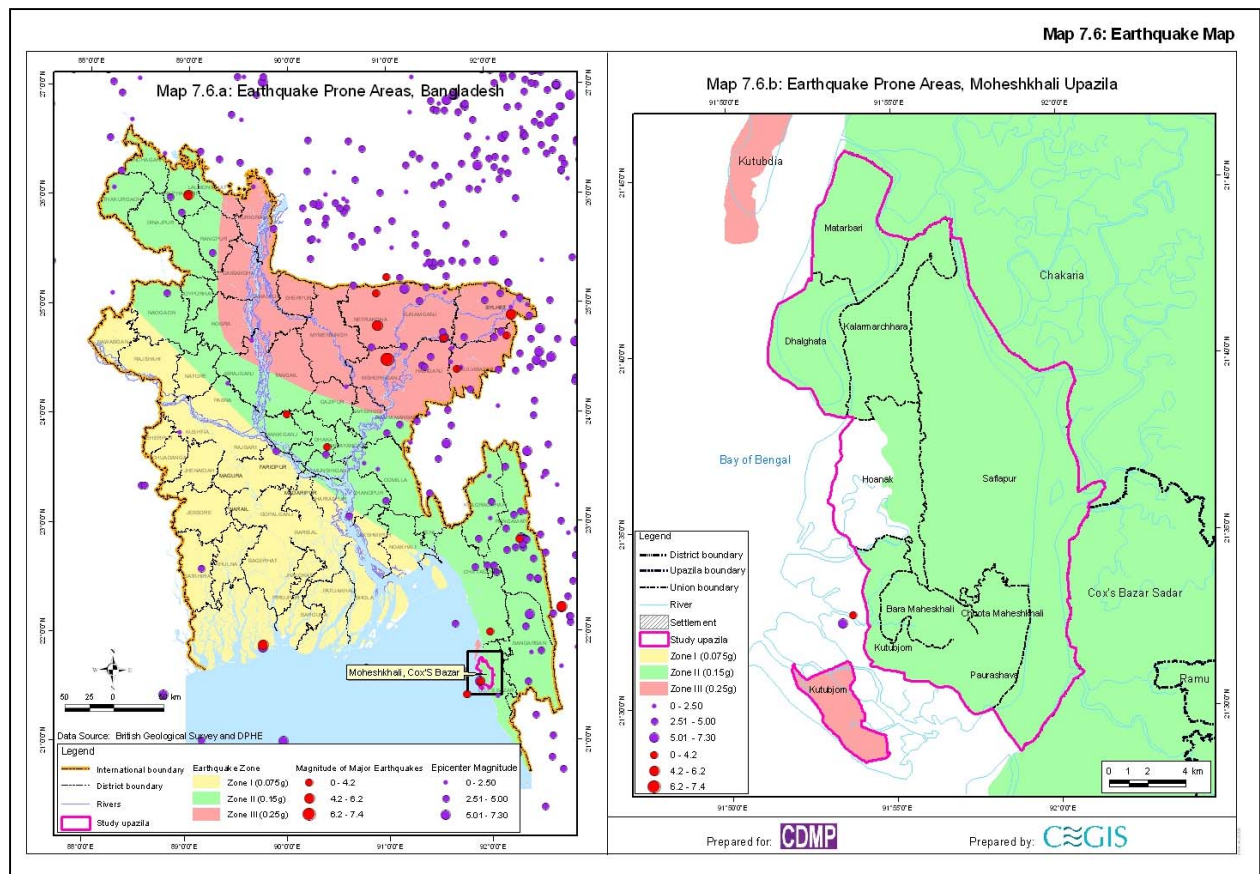


Figure 3.7.2: Earthquake prone areas focusing Moheshkhali upazila

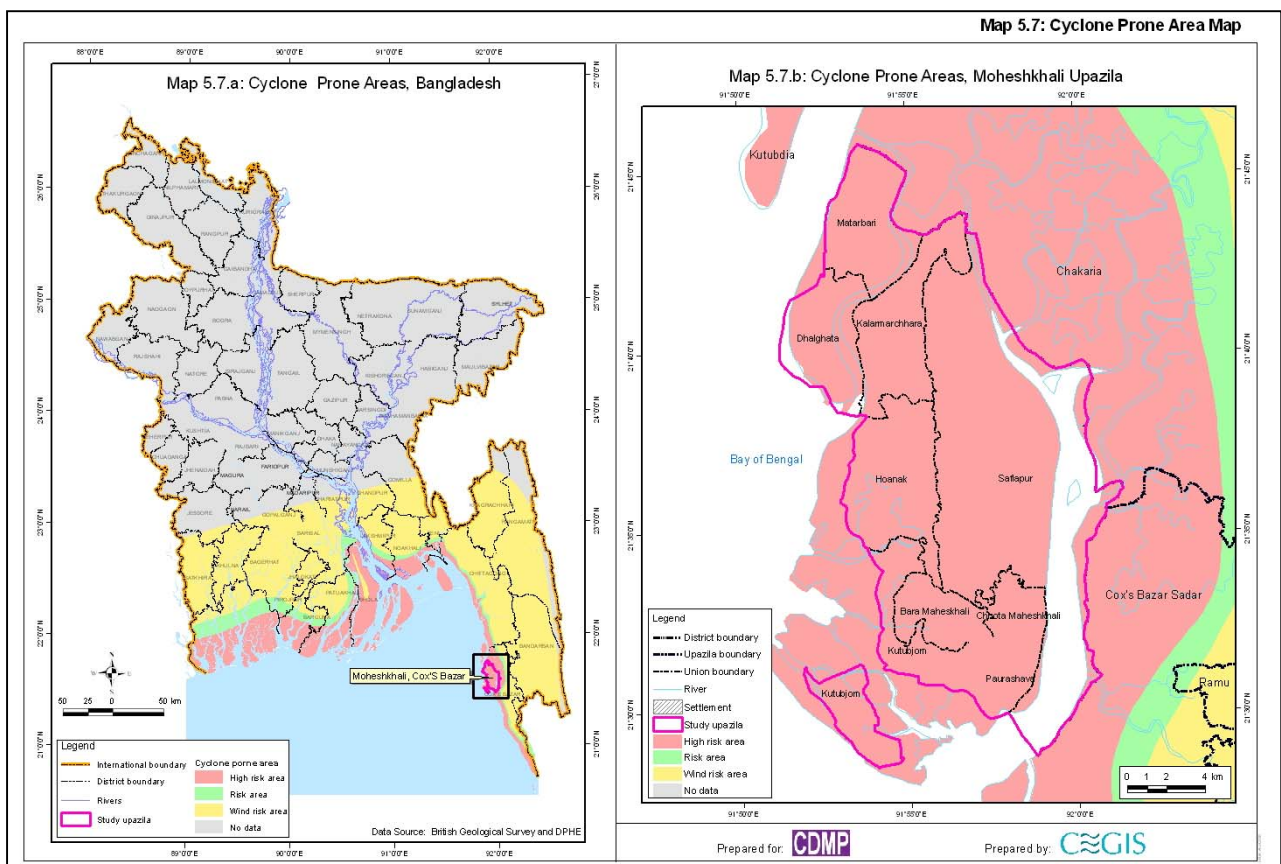


Figure 3.7.3: Cyclone prone areas focusing Moheshkhali upazila

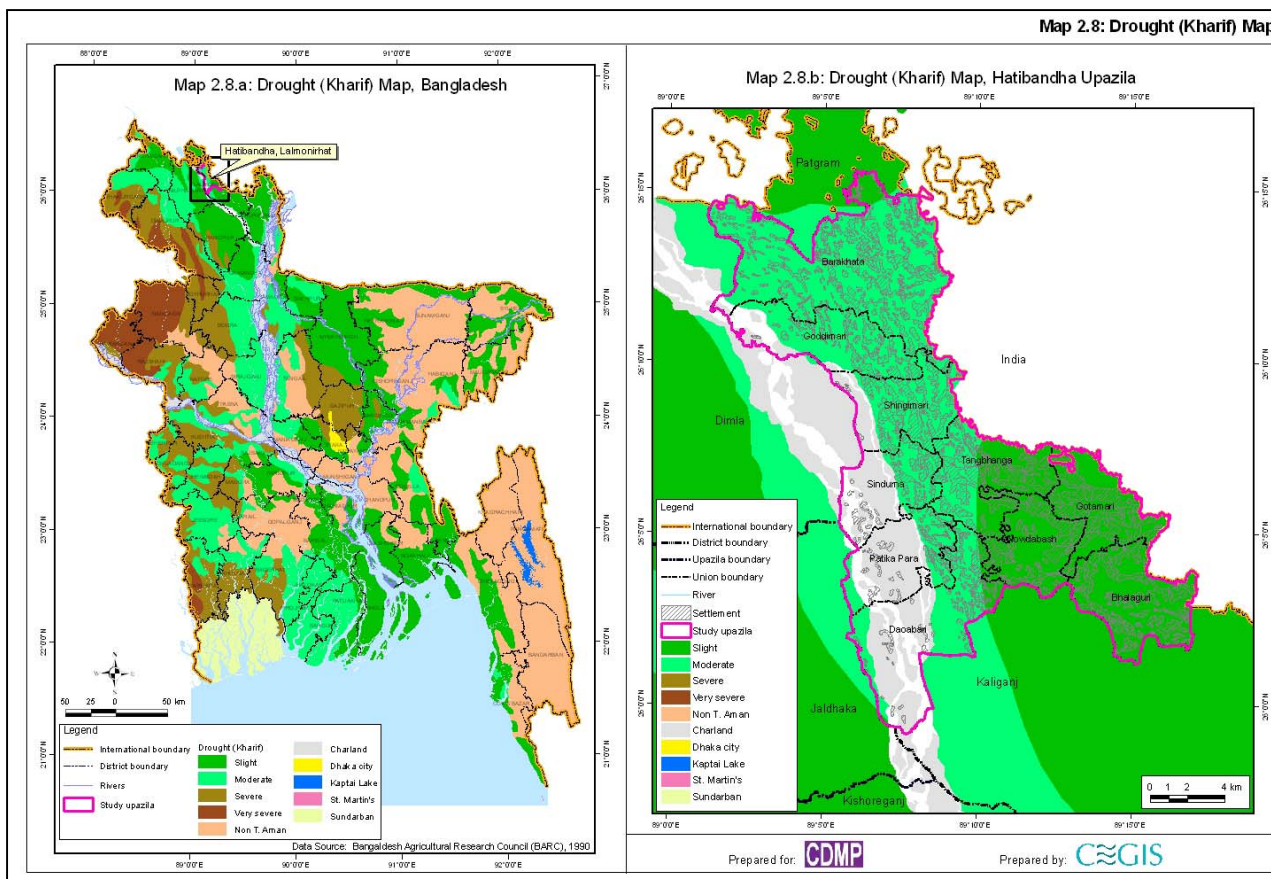


Figure 3.7.4: Drought (Kharif) map focusing Hatibandha upazila

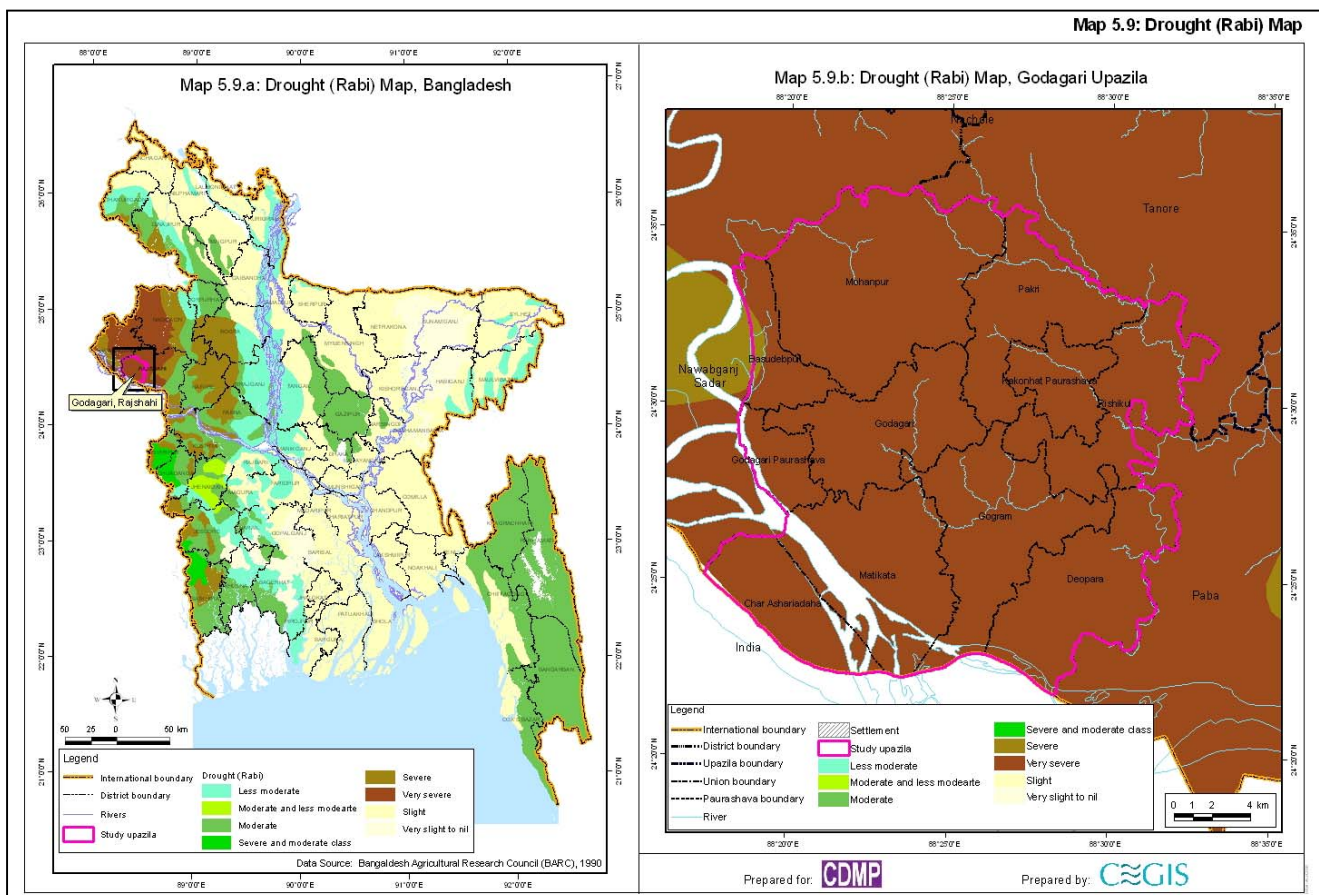


Figure 3.7.5: Drought (Rabi) map focusing Godagari upazila

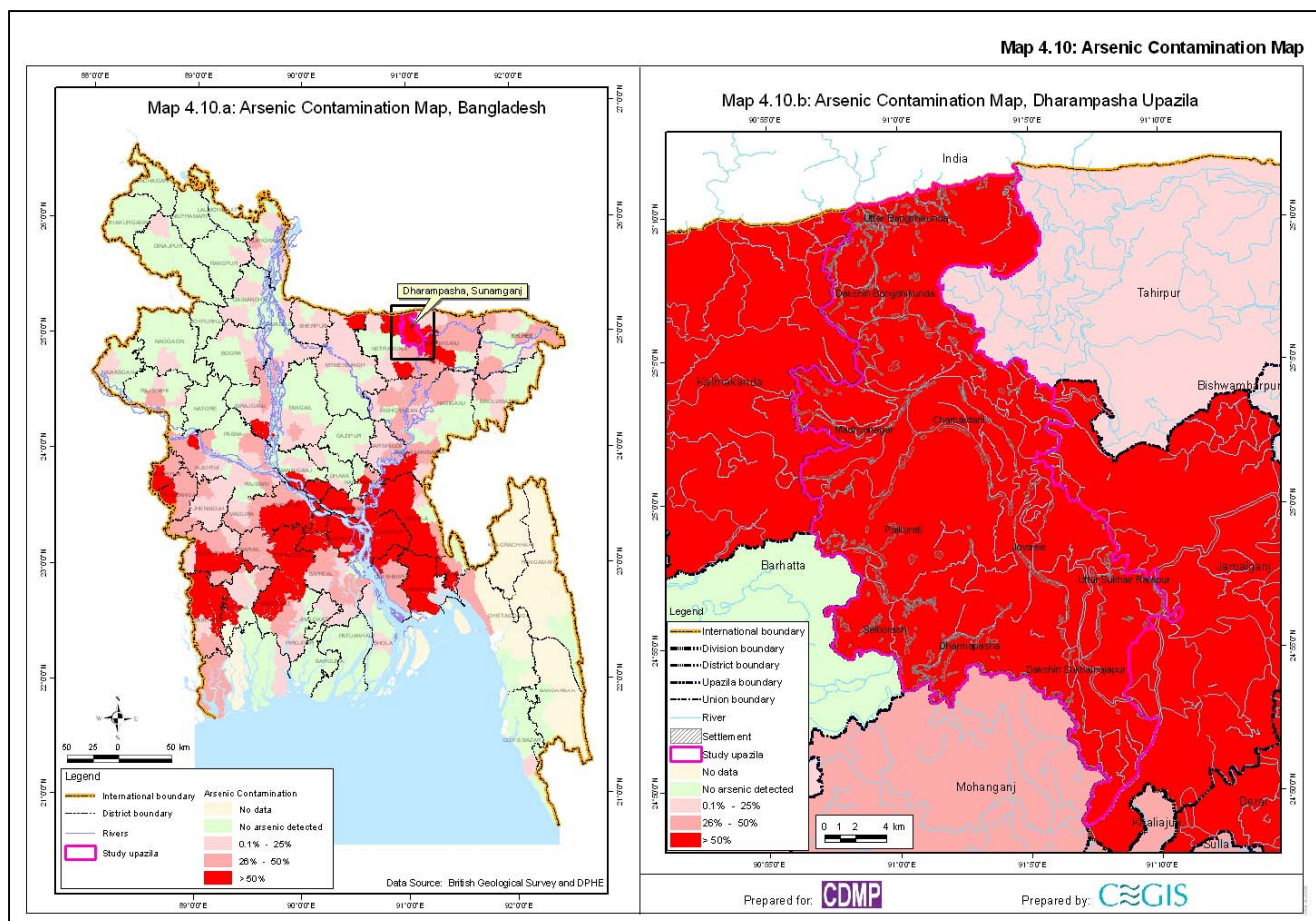


Figure 3.7.6: Arsenic contamination map focusing Dharampasha upazila

The unionwise maps in the Atlas contains Base Maps, Multi-Hazard Zone Maps, Livelihood Maps, major livelihood group information, Flood Map, future vulnerability map. The outputs are described in the following:

Base Maps

Base Maps for each of the unions/paurashavas were developed. The Base Maps included the basic information of the union which included administrative boundaries, roads, rivers, water bodies, educational institutes, local government institutes, offices, growth centers, haat/bazaars, religious centers, place names and many more. The information was collected ward wise. The Base Map also included the ward numbers. An example of base map is shown in Figure 3.7.1.

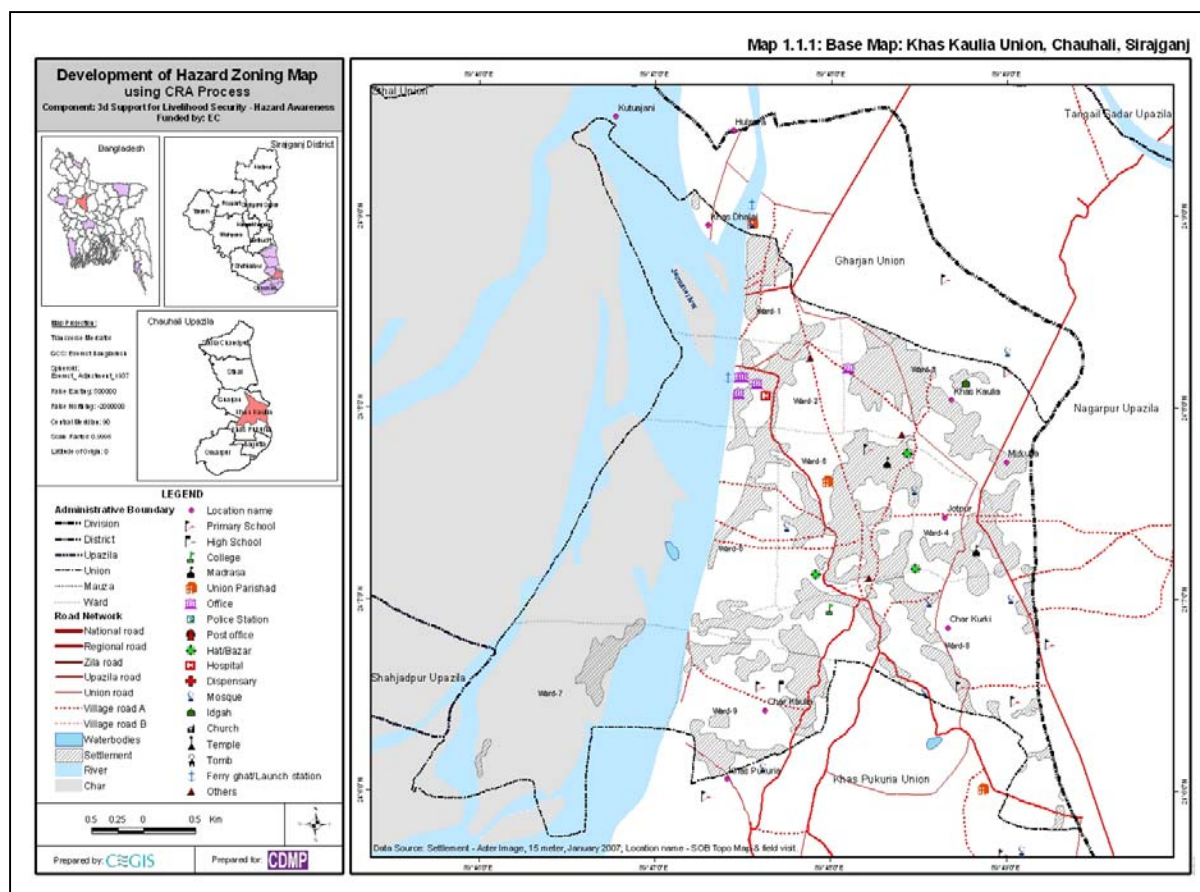


Figure 3.7.1: Base Map

Hazard Zoning Maps

Hazard and vulnerability analysis using GIS techniques for different natural hazards was done. Weights and preferences derived from FGD's were applied for developing Multi-hazard-index. The multi-hazard map is the key to understand the extent of the hazards and the vulnerable community at the local level.

From field hazard (major and minor) related information was collected through FGDs using the questionnaires shown above. GIS analysis was performed based on collected information, comprised of hazard magnitude, intensity and frequency. The population information, settlements, rivers, water bodies, roads were included in the maps as separate layers and the weightage were assigned to hazards (8 = High; 4= Medium;2= Low).

Table 3.7.2 shows an example of how the weightage has been assigned to each of the hazards. It also gives a generalized wardwise hazard scenario.

Table 3.7.2: Assigned weightage and occurrence of each hazard in Sadarpur

HAZARD																
	Riverine Flood				Rainfall Flood				Water Log				Dense Fog			
Ward	Weightage	Range (Yrs)	# of Occu.	Recurrence	Weightage	Range (Yrs)	# of Occu.	Recurrence	Weightage	Range (Yrs)	# of Occu.	Recurrence	Weightage	Range (Yrs)	# of Occu.	Recurrence
1	2	20	3	0.15	8	5	2	0.40	8	10	1	0.10	8	5	2	0.40

HAZARD																
Ward	Riverine Flood				Rainfall Flood				Water Log				Dense Fog			
	Weightage	Range (Yrs)	# of Occu.	Recurrence	Weightage	Range (Yrs)	# of Occu.	Recurrence	Weightage	Range (Yrs)	# of Occu.	Recurrence	Weightage	Range (Yrs)	# of Occu.	Recurrence
2	2	20	3	0.15	2	5	2	0.40	0	0	0	0	8	5	2	0.40
3	2	20	3	0.15	2	5	2	0.40	8	10	1	0.10	8	5	2	0.40
4	2	20	3	0.15	8	5	2	0.40	8	10	1	0.10	8	5	2	0.40
5	4	20	3	0.15	4	5	2	0.40	0	0	0	0	8	5	2	0.40
6	4	20	3	0.15	8	5	2	0.40	4	10	1	0.10	8	5	2	0.40
7	4	20	3	0.15	0	0	0	0.40	0	0	0	0	8	5	2	0.40
8	4	20	3	0.15	4	5	2	0.40	0	0	0	0	8	5	2	0.40
9	4	20	3	0.15	8	5	2	0.40	0	0	0	0	8	5	2	0.40

Hazard and vulnerability analysis was done using the GIS overlay techniques to compute the resource elements exposed to different hazard conditions. The assigned weightage were used for developing the Multi-hazard map as shown in Figure 3.7.2. The Figure shows a multi-hazard risk map of Sadarpur union of Sadarpur upazila of Faridpur district. The map illustrates a ward wise picture of multi hazard intensity. In this particular case the Ward no 3 is the most severely affected ward. Ward no 1 and Ward no 4 are the severely affected wards. Ward no 2,5,7 and 8 are very low effected wards. Other wards of this union are mostly affected by riverine flood.

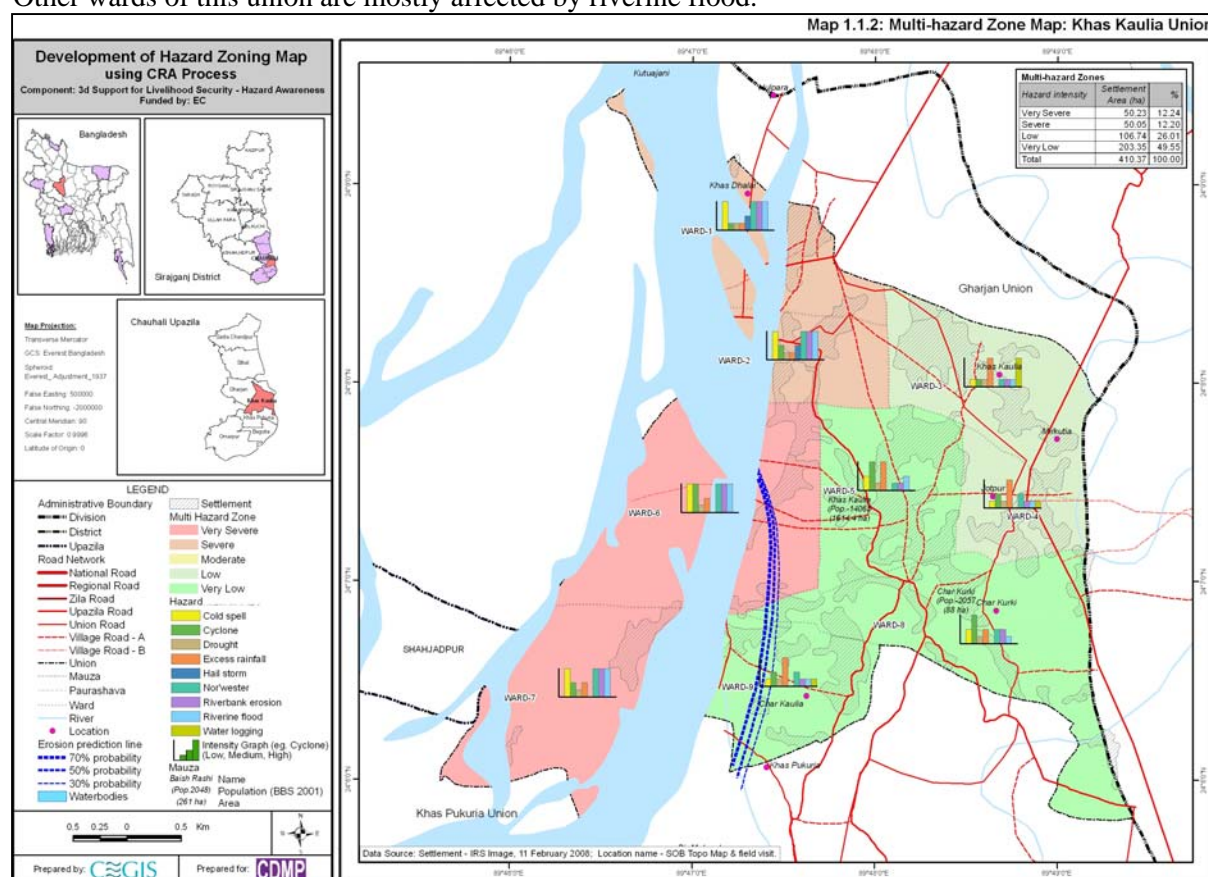


Figure 3.7.2: Multi-hazard Map

Livelihood Map

The map and the table was prepared based on the data collected from field visits. The data shows the settlementwise major livelihood community (farmer, fishermen, businessmen, day labour etc) distribution in the union. The multi-hazard zones are also shown in the map (Figure 3.7.3.a). The detail settlementwise major livelihood group statistics is shown in the related table (Figure 3.7.3.b).

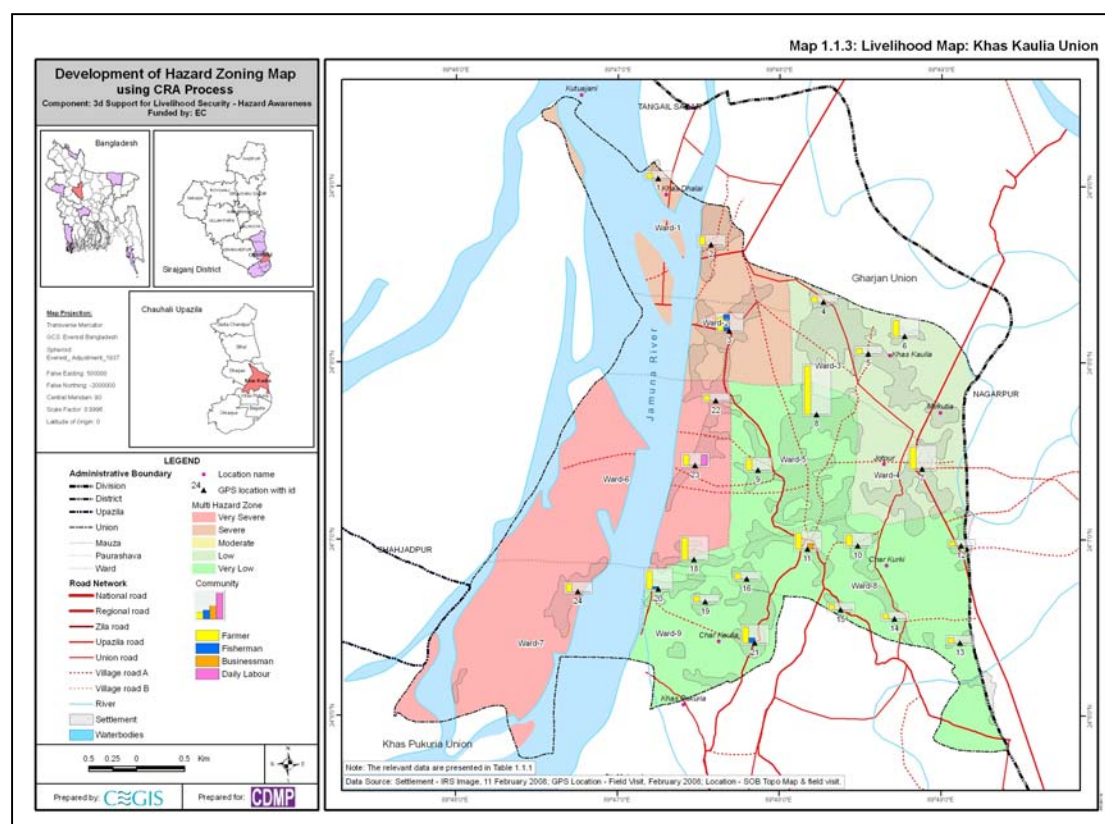


Figure 3.7.3.a: Livelihood map

Table 1.1.1: Major Livelihood Group Information, Khas Kaulia

Polygon ID	Name of Para / Village	Community	Household	Hazard-1	Affected asset	Hazard-2	Affected asset	Hazard-3	Affected assets
1	Paschim Khas Kaulia - Uttar	Farmer	50	River bank erosion	Homestead	Flood	Crops	Excess rainfall	Crops
2	Paschim Khas Kaulia - Uttar	Farmer	75	River bank erosion	Homestead	Flood	Crops	Excess rainfall	Crops
3	Paschim Khas Kaulia - Dakshin	Farmer	125	River bank erosion	Homestead	Flood	Crops	Excess rainfall	Crops
4	Paschim Khas Kaulia - Dakshin	Fisherman	150	River bank erosion	Homestead	Flood	Homestead	Excess rainfall	Fishing
5	Uttar Khas Kaulia	Farmer	50	Flood	Crops	Excess rainfall	Crops	Drought	Crops
6	Uttar Khas Kaulia	Farmer	500	Flood	Crops	Excess rainfall	Crops	Drought	Crops
7	Purba Khas Kaulia	Farmer	150	Flood	Crops	Excess rainfall	Crops	Drought	Crops
8	Maddha Khas Kaulia	Farmer	200	Flood	Crops	Excess rainfall	Crops	Drought	Crops
9	Maddha Khas Kaulia	Farmer	450	Flood	Crops	Excess rainfall	Crops	Drought	Crops
10	Maddha Kurki	Farmer	100	Flood	Crops	Excess rainfall	Crops	Drought	Crops
11	Kurki Collage Para	Farmer	100	Flood	Crops	Excess rainfall	Crops	Drought	Crops
12	Kurki Collage Para	Businessman	150	Flood	Crops	Excess rainfall	Crops	Drought	Crops
13	Kurki Sikder Para	Farmer	50	Flood	Business	Excess rainfall	Business	Nor'wester	Homestead
14	Kurki Sikder Para	Farmer	40	Flood	Crops	Excess rainfall	Crops	Drought	Crops
15	Maddha Kurki	Farmer	50	Flood	Crops	Excess rainfall	Crops	Drought	Crops
16	Kurki Collage Para	Farmer	50	Flood	Crops	Excess rainfall	Crops	Drought	Crops
17	Kurki Paschim Para	Farmer	50	Flood	Crops	Excess rainfall	Crops	Drought	Crops
18	Sikder Para	Farmer	60	Flood	Crops	Flood	Crops	Drought	Crops
19	Paschim Jot Para	Farmer	200	River bank erosion	Homestead	Flood	Crops	Excess rainfall	Crops
20	Dakshin Jot Para	Farmer	50	River bank erosion	Homestead	Flood	Crops	Excess rainfall	Crops
21	Dakshin Khas Kaulia	Farmer	175	River bank erosion	Homestead	Flood	Crops	Excess rainfall	Crops
22	Dakshin Khas Kaulia	Fisherman	25	River bank erosion	Homestead	Flood	Crops	Excess rainfall	Fishing
23	Maddha Khas Kaulia	Farmer	150	Flood	Crops	Excess rainfall	Crops	Drought	Crops
24	Maddha Khas Kaulia	Fisherman	50	Flood	Crops	Excess rainfall	Fishing	Nor'wester	Homestead
25	Paschim Khas Kaulia - Dakshin	Farmer	50	River bank erosion	Homestead	Flood	Crops	Excess rainfall	Crops
26	Chodda Rashi	Farmer	100	River bank erosion	Homestead	Flood	Crops	Excess rainfall	Crops
27	Chodda Rashi	Daily labour	100	River bank erosion	Homestead	Flood	No work	Excess rainfall	No work

Source: Field visit, February, 2008

Temporary Union Parishad, Khas Kaulia Union Parishad Chairman addressing FGD FGD at Khas Kaulia Road damaged by flood Embankment damaged by riverbank erosion

Figure 3.7.3.b: Major livelihood group information

Flood Map

A Digital Elevation Model (DEM) was developed for the study area (Figure 3.7.4) using the DEM of NWRD, which was resampled to 25 meter resolution for the unions/paurashavas as shown in Figure 3.7.4. Flood map for the study area was developed by using the DEM and the nearby BWDB water levels. Flood Map of 1:2 year, 1:5 year and 1:10 year was prepared and area of inundation for F0 (0 - 30 cm), F1 (30 – 90 cm), F2 (90 – 180 cm), F3 (180 - 360 cm) F4 (> 360 cm) was estimated using GIS spatial analysis.

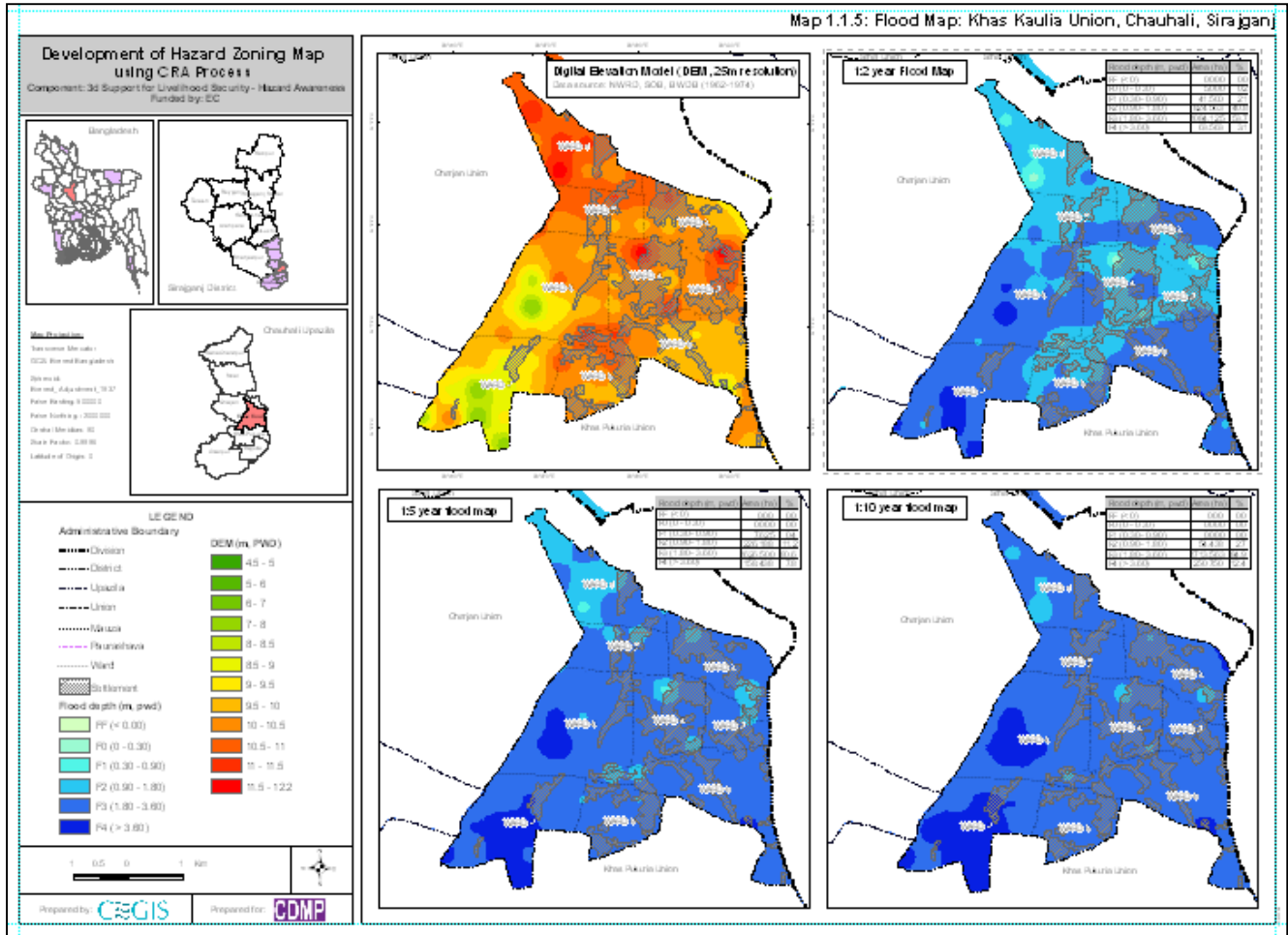


Figure 3.7.4: Flood map

Future vulnerability

CEGIS has developed Riverbank Erosion Prediction Model for predicting the riverbank erosion and morphological changes in some selected sites along the Jamuna, Padma and Ganges rivers using time-series of dry season satellite images. Among the rivers Jamuna river ranks first in terms of erosion extent along its 240 km long reach within Bangladesh. From 1970s to the early 1990s the extent of mean annual erosion was about 3,300 hectares along both banks of the Jamuna river. During the last decade the erosion diminished slightly ranging from 1,000 to 2,500 hectare per year. Within the study area of Hazard Zoning Maps only one union, Khas Kaulia union, Chauhali upazila falls under the erosion prediction model. Figure 3.7.2 shows the riverbank erosion lines in Khas Kaulia union, Chauhali uapzila.

CEGIS has conducted a project where climate change induced sea live rise was evaluated to find the change of flooding in year 2050 and 2080 considering scenarios of IPCC (SLR – 32 cm in 2050 and SLR – 62 cm in 2080). The result in is shown for Moheshkhali in Figure 3.7.5.

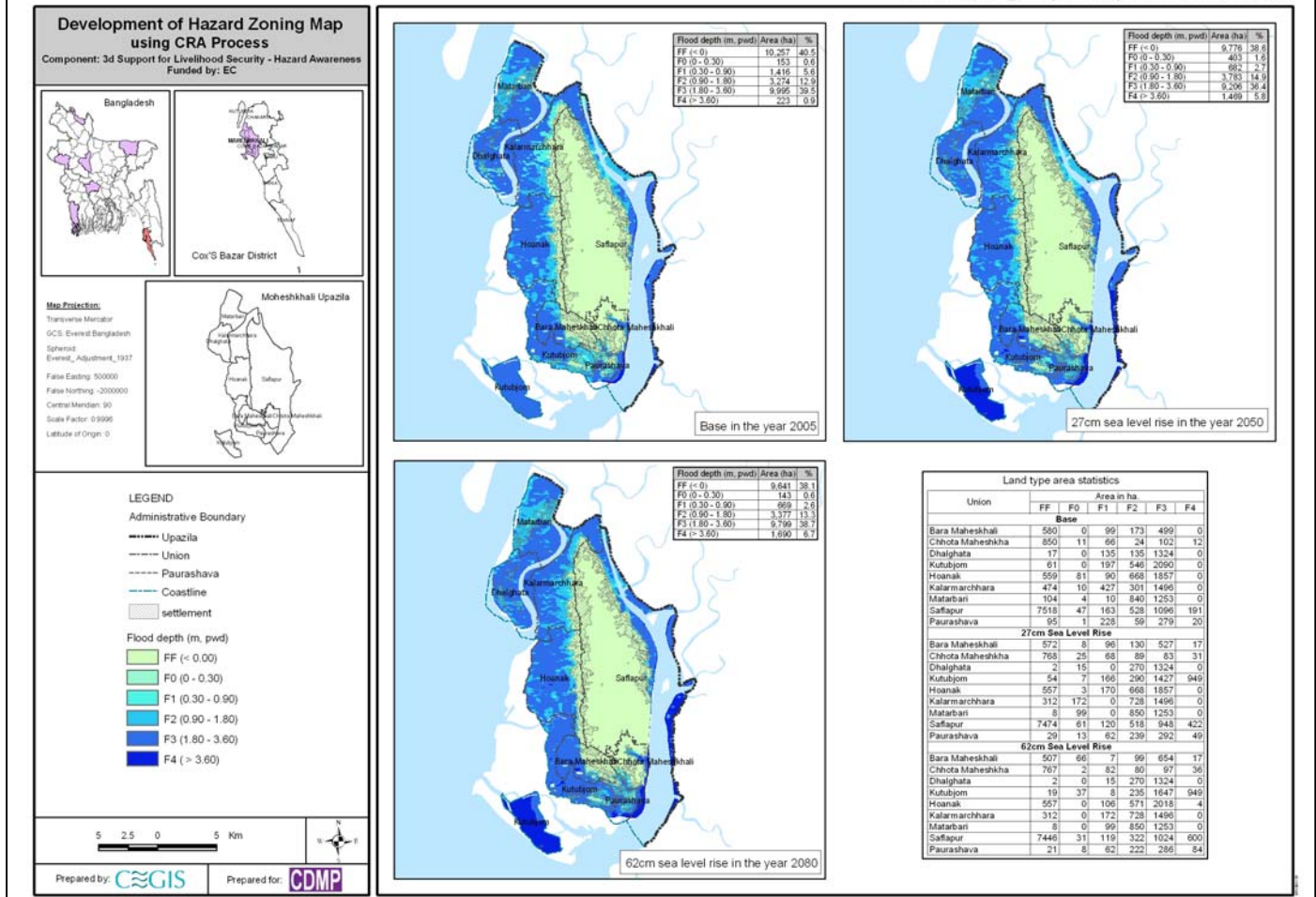


Figure 3.7.5: Impact of sea level rise in Moheshkhali

Chapter 4

Results, Limitations and Recommendations

4.1 Results

The result of this activity has been produced in the form of an Atlas, which consists 67 sets of maps covering 67 unions/paurashavas. Each of the unions/paurashavas consists of 4 maps. The maps are:

- Base Map consists all the basic information of the union
- Multi-hazard Zone Map consists the hazard zones of the unions and the ward wise hazards
- Livelihood Map consists of the livelihood pattern of the union vulnerable to the natural hazards
- Flood Map consists of DEM and Flood Map for 1 in 2 year, 1 in 5 year and 1 in 10 year recurring period.

The methodology of developing the maps has been discussed in the previous chapters in detail.

4.2 Limitations

During the development of the Hazard Zoning Maps, some limitations were felt as presented below:

The CRA reports were not written in a consistent format. Thus it took longer time to review the reports and extract hazard data.

The CRA reports did not have any maps, e.g. Social Map, Hazard Maps, Risk Maps.

Some of the CRA reports were ward wise and some did not follow the ward boundaries, it caused difficulties in validation.

The information in the CRA reports were not compatible for developing Hazard Zoning Maps because of lack of locational information.

The Climate Change Models with local level information was found unavailable. Thus frequency analysis was done for predicting the flooding hazard only.

4.3 Recommendations

The Multi-hazard Zoning Maps are easy, meaningful, scientific, user-friendly, value added outputs of the CRA process. This would be helpful for the local community, planners, disaster managers and decision makers for disaster management and risk reduction activities before, during and after the disasters. These maps will help the decision makers and local users to visualize the natural hazards at the local level to plan and act accordingly.

In future these maps can be more updated with recent information. Time to time GPS survey can be conducted to visualize the changes occurred in the local areas. In addition satellite images can be used to extract latest information on settlements, rivers, roads, community shelters and other service centers etc . Satellite images can be used in the riverbank erosion prone areas to visualize the changes in the river banklines. Pre disaster and post disaster satellite images along with ground investigation can be done to analyze the hazard profile and update the Multi-hazard Zoning Maps.

Guidelines for CRA reports must be applied so that all the CRA reports maintain a standard to make it easier to interpret and useful for preparing hazard zoning maps.

Mapping training for CRA should be given to the CRA NGOs. If mapping becomes a part of the CRA process then Hazard Zoning will become easier and less time consuming.

Initiatives should be taken to translate the Climate Change Model results upto the local level, so that in future climate change can be reflected in the analysis for the development of Hazard Zoning Maps.

Appendix - 1

Addressed issues pointed by CDMP in draft Report on Developing Hazard-zoning Maps based on CRA Process

Comment no.	Issues	Addressed on (page no.)
i.	Figures 1.4.2 to 1.4.8: What are the uses of images- need to be explained	6
ii.	At times very old image have been used (page 12, Figures 1.4.7: Image of year 2000).	12
iii.	At times maps are too small with illegible legend (as Figures 2.2.1 on page 22).	22
iv.	Use of the framework presented in Table 2.2.3 needs to be clarified	28 - 29
v.	Methodology presented on page 28 seemed misplaced because it is under the chapter on literature review (chapter 2). This should have been presented in details under the chapter on Methodology (ie chapter-3).	30
vi.	As per ToR the future vulnerabilities (like vulnerabilities emerged from climate change predictions) need to cover in the report despite that same were not reflected in CRA report.	56 - 57
vii.	Who will use the maps (soft copy & hard copy), for what purposes uses those maps will be used and what will be the process thereof should be further clarified.	59
viii.	How to get the map updated with proper information needs to be spelled out in the set of recommendation	59
ix.	Some issues are still unresolved despite we communicated those to you through our previous feedback and you agreed to act in accordance with our requirements (eg road codes in figure 3.5.8, 3.7.2, 3.7.3 are not complied with RHD and LGED).	44,49,53,54,55
x.	Settlement layers in relevant in figures (eg in figure 3.7.3) need to be updated.	55
xi.	The following assertion should be made in the top of cover page (provided that the present four logos will exist at the topmost position of the cover page and in case of UNDP, the latest logo should be used):	Cover page

Annex - A: FGD detail in Sadarpur upazila

Upazila name	Union Name	Date	Location of FGD	Total participant										
				Male/ Female	UDMC (male/Female)	Farmer	Fishermen	Local elite	Teacher	Imam	Businessman	Service Holder	Social Worker	Hazard effected people
Sadarpur	Sadarpur	17.01.08	Temporary Union Parishad Office, Vill: Sadarpur, Ward: 6, Mauza: Satarorashi, X 23°28'36" Y 90°01'31"	13 /3	10	2	-	-	2	1	-	-	-	-
	Dhewkhali	19.01.08	Union Parishad Office X 23°29'10.0" Y 90°03'07.9"	19 /3	8/ 3	3	1	2	1	1	2	-	1	-
	Akoter Char	19.01.08	Union Parishad Office, X 23°31'45" Y 90°01'18"	-	-	-	-	-	-	-	-	-	-	-
	Char Manair	19.01.08	Temporary Union Parishad Office, Char Bandarkhola Fazil Madrasha, Vill: Hazari Hazirkandi	27 /3	10 /3	3	-	1 4	-	-	-	-	-	-
	Krishnapur	19.01.08	Temporary Union Parishd Office, Vill: Krishnapur, Ward: 2, Mauza: Krishnapur X 23°30'29.1" Y 90°56'01.8"	21 /3	13	6	-	2	2	1	-	-	-	-
	Bhashanch ar	19.01.08	Bhashanchar Union Parishad Office	16 /3	11 /3	2	-	-	-	-	-	-	-	-
	Char Bishnupur	20.01.08	Union Parishad Office, Mulamerdangi High School, Vill: Mulamerdangi	18 /4	8/ 2	6	-	6	-	-	-	-	-	-

Upazila name	Union Name	Date	Location of FGD	Total participant										
				Male/ Female	UDMC (male/Female)	Farmer	Fishermen	Local elite	Teacher	Imam	Businessman	Service Holder	Social Worker	Hazard effected people
	Narikelbaria	21.01.08	Union Parishad Office X 23°30'47.7" Y 90°06'42.6"	20 /2	9/ 2	6	2	-	-	-	2	1	-	-
	Char Nasirpur	21.01.08	Temporary Union Parishad Office, Vill: Khataria, Ward: 2, Mauza: Khataria, X 23°26'25.8" Y 90°04'54.8"	15 /4	12	1	-	2	1	-	-	1	1	-
Chowhali	Khashpukuria	06.02.08	Union council office, Vill-Kodialia, X 24°06'03" Y 89°48'42"	18 /3	11 /3	3	-	3	-	-	-	-	-	2
	Baghutia	09.02.08	Shomvudia Bohumukhi High School, Vill: Baghutia X 24°04'08" Y 89°47'21"	20 /5	9/ 3	3	-	7	-	-	-	-	1	2
	Omarpur	09.02.08	council office, village-Pathrail X 24°02'37" Y 89°46'51"	16 /3	9/ 3	2	-	3	-	-	-	-	-	-
	Sthal	10.02.08	Union council office, vill: Chaluharara X 24°10'07" Y 89°45'36"	20 /1	10 /1	4	-	3	-	-	-	-	-	3
	Gharjan	10.02.08	Union Parishad Office X 24°09'00" Y 89°47'23"	19 /3	11 /3	4	-	3	-	-	-	1	-	-
	Sodia Chandpur	11.02.08	Union council office, vill:Khamargao n, X 24°14'22" Y 89°41'56"	18 /3	11 /3	4	-	2	-	-	-	-	-	1

Upazila name	Union Name	Date	Location of FGD	Total participant										
				Male/ Female	UDMC (male/Female)	Farmer	Fishermen	Local elite	Teacher	Imam	Businessman	Service Holder	Social Worker	Hazard effected people
	Khash Kawlia	16.02.08	Union council office, vill: moddho jotpara, X 24°07'36" Y 89°47'58"	21 /3	9/ 3	3	-	3	-	-	-	-	-	6
Godagari	Mohonpur	06.02.08	Temporary Union Porishod Office; Vill: Digram, Mouza: Cholong Ward-6 X 24°-31'-42.3" Y 88°-21'-38.10"	21 /3	11 /3	3	1	2	-	-	2	2	-	-
	Godagari	10.02.08	Union Porishod Complex Mouza: Aihai, vill: Rahi, ward: 2, X 24°-30'-12.8", Y 88°-24'-34.50"	21 /3	11 /3	4	1	2	-	-	2	1	-	-
	Godagari Paurashava	11.02.08	Paurashava Complex, Godagari X 24°-26'-27.30", Y 88°-17'-54.40"	25 /3	11 /3	3	-	3	-	-	4	-	4	-
	Pakri	12.02.08	Union Porishod Office Place: Iazpur, Mouza: Iazpur Ward 3 X 24°-33'-16.9", Y 88°-27'-28.20"	21 /3	11 /3	2	3	4	-	-	-	1	-	-

Upazila name	Union Name	Date	Location of FGD	Total participant										
				Male/ Female	UDMC (male/Female)	Farmer	Fishermen	Local elite	Teacher	Imam	Businessman	Service Holder	Social Worker	Hazard effected people
	Bashudevpur	13.02.08	Union Porishod Office; Sluice gate Bazar, Mouza: Basubebpur Ward 5; X 24°-31'-42.3", Y 88°-21'-38.10"	22 /3	11 /3	4	1	2	-	-	2	2	-	-
	Char Ashariadaha	14.02.08	Union Porishod Office Mouza-Char Nawsher Ward -6 X 24°-23'-10.8", Y 88°-20'-14.6"	22 /2	11 /2	3	2	2	-	-	2	2	-	-
	Kakonhat	17.02.08	Kakonhat Paurashava Complex, Mouza: Sundorpur, ward: 6 X 24°-30'-41.60", Y 88°-28'-08.80"	23 /3	11 /3	4	1	3	-	-	2	2	-	-
	Rishikul	18.02.08	Union Parishad office, Maroil Ward No-4 X 24°-30'-38.9", Y 88°-29'-57.10"	23 /2	10 /2	3	1	4	-	-	2	1	-	-
	Matikata	20.02.08	Union Porishod Office; Bidhirpur Bazar, Mouza: Bidhirpur Ward-2 X 24°-24'-36.3", Y 88°-22'-39.9"	19 /2	10 /2	3	1	4	-	-	-	1	-	-

Upazila name	Union Name	Date	Location of FGD	Total participant										
				Male/ Female	UDMC (male/Female)	Farmer	Fishermen	Local elite	Teacher	Imam	Businessman	Service Holder	Social Worker	Hazard effected people
	Gogram	23.02.08	Union Porishod Office; Ward-2; X 24°-27'-6.60", Y 88°-24'-54.40"	21 /2	11 /2	4	1	4	-	-	1	-	-	-
	Deopara	24.02.08	Union Porishod Office; Mouza- Palpur, Ward-06; X 24°-24'-27.90", Y 88°-29'-17.00"	23 /2	11 /2	4	1	3	-	-	2	2	-	-
Moheshkhali	Bara Moheshkhali	06.02.08	Union Council Office; X 21°32'5"; Y 91°56'33.4"	25 /3	11 /3	8	-	3	-	-	-	-	-	-
	Dhalghata	05.02.08	Union Council Office Vill: Madham Sutoria, Union: Dhalghata; X 21°40'7.6"; Y 91°51'44.3"	20 /2	10 /2	5	2	4	-	-	-	-	-	-
	Kalarmarchara	08.02.08	Union Council Office; Vill: Jhapua, Union: Kalarmarchara; X 21°41'18.5"; Y 91°55'18.6"	15 /3	8/ 3	4	1	2	-	-	-	-	-	-
	Matarbari	09.02.08	Union Council Office; Vill: Natun Bazar, Union: Matarbari, X 21°43'50.4"; Y 91°53'35.3"	15 /2	8/ 2	5	1	1	-	-	-	-	-	-
	Kutubjum	11.02.08	Union Council Office; X 21°30'48.7"; Y 91°56'41.3"	17 /2	7/ 2	3	4	3	-	-	-	-	-	-

Upazila name	Union Name	Date	Location of FGD	Total participant										
				Male/ Female	UDMC (male/Female)	Farmer	Fishermen	Local elite	Teacher	Imam	Businessman	Service Holder	Social Worker	Hazard effected people
	Moheshkhali Pourashava	13.02.08	Moheshkhali Pourashava Office; X 21°31'9.4"; Y 91°57'37.9"	19 /1	8/ 1	1	1	3	-	-	-	2	-	-
	Shaplapur	13.02.08	Union Council Office; X 21°35.8"; Y 91°58'34.9"	18 /2	10 /2	3	2	3	-	-	-	-	-	-
	Choto Moheshkhali	14.02.08	Union Council Office; Vill: Madham Sutoria, Union: Choto Moheshkhali; X 21°32'30.1"; Y 91°57'56.1"	16 /3	8/ 3	4	1	3	-	-	-	-	-	-
	Hoanak	16.02.08	Union Council Office; X 21°37'32.9"; Y 91°55'27.6"	21 /3	5/ 3	7	2	7	-	-	-	-	-	-
Assasuni	Kulla	04.02.08	Parishad complex. (Village: Gunakarkati, ward: 2, mouza: Gunakarkati, X 22° 37' 20.6'' Y 89° 09' 43.7''.	13 /3	9/ 3	4	-	-	-	-	-	-	-	-
	Budhhata	05.02.08	Union parishad complex; village: Swetpur, ward: 5, mouza: Swetpur; X 22° 36'35'' Y 89° 09' 12.3''	16 /2	9/ 2	5	-	-	-	1	-	-	1	-
	Assasuni	07.02.08	Union Parishad Complex. (Village: Assasuni, ward: 2, mouza: Assasuni; X 22° 32' 46.8'' Y 89° 10' 24.0''	15 /3	10 /3	2	-	1	1	-	-	-	1	-

Upazila name	Union Name	Date	Location of FGD	Total participant										
				Male/ Female	UDMC (male/Female)	Farmer	Fishermen	Local elite	Teacher	Imam	Businessman	Service Holder	Social Worker	Hazard effected people
	Kadakati	09.02.08	Union Parishad Complex. (Village: Mitratentulia, ward: 8, mouza: Mitratentulia; X 22° 34’ 02.3” Y 89° 13’ 06.0”	17 /4	10 /3	4	-	1	1	-	-	-	1	-
	Baradal	11.02.08	Union Parishad Complex. (Village: Buria, ward: 4, mouza: Buria, X 22° 32’ 28.7” Y 89° 14’ 18.3”	13 /3	8/ 3	-	-	2	-	1	-	1	1	-
	Khajra	14.02.08	Union Parishad Complex (village: Durgapur, ward: 2, Mouza: Durgapur; X 22° 28’ 07.6” Y 89° 15’ 23.1”	17 /3	10 /3	3	-	1	1	-	-	1	1	-
	Anulia	16.02.08	Union parishad complex Village: Basudebpur, ward: 5, Mouza: Basudebpur, X 22° 25’ 00.6” Y 89° 13’ 03.7”	11 /2	3/ 2	4	-	1	1	1	-	-	1	-
	Pratapnagar	17.02.08	Pratapnagar Union Parishad; village: Kurikahnia, ward: 3, mouza: Kurikahni, X 22° 23’ 08.8” Y 89° 13’ 16.0”	15 /2	8/ 2	4	-	-	1	1	-	-	1	-

Upazila name	Union Name	Date	Location of FGD	Total participant										
				Male/ Female	UDMC (male/Female)	Farmer	Fishermen	Local elite	Teacher	Imam	Businessman	Service Holder	Social Worker	Hazard effected people
	Sreeula	18.02.08	Union parishad complex, village: Naktara, ward: 5, mouza: Mariala; X 22° 25’ 53.9” Y 89° 10’ 33”	15 /2	10 /2	4	-	-	1	-	-	-	-	-
	Sobhnali	19.02.08	Union parishad comple; village: Kamalkathi, ward: 5, mouza: Kamalkathi; X 22° 33’ 41. 5” Y 89° 05’ 41. 8”	10 /2	3/ 2	5	-	-	1	1	-	-	-	-
	Dargahpur	20.02.08	Union parishad complex; village: Uttar Dargahpur, ward: 7, mouza: Dargahpur; X 22° 35’ 53. 7” Y 89° 15’ 19.2”	14 /2	8/ 2	3	-	1	-	1	-	-	1	-
Dharampa sha	Joyosree	02.03.08	Joyosree Union Porishad; X 24°-57’-26” Y 91°-05’-12”	22 /3	11 /3	7	-	4	-	-	-	-	-	-
	Shukhair Rajapur Dokkhin	04.03.08	Rajapur Bazar Community Center (Temporary office); Rajapur Bazar, Rajapur, X 24°-53’-10”, Y 91°-06’-11”	18 /3	11 /3	3	-	4	-	-	-	-	-	-
	Sukhair Rajapur Uttar	05.03.08	Protappur Govt primary School; Shukhair Rajapur Uttar, X 24°-56’-26”, Y 91°-07’-29”	19 /2	11 /3	2	1	5	-	-	-	-	-	-

Upazila name	Union Name	Date	Location of FGD	Total participant										
				Male/ Female	UDMC (male/Female)	Farmer	Fishermen	Local elite	Teacher	Imam	Businessman	Service Holder	Social Worker	Hazard effected people
	Paikurati	06.03.08	Paikurati Union Porishad, X 24°-58'-08" Y 90°-58'-41"	21 /2	11 /2	5	-	3	-	-	-	1	1	-
	Uttar Bongshikunda	08.03.08	Temporary UP office; Mohesh Khola Bazar , Uttar Bongshikunda Bazar; X 25°-09'-47" Y 91°-58'-41"	19 /3	11 /3	3	-	5	-	-	-	-	-	-
	Chamordani	11.03.08	Moddhanagar Community Hall (Temporary UP office),Moddhanagar Bazar; X 25°-02'-56" Y 90°-59'-30"	20 /3	11 /3	4	2	3	-	-	-	-	-	-
	Maddhanagar	11.03.08	Moddhonagar Union Porishad Hallroom; Moddhonagar Bazar, X 24°-02'-49" Y 90°-59'-27"	19 /3	10 /3	4	2	3	-	-	-	-	-	-
	Selborosh	12.03.08	Shelborosh Union Porishad, X 24°-56'-44" Y 90°-59'-55"	15 /3	9/ 3	2	-	4	-	-	-	-	-	-
	Dokkhin Bongshikunda	15.03.08	Dokkhin Bongshikunda UP office; X 25°-09'-39" Y 91°-00'-11"	15 /3	9/ 3	3	-	3	-	-	-	-	-	-
	Dharmapasha Sadar	16.03.08	Dharampasha Sadar Union Porishad, X 24°-54'-07" Y 91°-01'-14"	9/ 3	8/ 3	-	-	-	-	-	-	1	-	-
Hatibandha	Tongbhang a	13.04.08	Tongbhanga union parishad, X 26°-07'-34" Y 89°-08'-34"	20 /3	11 /3	5	-	4	-	1	-	-	-	-

Upazila name	Union Name	Date	Location of FGD	Total participant										
				Male/ Female	UDMC (male/Female)	Farmer	Fishermen	Local elite	Teacher	Imam	Businessman	Service Holder	Social Worker	Hazard effected people
	Bhelaguri	15.04.08	Bhelaguri union parishad, X 26°-02'-13" Y 89°-14'-24"	20 /3	11 /3	5	-	4	-	-	-	-	-	-
	Borakhata	16.04.08	Borakhata union parishad, X 26°-12'-21" Y 89°-06'-41"	17 /4	8/ 3	3	-	7	-	-	-	-	-	-
	Goddimari	17.04.08	Goddimari union parishad, X 26°-10'-12" Y 89°-05'-55"	18 /4	11 /3	5	-	3	-	-	-	-	-	-
	Gotamari	18.04.08	Gotamari union parishad, X 26°-05'-29" Y 89°-13'-31"	21 /3	11 /3	4	-	6	-	-	-	-	-	-
	Singimari	20.04.08	Singimari union parishad, X 26°-08'-31" Y 89°-07'-40"	22 /2	11 /2	7	-	4	-	-	-	-	-	-
	Dowabari	21.04.08	Dawabari union parishad; X 26°-03'-05" Y 89°-09'-23"	20 /3	11 /3	4	-	5	-	-	-	-	-	-
	Nowdabash	22.04.08	Nowdabash union parishad, X 26°-05'-51" Y 89°-11'-22"	18 /3	10 /3	5	-	3	-	-	-	-	-	-
	Sindurna	24.04.08	Sindurna union parishad, X 26°-07'-17" Y 89°-08'-21"	20 /4	11 /3	4	-	6	-	-	-	-	-	-
	Patikapara	26.04.08	Patika para union parishad, X 26°-04'-41" Y 89°-08'-08"	19 /3	11 /3	3	-	5	-	-	-	-	-	-

Annex - B: Field Report Assasuni union, Satkhira district

Annex B.1 Field report on Anulia union, Assasuni, Satkhira

Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N.M. Alamgir

Location: Anulia union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 24' to 22° 28' and E - 89° 12' 00" to 89° 16'. Anulia union borders with Khajra union in the north, Pratapnagar union is in the south, Sreeula union is in the west and Khulna district (Koyra upazila) is in the east. River Kholpetua and Kobadak flows through the west and the east respectively (see Figure B.1.1.a-b). The union is about 26 kilometers from Upazila Parishad and 52 kilometers (approx.) from District Head Quarter^{[1]–[2]}.

Area and Population: The union is about 37.82 sq. kilometer and the population is about 20650^{[1]–[2]}. According to BBS 2001 census the population is 22,042.

Road network and mode of transport: The road network is very poor, mainly earthen roads and few kilometer herringbones. Mode of transport is van, motorized van, motorcycle and bicycle^[1].

Major Infrastructures: Union Parishad Complex (Figure B.1.2), embankment, culverts, educational institutes (primary, secondary school and madrasa), mosques and temples are the main infrastructures of the union^{[1]–[2]}.

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. Rivers (Kobadak and Kholpetua), canals, marshlands, ponds and ditches are the dominating hydrological features of Anulia union^[1].

Cropping pattern: Shrimp (Baghda) has massively replaced the agriculture, 65% of total cultivated area is under shrimp farm (Gher) and only 35% is used for agricultural crops mainly paddy^[1].

Occupational group: 65% people are engaged in shrimp culture as their main occupation, 30% are fully engaged in agriculture and 5% with other occupation^[1].

Natural hazard: Mostly occurred natural hazards are riverine flood, shrimp virus, salinity, hailstorm, riverbank erosion, cyclone, water logging, arsenic, excess rainfall, and thunderbolt^{[1]–[2]}.

Focus Group Discussion (FGD): One FGD was done in the union on 16 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ❑ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ❑ Representative from shrimp farmer from 3 old wards as major occupational group
- ❑ Farmer as second dominated occupational group
- ❑ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ❑ Government officer Sub- Assistant Agriculture Officer
- ❑ NGO representative

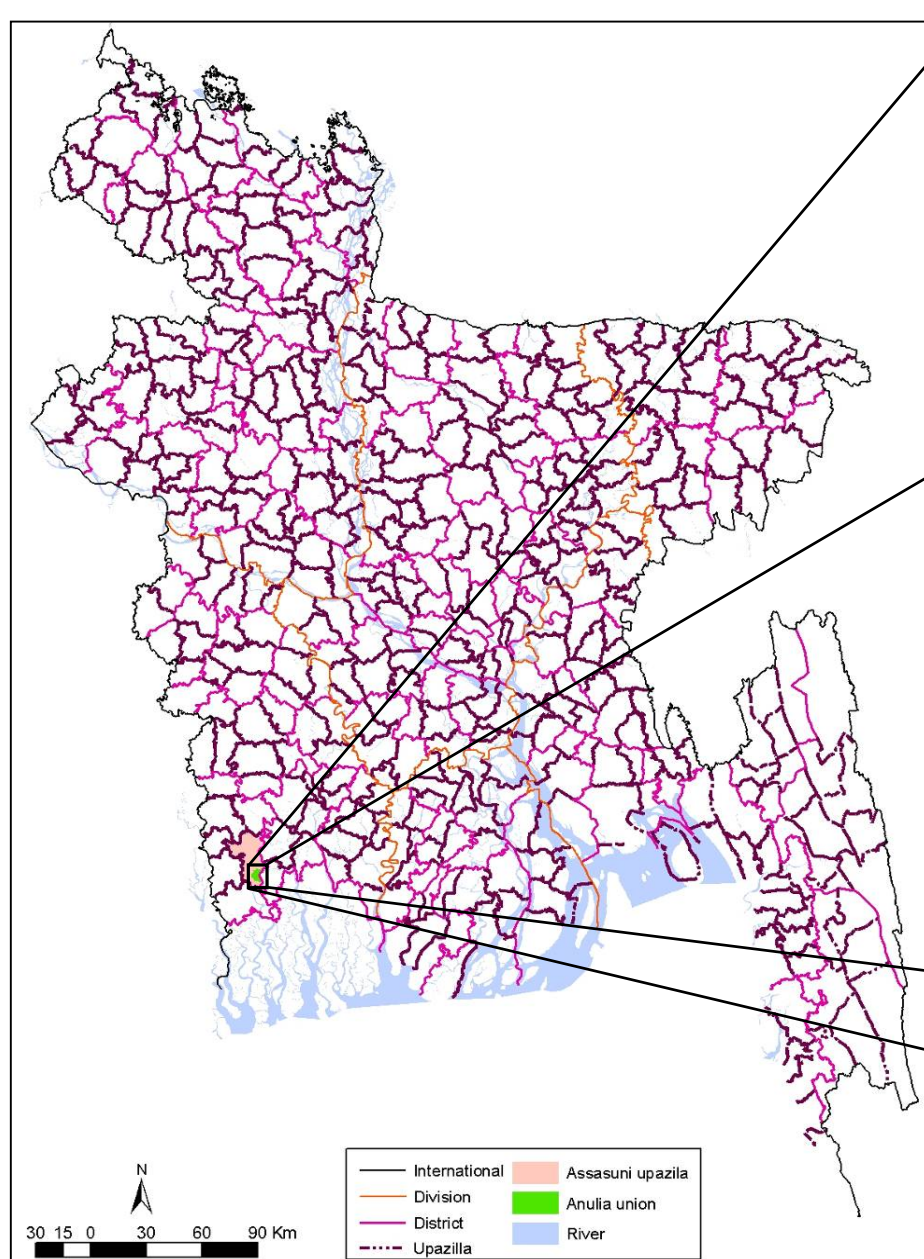


Figure B.1.1.a: Index map showing Anulia union

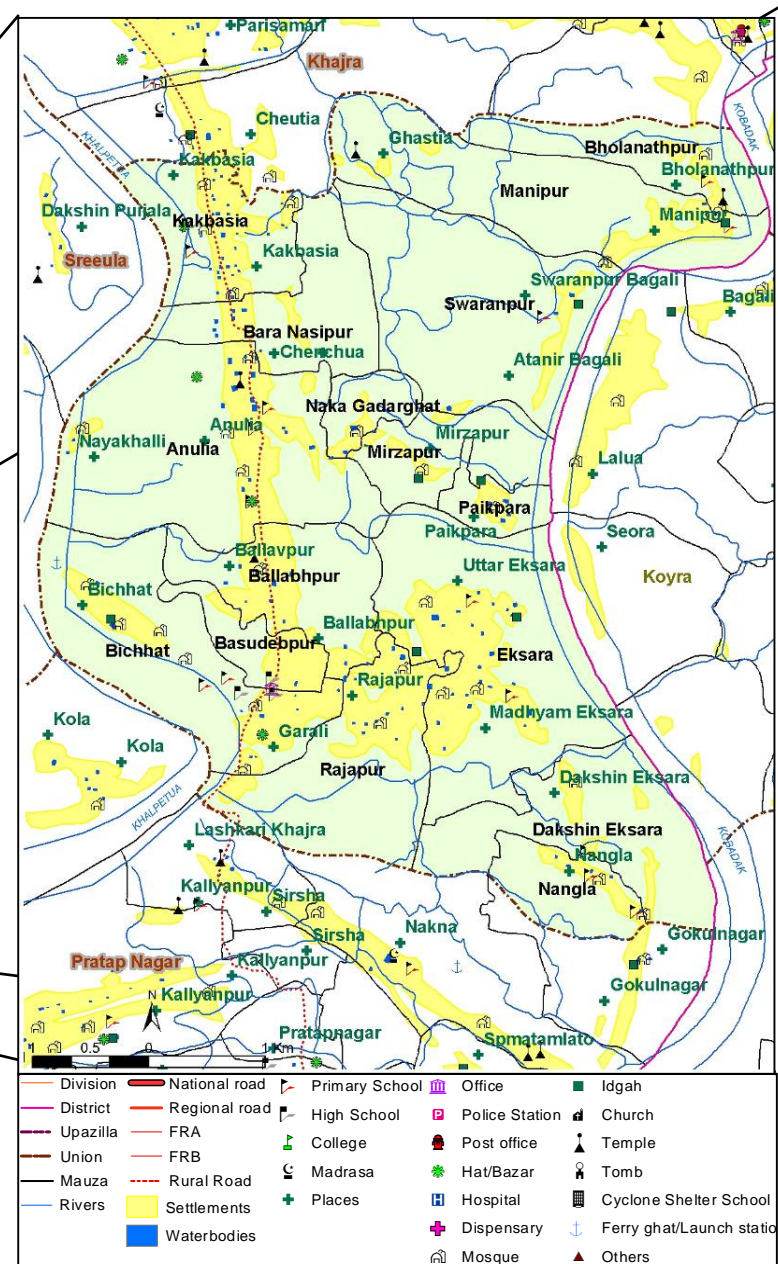


Figure B.1.1.b: Detail of Anulia union



Figure B.1.2: Union Parishad Complex, Anulia

General information on FGD meeting:

Address: Union Parishad complex, Anulia (Village: Basudebpur, Ward: 5, Mouza: Basudebpur,).

GPS location: N 22° 25' 00.6" and E - 89° 13' 03.7"

Date: 16 – 02 – 2008,

Time: 11: 30 am.

Participants:

Total: 13 (Male- 15 and Female- 2)

UDMC: 5 (Chairman- 1, Secretary- 1 and Ward member- 3)

Shrimp: 3

Farmer: 1

Teacher: 1

NGO representative: 1

Purohit: 1

Imam: 1

Figure B.1.3 shows some pictures of FGD at Anulia was chaired by Union Parishad Chairman.



Figure B.1.3: Conducting FGD at Anulia

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.1.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.1.1: Questionnaire 1- List of Hazards, Anulia

Development of Hazard Zoning Maps using CRA
(List of Hazard)

Questionnaire-05/01

Name of key informants: Shahriar / Ragib / Abangir Date: 16.02.08

Union: Anulia Upazila: Assasuni District: Satkhira

Sl No	Hazards
1	Salinity
2	Arsenic
3	Water logging
4	Cyclone
5	Riverine flood
6	Shrimp Virus
7	Hailstorm
8	Thunderbolt
9	Excess rainfall
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

CEGIS CDMP

Table B.1.2: Questionnaire 2 - Hazard information, Anulia

Development of Hazard Zoning Maps using CRA Process

(Hazard information)

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>	Date: <i>16-02-08</i>
Union: <i>Anulia</i>	Upazila: <i>Assasuni</i>
	District: <i>Satkhira</i>

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
Arsenic	January - December	✓	✓	✓	All group
Riverine flood	Mid June - August	✓	✓	✓	All group
Shrimp virus	March – Mid January	✓		Shrimp Farmer	
Water logging	Mid August - Mid February	✓	✓	Shrimp Farmer	
Cyclone	Mid March - Mid April & November	✓	✓	✓	All group
Excess rainfall	Mid June - August	✓	✓	✓	All group
River bank erosion	Mid July - August	✓	✓	Shrimp Farmer	
Salinity	January - December	✓	✓	✓	All group
Hailstorm	Mid March - May	✓	✓	✓	All group
Thunderbolt	Mid February - Mid September	✓	✓	✓	All group

Table B.1.3: Questionnaire 3 - Multi-hazard information, Anulia

Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

Questionnaire-# 03

Name of key informant: *Shahriar / Ragib / Alamgir* Date: *16-02-08*

Union: *Anulia* Upazila: *Assasuni* District: *Satkhira*

Table: Union wise Hazard intensity and frequency information

Ward No.	Parameter	Hazard										
		Salinity	Arsenic	Water log	Cyclone	R. Flood	Shrimp virus	Thunder bolt	Ex. rainfall	R-B. erosion		
01	Intensity	M	H	—	M	H	H	H	H	H	—	
		M	H	—	L	H	H	—	H	H	—	
		M	H	—	H	—	H	—	H	H	—	
	Year of Occurrence	2007	2007	2007	2007	2007	2007	1991	2007	2007	—	
		2006	2006	2006	1991	2006	2006	—	2006	2006	—	
		2005	2005	2005	1988	—	2005	—	2005	2005	—	
02	Intensity	M	H	—	M	H	H	H	H	H	—	
		M	H	—	L	H	H	—	H	H	—	
		M	H	—	H	—	H	—	H	H	—	
	Year of Occurrence	2007	2007	2007	2007	2007	2007	1991	2007	2007	—	
		2006	2006	2006	1991	2006	2006	—	2006	2006	—	
		2005	2005	2005	1988	—	2005	—	2005	2005	—	

C&GIS CDMP

Table B.1.4: Questionnaire 4 - Hazard seasonality index, Anulia

Name of the key informant: <i>Shahriar, Ragib, Alamgir</i>												Date: 16 - 02 - 08												
Union: <i>Anulia</i>						Upazilla: <i>Assasuni</i>						District: <i>Satkhira</i>												
Table Seasonal calendar of the exposed hazards																								
Hazard	Seasonality																							
	M	A	A	M	M	J	J	J	J	A	A	S	S	O	O	N	N	D	D	J	J	F	F	M
	Chaitra	Boishakh	Boishakh	Jaishthya	Jaishthya	Ashar	Ashar	Sravan	Sravan	Bhadra	Bhadra	Ashwin	Ashwin	Kartik	Kartik	Agrahayan	Agrahayan	Poush	Poush	Magh	Magh	Falgun	Falgun	M
Arsenic																								
Riverine flood																								
Shrimp virus																								
Water logging																								
Cyclone																								
Excess rainfall																								
River bank erosion																								
Salinity																								
Hailstorm																								
Thunderbolt																								
Source: FGD at <i>Anulia</i> Union (16 - 02 - 2008)																								
<div><div><div><div></div><div>High</div></div><div><div></div><div>Medium</div></div><div><div></div><div>Low</div></div></div><div><div><div></div><div>CEGIS</div></div><div><div></div><div>CDMP</div></div></div></div>																								

The hazard scenario of Anulia union from FGD and field investigation is summarized as shown in Table B.1.5.

Table B.1.5: Summary of Field investigation, Anulia union

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Riverine flood	<ul style="list-style-type: none"> Embankment breach Overflow of Kholpetua and Kobadak river 	1,2,3,6,9	High	Infrastructure (homestead, roads, embankment, educational institutes, religious centers, bazaars), shrimp farms, cropland, ponds, livestock	People become shelter less, scarcity of drinking water, suffering from water borne diseases, economic losses	
		4,5,7,8	Medium			
Water logging	<ul style="list-style-type: none"> Overflow of Kholpetua and Kobadak river 	4, 5, and 8	High	Shrimp, vegetation, crops	Change in biodiversity, agriculture, and economic losses.	Local people's opinion is that water logging is a
		6,7,9	Medium			

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
	<ul style="list-style-type: none"> Poor drainage system Sealing of sluice gate, Khal leasing Excess rainfall 	Others	No occurrence			hazard because it changed them to shift their occupation from agriculture to shrimp. But from field investigation it came out that these waterlogged areas are now under the shrimp cultivation and people are economically benefited.
Shrimp virus	<ul style="list-style-type: none"> Increase use of Hydrogen Sulphide, Methane and PH rate (> 9.6) Lack of Oxygen, Zooplankton, food 	1 - 9	High	Shrimp loss	Economic loss	
Salinity	<ul style="list-style-type: none"> Lack of fresh water flow Excess shrimp cultivation Saline water intrusion from Bay of Bengal 	6, 7	High	Agriculture, scarcity of safe drinking water	Ecological degradation, agriculture loss, economic loss	
		Other	Medium			
Cyclone	<ul style="list-style-type: none"> Low pressure in the Bay of Bengal 	1 - 9	Medium	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	
Riverbank erosion	<ul style="list-style-type: none"> Excess pressure of 	3 and 6	High	Loss of land, inundation,	Loss of property,	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
	tide on the embankment in the rainy season	8	Low	loss of infrastructure	people become homeless	
		Others	No occurrence	life and property		
Arsenic	• Due to excess withdrawal of ground water	1, 2, 3, 4, 5, 6, 7 and 8	High	Skin disease (Arsenicosis)		
		9	Low			
Excess rainfall	•	1 - 9	High	Shrimp, crops, infrastructure	Loss of life, property, agricultural crops, shrimp	Local people's opinion is that during the last few years
Hail storm	•	1 - 9	High	Shrimp, agricultural crops, infrastructure	Shrimp, crops	
Thunderbolt	•	1 - 9	High	Shrimp, agricultural crops, infrastructure	Shrimp, crops	In 2007, 3 person died (source: FGD)

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.1.6). Figure B.1.7-8 shows the demarcation of the ward boundary map by local community and Union Parishad members.

Table B.1.6: List of wards, mauzas and villages, Anulia union

New wards	Old wards	Mouzas	Villages
1	1	Kakbasia Bara nasirpur	Kakbaria Chenchua Bara Nasirpur Kholardanga
2	1	Monipur Swaranpur	Ghastia Jaliakati Bagali Atani Koitor Bill Hamder kunia
3	1	Monipur Bholanathpur	Monipur Bholanathpur

New wards	Old wards	Mouzas	Villages
4	2	Anulia Paikpara Mirjapur Naka Gadarghat	Anulia Paikpara Mirjapur Naka Gadarghat
5	2	Ballavpur Basudevpur	Ballavpur Basudevpur
6	2	Anulia Bichat Rajapur	Nayakhali Bichat Garali
7	3	Rajapur Eksara	Rajapur Madyam Eksara
8	3	Eksara	Madyam Eksara Uttar Eksara
9	3	Dakshin Eksara Nangla	Dakshin Eksara Nangla



Figure B.1.7: Ward boundary map, Anulia



Figure B.1.8: Demarcation of ward boundaries, Anulia

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of some important features of the union such as historical sites, presence of hazards at the time of FGD, important structures etc.

Important hazards: 1998 – cyclone
1991 – hail storm

Observation: Excess rainfall is a newly identified hazard, which was not in the CRA report. According to the FGD stakeholders, excess rainfall is hampering shrimp, agricultural production. On the other hand riverbed siltation which is included in the CRA report is not reported by the local people.

Conclusion: Major portion of the union is under shrimp cultivation (see Figure B.1.9). The main occupation of people is shrimp culture. According to the local community arsenic, riverine flood and water logging are also major hazard. It is remarkable that shrimp is being cultivated in the water logged areas. According to the local community, excess rainfall occurring during the last few years is one of the causes of water logging.



Figure B.1.9: Shrimp farm in Anulia

Annex B.2 Field report on Kulla union, Assasuni, Satkhira

Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N.M. Alamgir

Location: Kulla union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 34' 25" to 22° 39' 10" and E - 89° 8' 20" to 89° 12' 30". Kulla union borders with Tala upazilla in the north, Budhhata union is in the south, Budhhata union is in the west and Kadakati union in the east. River Betna flows through the west (see Figure B.2.1) ^{[3] – [4]}.

Area and Population: The union is about 18.54 sq. km and the population is about 23500 ^{[3] – [4]}. According to BBS 2001 census the population is 21,889.

Road network and mode of transport: The road network is mainly pucca with few kilometers herringbone and earthen surface. Mode of transport is bus, van, motorized van, motorcycle and bicycle ^[3].

Major Infrastructures: Union Parishad Complex (Figure B.2.2), bridge, culvert, educational institutes (primary, secondary school and madrasa), mosques and temples are the main infrastructures of the union ^{[3] – [4]}.

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. River Betna, canals, marshlands, ponds and ditches are the dominating hydrological features of Kulla union ^[3].

Cropping pattern: Shrimp (Baghda) has massively replaced the agriculture, 80% of total cultivated area is under shrimp farm (Gher) and only 20% is used for agricultural crops mainly paddy ^[3].

Occupational group: 90% people are engaged in shrimp culture as their main occupation, 8% are fully engaged in agriculture and 2% with other occupation ^[3].

Natural hazard: Mostly occurred natural hazards are riverine flood, shrimp virus, salinity, cyclone, water logging, arsenic, hailstorm, cold spell, dense fog, Norwester, riverbed siltation and riverbank erosion ^{[3] – [4]}.

Focus Group Discussion (FGD): One FGD was done in the union on 04 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ☐ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ☐ Representative from shrimp farmer from 3 old wards as major occupational group
- ☐ Farmer as second dominated occupational group
- ☐ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ☐ Government officer Sub- Assistant Agriculture Officer
- ☐ NGO representative

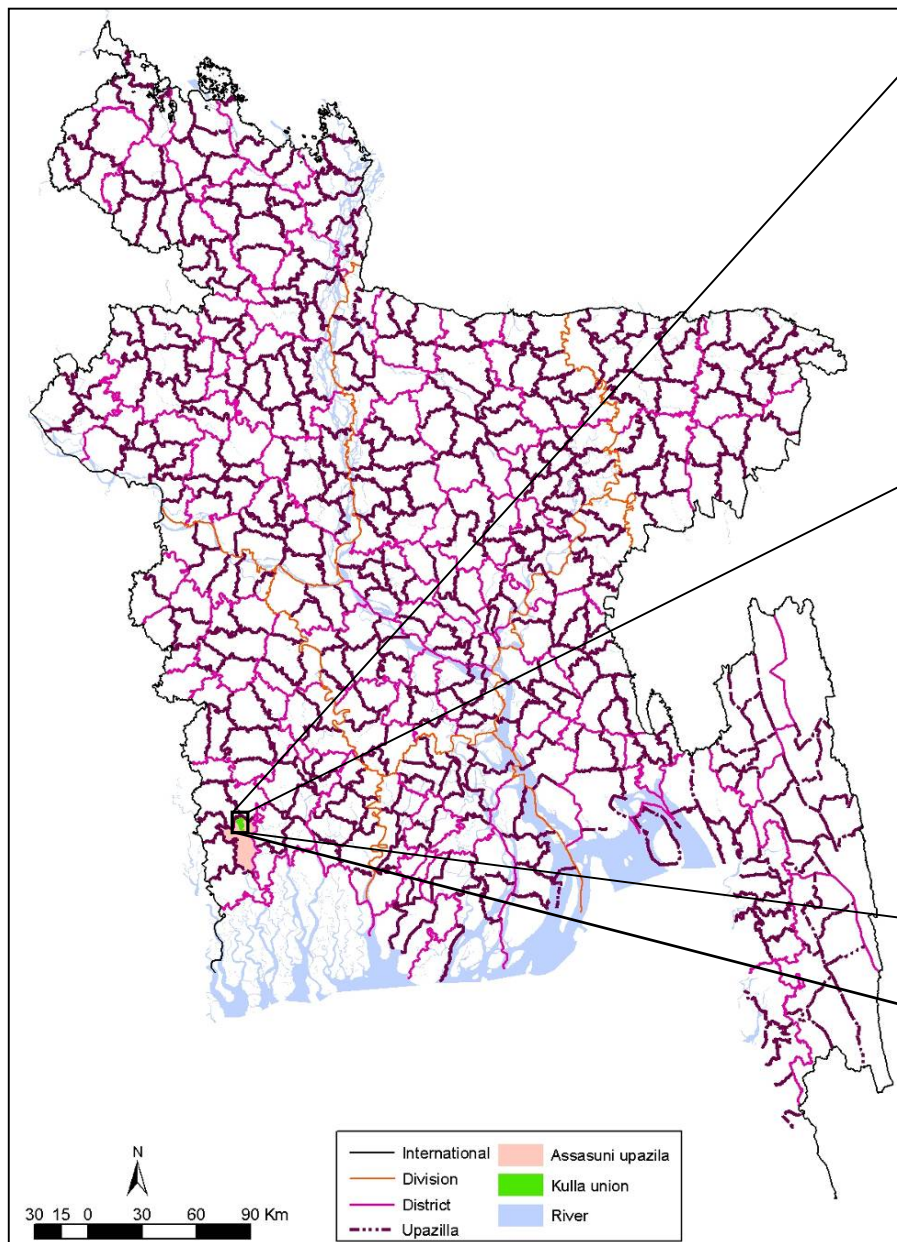


Figure B.2.1.a: Index map showing Kulla union

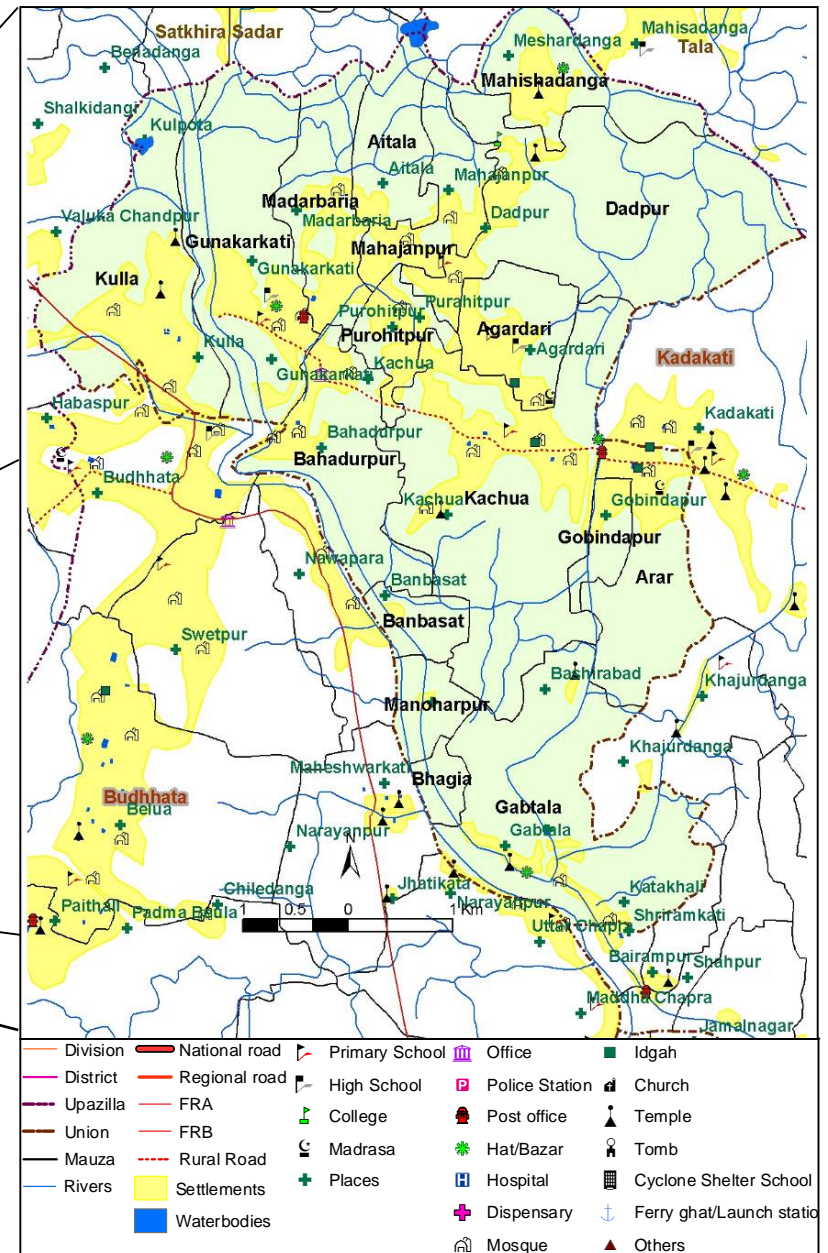


Figure B.2.1.b: Detail of Kulla union



Figure B.2.2: Union Parishad Complex, Kulla

General information on FGD meeting:

Address: Union Parishad complex, Kulla (Village: Gunakarkati, ward: 2, mouza: Gunakarkati)

GPS location: N 22° 37' 20.6" and E - 89° 09' 43.7"

Date: 04 – 02 – 2008,

Time: 10:00 am.

Participants:

Total: 16 (Male- 15 and Female- 2)

UDMC: 12 (Chairman- 1, Secretary- 1 and Ward member- 10)

Shrimp: 4

Figure B.2.3 shows FGD at Kulla was chaired by Union Parishad Chairman.



Figure B.2.3: Conducting FGD at Kulla

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.2.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.2.1: Questionnaire 1- List of Hazards, Kulla

Development of Hazard Zoning Maps using CRA
(List of Hazard)

Questionnaire-08 01

Name of key informants: *Shahriar / Ragib / Abangir* Date: *04.02.08*
 Union: *Kulla* Upazila: *Assasuni* District: *Satkhira*

Sl No	Hazards
1	<i>Arsenic</i>
2	<i>Salinity</i>
3	<i>Water logging</i>
4	<i>River bed siltration</i>
5	<i>Cyclone</i>
6	<i>Shrimp Virus</i>
7	<i>Hailstorm</i>
8	<i>Northwester</i>
9	<i>Smoke fog</i>
10	<i>Cold spell</i>
11	<i>River bank erosion</i>
12	
13	
14	
15	
16	
17	
18	
19	
20	

CAGIS CDMP

Table B.2.2: Questionnaire 2 - Hazard information, Kulla

Development of Hazard Zoning Maps using CRA Process

(Hazard information)

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>	Date: <i>04 – 02- 08</i>
Union: <i>Kulla</i>	Upazila: <i>Assasuni</i> District: <i>Satkhira</i>

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
Arsenic	January - December	✓	✓	✓	All group
Shrimp virus	March – Mid January	✓	✓	Shrimp Farmer	
Water logging	Mid August - Mid February	✓	✓	Shrimp Farmer	
Cyclone	Mid March - Mid April & November	✓	✓	✓	All group
Excess rainfall	Mid June - August	✓	✓	✓	All group
River bank erosion	Mid July - August	✓	✓	Shrimp Farmer	
Salinity	January - December	✓	✓	✓	All group
Hailstorm	Mid March - May	✓	✓	✓	All group
Cold spell	Mid December - Mid February	✓	✓	✓	All group
Dense fog	Mid December - Mid February	✓	✓	✓	All group
Riverbed Siltation	January - December	✓	✓	Shrimp Farmer	

Table B.2.3: Questionnaire 3 - Multi-hazard information, Kulla

Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

Questionnaire-02_05

Name of key informant: <i>Shahriar/ Ragib/ Alamgir</i>	Date: <i>04.02.08</i>
Union: <i>Kulla</i>	Upazila: <i>Assasuni</i> District: <i>Satkhira</i>

Table: Mauza wise Hazard intensity and frequency information

Ward No.	Parameter	Hazard										
		Arsenic	Salinity	Water logging	River bank erosion	Cyclone	Shrimp	Thunder	Excess	Dense fog	Cold spell	Excess
01	Intensity	H	H	H	H	H	H	M	L	H	H	H
		H	H	H	H	H	H	M	H	H	H	M
		H	H	H	H	H	H	M	H	H	H	M
	Year of Occurrence	2007	2007	2007	2007	2007	2007	2003	2007	2006	2006	2007
		2006	2006	2006	2006	1998	2006	1983	2006	2005	2005	2006
		2005	2005	2005	2005	1971	2005	1979	2005	2004	2004	1995
02	Intensity	H	H	H	H	H	H	H	L	H	H	H
		H	H	H	H	H	H	H	H	H	H	M
		H	H	H	H	H	H	H	M	H	H	M
	Year of Occurrence	2007	2007	2007	2007	2007	2007	2003	2007	2006	2006	2007
		2006	2006	2006	2006	1998	2006	1983	2006	2005	2005	2006
		2005	2005	2005	2005	1971	2005	1979	2005	2004	2004	1995

C&GIS

CDMP

Table B.2.4: Questionnaire 4 - Hazard seasonality index, Kulla



The hazard scenario of Kulla union from FGD and field investigation is summarized as shown in Table B.2.5.

Table B.2.5: Summary of Field investigation, Kulla union

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Water logging	<ul style="list-style-type: none"> • Overflow of Betna river • Poor drainage system • Khal leasing • Closing of sluice gate 	1- 9	High	Shrimp, vegetation, crops	Change in biodiversity, agricultural and economical losses	Local people's opinion is that water logging is a hazard because it changed them to shift their occupation from agriculture to shrimp. But from field investigation it came out that these waterlogged areas are now under the shrimp cultivation and people are economically benefited.
	•					
Shrimp virus	<ul style="list-style-type: none"> • Increase use of Hydrogen Sulphide, Methane and PH rate (> 9.6) • Lack of Oxygen, Zooplankton, food 	1 - 9	High	Shrimp loss	Economic loss	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Salinity	<ul style="list-style-type: none"> Lack of fresh water flow from upstream (Morichap river) Excess shrimp cultivation Saline water intrusion from Bay of Bengal 	1 - 9	High	Agriculture, scarcity of safe drinking water	Ecological degradation, change in biodiversity, agriculture loss, economic loss	
Cyclone	<ul style="list-style-type: none"> Low pressure in the Bay of Bengal 	1,2,3,4 and 6	High	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	
		5,7,8 and 9	Medium			
Arsenic	<ul style="list-style-type: none"> Due to excess withdrawal of ground water 	1 - 9	High	Skin disease (Arsenicosis)	Loss of life	
Riverbed siltation	<ul style="list-style-type: none"> Excess upstream erosion Tidal action 	1,2,3,4, 6,8 and 9	High	Flood, sluice gate closure, water logging		
		5 and 7	No occurrence			
Riverbank erosion	<ul style="list-style-type: none"> Excess pressure of tide on the embankment in the rainy season 	1,2,3 and 6	Medium	Loss of land, inundation, loss of infrastructure life and property	Loss of property, people become homeless	
		4,5,7,8 and 9	No occurrence			
Hail storm		2,3,4,5,6,8 and 9	High	Shrimp, agricultural crops, infrastructure	Shrimp, crops	
		1 and 7	Medium			
Cold spell		1,2,3, and 6	High	Shrimp, crops, communication	Agricultural crops, shrimp	
		4,7, and 8	Medium			
		5 and 9	Low			
Dense fog		1,2,3, and 6	High	Shrimp, crops, communication	Agricultural crops, shrimp	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Norwester	•	4,7, and 8	Medium	Shrimp, crops, infrastructure	Loss of life, property, agricultural crops, shrimp	
		5 and 9	Low			
		1,2,3, and 6	Medium			
		4,5,7,8 and 9	Low			

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.2.6). Figure B.2.4 shows the demarcation of the ward boundary map by local community and Union Parishad members.

Table B.2.6: List of wards, mauzas and villages, Kulla union

New wards	Old wards	Mouzas	Villages
1	1	Kulla Benabhanga	Kulla
2	1	Gunakarkati Motherbaria	Gunakarkati Motherbaria
3	1	Bahadurpur	Bahadurpur
4	2	Kachua Hamkura	Kachua Hamkura
5	2	Arar Gobindapur	Arar Gobindapur
6	2	Katakhali Bogia Gabtala Bashtala Monohorpur Bashirabad Bainbasat	Katakhali Gabtala Bashtala Monohorpur Bashirabad Bainbasat
7	3	Agardaria Purohitpur	Agardaria Purohitpur
8	3	Aitala Mohajonpur Dadpur	Aitala Mohajonpur Dadpur(Muslimpara)
9	3	Mohishadanga Dadpur	Mohishadanga Dadpur(Hindupara)

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of the Union Parishad Complex.



Figure B.2.4: Demarcation of ward boundaries, Kulla union

Observation: Norwester, cold spell, dense fog are newly identified hazard, which are not in the CRA report. On the other hand the union does not suffer from drought, which is included in the CRA report is not reported by the local people because the soil is moist for water logging.

Conclusion: Major portion of the union is under shrimp cultivation. The main occupation of people is shrimp culture. According to the stakeholders, arsenic, shrimp virus, riverbed siltation, water logging are the major hazards. It is remarkable that shrimp is being cultivated in the water logged areas.

Annex B.3 Field report on Assasuni union, Assasuni, Satkhira**Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N. M. Alamgir**

Location: Assasuni union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 28' 30" to 22° 33' 25" and E - 89° 7' 50" to 89° 11' 40". Assasuni union borders with Budhhata union in the north, Sreeula union is in the south, Kaliganj upazilla and Shobhnali union is in the west and Khajra and Barada unions are in the east. River Morichap flows through the north, Kholpetua flows through the east and Gutia khali river flows through the west (see Figure B.3.1a-b). The union is about 1 kilometer from Upazilla Parishad and 27 kilometers (approx.) from District Head Quarter ^{[5]–[6]}.

Area and Population: The union is about 22.26 sq. kilometer and the population is about 22,239 ^{[5]–[6]}. According to BBS 2001 census the population is 22,458.

Road network and mode of transport: The road network is mainly pucca and few kilometer herringbone and earthen surface. Mode of transport is bus, van, motorized van, motorcycle and bicycle ^[5].

Major Infrastructures: Assasuni union being the Upazilla head quarter of Assasuni upazilla has plenty of structures such as Upazilla Parishad complex (Figure B.3.2), Union Parishad Complex (Figure B.3.3), Police station (Figure B.3.4.a), Sub-register office (Figure B.3.4.b), Upazilla resource center (Figure B.3.4.c), Upazilla Youth Development Office (Figure B.3.4.d), BRDB office (Figure B.3.4.e), Upazilla Women's Affairs Office (Figure B.3.4.f), Upazilla Social Welfare Office (Figure B.3.4.g) Upazilla Dak Bungalow (Figure B.3.4.h), , culverts, Upazilla education office (Figure B.3.5), Upazilla Public Library (Figure B.3.6), educational institutes (college, primary, secondary school and madrasa,) (Figure B.3.7), bridges (Figure B.3.8), mosques (Figure B.3.9) and temples are the main infrastructures of the union ^{[5]–[6]}.

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. Rivers (Morichap, Kholpetua, Gutia khali), canals, marshlands, ponds and ditches are the dominating hydrological features of Assasuni union ^[5].

Cropping pattern: Shrimp (Baghdha) has massively replaced the agriculture, 90% of total cultivated area is under shrimp farm (Gher) and only 10% is used for agricultural crops mainly paddy ^[5].

Occupational group: 92% people are engaged in shrimp culture as their main occupation, 50% are fully engaged in agriculture and 3% with other occupation ^[5].

Natural hazard: Mostly occurred natural hazards are riverine flood, shrimp virus, salinity, cyclone, water logging, arsenic, hailstorm, cold spell, excess rainfall, riverbed siltation (see Figure B.3.10) and riverbank erosion ^{[5]–[6]}.

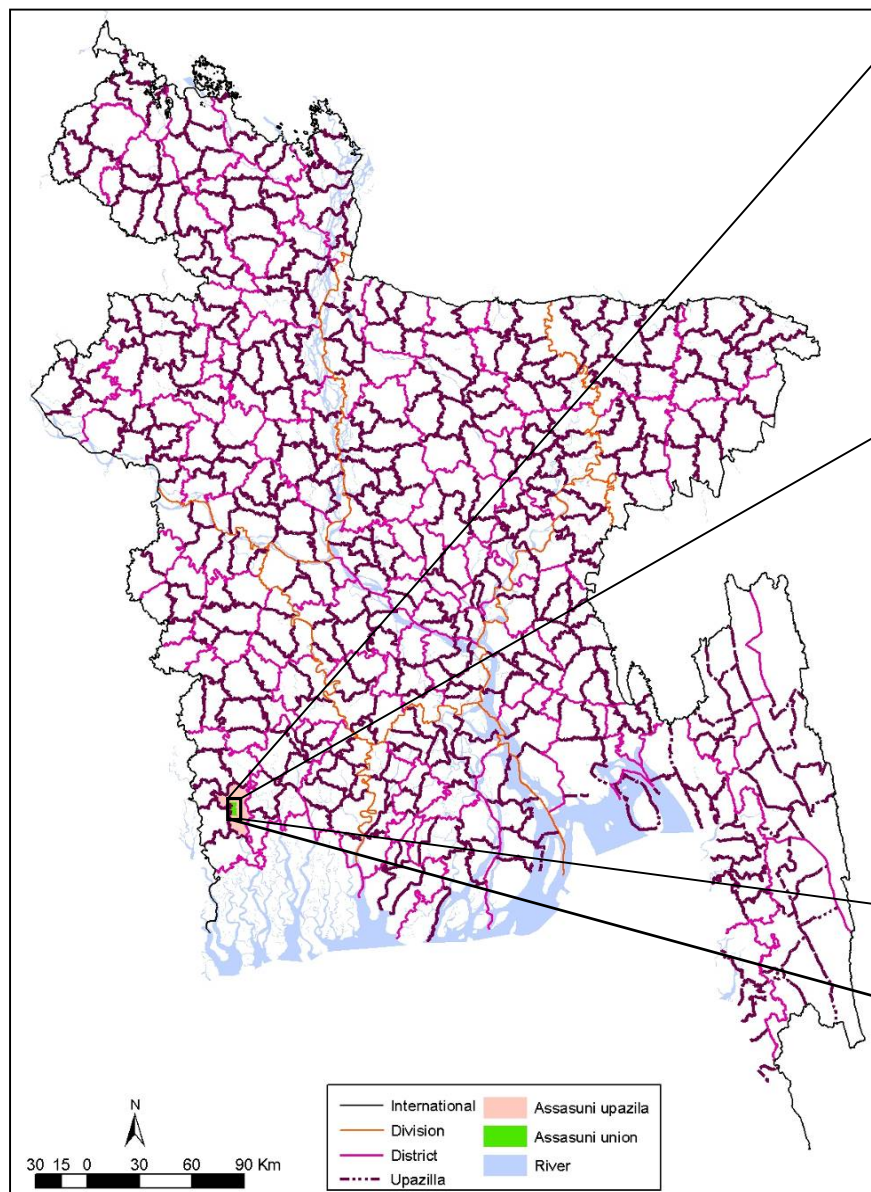


Figure B.3.1.a: Index map showing Assasuni union

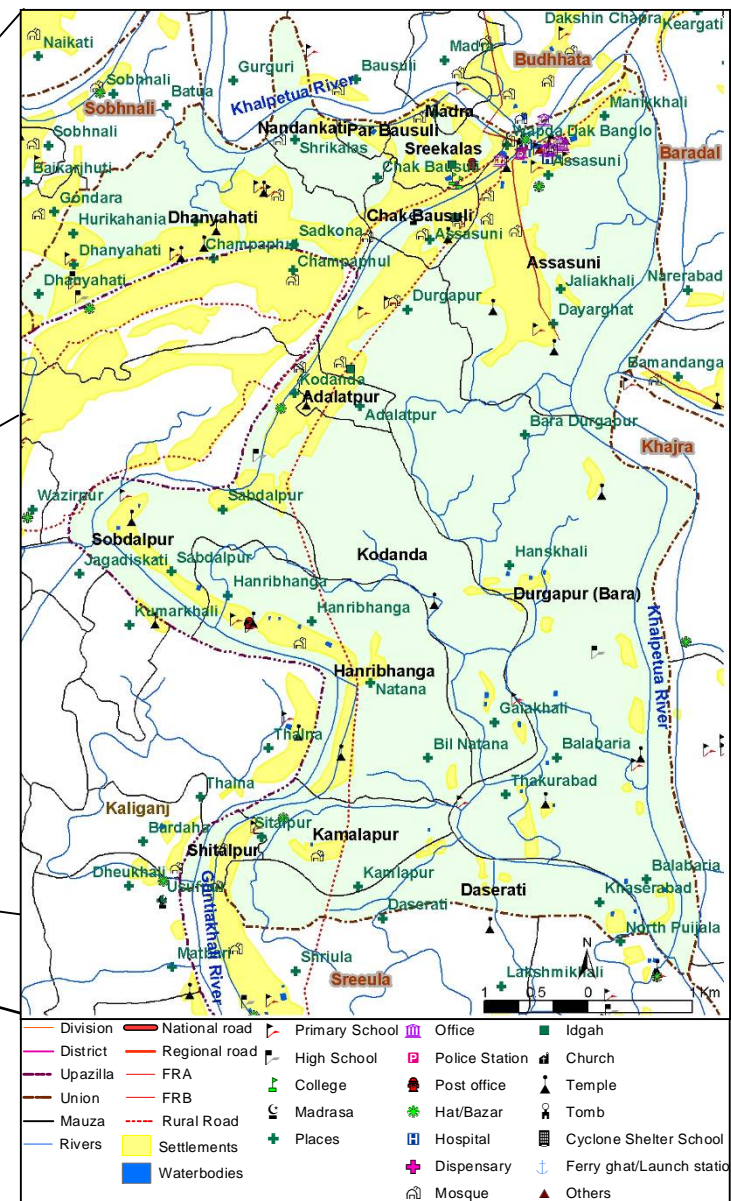


Figure B.3.1.b: Detail of Assasuni union



Figure B.3.2: UNO office, Assasuni



Figure B.3.3: Union Parishad, Assasuni

Focus Group Discussion (FGD): One FGD was done in the union on 07 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ❑ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ❑ Representative from shrimp farmer from 3 old wards as major occupational group
- ❑ Farmer as second dominated occupational group
- ❑ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ❑ Government officer Sub- Assistant Agriculture Officer
- ❑ NGO representative



Figure B.3.4: Local government institutions (A) Police Station (B) Sub-register office (C) Upazilla Resource Center (D) Upazilla Youth Development Office (E) BRDB (F) Upazilla Women's Affairs Office (G) Upazilla Social Welfare Office (H) Upazilla Dak Bungalow



Figure B.3.7: Educational institutes



Figure B.3.8: Morichar bridge



Figure B.3.9: Upazilla Complex Jame Mosque



Figure B.3.10: Riverbed siltation (Morichap river)



Figure B.3.11: Water logging, Assasuni

General information on FGD meeting:

Address: Union Parishad complex, Anulia (Village: Assasuni, Ward: 2, Mauza: Assasuni).

GPS location: N 22° 32' 46.8" and E - 89° 10' 24.0"

Date: 07 – 02 – 2008,

Time: 11: 00 am.

Participants:

Total: 18 (Male- 15 and Female- 3)

UDMC: 13 (Chairman- 1, Secretary- 1 and Ward member- 11)

Shrimp: 2

Teacher: 1

NGO representative: 1

Elite person: 1

Figure B.3.12 shows some pictures of FGD at Assasuni was chaired by Union Parishad Chairman.



Figure B.3.12: Conducting FGD at Assasuni union

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.3.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.3.1: Questionnaire 1- List of Hazards, Assasuni

Development of Hazard Zoning Maps using CRA (List of Hazard)		Questionnaire-08																																										
Name of key informants: Shahriar / Ragib / Alamgir		Date: 07/02/09																																										
Union: Assasuni		Upazila: Assasuni																																										
		District: Satkhira																																										
<table border="1"> <thead> <tr> <th>Sl No</th> <th>Hazards</th> </tr> </thead> <tbody> <tr><td>1</td><td>Shrimp Virus</td></tr> <tr><td>2</td><td>Waterlogging</td></tr> <tr><td>3</td><td>Salinity</td></tr> <tr><td>4</td><td>Arsenic</td></tr> <tr><td>5</td><td>Flood</td></tr> <tr><td>6</td><td>Cyclone</td></tr> <tr><td>7</td><td>Hailstorm</td></tr> <tr><td>8</td><td>Cold spell</td></tr> <tr><td>9</td><td>Excess rainfall</td></tr> <tr><td>10</td><td>River bed siltation</td></tr> <tr><td>11</td><td></td></tr> <tr><td>12</td><td></td></tr> <tr><td>13</td><td></td></tr> <tr><td>14</td><td></td></tr> <tr><td>15</td><td></td></tr> <tr><td>16</td><td></td></tr> <tr><td>17</td><td></td></tr> <tr><td>18</td><td></td></tr> <tr><td>19</td><td></td></tr> <tr><td>20</td><td></td></tr> </tbody> </table>			Sl No	Hazards	1	Shrimp Virus	2	Waterlogging	3	Salinity	4	Arsenic	5	Flood	6	Cyclone	7	Hailstorm	8	Cold spell	9	Excess rainfall	10	River bed siltation	11		12		13		14		15		16		17		18		19		20	
Sl No	Hazards																																											
1	Shrimp Virus																																											
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4	Arsenic																																											
5	Flood																																											
6	Cyclone																																											
7	Hailstorm																																											
8	Cold spell																																											
9	Excess rainfall																																											
10	River bed siltation																																											
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Table B.3.2: Questionnaire 2 - Hazard information, Assasuni*Development of Hazard Zoning Maps using CRA Process***(Hazard information)**

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>		Date: 07 – 02- 08	
Union: <i>Assasuni</i>	Upazila: <i>Assasuni</i>	District: <i>Satkhira</i>	

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer		
Arsenic	January - December	✓	✓	Arsenic	January - December
Riverine flood	Mid June - August	✓	✓	Riverine flood	Mid June - August
Shrimp virus	March – Mid January	✓		Shrimp virus	March – Mid January
Water logging	Mid August - Mid February	✓	✓	Water logging	Mid August - Mid February
Cyclone	Mid March - Mid April & November	✓	✓	Cyclone	Mid March - Mid April & November
Excess rainfall	Mid June - August	✓	✓	Excess rainfall	Mid June - August
River bank erosion	Mid July - August	✓	✓	River bank erosion	Mid July - August
Salinity	January - December	✓	✓	Salinity	January - December
Hailstorm	Mid March - May	✓	✓	Hailstorm	Mid March - May
Cold spell	Mid December - Mid February	✓	✓	Cold spell	Mid December - Mid February
River bed Siltation	January - December	✓	✓	Shrimp Farmer	

Table B.3.3: Questionnaire 3 - Multi-hazard information, Assasuni

Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

Questionnaire-02 03

Name of key informant: *Shahriar / Ragib / Alamgir* Date: *07/02/08*

Union: *Assasuni* Upazila: *Assasuni* District: *Satkhira*

Table: Mauza wise Hazard intensity and frequency information

Ward No.	Parameter	Hazard											
		Shrimp	Water log	Salinity	Arsenic	Flood	Cyclone	Hailstorm	Cold spell	Excess rainfall	River bed siltation	R.B. erosion	
01	Intensity	H	M	H	H	M	H	M	L	M	H	M	
		H	M	H	H	H	L	H	L	M	H	M	
		H	M	H	H	H	H	H	L	M	H	M	
	Year of Occurrence	2007	2007	2007	2007	2003	2007	2007	2007	2006	2007	2007	
		2006	2006	2006	2006	1995	1991	2006	2006	2005	2006	2006	
		2005	2005	2005	2005	1988	1988	1980	2005	1981	2005	2005	
02	Intensity	H	H	H	H	M	H	M	L	H	H	L	
		H	H	H	H	H	L	H	L	H	H	L	
		H	H	H	H	H	H	H	L	H	H	L	
	Year of Occurrence	2007	2007	2007	2007	2003	2007	2007	2007	2006	2007	2007	
		2006	2006	2006	2006	1995	1991	2006	2006	2005	2006	2006	
		2005	2005	2005	2005	1988	1988	1980	2005	1981	2005	2005	

CGIS CDMP

Table B.3.4: Questionnaire 4 - Hazard seasonality index, Assasuni

Development of Hazard Zoning Maps using CRA
Seasonal Hazard Calendar

Questionnaire-03

Name of the key informant: *Shahriar, Ragib, Alamgir* Date: *07 - 02 - 08*

Union: *Assasuni* Upazilla: *Assasuni* District: *Satkhira*

Table: Seasonal calendar of the exposed hazards

Hazard	Seasonality																				
	M	A	M	J	J	J	A	A	S	S	O	O	N	N	D	D	J	J	F	F	M
	Chaitra	Boishakh	Jaishth	Ashar	Shravan	Bhadra	Ashwin	Kartik	Agrahayan	Poush	Magh	Falgun									
Arsenic																					
Riverine flood																					
Shrimp virus																					
Water logging																					
Cyclone																					
Excess rainfall																					
River bank erosion																					
Salinity																					
Hailstorm																					
River bed siltation																					
Cold spell																					

Source: FGD at Assasuni Union (07 - 02 - 2008)

CGIS High Medium Low No occurrence CDMP

The hazard scenario of Assasuni union from FGD and field investigation is summarized as shown in Table B.3.5.

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Riverine flood	<input type="checkbox"/> Embankment breach <input type="checkbox"/> Overflow of Morichap, Kholpetua and Gutiakhali river	1 - 9	High	Infrastructure (homestead, roads, embankment, educational institutes, religious centers, bazaars), shrimp farms, cropland, ponds, livestock	People become shelter less, scarcity of drinking water, suffering from water borne diseases, economic losses	
Water logging	<input type="checkbox"/> Overflow of Morichap, Kholpetua and Gutiakhali river <input type="checkbox"/> Poor drainage system <input type="checkbox"/> Khal leasing <input type="checkbox"/> Sluice gate closure <input type="checkbox"/> <input type="checkbox"/>	2,3,5,6,7,8,and 9	High	Shrimp, vegetation, crops	Change in biodiversity, agriculture, and economic losses.	
		1 and 4	Medium			
		Others	No occurrence			
Shrimp virus	<input type="checkbox"/> Increase use of Hydrogen Sulphide, Methane and PH rate (> 9.6) <input type="checkbox"/> Lack of Oxygen, Zooplankton, food	1 - 9	High	Shrimp loss	Economic loss	
Salinity	<input type="checkbox"/> Lack of fresh water flow from Morichap river <input type="checkbox"/> Excess shrimp cultivation <input type="checkbox"/> Saline water intrusion from Bay of Bengal	1 - 9	High	Agriculture, scarcity of safe drinking water	Ecological degradation, change in biodiversity, agriculture loss, economic loss	
Cyclone	<input type="checkbox"/> Low pressure in the Bay of Bengal	1 - 9	High	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	
Arsenic	<input type="checkbox"/> Due to excess withdrawal of ground water	1 - 9	High	Skin disease (Arsenicosis)	Loss of life	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Riverbed siltation	<input type="checkbox"/> Excess upstream erosion <input type="checkbox"/> Tidal action	1 - 9	High		Flood, water logging, closure of sluice gate	
Riverbank erosion	<input type="checkbox"/> Excess pressure of tide on the embankment in the rainy season	6	High	Loss of land, inundation, loss of infrastructure life and property	Loss of property, people become homeless	
		1	Medium			
		Others	No occurrence			
Hail storm	<input type="checkbox"/>	1 - 9	High	Shrimp, agricultural crops, infrastructure	Shrimp, crops, homestead	
Excess rainfall	<input type="checkbox"/>	2,6,7,8 and 9	High	Shrimp, crops, infrastructure	Loss of property, agricultural crops, shrimp	
		Others	Medium			
Cold spell	<input type="checkbox"/>	1 - 9	High	Shrimp, crops	Loss of property, agricultural crops, shrimp	

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.3.6). Figure B.3.12 shows the demarcation of the ward boundary map by local community and Union Parishad members.



Figure B.3.12: Demarcation of ward boundaries, Assasuni

Table B.3.6: List of wards, mauzas and villages, Assasuni

New wards	Old wards	Mouzas	Villages
1	1	Assasuni	Assasuni Dayarghat Jaliarkati
2	1	Assasuni	Assasuni
3	1	Chak Bausuli Assasuni Madra Sreekalas Par Bausuli Nadankati	Sreekalas Par Bausuli Prosanti Chakbausuli Manikhkali
4	2	Dhanyahati	Dhanyahati Kurikahnia Satkona
5	2	Adalatpur Durgapur	Adalatpur Durgapur
6	2	Baro Durgapur Kodonda	Bolabaria Haskhali Gaiyakhali Thakurabad
7	3	Kodonda Sobdalpur	Kodonda Sobdalpur
8	3	Hanribhanga	Hanribhanga
9	3	Kamlapur Setalpur Daserati	Kamlapur Setalpur Daserati Khaserabad

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of some important features of the union such as local government institutes, educational institutes, presence of hazards at the time of FGD (see Figure B.3. 2 – 11).

Observation: Excess rainfall, hailstorm, riverbank erosion are newly identified hazard, which are not in the CRA report. On the other hand the union does not suffer from drought, which is included in the CRA report is not reported by the local people because the soil is moist for water logging (see Figure B.3. 2 – 12).

Conclusion: Major portion of the union is under shrimp cultivation. The main occupation of people is shrimp culture. According to the local community, riverine flood, riverbed siltation, water logging the major hazards. But shrimp cultivation is also done in the water logged areas.

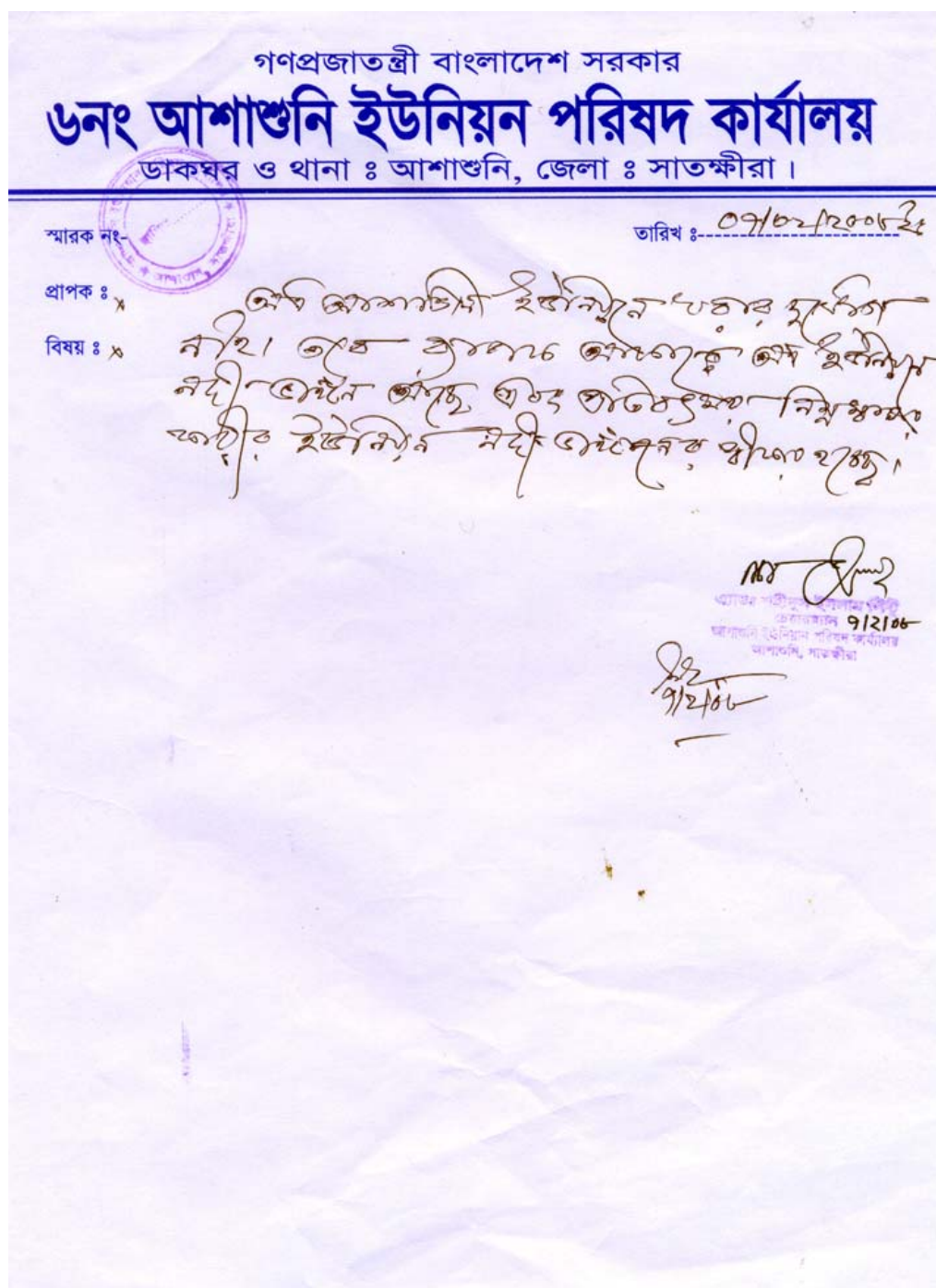


Figure B.3.13: Certificate from Union Parishad

Annex B.4 Field report on Budhhata union, Assasuni, Satkhira**Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N.M. Alamgir**

Location: Budhhata union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 32' 50" to 22° 37' 20" and E - 89° 7' 40" to 89° 11' 30". Anulia union borders with Kulla union in the north, Sobhnali and Assasuni unions in the south, Satkhira Sadar upazilla and Sobhnali union in the west and Kulla and Kadakati unions in the east. River Betna and Morichap flows through the south and south-west respectively (see Figure B.4.1.a-b). The union is about 10 kilometers from Upazila Parishad and 16 kilometers (approx.) from District Head Quarter^{[7]–[8]}.

Area and Population: The union is about 20.585 sq. kilometer and the population is about 25,107^{[7]–[8]}. According to BBS 2001 census the population of Budhhata union is 24,752.

Road network and mode of transport: The road network is mainly earthen roads and few kilometer herringbone and pucca. Mode of transport is bus, van, motorized van, motorcycle and bicycle^[7].

Major Infrastructures: Union Parishad Complex (Figure B.4.2), bridge, culverts, educational institutes (primary, secondary school and madrasa), mosques and temples are the main infrastructures of the union^{[7]–[8]}.

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. Rivers (Betna and Morichap), canals, marshlands, ponds and ditches are the dominating hydrological features of Budhhata union^[7].

Cropping pattern: Shrimp (Baghda) has massively replaced the agriculture, 85% of total cultivated area is under shrimp farm (Gher) and only 15% is used for agricultural crops mainly paddy^[7].

Occupational group: 90% people are engaged in shrimp culture as their main occupation, 8% are fully engaged in agriculture and 2% with other occupation^[7].

Natural hazard: Mostly occurred natural hazards are riverine flood, shrimp virus, salinity, cyclone, water logging, arsenic, hailstorm and dense fog^{[7]–[8]}.

Focus Group Discussion (FGD): One FGD was done in the union on 05 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ❑ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ❑ Representative from shrimp farmer from 3 old wards as major occupational group
- ❑ Farmer as second dominated occupational group
- ❑ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ❑ Government officer Sub- Assistant Agriculture Officer
- ❑ NGO representative

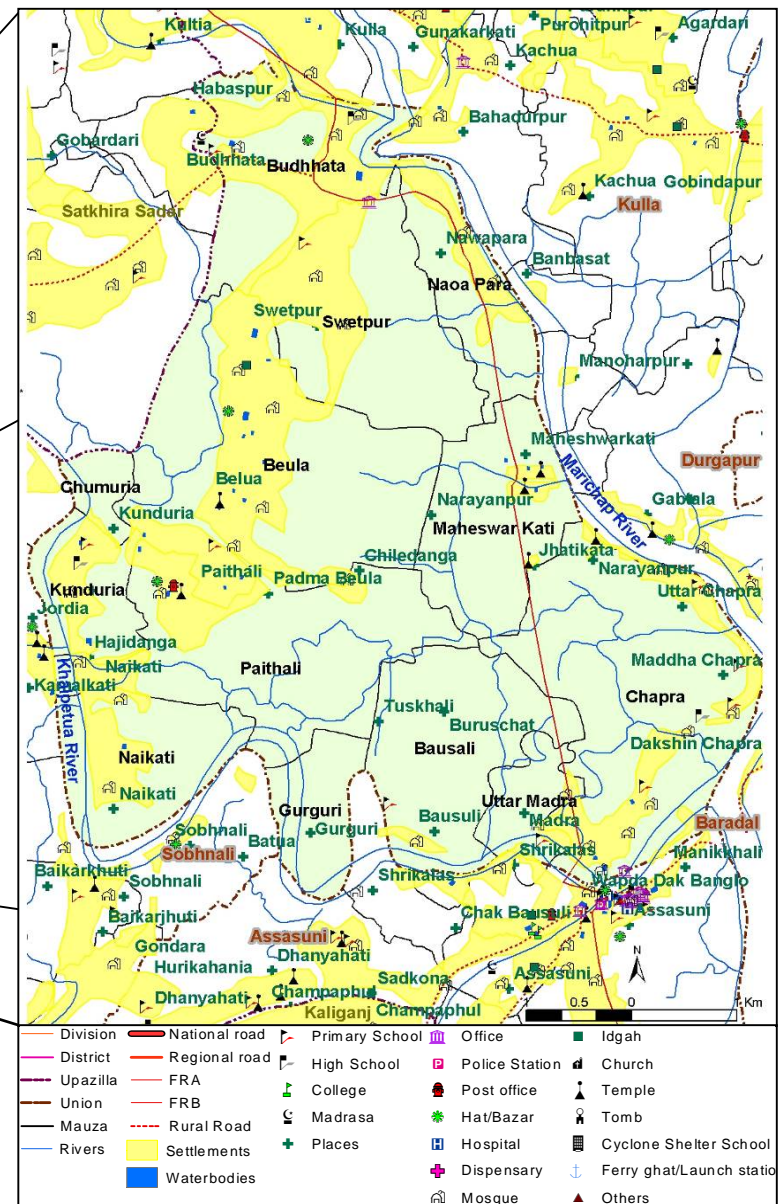
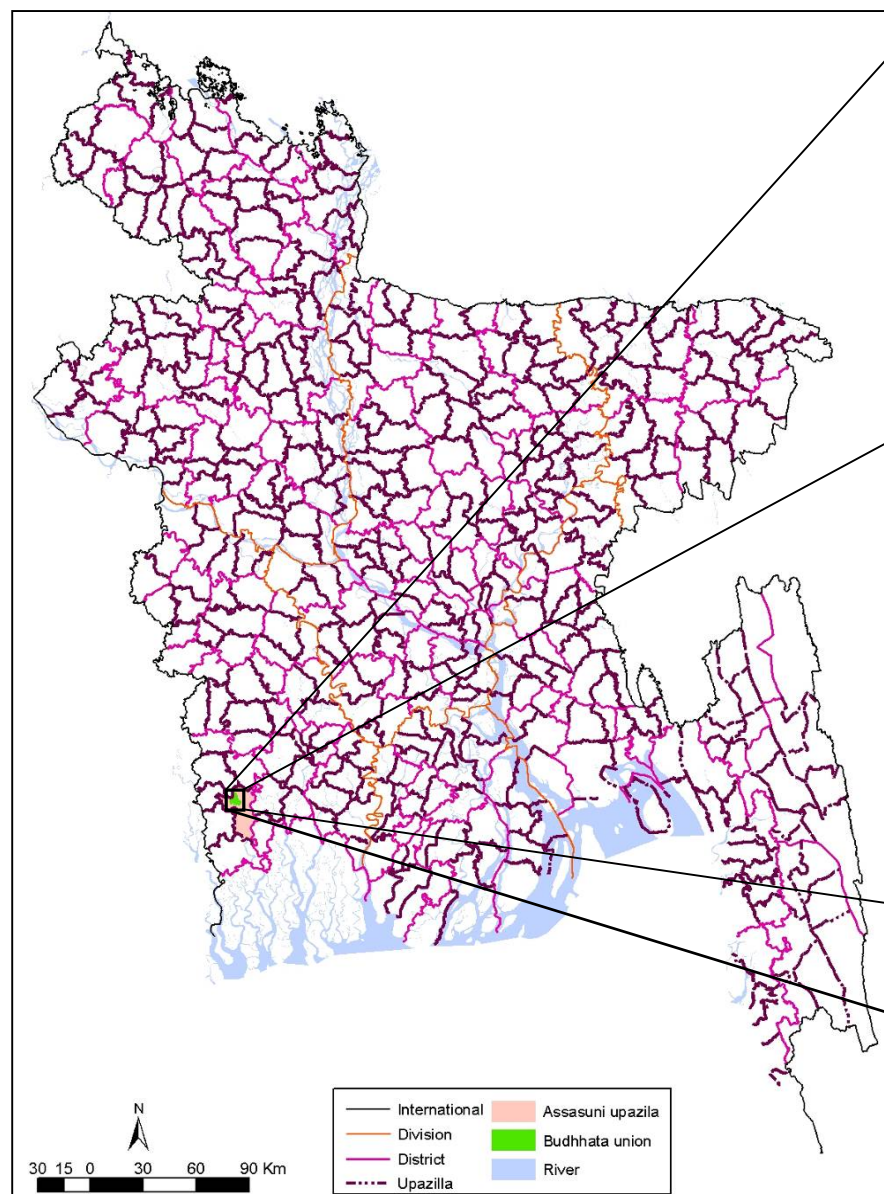




Figure B.4.2: Temporary Union Parishad office, Budhhata

General information on FGD meeting:

Address: Union Parishad complex is not yet build. The FGD was arranged at the temporary union parishad (Village: Swetpur, Ward: 5, Mauza: Swetpur).

GPS location: N 22° 36'35" and E - 89° 09' 12.3"

Date: 05 – 02 – 2008,

Time: 10:00 am.

Participants:

Total: 18 (Male- 16 and Female- 2)

UDMC: 11 (Chairman- 1, Secretary- 1 and Ward member- 9)

Shrimp: 3

Farmer: 2

NGO representative: 1

Imam: 1

Figure B.4.3 shows some pictures of FGD at Budhhata was chaired by Union Parishad Chairman.



Figure B.4.3: Conducting FGD at Budhhata

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.4.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.4.1: Questionnaire 1- List of Hazards, Budhhata

Development of Hazard Zoning Maps using CRA (List of Hazard)		Questionnaire-05 01
Name of key informants: <i>Shahriar / Ragib / Ahmad</i>		Date: <i>05.02.08</i>
Union: <i>Budhhata</i> Upazila: <i>Assasuni</i>		District: <i>Satkhira</i>
Sl No	Hazards	
1	<i>Water logging</i>	
2	<i>Arsenic</i>	
3	<i>Cyclone</i>	
4	<i>Salinity</i>	
5	<i>Shrimp Virus</i>	
6	<i>Hailstorm</i>	
7	<i>Dense fog</i>	
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		






Table B.4.2: Questionnaire 2 - Hazard information, Budhhata

Development of Hazard Zoning Maps using CRA Process

(Hazard information)

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>	Date: <i>05 – 02- 08</i>
Union: <i>Budhhata</i>	Upazila: <i>Assasuni</i>
	District: <i>Satkhira</i>

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
Arsenic	January - December	✓	✓	✓	All group
Riverine flood	Mid June - August	✓	✓	✓	All group
Shrimp virus	March – Mid January	✓		Shrimp Farmer	
Water logging	Mid August - Mid February	✓	✓	Shrimp Farmer	
Cyclone	Mid March - Mid April & November	✓	✓	✓	All group
River bank erosion	Mid July - August	✓	✓	Shrimp Farmer	
Salinity	January - December	✓	✓	✓	All group
Hailstorm	Mid March - May	✓	✓	✓	All group
Dense fog	Mid December - Mid February	✓	✓	✓	All group

Table B.4.3: Questionnaire 3 - Multi-hazard information, Budhhata

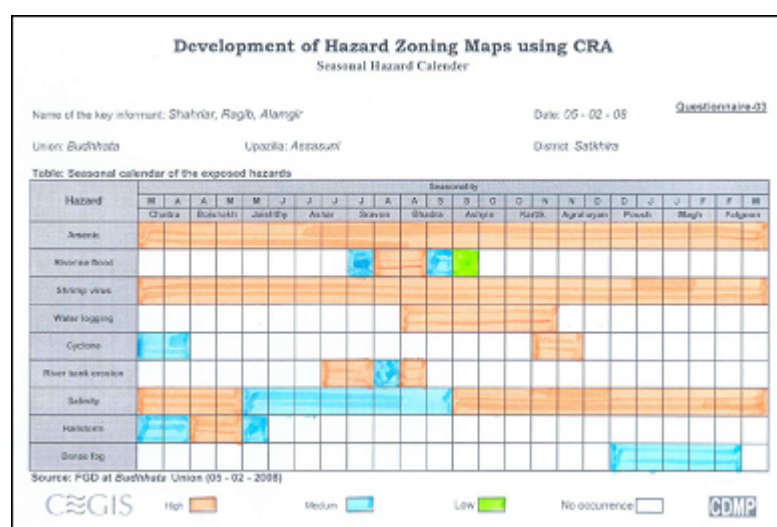
Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

Questionnaire No. 03

Name of key informant: <i>Shahriar / Ragib / Alamgir</i>		Date: <i>05.02.08</i>	
Union: <i>Budhhata</i>		Upazila: <i>Assasuni</i>	
		District: <i>Satkhira</i>	

Table: Mouza wise Hazard intensity and frequency information

Ward No.	Parameter	Hazard									
		Water log	Arsenic	Cyclone	Salinity	Shrimp virus	Hailstorm	Dense fog	R. Flood	R. B. erosion	
01	Intensity	L	H	H	H	H	—	M	H	L	
		L	H	H	H	H	L	M	H	L	
		L	H	M	H	H	M	M	H	L	
	Year of Occurrence	2007	2007	2007	2007	2007	—	2006	1990	2007	
		2006	2006	2004	2006	2006	2004	2005	1987	2006	
		2005	2005	1991	2005	2005	1987	2004	1984	2005	
02	Intensity	L	H	H	H	H	—	M	H	M	
		L	H	H	H	H	L	M	H	M	
		L	H	M	H	H	M	M	H	M	
	Year of Occurrence	2007	2007	2007	2007	2007	—	2006	1990	2007	
		2006	2006	2004	2006	2006	2004	2005	1987	2006	
		2005	2005	1991	2005	2005	1987	2004	1984	2005	

Table B.4.4: Questionnaire 4 - Hazard seasonality index, Budhhata

The hazard scenario of Budhhata union from FGD and field investigation is summarized as shown in Table B.4.5.

Table B.4.5: Summary of Field investigation, Budhhata union

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Water logging	<input type="checkbox"/> Overflow of Betna, Morirchap and Khalpetua river <input type="checkbox"/> Poor drainage system <input type="checkbox"/> Closure of sluice gate, <input type="checkbox"/> Khal leasing <input type="checkbox"/>	6,7,8 and 9	High	Shrimp, vegetation, crops	Change in biodiversity, agriculture, and economic losses.	Local people's opinion is that water logging is a hazard because it changed them to shift their occupation from agriculture to shrimp. But from field investigation it came out that these waterlogged areas are now under the shrimp cultivation and people are economically benefited.
		4 and 5	Medium			
		1,2,3	Low			
Shrimp virus	<input type="checkbox"/> Increase use of Hydrogen Sulphide,	1,2 and 3	High	Shrimp loss	Economic loss	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
	Methane and PH rate (> 9.6) <input type="checkbox"/> Lack of Oxygen, Zooplankton, food	4, 6, 7, 8 and 9	Medium			
		5	No occurrence			
Salinity	<input type="checkbox"/> Lack of fresh water flow from Morichap and Betna river <input type="checkbox"/> Excess shrimp cultivation <input type="checkbox"/> Saline water intrusion from Bay of Bengal	1, 2, 3, 8 and 9	High	Agriculture, scarcity of safe drinking water	Ecological degradation, agriculture loss, economic loss	
		4, 5, 6 and 7	Medium			
Cyclone	<input type="checkbox"/> Low pressure in the Bay of Bengal	1 - 9	High	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	
Arsenic	<input type="checkbox"/> Due to excess withdrawal of ground water	1 - 9	High	Skin disease (Arsenicosis)	Loss of life	
Hail storm	<input type="checkbox"/>	9	Medium	Shrimp, agricultural crops, infrastructure	Shrimp, crops, homestead	Local people's opinion is seasonal fruits are affected. Hailstorm also damages roofs made of Tali.
		1, 2, 3, 4, 5, 6, 7 and 8	Low			
Dense Fog	<input type="checkbox"/>	1 - 9	Medium	Shrimp, agricultural crops, communication	Shrimp, crops	
Riverine flood	<input type="checkbox"/> Embankment breach <input type="checkbox"/> Overflow of Kholpetua, Betna and Morichap	1.2.3.6 and 9	Medium	Infrastructure (homestead, roads, embankment, educational institutes,	People become shelter less, scarcity of drinking water,	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
	Morichap river	5 and 7	No occurrence	institutes, religious centers, bazaars), shrimp farms, cropland, ponds, livestock	water, suffering from water borne diseases, economic losses	

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.4.6). Figure B.4.4 -5 shows the demarcation of the ward boundary map by local community and Union Parishad members.

Table B.4.6: List of wards, mauzas and villages, Budhhata union

New wards	Old wards	Mouzas	Villages
1	1	Bausuli Chapra Madra Gurguri	SouthChapra Madra Bururchak Bausuli Gurguri Tuskhali
2	1	Chapra	Madyam chapra
3	1	Chapra Moheshuar kati	Uttar Chapra Ramdeukati Maheswarkati Navayanpur Jhatikata Kultuardangi
4	2	Naowapura	Naowapara
5	2	Shetpur	Shetpur
6	2	Budhhata	Budhhata
7	3	Beula	Beula Lambadhanha
8	3	Beula Paithali	Chiledanga Padmabeula Paithali
9	3	Kundurua Chumumria Hajidanga Naikathi	Kundurua Chumumria Hajidanga Naikathi

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of some important features of the union such as presence of hazards at the time of FGD, important structures etc.



Figure B.4.4: Ward boundary map, Budhhata



Figure B.4.5: Demarcation of ward boundaries, Budhhata

Important hazards: Riverine flood - 1984, 1987 and 1990
Hailstorm - 1987

Observation: Hailstorm, dense fog are newly identified hazard, which are not in the CRA report. According to the FGD stakeholders, hailstorm damages house roofs and seasonal fruits while dense fog damages agricultural production. On the other hand the union does not suffer from drought, which is included in the CRA report is not reported by the local people because the soil is moist for water logging.

Conclusion: Major portion of the union is under shrimp cultivation (see Figure B.4.6). The main occupation of people is shrimp culture. According to the local community arsenic, shrimp virus, water logging also major hazard (Figure B.4.6). It is to be noted that shrimp is being cultivated in the water logged areas.



Figure B.4.6: Water logging in Budhhata

Annex B.5 Field report on Baradal union, Assasuni, Satkhira

Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N.M. Alamgir

Location: Baradal union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 29' 20" to 22° 34' 00" and E - 89° 11' 10" to 89° 15' 25". Baradal union borders with Daraghpur union in the north, Khajra union in the south, Assasuni and Budhhata unions in the west and Kulla and Khulna district (Paikgacha upazilla) in the east. River Morichap river Kholpetua and river Kobadak flows through the north, west and east respectively (see Figure B.5.1a-b). The union is about 14 kilometers from Upazilla Parishad and 40 kilometers (approx.) from District Head Quarter^[9] –^[10].

Area and Population: The union is about 36 sq. kilometer and the population is about 27,659^[9] –^[10]. According to BBS 2001 census the population of Budhhata union is 26,921.

Road network and mode of transport: The road network is poor mainly earthen roads and few kilometer herringbone. Mode of transport is van, motorized van, motorcycle and bicycle^[9].

Major Infrastructures: Union Parishad Complex (Figure B.5.2), culverts, educational institutes (primary, secondary school and madrasa), mosques, churches (Figure B.5.3) and temples are the main infrastructures of the union^[9] –^[10].

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. Rivers (Morichap, Kholpetua, Kobadak), canals, marshlands, ponds and ditches are the dominating hydrological features of Budhhata union^[9].

Cropping pattern: Paddy (Boro) is mainly cultivated in Baradal union. 90% of total cultivated area is under agriculture and only 10% is used for shrimp cultivation^[9].

Occupational group: 90% people are engaged in agriculture as their main occupation, 5% are fully engaged in shrimp cultivation and 5% with other occupation^[9].

Natural hazard: Mostly occurred natural hazards are riverine flood, shrimp virus, salinity, cyclone, water logging, arsenic, riverbed siltation and riverbank erosion^[9] –^[10].

Focus Group Discussion (FGD): One FGD was done in the union on 12 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ❑ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ❑ Representative from shrimp farmer from 3 old wards as major occupational group
- ❑ Farmer as second dominated occupational group
- ❑ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ❑ Government officer Sub- Assistant Agriculture Officer
- ❑ NGO representative

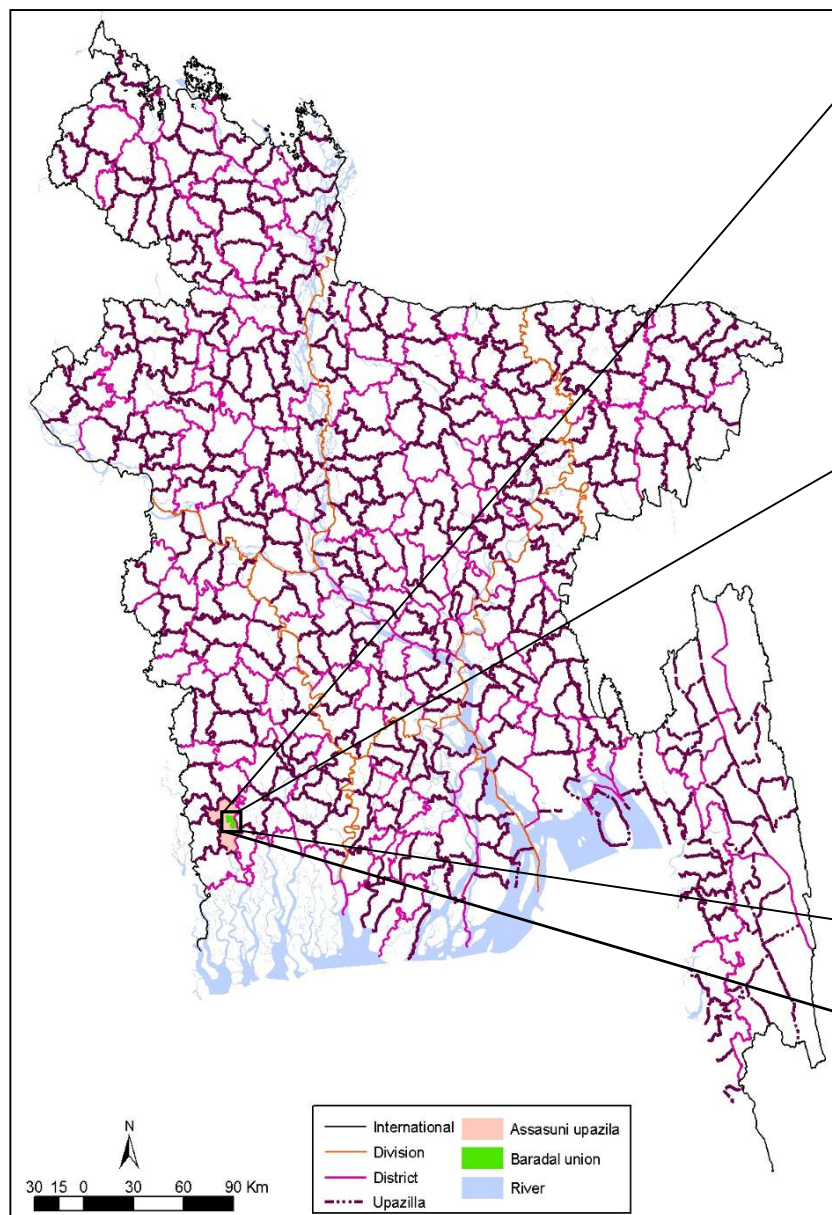


Figure B.5.1.a: Index map of Baradal Union

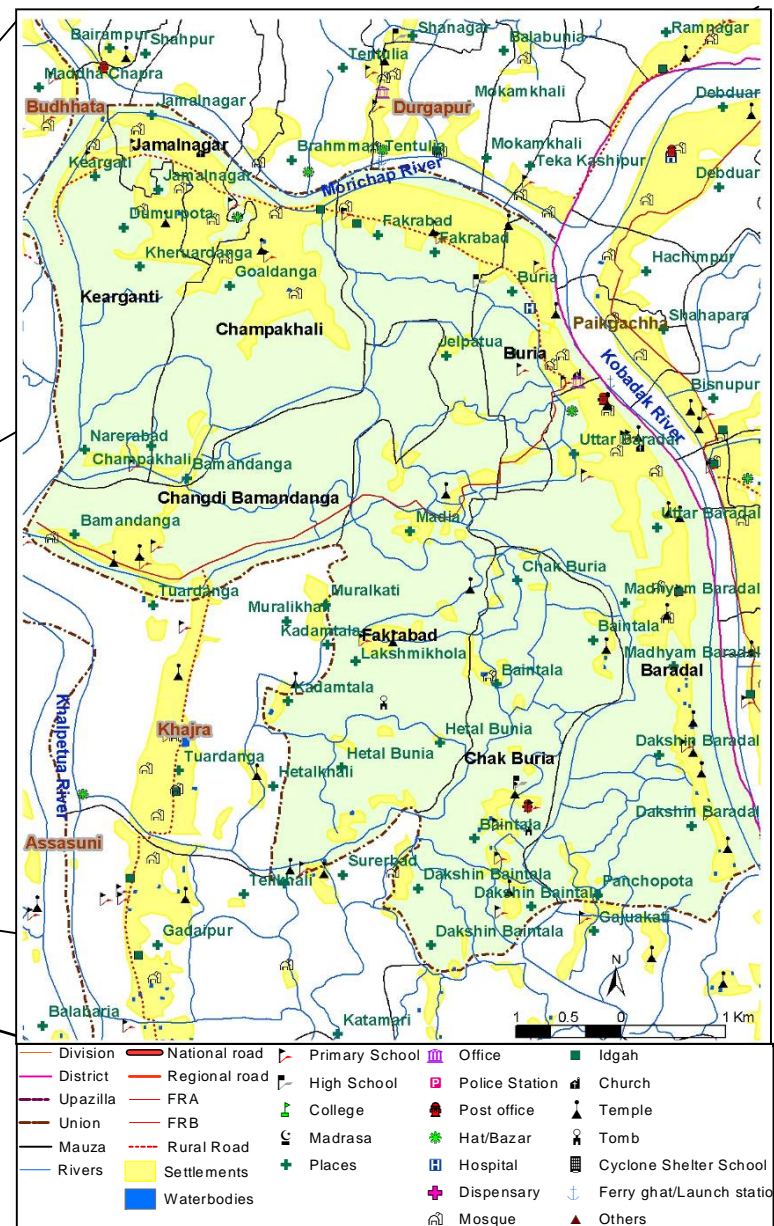


Figure B.5.1.b: Detail of Baradal Union



Figure B.5.2: Union Parishad complex, Baradal



Figure B.5.3: Churches in Baradal

General information on FGD meeting:

Address: Union Parishad complex (Village: Buria, ward: 4, mauza: Buria,).

GPS location: N 22° 32' 28.7" and E - 89° 14' 18.3"

Date: 12 – 02 – 2008,

Time: 12:15 pm

Participants:

Total: 16 (Male- 13 and Female- 3)

UDMC: 11 (Chairman- 1, Secretary- 1 and Ward member- 9)

Imam: 1

NGO representative: 1

Elite person: 2 and Sub-assistant agriculture officer: 1

Figure B.5.4 shows some pictures of FGD at Baradal was chaired by Union Parishad Chairman.



Figure B.5.4: Conducting FGD at Baradal

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.5.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.5.1: Questionnaire 1- List of Hazards, Baradal

Development of Hazard Zoning Maps using CRA (List of Hazard)		Questionnaire-001
Name of the informant:	Shahriar / Rajib / Alauddin	Date: 11.02.08
Union:	Baradal	Upazila: Assasuni
		District: Satkhira

Sl No	Hazard
1	Water logging
2	Arsenic
3	Flood (Riverine)
4	Shrimp Virus
5	Cyclone
6	Overboard salination
7	River bank erosion
8	Salinity
9	Other
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

CEGIS CDMP

Table B.5.2: Questionnaire 2 - Hazard information, Baradal

Development of Hazard Zoning Maps using CRA Process

(Hazard information)

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>	Date: <i>12 – 02- 08</i>
Union: <i>Baradal</i>	Upazila: <i>Assasuni</i>
	District: <i>Satkhira</i>

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
Arsenic	January - December	✓	✓	✓	All group
Riverine flood	Mid June - August	✓	✓	✓	All group
Shrimp virus	March – Mid January	✓		Shrimp Farmer	
Water logging	Mid August - Mid February	✓	✓	Shrimp Farmer	
Cyclone	Mid March - Mid April & November	✓	✓	✓	All group
Riverbank erosion	Mid July - August	✓	✓	Shrimp Farmer	
Salinity	January - December	✓	✓	✓	All group
Riverbed Siltation	January - December	✓	✓	Shrimp Farmer	

Table B.5.3: Questionnaire 3 - Multi-hazard information, Baradal

Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

Questionnaire-03

Name of key informant: *Shahriar / Ragib / Alamgir* Date: *11.02.08*

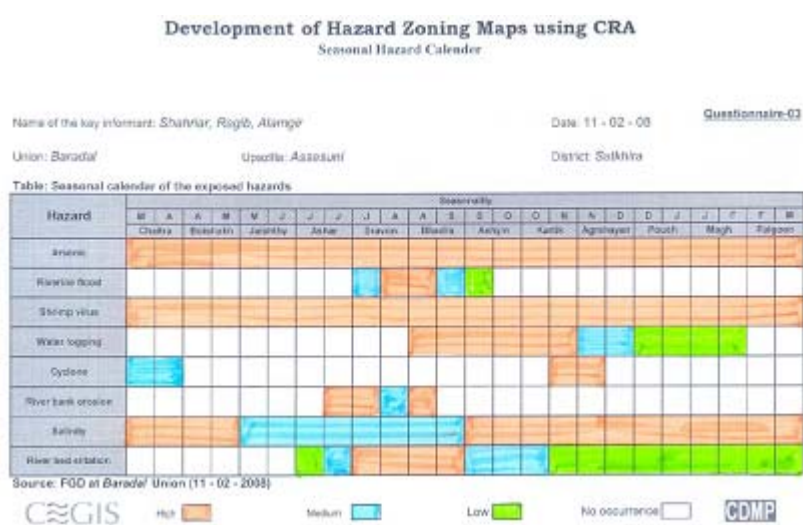
Union: *Baradal* Upazila: *Assasuni* District: *Satkhira*

Table: Mauza wise Hazard intensity and frequency information

Ward No.	Parameter	Hazard							
		Water log	Arsenic	R. Flood	Shrimp V	Cyclone	Riverbed siltation	River bank erosion	Salinity
01	Intensity	H	H	L	H	M	H	-	H
		H	H	L	H	L	H	-	H
		H	H	L	H	H	H	-	H
	Year of Occurrence	2007	2007	2007	2007	2007	2007	-	2007
		2006	2006	1998	2006	1991	2006	-	2006
		2005	2005	1988	2005	1988	2005	-	2005
02	Intensity	H	H	H	H	M	H	H	H
		H	H	H	H	L	H	H	H
		H	H	H	H	H	H	H	H
	Year of Occurrence	2007	2007	2007	2007	2007	2007	2007	2007
		2006	2006	1998	2006	1991	2006	1998	2006
		2005	2005	1988	2005	1988	2005	1988	2005

CGIS

CDMP

Table B.5.4: Questionnaire 4 - Hazard seasonality index, Baradal

The hazard scenario of Baradal union from FGD and field investigation is summarized as shown in Table B.5.5.

Table B.5.5: Summary of Field investigation, Budhhata union

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Riverine flood	<input type="checkbox"/> Embankment breach <input type="checkbox"/> Overflow of Kholpetua, Kobadak and Morichap river	2,7 and 9	High	Infrastructure (homestead, roads, embankment, educational institutes, religious centers, bazaars), shrimp farms, cropland, ponds, livestock	People become shelter less, scarcity of drinking water, suffering from water borne diseases, economic losses	
		Others	Low			
Water logging	<input type="checkbox"/> Overflow of Kobadak, Morichap and Khalpetua river <input type="checkbox"/> Poor drainage system <input type="checkbox"/> Closure of sluice gate, <input type="checkbox"/> Khal leasing <input type="checkbox"/>	1,2,5,6,7,8 and 9	High	Shrimp, vegetation, crops	Change in biodiversity, agriculture, and economic losses.	
		3 and 4	Medium			

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Shrimp virus	<input type="checkbox"/> Increase use of Hydrogen Sulphide, Methane and PH rate (> 9.6) <input type="checkbox"/> Lack of Oxygen, Zooplankton, food	1 - 9	High	Shrimp loss	Economic loss	
Salinity	<input type="checkbox"/> Lack of fresh water flow from Morichap and Kobadak and Kholpetua rivers <input type="checkbox"/> Excess shrimp cultivation <input type="checkbox"/> Saline water intrusion from Bay of Bengal	1 - 9	High	Agriculture, scarcity of safe drinking water	Ecological degradation, agriculture loss, economic loss	
Cyclone	<input type="checkbox"/> Low pressure in the Bay of Bengal	1 - 9	High	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	
Arsenic	<input type="checkbox"/> Due to excess withdrawal of ground water	1 - 9	High	Skin disease (Arsenicosis)	Loss of life	
Riverbed siltation	<input type="checkbox"/> Excess upstream erosion <input type="checkbox"/> Tidal effects	1,2,3,4,7,8 and 9	High	Flood, closure of sluice gate, water logging		
		5 and 6	No occurrence			
Riverbank erosion	<input type="checkbox"/> Excess pressure of tide on the embankment	2,7 and 9	High	Loss of land, inundation, loss of people	Loss of property, people	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
	the embankment in the rainy season	Others	No occurrence	loss of infrastructure life and property	people become homeless	

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.5.6). Figure B.5.5 -6 shows the demarcation of the ward boundary map by local community and Union Parishad members.

Table B.5.6: List of wards, mauzas and villages, Baradal

New wards	Old wards	Mouzas	Villages
1	1	Champakhali Bamondanga	Champakhali, Bamondanga, Narerabad
2	1	Keargati Jamalnagar	Keargati, Jamalnagar, Dumurpota
3	1	Champakhali	Goaldanga, Kheruardanga
4	2	Fakrabad, Buria	Fakrabad, Buria
5	2	Fakrabad	Murarikati, Laxmitala, Jailpotua Kadamtala, Madia, Hetalbunia
6	2	Baintala Chak Buria	Uttar Baintala, Modyam Baintala Dokshin Baintala
7	3	Baradal	Uttar Baradal, Baradal Bazar Christianpara
8	3	Baradal	Modyam Baradal, Majherdanga
9	3	Baradal	Dokshin Baradal, Pachpota

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of some important features of the union such as presence of hazards at the time of FGD, important structures etc.

Important hazards: Cyclone – 1988

Observation: Salinity and riverbed siltation are newly identified hazard, which are not in the CRA report.

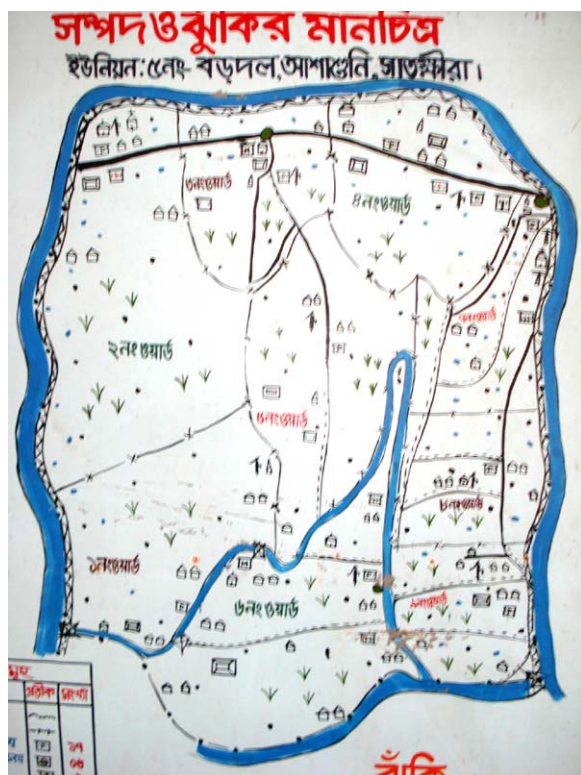


Figure B.5.5: Ward boundary map, Baradal



Figure B.5.6: Demarcation of ward

Conclusion: Baradal union is dominated by agriculture (see Figure B.5.7). According to the local community arsenic and water logging are the major hazards.



Figure B.5.7: Cultivating paddy in Baradal

Annex B.6 Field report on Pratapnagar union, Assasuni, Satkhira**Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N.M. Alamgir**

Location: Pratapnagar union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 20' 35" to 22° 25' 25" and E - 89° 11' 00" to 89° 16' 20". Parapnagar union borders with Anulia union in the north, Shyamnagar upazilla in the south, Sreeula union in the north-west and Paikgacha upazilla in the east. River Kholpetua and river Kobadak flows through the west and east respectively (see Figure B.6.1.a- b). The union is about 34 kilometers from Upazilla Parishad and 62 kilometers (approx.) from District Head Quarter^{[11]–[12]}.

Area and Population: The union is about 16.70 sq. kilometer and the population is about 25,083^{[11]–[12]}. According to BBS 2001 census the population of Pratapnagar union is 25,932.

Road network and mode of transport: The road network is poor mainly earthen roads and few kilometer herringbone. Mode of transport is van, motorized van, motorcycle and bicycle^[9].

Major Infrastructures: Union Parishad Complex (Figure B.6.2), cyclone shelter centre (by Karitash NGO), culverts, educational institutes (primary, secondary school and madrasa) (Figure B.6.3), mosques, churches, and temples are the main infrastructures of the union^{[11]–[12]}.

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. Rivers (Kholpetua, Kobadak), canals, marshlands, ponds and ditches are the dominating hydrological features of Pratapnagar union^[11].

Cropping pattern: Shrimp (Baghda) has replaced massively the agricultural land. 70% of the total cultivated are is under shrimp farm (Gher) and only 30% is used for agriculture^[11].

Occupational group: 90% people are engaged in shrimp cultivation as their main occupation, 8% are fully engaged in agricultural activities and 2% with other occupation^[11].

Natural hazard: Mostly occurred natural hazards are riverine flood, shrimp virus, salinity, hail storm, riverbank erosion, cyclone and water logging^{[11]–[12]}.

Focus Group Discussion (FGD): One FGD was done in the union on 17 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ❑ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ❑ Representative from shrimp farmer from 3 old wards as major occupational group
- ❑ Farmer as second dominated occupational group
- ❑ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ❑ Government officer Sub- Assistant Agriculture Officer
- ❑ NGO representative

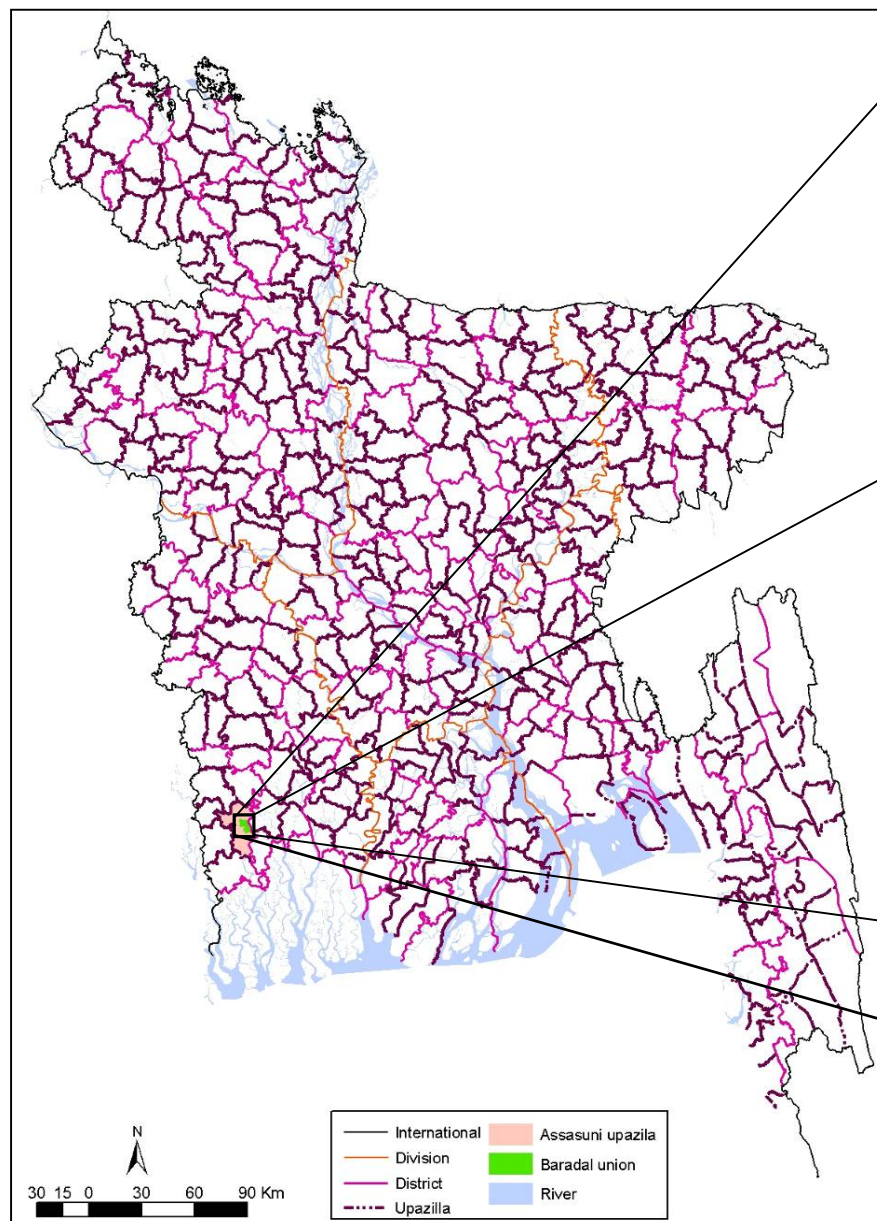


Figure B.6.1.a: Index map showing Pratapnagar Union

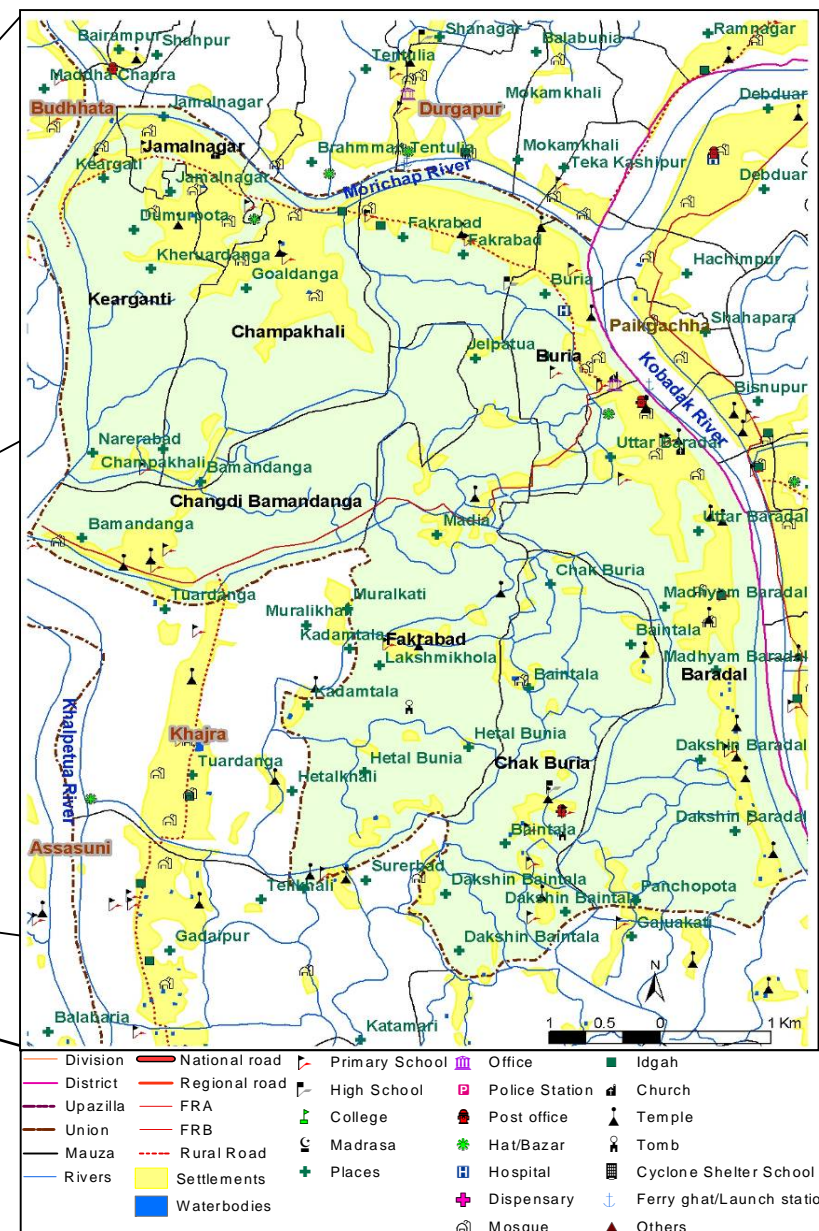


Figure B.6.1.b: Detail of Pratapnagar Union



Figure B.5.2: Union Parishad in Pratapnagar



Figure B.5.3: Pratapnagar High School

General information on FGD meeting:

Address: The Union Parishad is a temporary structure and is damaged by flood. The FGD was arranged in a Growth center office (Village: Kurikahnna, ward: 3, mauza: Kurikahni).

GPS location: N 22° 23' 08.2" and E - 89° 13' 15.6"

Date: 17 – 02 – 2008,

Time: 12:15 pm

Participants:

Total: 17 (Male- 15 and Female- 2)

UDMC: 10 (Chairman- 1, Secretary- 1 and Ward member- 8)

Shrimp farmer: 3

Farmer: 1

NGO representative: 1

Teacher: 1

Imam: 1

Figure B.6.4 shows some pictures of FGD at Pratapnagar was chaired by Union Parishad Chairman.



Figure B.6.4: Conducting FGD at Pratapnagar

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.6.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.6.1: Questionnaire 1- List of Hazards, Pratapnagar

Development of Hazard Zoning Maps using CRA (List of Hazard)		Questionnaire-05 01
Name of key informants: <i>Shahriar/Ragib/Alamgir</i>		Date: <i>17-02-08</i>
Union: <i>Pratapnagar</i> Upazila: <i>Assasuni</i>		District: <i>Satkhira</i>
Sl No.	Hazards	
1	<i>Shrimp virus</i>	
2	<i>Cyclone</i>	
3	<i>Riverine flood</i>	
4	<i>Salinity</i>	
5	<i>Hailstorm</i>	
6		
7	<i>Waterlogging</i>	
8	<i>River bank erosion</i>	
9		
10		
11		

Table B.6.2: Questionnaire 2 - Hazard information, Pratapnagar*Development of Hazard Zoning Maps using CRA Process***(Hazard information)**

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>	Date: <i>12 – 02- 08</i>
Union: <i>Pratapnagar</i>	Upazila: <i>Assasuni</i> District: <i>Satkhira</i>

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
Riverine flood	Mid June - August	✓	✓	✓	All group
Shrimp virus	March – Mid January	✓		Shrimp Farmer	
Water logging	Mid August - Mid February	✓	✓	Shrimp Farmer	
Cyclone	Mid March - Mid April & November	✓	✓	✓	All group
River bank erosion	Mid July - August	✓	✓	Shrimp Farmer	
Salinity	January - December	✓	✓	✓	All group
Hailstorm	Mid March - May	✓	✓	✓	All group

Table B.6.3: Questionnaire 3 - Multi-hazard information, Pratapnagar**Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)**

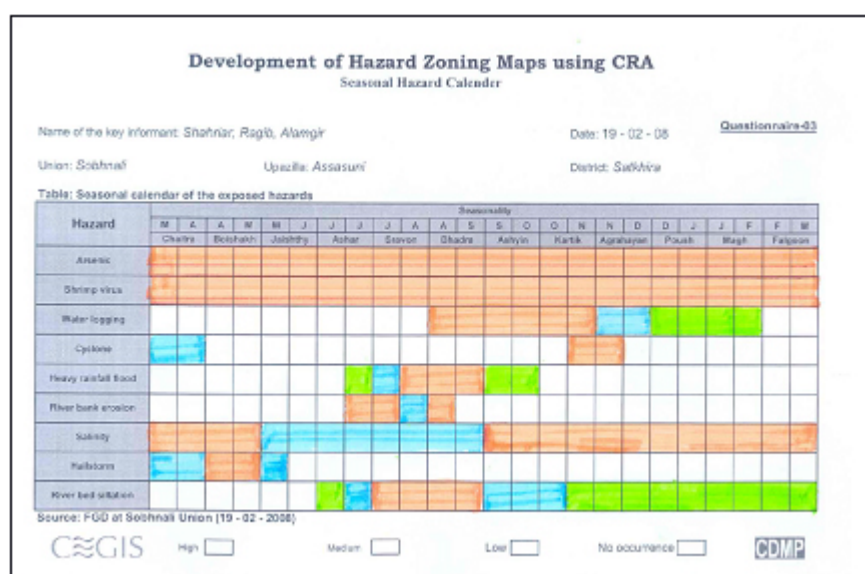
Questionnaire-02 03

Name of key informant: <i>Shahriar, Ragib Alamgir</i>	Date: <i>17.02.08</i>
Union: <i>Pratapnagar</i>	Upazila: <i>Assasuni</i> District: <i>Satkhira</i>

Table: Mauza wise Hazard intensity and frequency information								
Ward No.	Parameter	Hazard						
		R. Flood	Shrimp Virus	Water logging	Cyclone	R. bank Erosion	Salinity	Hailstorm
01	Intensity	H	H	L	H	H	H	M
		H	H	L	H	H	H	-
		H	H	L	H	H	H	-
	Year of Occurrence	2007	2007	2007	2007	2007	2007	1998
		2006	2006	2006	1988	2006	2006	-
		2001	2005	2005	1970	2005	2005	-
02	Intensity	H	H	M	H	H	H	M
		H	H	M	H	H	H	-
		H	H	M	H	H	H	-
	Year of Occurrence	2007	2007	2007	2007	2007	2007	1998
		2006	2006	2006	1988	2006	2006	-
		2001	2005	2005	1970	2005	2005	-

GIS

CDMP

Table B.6.4: Questionnaire 4 - Hazard seasonality index, Pratapnagar

The hazard scenario of Pratapnagar union from FGD and field investigation is summarized as shown in Table B.6.5.

Table B.6.5: Summary of Field investigation, Pratapnagar union

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Riverine flood	<input type="checkbox"/> Embankment breach <input type="checkbox"/> Overflow of Kholpetua, Kobadak river	1, 2 and 3	High	Infrastructure (homestead, roads, embankment, educational institutes, religious centers, bazaars), shrimp farms, cropland, ponds, livestock	People become shelter less, scarcity of drinking water, suffering from water borne diseases, economic losses	
		4, 5, 6 and 7	Medium			
		8 and 9	Low			
Water logging	<input type="checkbox"/> Overflow of Kobadak, and Khalpetua river <input type="checkbox"/> Poor drainage system <input type="checkbox"/> Closure of sluice gate,	3, 4, 5, 7 and 8	High	Shrimp, vegetation, crops	Change in biodiversity, agriculture, and economic losses.	Local people's opinion is that water logging is a hazard because it
		2 and 9	Medium			

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
	sluice gate, <input type="checkbox"/> Khal leasing <input type="checkbox"/>	1 and 6	Low			because it changed them to shift their occupation from agriculture to shrimp. But from field investigation it came out that these waterlogged areas are now under the shrimp cultivation and people are economically benefited.
Shrimp virus	<input type="checkbox"/> Increase use of Hydrogen Sulphide, Methane and PH rate (> 9.6) <input type="checkbox"/> Lack of Oxygen, Zooplankton, food	1 - 9	High	Shrimp loss	Economic loss	
Salinity	<input type="checkbox"/> Lack of fresh water flow from Kobadak and Kholpetua rivers <input type="checkbox"/> Excess shrimp cultivation <input type="checkbox"/> Saline water intrusion from Bay of Bengal	1 - 9	High	Agriculture, scarcity of safe drinking water	Ecological degradation, agriculture loss, economic loss	
Cyclone	<input type="checkbox"/> Low pressure in the Bay of Bengal	1 - 9	High	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Arsenic	☐ Due to excess withdrawal of ground water	1 - 9	High	Skin disease (Arsenicosis)	Loss of life	
Riverbank erosion	☐ Excess pressure of tide on the embankment in the rainy season	1, 2, 3 and 6	High	Loss of land, inundation, loss of infrastructure life and property	Loss of property, people become homeless	
		4, 5 and 9	Medium			
		7 and 8	Low			
Hail storm	☐	1 - 9	High	Shrimp, agricultural crops, infrastructure	Shrimp, crops	

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.6.6). Figure B.6.5 -6 shows the demarcation of the ward boundary map by local community and Union Parishad members.

Table B.6.6: List of wards, mauzas and villages, Pratapnagar

New wards	Old wards	Mouzas	Villages
1	1	Chakla Telikhali	Chakla, Chuibaria
2	1	Chakla Telikhali	Dighalar Ait Sobhadrakati, Ruiarbil
3	1	Kurikahnia Sreepur	Kurikahnia, Sreepur
4	2	Pratapnagar Madia	Purbo Pratapnagar
5	2	Pratapnagar	Poschim Pratapnaga, Madarbari
6	2	Kola, Hijalia	Kola, Hijalia
7	3	Kaliyanpur	Kaliyanpur
8	3	Laskari khajra Shirsa, Goalbati Nakna	Laskari khajra, Shirsa, Goalbati Nakna
9	3	Gokulnagar Nakna Sanatankati	Gokulnagar, Nakna, Sanatankati

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of some important features of the union such as presence of hazards at the time of FGD, important structures etc.

Important hazards: Hail storm – 1988 and 1998

Riverine flood – 2001, 2006, 2007

Observation: In the CRA report Arsenic have been mentioned as a hazard. But according to the local people arsenic is not a hazard.



Figure B.6.5: Ward boundary map, Pratapnagar



Figure B.6.6: Demarcation of ward boundaries, Pratapnagar

Conclusion: Pratapnagar union is dominated by shrimp cultivation. According to the local community riverine flood, water logging and riverbank erosion (see Figure B.6.7) are the major hazards but in the water logged areas shrimp is also being cultivated.



Figure B.6.7: Riverbank erosion



প্রত্যক্ষপন

অন্তঃ-আন্তর্য্য নিম্ন স্থানায় ক্রীড়ায় এই মতে
প্রত্যেক কাছি ৫০. অল্প ইতিমধ্যে সন্তান আনুষঙ্গিক
প্রজা.

- [illegible]

137

Annex B.7 Field report on Kadakati union, Assasuni, Satkhira**Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N.M. Alamgir**

Location: Pratapnagar union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 33' 20" to 22° 38' 15" and E - 89° 11' 10" to 89° 14' 30". Kadakati union borders with Kulla union in the north, Baradal union in the south, Kulla and Budhhata unions in the - west and Daraghpur union in the east. River Morichap flows through the south of the union. (see Figure B.7.1.a- b). The union is about 25 kilometers from Upazilla Parishad and 51 kilometers (approx.) from District Head Quarter^{[13]–[14]}.

Area and Population: The union is about 25 sq. kilometer and the population is about 14,409^{[13]–[14]}. According to BBS 2001 census the population of Kadakati union is 12,772.

Road network and mode of transport: The road network is poor mainly earthen roads and few kilometer herringbone. Mode of transport is van, motorized van, motorcycle and bicycle^[13].

Major Infrastructures: Union Parishad Complex (Figure B.7.2), culverts, educational institutes (primary, secondary school and madrasa) mosques, churches, and temples are the main infrastructures of the union^{[13]–[14]}.

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. River (Morichap), canals, marshlands, ponds and ditches are the dominating hydrological features of Kadakati union^[13].

Cropping pattern: Shrimp (Baghda) has replaced massively the agricultural land. 80% of the total cultivated are is under shrimp farm (Gher) and only 20% is used for agriculture^[13].

Occupational group: 90% people are engaged in shrimp cultivation as their main occupation, 5% are fully engaged in agricultural activities and 5% with other occupation^[13].

Natural hazard: Mostly occurred natural hazards are riverine flood, shrimp virus, salinity, cyclone, water logging, arsenic, riverbed siltation and excess rainfall.^{[13]–[14]}

Focus Group Discussion (FGD): One FGD was done in the union on 09 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ☐ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ☐ Representative from shrimp farmer from 3 old wards as major occupational group
- ☐ Farmer as second dominated occupational group
- ☐ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ☐ Government officer Sub- Assistant Agriculture Officer
- ☐ NGO representative

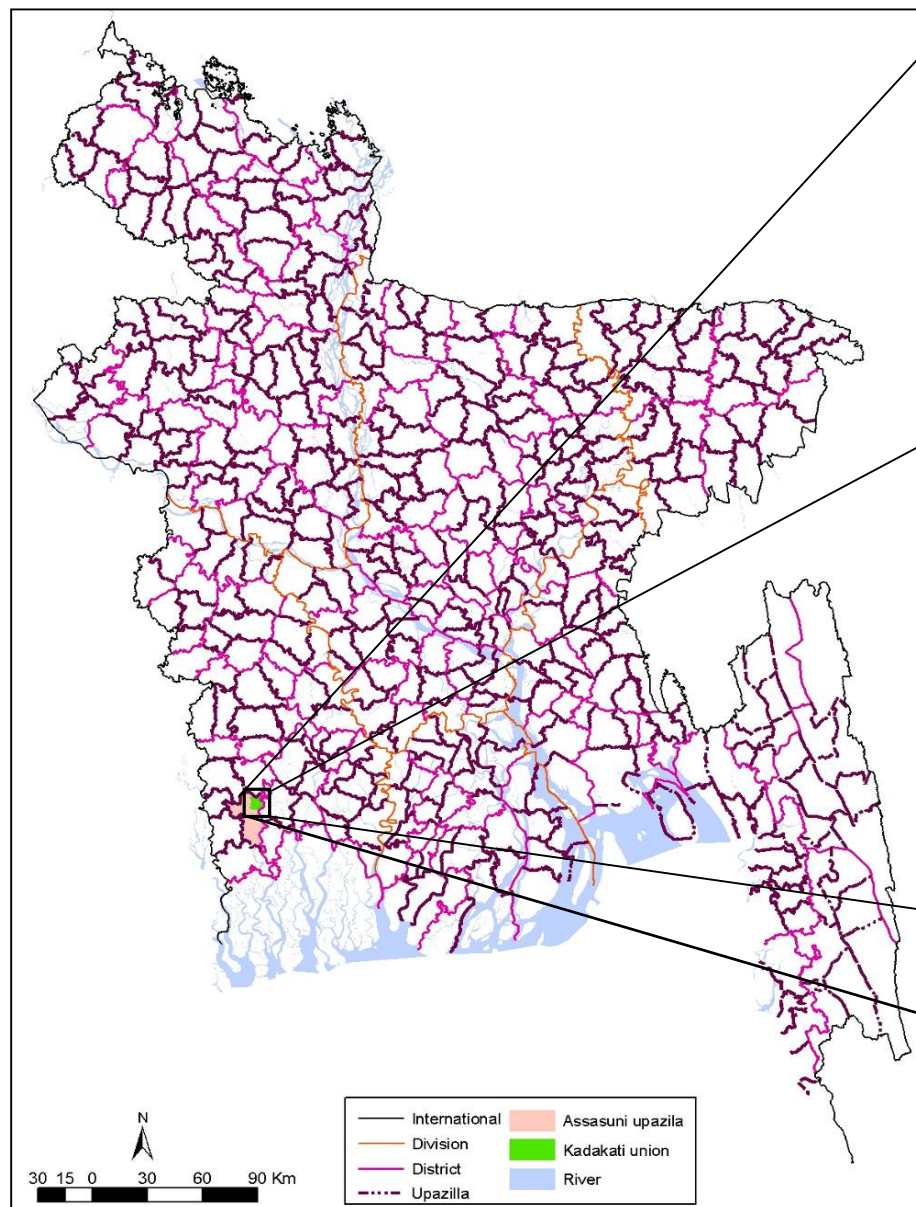


Figure B.7.1.a: Index map showing Kadakati Union

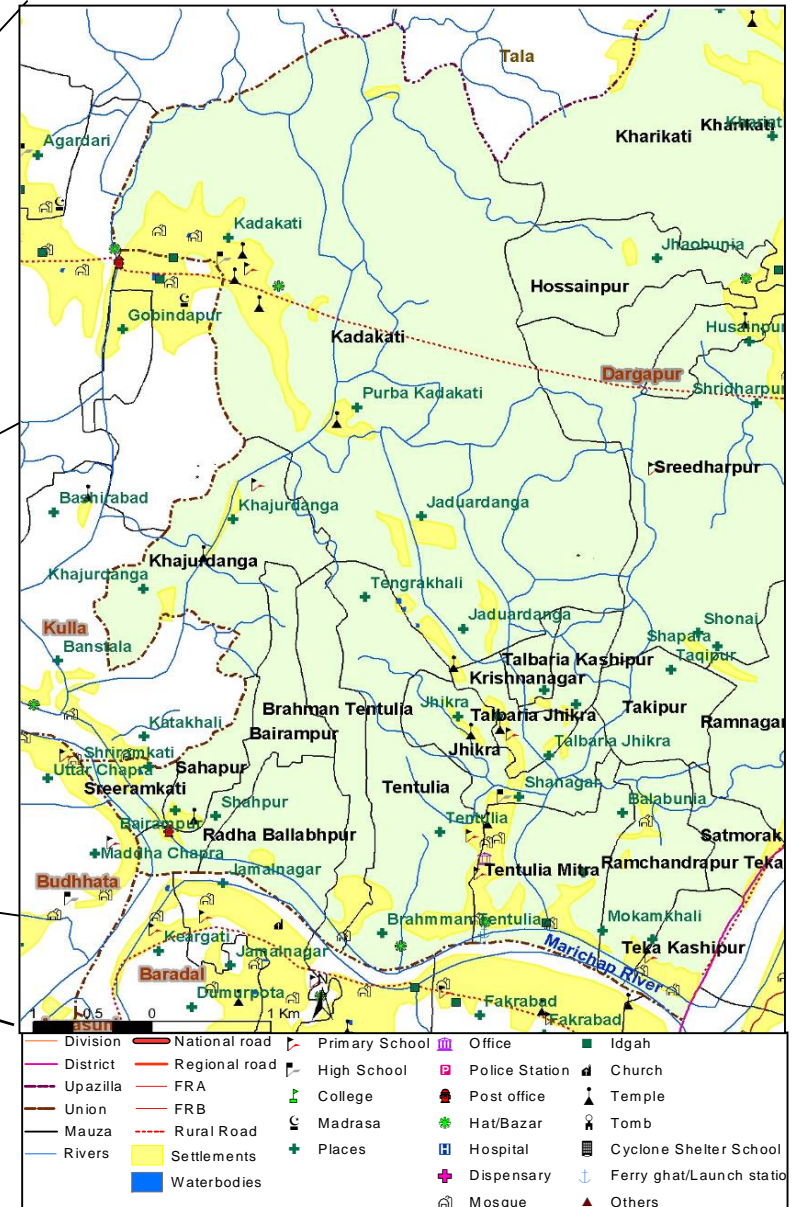


Figure B.7.1.b: Detail of Kadakati Union



Figure B.7.2: Union Parishad, Kadakatii

General information on FGD meeting:

Address: Union Parishad complex (Village: Mitratentulia, Ward: 8, Mauza: Mitratentulia,).

GPS location: N 22° 34' 02.3" and E - 89° 13' 06.0"

Date: 09 – 02 – 2008,

Time: 11:30 pm

Participants:

Total: 21 (Male- 17 and Female- 4)

UDMC: 13 (Chairman- 1, Secretary- 1 and Ward member- 11)

Shrimp farmer: 3

Farmer: 2

NGO representative: 1

Teacher: 1

Elite person: 1

Figure B.7.4 shows some pictures of FGD at Kadakati was chaired by Union Parishad Chairman.





Figure B.7.4: Conducting FGD at Kadakati

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.7.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.7.1: Questionnaire 1- List of Hazards, Kadakati

Development of Hazard Zoning Maps using CRA (List of Hazard)		Questionnaire-01
Name of key informants: Shahriar / Rajib / Alamgir		Date: 09-02-09
Union: Kadakati	Upazila: Assasuni	District: Satkhira

Sl No	Hazards
1	Water Logging
2	Arsenic
3	Shrimp Virus
4	River bed siltation
5	Cyclone
6	Salinity
7	Excess rainfall
8	Riverine flood
9	
10	
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CGIS CDMP

Table B.7.2: Questionnaire 2 - Hazard information, Kadakati

Development of Hazard Zoning Maps using CRA Process

(Hazard information)

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>	Date: <i>12 – 02- 08</i>
Union: <i>Kadakati</i>	Upazila: <i>Assasuni</i>
	District: <i>Satkhira</i>

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
Arsenic	January - December	✓	✓	✓	All group
Riverine flood	Mid June - August	✓	✓	✓	All group
Shrimp virus	March – Mid January	✓		Shrimp Farmer	
Water logging	Mid August - Mid February	✓	✓	✓	All group
Cyclone	Mid March - Mid April & November	✓	✓	✓	All group
Excess rainfall	Mid June - August	✓	✓	✓	All group
Salinity	January - December	✓	✓	✓	All group
Riverbed siltation	January - December	✓	✓	✓	All group

Table B.7.3: Questionnaire 3 - Multi-hazard information, Kadakati

Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

Questionnaire-#03

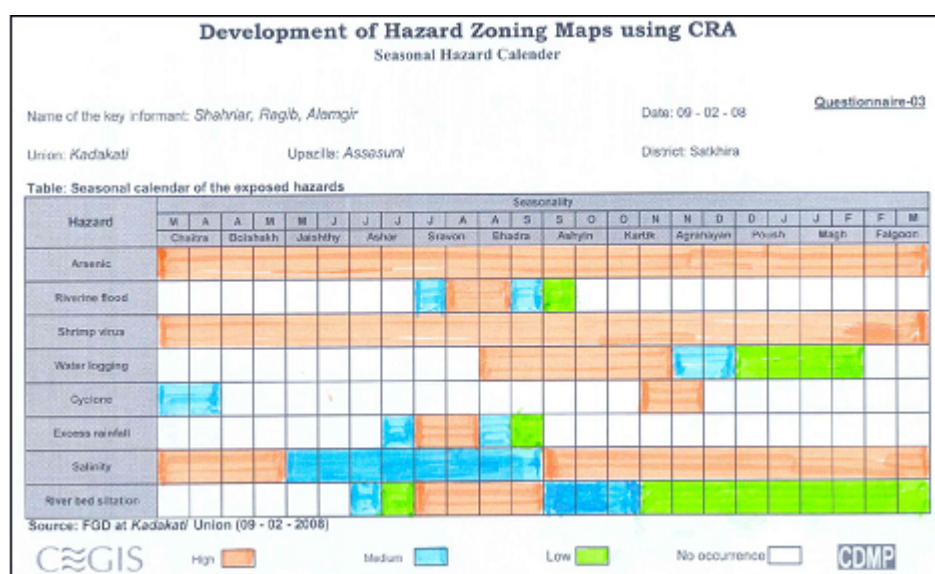
Name of key informant: *Shahriar / Ragib / Alamgir* Date: *09.02.08*

Union: *Kadakati* Upazila: *Assasuni* District: *Satkhira*

Table: Muzra wise Hazard intensity and frequency information

Ward No.	Parameter	Hazard							
		Waterlog	Arsenic	Shrimp	Riverbed siltation	Cyclone	Salinity	Ex. Rain	R. Flood
01	Intensity	M	H	H	—	M	H	M	—
		M	H	H	—	H	H	H	—
		M	H	H	—	H	H	H	—
	Year of Occurrence	2007	2007	2007	2007	2007	2007	2007	—
		2006	2006	2006	2006	1988	2006	2006	—
		2005	2005	2005	2005	1965	2005	2003	—
02	Intensity	M	H	H	—	M	H	M	—
		M	H	H	—	H	H	H	—
		M	H	H	—	H	H	H	—
	Year of Occurrence	2007	2007	2007	2007	2007	2007	2007	—
		2006	2006	2006	2006	1988	2006	2006	—
		2005	2005	2005	2005	1965	2005	2003	—

GIS CDMP

Table B.7.4: Questionnaire 4 - Hazard seasonality index, Kadakati

The hazard scenario of Kadakati union from FGD and field investigation is summarized as shown in Table B.75.

Table B.7.5: Summary of Field investigation, Kadakati

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Riverine flood	<input type="checkbox"/> Embankment breach <input type="checkbox"/> Overflow of Morichap river	4, 7, 8 and 9	High	Infrastructure (homestead, roads, embankment, educational institutes, religious centers, bazaars), shrimp farms, cropland, ponds, livestock	People become shelter less, scarcity of drinking water, suffering from water borne diseases, economic losses	
		Others	No occurrence			
Water logging	<input type="checkbox"/> Overflow of Morichap river	7, 8 and 9	High	Shrimp, vegetation, crops	Change in biodiversity, agriculture	Local people's opinion is

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
	<input type="checkbox"/> Poor drainage system <input type="checkbox"/> Closure of sluice gate, <input type="checkbox"/> Khal leasing <input type="checkbox"/>	Others	Medium	crops	agriculture, and economic losses.	opinion is that water logging is a hazard because it changed them to shift their occupation from agriculture to shrimp. But from field investigation it came out that these waterlogged areas are now under the shrimp cultivation and people are economically benefited.
Shrimp virus	<input type="checkbox"/> Increase use of Hydrogen Sulphide, Methane and PH rate (> 9.6) <input type="checkbox"/> Lack of Oxygen, Zooplankton, food	1 - 9	High	Shrimp loss	Economic loss	
Salinity	<input type="checkbox"/> Lack of fresh water flow from Morichap rivers <input type="checkbox"/> Excess shrimp cultivation <input type="checkbox"/> Saline water intrusion from Bay of Bengal	1 - 9	High	Agriculture, scarcity of safe drinking water	Ecological degradation, agriculture loss, economic loss	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Cyclone	☐ Low pressure in the Bay of Bengal	1 - 9	High	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	
Arsenic	☐ Due to excess withdrawal of ground water	1 - 9	High	Skin disease (Arsenicosis)	Loss of life	
Excess rainfall	☐	1 - 9	High	Shrimp, crops, infrastructure	Loss of life, property, agricultural crops, shrimp	Local people's opinion is that for the last few years excess rainfall is hampering shrimp, crops and daily life
Riverbed siltation	☐ Excess upstream erosion	7,8 and 9	High		Flood, closure of sluice gate, water logging	
	☐ Tidal effects	Others	No occurrence			

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.7.6). Figure B.7.5 -6 shows the demarcation of the ward boundary map by local community and Union Parishad members.

Table B.7.6: List of wards, mauzas and villages, Kadakati

New wards	Old wards	Mouzas	Villages
1	1	Kadakati	Kadakati
2	1	Kadakati	Kadakati
3	1	Kadakati	Purbokadakati, Kultuardangi
4	2	Khajuardanga Shahapur, Sreerampurkathi Bairampur	Shahapur, khajuardangi Sreerampurkathi Parkhajuardangi, Bairampur
5	2	Kadakati	Janguardanga, Kabirkini
6	2	Tetulia Jhikra Tal Jhikra	Tangrakhali, Krishnanagar Kaschakhali, Tal Jhikra, Talbaria

New wards	Old wards	Mouzas	Villages
7	3	Tetulia Radhabllavpur Brahman Tetulia	Tetulia, Radhabllavpur, Brahman Tetulia
8	3	Mitra Tetulia Jhikra	Mitra tetulia, Shahanagar, Jhikra
9	3	Teka Kashipur Teka Ramchandrapur Mitra Tetulia	Teka Kashipur, Teka Ramchandrapur, Mitra Tetulia



Figure B.7.5: Ward boundary map, Kadakati



Figure B.7.6: Demarcation of ward boundaries, Kadakati

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of some important features of the union such as presence of hazards at the time of FGD (see Figure B.7.7.a-b)



Figure B.7.7.a: Signs of destruction by Sidr

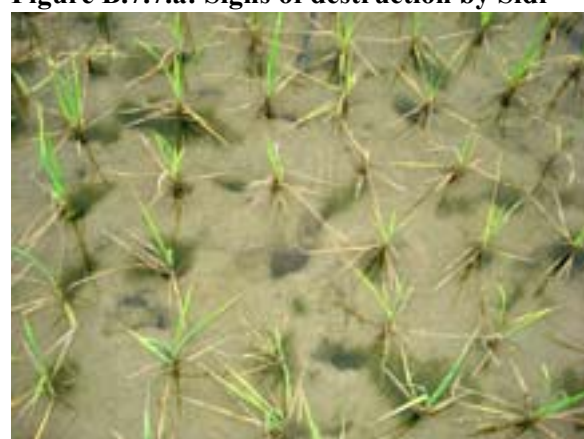


Figure B.7.7.b: Paddy affected by salinity

Important hazards: Cyclone – 1965, 1988

Observation: Excess rainfall and salinity is newly identified hazards, which were not in the CRA report. According to the FGD stakeholders, excess rainfall is hampering shrimp, agricultural production and salinity affects the availability of safe drinking water.

Conclusion: Kadakati union is dominated by shrimp cultivation. According to the local community salinity, arsenic, shrimp virus, water logging are the major hazards but in the water logged areas shrimp (see B.7.8) is also being cultivated.



Figure B.7.8: Shrimp farms in Kadakati

Annex B.8 Field report on Durgapur union, Assasuni, Satkhira**Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N.M. Alamgir**

Location: Durgapur union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 33' 40" to 25° 38' 40" and E - 89° 13' 20" to 89° 16' 00". Durgapur union borders with Tala upazilla in the north, Baradal union in the south, Kadakati union in the west and Paikgacha upazilla in the east. River Papri and Kobadak flows through the north and south of the union respectively. (see Figure B.8.1.a- b). The union is about 28 kilometers from Upazilla Parishad and 54 kilometers (approx.) from District Head Quarter^{[15]–[16]}.

Area and Population: The union is about 10,873 sq. feet and the population is about 18,371^{[15]–[16]}. According to BBS 2001 census the population of Durgapur union is 16,682.

Road network and mode of transport: The road network is poor mainly earthen roads and few kilometer herringbone and pucca. Mode of transport is bus, van, motorized van, motorcycle and bicycle^[15].

Major Infrastructures: Temporary Union Parishad (Figure B.8.2), bridge, culverts, educational institutes (primary, secondary school and madrasa) mosques, churches, and temples are the main infrastructures of the union^{[15]–[16]}.

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. Rivers (Papri and Kobadak), canals, marshlands, ponds and ditches are the dominating hydrological features of Durgapur union^[15].

Cropping pattern: Shrimp (Baghda) has replaced massively the agricultural land. 75% of the total cultivated are is under shrimp farm (Gher) and only 25% is used for agriculture^[15].

Occupational group: 90% people are engaged in shrimp cultivation as their main occupation, 8% are fully engaged in agricultural activities and 2% with other occupation^[15].

Natural hazard: Mostly occurred natural hazards are riverine flood, shrimp virus, salinity, cyclone, water logging, arsenic, hail storm, riverbed siltation and thunderstorm.^{[15]–[16]}

Focus Group Discussion (FGD): One FGD was done in the union on 20 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ❑ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ❑ Representative from shrimp farmer from 3 old wards as major occupational group
- ❑ Farmer as second dominated occupational group
- ❑ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ❑ Government officer Sub- Assistant Agriculture Officer
- ❑ NGO representative

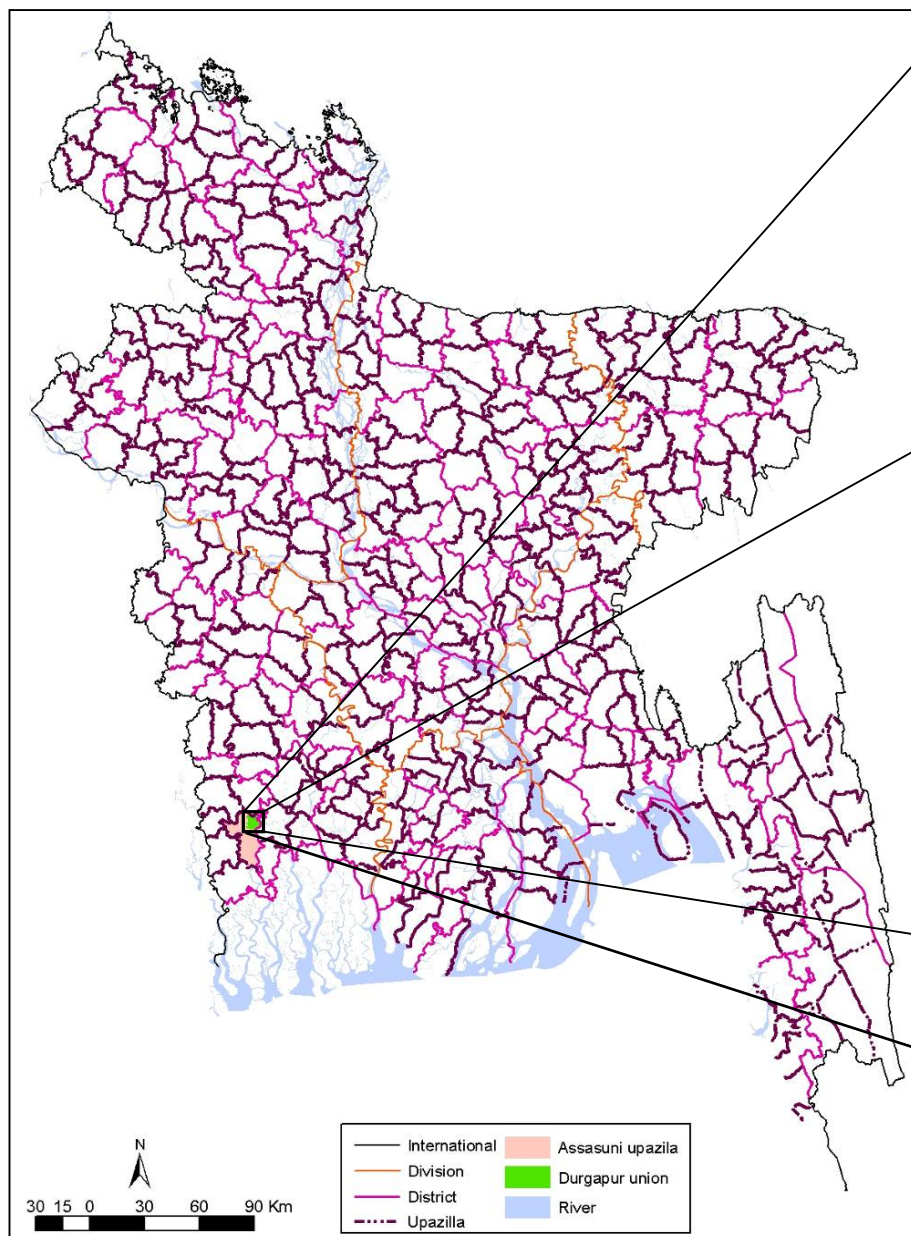


Figure B.8.1.a: Index map showing Durgapur Union

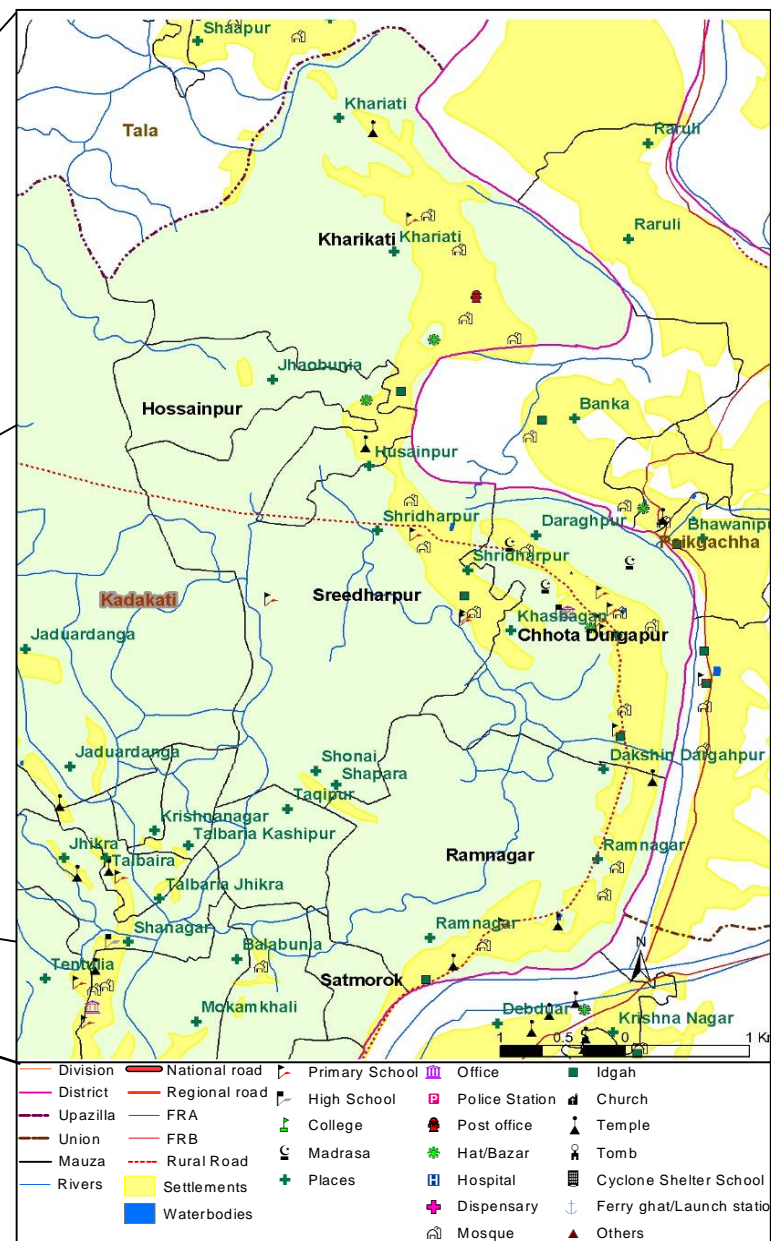


Figure B.8.1.b: Detail of Durgapur Union



Figure B.8.2: Union Parishad, Durgapur

General information on FGD meeting:

Address: Temporary Union Parishad complex (Uttar Dargahpur, Ward: 7, Mouza: Dargahpur)

GPS location: N 22° 35' 53. 7" and E - 89° 15' 19.2"

Date: 20 – 02 – 2008,

Time: 11:30 pm

Participants:

Total: 16 (Male- 14 and Female- 2)

UDMC: 10 (Secretary- 1 and Ward member- 9)

Shrimp farmer: 2

Farmer: 1

NGO representative: 1

Imam: 1

Elite person: 1

Figure B.8.3 shows some pictures of FGD at Durgapur was chaired by Union Parishad Secretary.



Figure B.8.3: Conducting FGD at Durgapur

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.8.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.8.1: Questionnaire 1- List of Hazards, Durgapur

Development of Hazard Zoning Maps using CRA (List of Hazard)		Questionnaire-05 01
Name of key informants: Shahriar / Ragib / Alamgir		Date: 20.02.08
Union: Durgapur	Upazila: Assasuni	District: Satkhira

Sl No	Hazards
1	Shrimp Virus
2	Arsenic
3	Salinity
4	Waterlogging
5	River bed salination
6	Riverine flood
7	Cyclone
8	Thunderbolt
9	Hailstorm
10	
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Table B.8.2: Questionnaire 2 - Hazard information, Durgapur*Development of Hazard Zoning Maps using CRA Process***(Hazard information)**

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>	Date: <i>12 – 02- 08</i>
Union: <i>Durgapur</i>	Upazila: <i>Assasuni</i> District: <i>Satkhira</i>

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
Arsenic	January - December	✓	✓	✓	All group
Riverine flood	Mid June - August	✓	✓	✓	All group
Shrimp virus	March – Mid January	✓		Shrimp Farmer	
Water logging	Mid August - Mid February	✓	✓	✓	All group
Cyclone	Mid March - Mid April & November	✓	✓	✓	All group
Salinity	January - December	✓	✓	✓	All group
Hailstorm	Mid March - May	✓	✓	✓	All group
Thunderbolt	Mid March – Mid August	✓	✓	✓	All group
Riverbed siltation	January - December	✓	✓	Shrimp Farmer	

Table B.8.3: Questionnaire 3 - Multi-hazard information, Durgapur

Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

Questionnaire-02 03

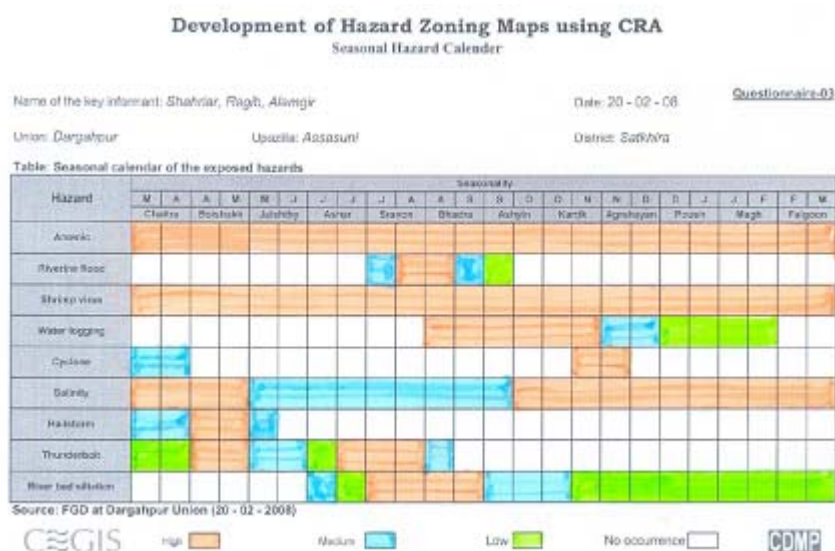
Name of key informant: Shahriar/Ragib/Alamgir Date: 20.2.08
 Union: Durgapur Upazila: Assasuni District: Satkhira

Table: Mauza wise Hazard intensity and frequency information

Ward No.	Parameter	Hazard									
		Shrimp Virus	Arsenic	Salinity	Water log	River bed silting	R. Flood	Cyclone	Thunder bolt	Hailstorm	
01	Intensity	H	H	H	H	H	M	H	H	L	
		H	H	H	H	H	H	M	H	L	
		H	H	H	H	H		M	H	H	
	Year of Occurrence	2007	2007	2007	2007	2007	1996	2007	2007	2005	
		2006	2006	2006	2006	2006	1988	1991	2006	2003	
		2005	2005	2005	2005	2005		1988	2005	1998	
02	Intensity	H	H	H	H	H	M	H	H	L	
		H	H	H	H	H	H	M	H	L	
		H	H	H	H	H		H	H	H	
	Year of Occurrence	2007	2007	2007	2007	2007	1996	2007	2007	2005	
		2006	2006	2006	2006	2006	1988	1991	2006	2003	
		2005	2005	2005	2005	2005		1988	2005	1998	

CGIS CDMP

Table B.8.4: Questionnaire 4 - Hazard seasonality index, Durgapur



The hazard scenario of Durgapur union from FGD and field investigation is summarized as shown in Table B.8.5.

Table B.8.5: Summary of Field investigation, Durgapur

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
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Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Water logging	<ul style="list-style-type: none"> • Overflow of Kobadak and Papri river • Poor drainage system • Closure of sluice gate, • Khal leasing 	1, 2, 3, 7, 8 and 9	High	Shrimp, vegetation, crops	Change in biodiversity, agriculture, and economic losses.	Local people's opinion is that water logging is a hazard because it changed them to shift their occupation from agriculture to shrimp. But from field investigation it came out that these waterlogged areas are now under the shrimp cultivation and people are economically benefited.
		4, 5 and 6	Medium			
Shrimp virus	<ul style="list-style-type: none"> • Increase use of Hydrogen Sulphide, Methane and PH rate (> 9.6) • Lack of Oxygen, Zooplankton, food 	1 - 9	High	Shrimp loss	Economic loss	
Salinity	<ul style="list-style-type: none"> • Lack of fresh water flow from Kobadak and Papri rivers • Excess shrimp cultivation • Saline water intrusion from Bay of Bengal 	1 - 9	High	Agriculture, scarcity of safe drinking water	Ecological degradation, agriculture loss, economic loss	
Cyclone	<ul style="list-style-type: none"> • Low pressure in the Bay of Bengal 	1 - 9	High	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Arsenic	• Due to excess withdrawal of ground water	1 - 9	High	Skin disease (Arsenicosis)	Loss of life	
Riverbed siltation	• Excess upstream erosion • Tidal effects	1, 2, 3, 4, 6, 7, 8 and 9	High		Flood, closure of sluice gate, water logging	
		5	No occurrence			
Hailstorm		1 - 9	Low	Property, crops, shrimp		Local people's opinion is that hailstorm damages seasonal fruits and house roofs made of Tali
Thunderbolt		1 - 9	High	Shrimp, agricultural crops, infrastructure	Shrimp, crops	In 2007, 3 person died (source: FGD)

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.8.6). Figure B.8.4 -5 shows the demarcation of the ward boundary map by local community and Union Parishad members.

Table B.8.6: List of wards, mauzas and villages, Dargahpur

New wards	Old wards	Mouzas	Villages
1	1	Khariati	Uttar Khariati
2	1	Khariati	Dakshin Khariati
3	1	Hossainpur Khariati	Hossainpur, Khariati, Jhaubunia
4	2	Sreedharpur	Sreedharpur
5	2	Sreedharpur takipur	Khasbaghan, Sreedharpur, Takipur Shonai
6	2	Ramnagar Satmorak	Ramnagar, Satmorak
7	3	Dargahpur	Uttar Dargahpur
8	3	Dargahpur	Madyam Dargahpur
9	3	Dargahpur	Dakshin Dargahpur



Figure B.8.4: Ward boundary map, Durgapur



Figure B.8.5: Demarcation of ward boundaries, Durgapur

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of some important features of the union such as presence of hazards at the time of FGD (see Figure B.8.6)



Figure B.8.6.a: Siltation on Kobadak river leading to closure of sluice gate



Figure B.8.6.b: Siltation on Kobadak river

Important hazards:	Riverine flood	-	1988
	Cyclone	-	1988
	Hailstorm	-	1988

Observation: Thunderbolt and hailstorm are newly identified hazards, which were not in the CRA report. According to the local people 3 persons died in 2007 from thunderbolt, hailstorm damages seasonal fruits and house roofs.

Conclusion: Durgapur union is dominated by shrimp cultivation. According to the local community arsenic, shrimp virus, riverbed siltation, water logging are the major hazards but in the water logged areas shrimp is also being cultivated.

Annex B.9 Field report on Khajra union, Assasuni, Satkhira

Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N.M. Alamgir

Location: Khajra union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 27' 20" to 22° 31' 35" and E - 89° 11' 20" to 89° 17' 00". Khajra union borders with Baradal union in the north, Anulia union in the south, Sreeula and Assasuni unions in the west and Koyra upazilla in the east. River Kholpetua and Kobadak flows through the west and the east of the union respectively. (see Figure B.9.1.a- b). The union is about 20 kilometers from Upazilla Parishad and 46 kilometers (approx.) from District Head Quarter^{[17]–[18]}.

Area and Population: The union is about 12 sq. km and the population is about 24,391^{[17]–[18]}. According to BBS 2001 census the population of Khajra union is 25,519.

Road network and mode of transport: The road network is poor mainly earthen roads and few kilometer herringbone. Mode of transport is van, motorized van, motorcycle and bicycle^[17].

Major Infrastructures: Temporary Union Parishad (Figure B.9.2), culverts, educational institutes (primary, secondary school and madrasa) mosques, churches, and temples are the main infrastructures of the union^{[17]–[18]}.

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. Rivers (Kholpetua and Kobadak), canals, marshlands, ponds and ditches are the dominating hydrological features of Khajra union^[17].

Cropping pattern: Shrimp (Baghda) has replaced massively the agricultural land. 80% of the total cultivated are is under shrimp farm (Gher) and only 20% is used for agriculture^[17].

Occupational group: 85% people are engaged in shrimp cultivation as their main occupation, 12% are fully engaged in agricultural activities and 3% with other occupation^[17].

Natural hazard: Mostly occurred natural hazards are riverine flood, shrimp virus, salinity, cyclone, water logging, arsenic, excess rainfall and riverbed siltation.^{[17]–[18]}

Focus Group Discussion (FGD): One FGD was done in the union on 14 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ❑ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ❑ Representative from shrimp farmer from 3 old wards as major occupational group
- ❑ Farmer as second dominated occupational group
- ❑ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ❑ Government officer Sub- Assistant Agriculture Officer
- ❑ NGO representative

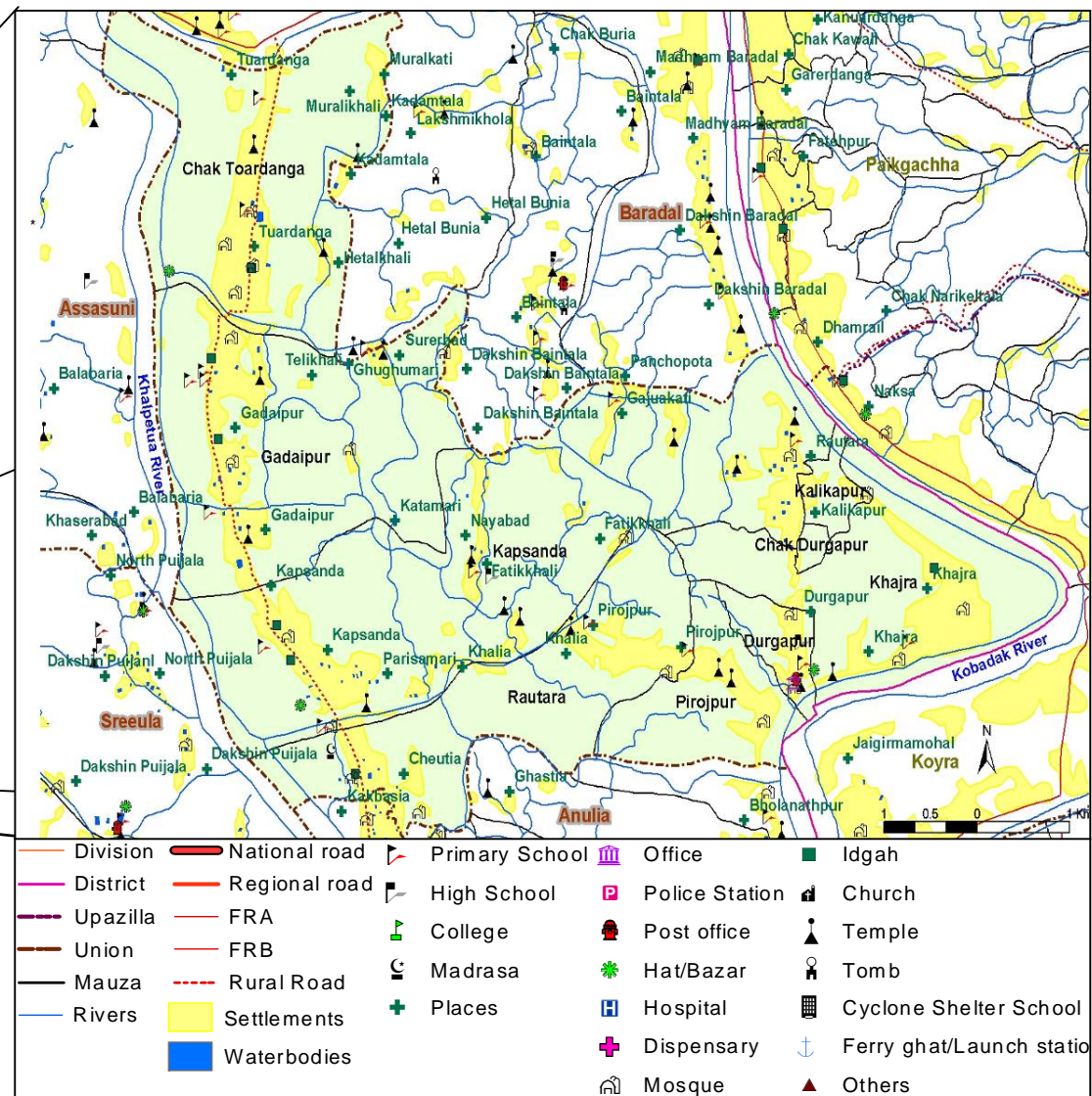
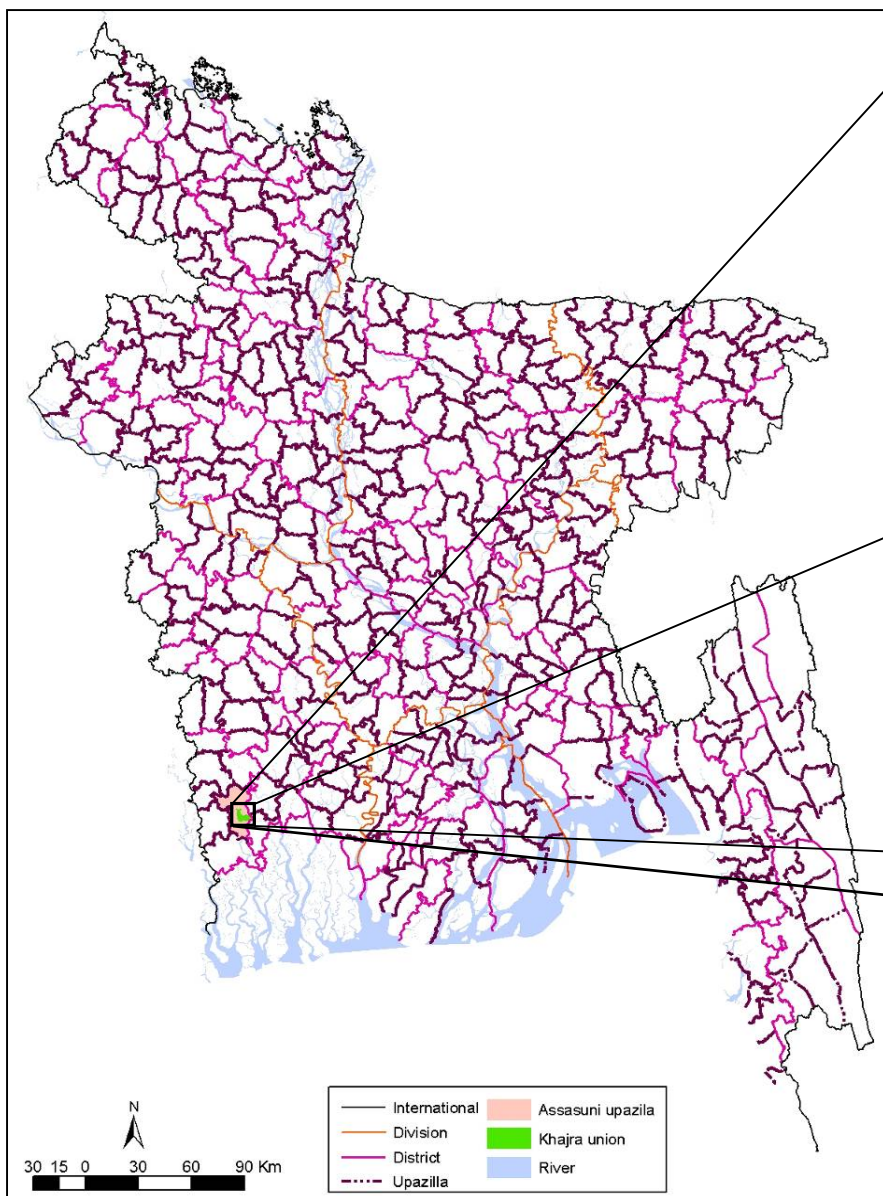


Figure B.9.1.a: Index map showing Khajra Union

Figure B.9.1.b: Detail of Khajra Union



Figure B.9.2: Union Parishad, Khajra

General information on FGD meeting:

Address: Union Parishad complex (Village: Durgapur, Ward: 2, Mauza: Durgapur)

GPS location: N 22° 28' 07.6" and E - 89° 15' 23.1"

Date: 14 – 02 – 2008,

Time: 10:30 pm

Participants:

Total: 20 (Male- 17 and Female- 3)

UDMC: 13(Chairman – 1, Secretary- 1 and Ward member- 11)

Shrimp farmer: 2

Farmer: 1

NGO representative: 1

Teacher: 1, Sub-assistant agriculture officer: 1

Purohit: 1

Figure B.9.3 shows some pictures of FGD at Khajra was chaired by Union Parishad Chairman.



Figure B.9.3: Conducting FGD at Khajra

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.9.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.9.1: Questionnaire 1- List of Hazards, Khajra

Development of Hazard Zoning Maps using CRA (List of Hazard)		Questionnaire-05 01
Name of key informants:	Shahriar/Ragib/Alamgir	Date: 14.02.08
Union:	Khajra	District: Satkhira
Upazila:	Assasuni	

Sl No	Hazards
1	Shrimp virus
2	Salinity
3	Arsenic
4	Riverine flood
5	Cyclone
6	Waterlogging
7	Excess rainfall
8	River bed siltation
9	River bank erosion
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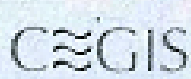




Table B.9.2: Questionnaire 2 - Hazard information, Khajra*Development of Hazard Zoning Maps using CRA Process***(Hazard information)**

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>	Date: <i>12 – 02- 08</i>
Union: <i>Khajra</i>	Upazila: <i>Assasuni</i> District: <i>Satkhira</i>

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
Arsenic	January - December	✓	✓	✓	All group
Riverine flood	Mid June - August	✓	✓	✓	All group
Shrimp virus	March - December	✓		Shrimp Farmer	
Water logging	Mid August - Mid February	✓	✓	✓	All group
Cyclone	Mid March - Mid April & November	✓	✓	✓	All group
Excess rainfall	Mid June - August	✓	✓	✓	All group
River bank erosion	Mid July - August	✓	✓	✓	All group
Salinity	January - December	✓	✓	✓	All group
River bed Siltation	January - December	✓	✓	✓	All group

Table B.9.3: Questionnaire 3 - Multi-hazard information, Khajra

Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

Questionnaire-02-03

Name of key informant: *Shahriar / Ragib / Alamgir* Date: *14. 02. 08*

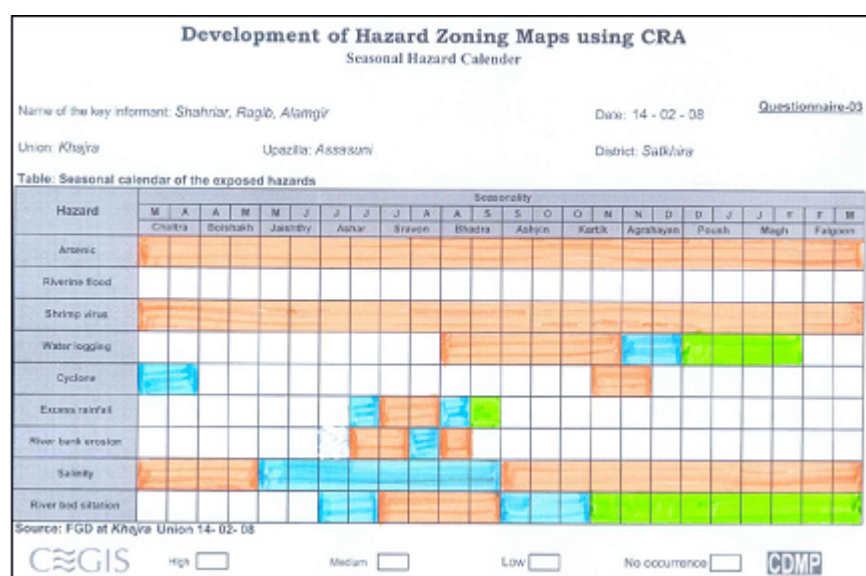
Union: *Khajra* Upazila: *Assasuni* District: *Satkhira*

Table: Mauza wise Hazard intensity and frequency information

Ward No.	Parameter	Hazard									
		Shrimp Virus	Salinity	Arsenic	Riverine flood	Cyclone	Water log	Excess rainfall	River bed siltation	R.B. erosion	
01	Intensity	H	H	H	M	H	H	H	H	H	
		H	H	H	M	H	H	H	H	H	
		H	H	H	M	H	H	H	H	H	
	Year of Occurrence	2007	2007	2007	1990	2007	2007	2007	2007	2007	
		2006	2006	2006	1988	1988	2006	2006	2006	2006	
		2005	2005	2005	1971	1969	2005	2005	2005	2005	
02	Intensity	H	H	H	M	H	H	H	H	H	
		H	H	H	M	H	H	H	H	H	
		H	H	H	M	H	H	H	H	H	
	Year of Occurrence	2007	2007	2007	1990	2007	2007	2007	2007	2007	
		2006	2006	2006	1988	1988	2006	2006	2006	2006	
		2005	2005	2005	1971	1969	2005	2005	2005	2005	

CAGIS

CDMP

Table B.9.4: Questionnaire 4 - Hazard seasonality index, Khajra

The hazard scenario of Khajra union from FGD and field investigation is summarized as shown in Table B.9.5.

Table B.98.5: Summary of Field investigation, Khajra

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Riverine flood	<ul style="list-style-type: none"> Embankment breach Overflow of Kholpetua and Kobadak river 	4, 5 and 6	High	Infrastructure (homestead, roads, embankment, educational institutes, religious centers, bazaars), shrimp farms, cropland, ponds, livestock	People become shelter less, scarcity of drinking water, suffering from water borne diseases, economic losses	
		Others	Medium			

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Water logging	<ul style="list-style-type: none"> • Overflow of Kobadak and Papri river • Poor drainage system • Closure of sluice gate, • Khal leasing 	1 - 9	High	Shrimp, vegetation, crops	Change in biodiversity, agriculture, and economic losses.	Local people's opinion is that water logging is a hazard because it changed them to shift their occupation from agriculture to shrimp. But from field investigation it came out that these waterlogged areas are now under the shrimp cultivation and people are economically benefited.
Shrimp virus	<ul style="list-style-type: none"> • Increase use of Hydrogen Sulphide, Methane and PH rate (> 9.6) • Lack of Oxygen, Zooplankton, food 	1 - 9	High	Shrimp loss	Economic loss	
Salinity	<ul style="list-style-type: none"> • Lack of fresh water flow from Kobadak and Papri rivers • Excess shrimp cultivation • Saline water intrusion from Bay of Bengal 	1, 2, 3, 5, 6, 7, 8 and 9	High	Agriculture, scarcity of safe drinking water	Ecological degradation, agriculture loss, economic loss	
		4	Medium			

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Cyclone	• Low pressure in the Bay of Bengal	1 - 9	High	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	
Arsenic	• Due to excess withdrawal of ground water	1 - 9	High	Skin disease (Arsenicosis)	Loss of life	
Excess rainfall	•	1 - 9	Medium	Shrimp, crops, infrastructure	Loss of life, property, agricultural crops, shrimp	Local people's opinion is that due to excess rainfall during the last few years daily life, shrimp, crops is being damaged
Riverbed siltation	<ul style="list-style-type: none"> Excess upstream erosion Tidal effects 	1, 2, 5, 6, 7, 8 and 9	High		Flood, closure of sluice gate, water logging	Local's people opinion is that Kholpetua and Kobadak rivers are being silted up, the sluice gates are being silted up. As a result flood, water logging occurs in the union.
		3	Medium			
		4	No occurrence			

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.9.6). Figure B.9.4 -5 shows the demarcation of the ward boundary map by local community and Union Parishad members.

Table B.9.6: List of wards, mauzas and villages, Kadakati

New wards	Old wards	Mouzas	Villages
1	1	Khajra	Khajra
2	1	Pirojpur Durgapur Khajra	Goaldanga, Poschim Khajra Pirajpur, Durgapur
3	1	Rautara	Rautara, Gajuakati, Kalikapur Chak Durgapur
4	2	Rautara Kapsdanga	Khalia, Parshemari, Fatikkhali Nayabad
5	2	kapsdanga	Kapsdanga
6	2	Kapsdanga	Cheoria
7	3	Gadaipur	South gadaipur, Katamari
8	3	Gadaipur	Gadaipur, Ghughumari Hetalkati, Surerabad Telikhali
9	3	Chak Tuardanga	Murarikati

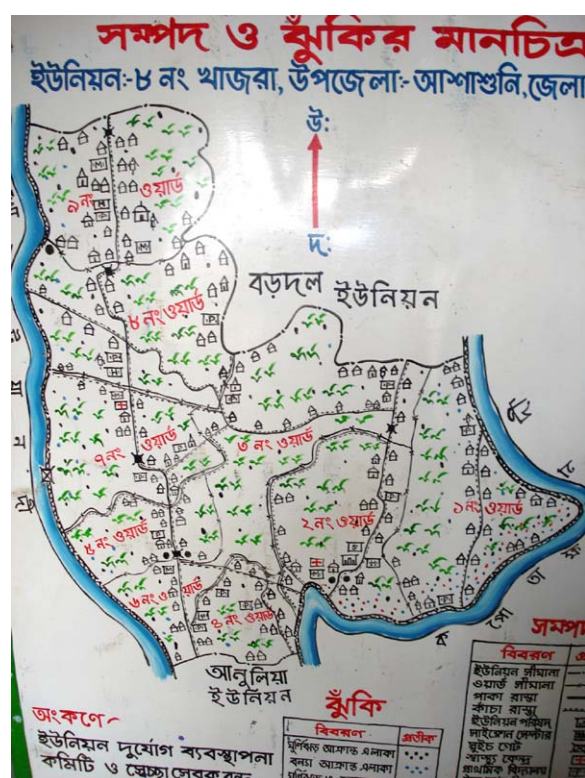


Figure B.9.4: Ward boundary map, Khajra



Figure B.9.5: Demarcation of ward boundaries, Khajra

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of some important features of the union such as presence of hazards at the time of FGD.

Important hazards: Riverine flood - 1971, 1988 and 1991
Cyclone - 1969 and 1988

Observation: Riverbed siltation, water logging and excess rainfall are newly identified hazards, which were not in the CRA report. According to the local people Kholpetua and Kobadak rivers are being silted up which is closing the sluice gates. As a result flood, water logging frequency is increasing. Water logging is damaging shrimp, vegetation and crops. Excess rainfall is affects the shrimp, crops and daily life.

Conclusion: Khajra union is dominated by shrimp cultivation. According to the local community arsenic, water logging are the major hazards but in the water logged areas shrimp is also being cultivated.

Annex B.10 Field report on Shobhnali union, Assasuni, Satkhira**Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N.M. Alamgir**

Location: Shobhnali union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 32' 10" to 22° 36' 30" and E - 89° 3' 00" to 89° 8' 50". Shobhnali union borders with Satkhira Sadar upazilla in the north, Kaliganj upazilla in the south and west, Budhhata union in the east. River Kholpetua flows through the east of the union. (see Figure B.10.1.a- b). The union is about 12 kilometers from Upazilla Parishad and 38 kilometers (approx.) from District Head Quarter [19] – [20].

Area and Population: The union is about 33.33 sq. km and the population is about 35,000 [19] – [20]. According to BBS 2001 census the population of Shobhnali union is 26,591.

Road network and mode of transport: The road network is better in Shobhnali union than that of others. The road from Assasuni upazilla to Shobhnali is pucca. Other roads include earthen roads and herringbone. Mode of transport is bus, van, motorized van, motorcycle and bicycle [19].

Major Infrastructures: Temporary Union Parishad (Figure B.10.2), cyclone shelters, culverts, educational institutes (primary, secondary school and madrasa) mosques, churches, and temples are the main infrastructures of the union [19] – [20].

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. River (Kholpetua), canals, marshlands, ponds and ditches are the dominating hydrological features of Shobhnali union [19].

Cropping pattern: Shrimp (Baghdha) has replaced massively the agricultural land. 95% of the total cultivated area is under shrimp farm (Gher) and only 5% is used for agriculture [19].

Occupational group: 95% people are engaged in shrimp cultivation as their main occupation, 4% are fully engaged in agricultural activities and 1% with other occupation [17].

Natural hazard: Mostly occurred natural hazards are heavy rainfall flood, shrimp virus, salinity, hail storm, riverbank erosion, cyclone, water logging, and riverbed siltation. [19] – [20].

Focus Group Discussion (FGD): One FGD was done in the union on 19 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ❑ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ❑ Representative from shrimp farmer from 3 old wards as major occupational group
- ❑ Farmer as second dominated occupational group
- ❑ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ❑ Government officer Sub- Assistant Agriculture Officer
- ❑ NGO representative

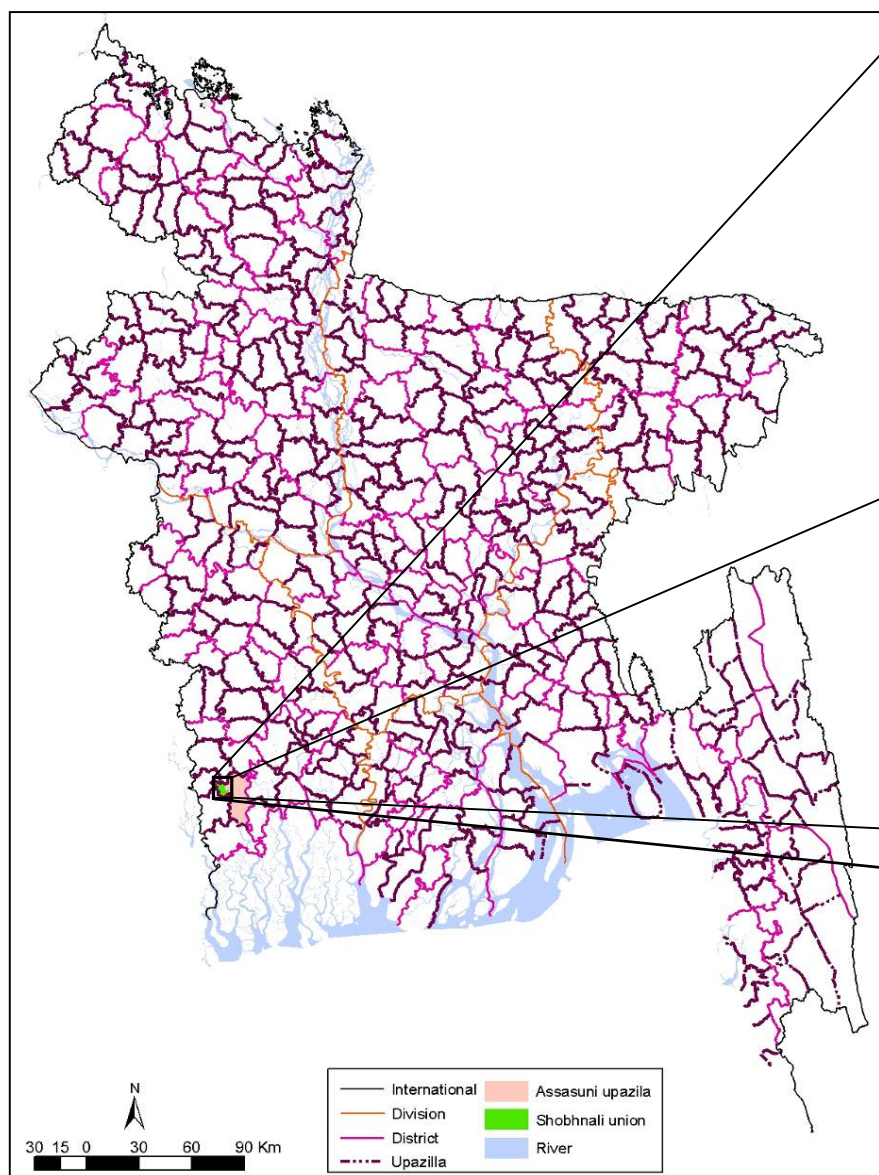


Figure B.10.1.a: Index map showing Shobhnali Union

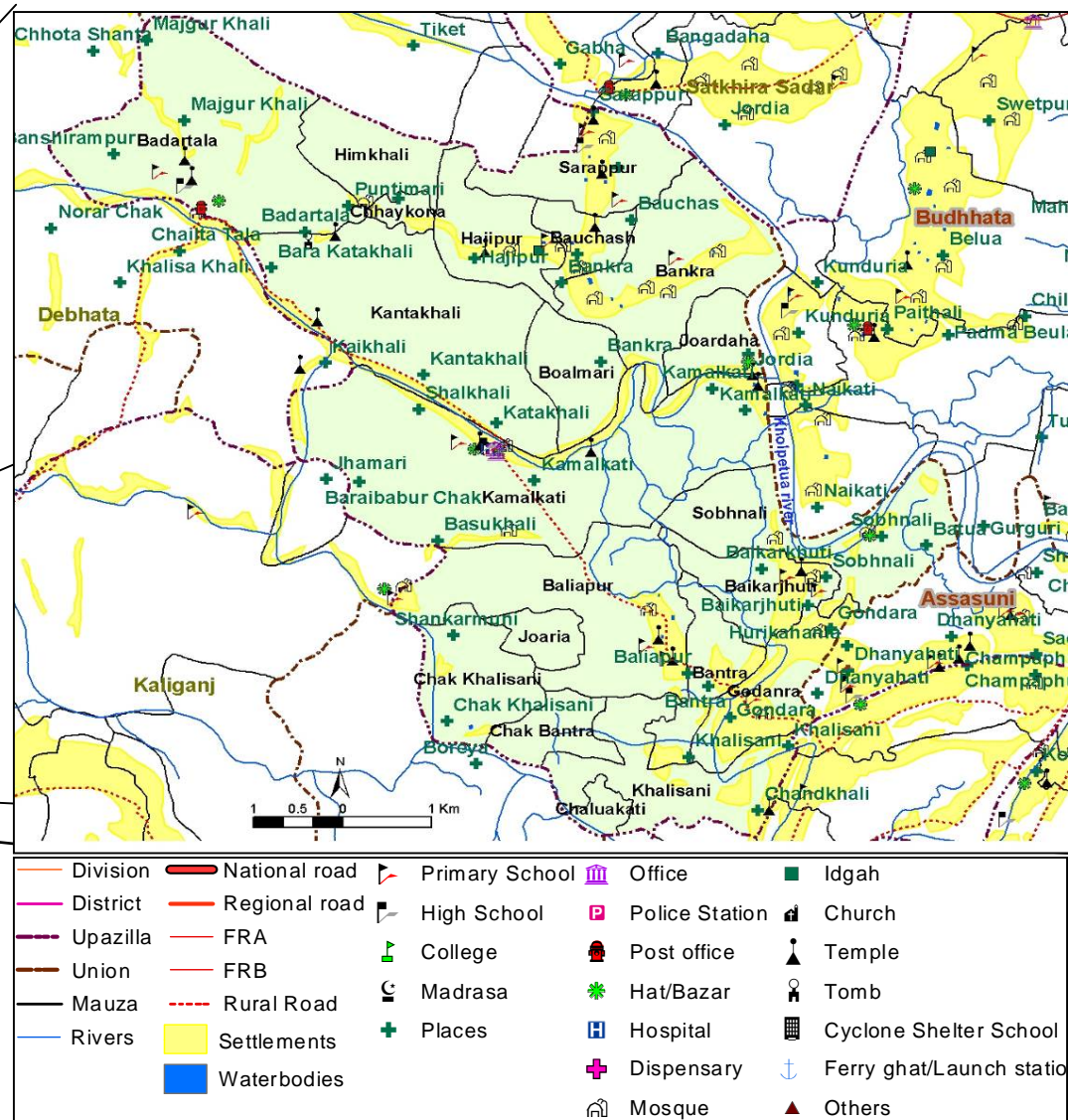


Figure B.10.1.b: Detail of Shobhnali Union



Figure B.10.2: Union Parishad, Shobnali (old building and new building under construction)

General information on FGD meeting:

Address: Temporary Union Parishad (Village: Kamalkathi, Ward: 5, Mauza: Kamalkathi,)

GPS location: N 22° 33' 41. 5" and E - 89° 05' 41. 8"

Date: 19 – 02 – 2008,

Time: 03:30 pm

Participants:

Total: 12 (Male- 10 and Female- 2)

UDMC: 5(Chairman – 1, Secretary- 1 and Ward member- 3)

Shrimp farmer: 3

Farmer: 2

Teacher: 1

Imam: 1

Figure B.10.3 shows some pictures of FGD at Shobnali was chaired by Union Parishad Chairman.



Figure B.10.3: Conducting FGD at Shobhnali

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.10.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.10.1: Questionnaire 1- List of Hazards, Shobhnali

Development of Hazard Zoning Maps using CRA (List of Hazard)		Questionnaire-05/01
Name of key informants: Shahriar/Ragib/Alamgir		Date: 19.02.08
Union: Sobhnali Upazila: Assasuni		District: Satkhira

Sl No	Hazards
1	Arsenic
2	Heavy rainfall flood
3	Shrimp Virus
4	Water logging
5	Cyclone
6	R.B erosion
7	Salinity
8	Hailstorm
9	R.B siltation
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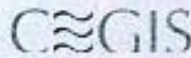




Table B.10.2: Questionnaire 2 - Hazard information, Shobhnali

Development of Hazard Zoning Maps using CRA Process

(Hazard information)

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>	Date: <i>12 – 02- 08</i>
Union: <i>Shobhnali</i>	Upazila: <i>Assasuni</i>
	District: <i>Satkhira</i>

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
Arsenic	January - December	✓	✓	✓	All group
Riverine flood	Mid July - September	✓	✓	✓	All group
Shrimp virus	March - Mid January	✓		Shrimp Farmer	
Water logging	Mid August – Mid February	✓	✓	Shrimp Farmer	
Cyclone	Mid March - Mid April & November	✓	✓	✓	All group
River bank erosion	Mid July - August	✓	✓	Shrimp Farmer	
Salinity	January - December	✓	✓	✓	All group
Dense fog	Mid December - Mid February	✓	✓	✓	All group
River bed Siltation	January - December	✓	✓	Shrimp Farmer	

Table B.10.3: Questionnaire 3 - Multi-hazard information, Shobhnali

Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

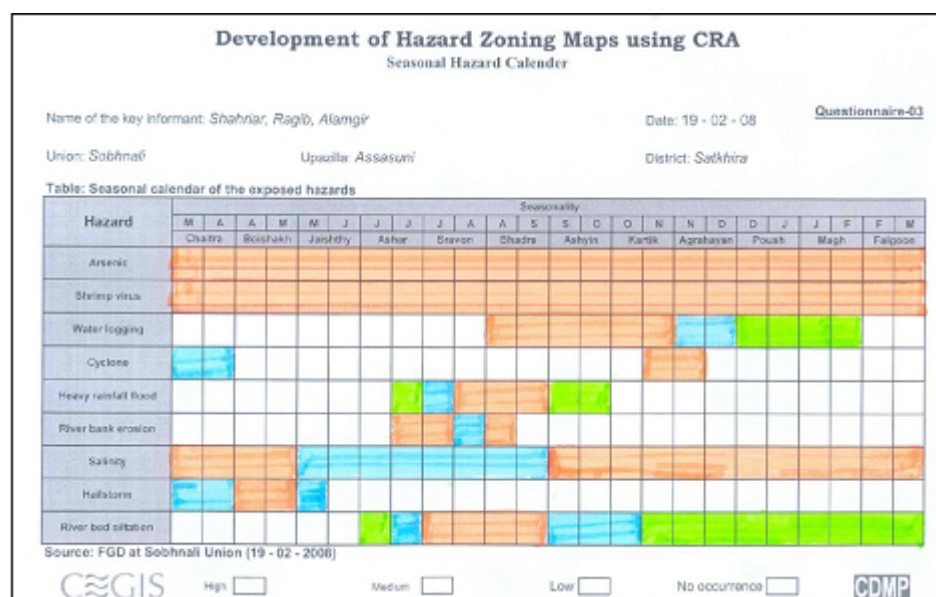
Questionnaire-03

Name of key informant: <i>Shahriar / Ragib / Alamgir</i>		Date: <i>19-02-08</i>	
Union: <i>Shobhnali</i>		Upazila: <i>Assasuni</i>	
		District: <i>Satkhira</i>	

Table: Mouza wise Hazard intensity and frequency information

Ward No.	Parameter	Hazard								
		Arsenic	Shrimp virus	Water logging	Enclosure	R. B. erosion	Salinity	Bank erosion	R. B. siltation	
01	Intensity	—	H	H	H	M	—	H	—	H
		—	H	H	H	L	—	H	—	H
		—	H	H	H	H	—	H	—	H
	Year of Occurrence	2007	2007	2007	2007	—	2007	2007	2007	
		2006	2006	2006	1991	—	2006	—	2006	
		2005	2005	2005	1988	—	2005	—	2005	
02	Intensity	—	H	H	H	M	—	H	H	H
		—	H	H	H	L	—	H	—	H
		—	H	H	H	H	—	H	—	H
	Year of Occurrence	2007	2007	2007	2007	—	2007	2007	2007	
		2006	2006	2006	1991	—	2006	—	2006	
		2005	2005	2005	1988	—	2005	—	2005	

GIS GDMP

Table B.10.4: Questionnaire 4 - Hazard seasonality index, Shobhnali

The hazard scenario of Shobhnali union from FGD and field investigation is summarized as shown in Table B.10.5.

Table B.10.5: Summary of Field investigation, Sreeula

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Heavy rainfall flood	<ul style="list-style-type: none"> Embankment breach Overflow of Kholpetua and Kobadak river 	1 - 9	High	Infrastructure (homestead, roads, embankment, educational institutes, religious centers, bazaars), shrimp farms, cropland, ponds, livestock	People become shelter less, scarcity of drinking water, suffering from water borne diseases, economic losses	
Water logging	<ul style="list-style-type: none"> Overflow of Khalpetua river Poor drainage system Closure of sluice gate, Khal leasing 	1, 2, 3, 4, 5, 6 and 7	High	Shrimp, vegetation, crops	Change in biodiversity, agriculture, and economic losses.	Local people's opinion is that water logging is a hazard because it changed them to shift their

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
		Others	Low			occupation from agriculture to shrimp. But from field investigation it came out that these waterlogged areas are now under the shrimp cultivation and people are economically benefited.
Shrimp virus	<ul style="list-style-type: none"> • Increase use of Hydrogen Sulphide, Methane and PH rate (> 9.6) • Lack of Oxygen, Zooplankton, food 	1 - 9	High	Shrimp loss	Economic loss	
Salinity	<ul style="list-style-type: none"> • Lack of fresh water flow from Khalpetua river • Excess shrimp cultivation • Saline water intrusion from Bay of Bengal 	1 - 9	High	Agriculture, scarcity of safe drinking water	Ecological degradation, agriculture loss, economic loss	
Cyclone	<ul style="list-style-type: none"> • Low pressure in the Bay of Bengal 	1 - 9	High	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	
Riverbank erosion	<ul style="list-style-type: none"> • Excess pressure of tide on the embankment in the rainy season 	9	Low	Loss of land, inundation, loss of infrastructure life and property	Loss of property, people become homeless	
Hail storm	<ul style="list-style-type: none"> • 	1 - 9	High	Shrimp, agricultural crops, infrastructure	Shrimp, crops	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Arsenic	<ul style="list-style-type: none"> Due to excess withdrawal of ground water 	3, 4, 7 and 9	High	Skin disease (Arsenicosis)	Loss of life	
		Others	No occurrence			
Riverbed siltation	<ul style="list-style-type: none"> Excess upstream erosion Tidal effects 	1 - 9	High		Flood, closure of sluice gate, water logging	

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.10.6). Figure B.10.4 shows the demarcation of the ward boundary map by local community and Union Parishad members.

Table B.10.6: List of wards, mauzas and villages, Shobhnali

New wards	Old wards	Mouzas	Villages
1	1	Badartala	Majgurkhali, Banshirampur Putimari, Badartala
2	1	Hazipur Himkhali Kantakhali Chhaykona	Hazipur, Kantakhali, Bara Kantakhali, Chhaykona
3	1	Sarabpur Bauchash	Sarabpur, Bauchash
4	2	Bankra Boalmari	Bankra, Boalmari, Beledanga
5	2	Kamalkati Joardanga	Kamalkati, Joardanga, Koikhali Senerchak, Basukhali
6	2	Baliapur Joaria	Baliapur, Bashukhali
7	3	Bantra Khalishani Chak Bantra Chak Khalishani	Bantra, Khalishani, Latakhali Balabunia, Chandidaha, Nayakati
8	3	Godara	Godara
9	3	Sobhnali Boikarjhuti	Sobhnali, Boikarjhuti



Figure B.10.4: Demarcation of ward boundaries, Sobhnali

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of some important features of the union such as presence of hazards (see Figure B.10.5.a – d) at the time of FGD.



Figure B.10.5. Important features in Sobhnali (A). Hari mondir, Shobhnali , (B) Kamak Kati culvert (C) Riverbed siltation (D) Water logging

Important hazards:

Cyclone	-	1988 and 1991
Hail storm	-	2003

Observation: The local people reported that the union does not suffer from drought, which is included in the CRA report. The soil is moist for water logging and the soil moisture retains in the dry season.

Conclusion: Shobnali union is dominated by shrimp cultivation. According to the local community heavy rainfall flood, riverbed siltation, and water logging are the major hazards but in the water logged areas shrimp is also being cultivated.

Annex B.11 Field report on Sreeula union, Assasuni, Satkhira**Prepared by: Mohammad Shahriar Khan, Ragib Ahmad, N.M. Alamgir**

Location: Sreeula union is one of the most hazard prone area of the Assasuni upazila. This union lies between N -22° 23' 40" to 22° 28' 50" and E - 89° 8'30" to 89° 12' 40". Sreeula union borders with Assasuni union in the north, Shyamnagar upazilla in the south Khajra and Anulia union on the west, Kaliganj upazilla in the west. River Kholpetua and Golghesia river flows through the east and the west of the union respectively. (see Figure B.11.1.a- b). The union is about 16 kilometers from Upazilla Parishad and 39 kilometers (approx.) from District Head Quarter^{[21] – [22]}.

Area and Population: The union is about 10,297 sq. feet and the population is about 24,890^{[21] – [22]}. According to BBS 2001 census the population of Shobhnali union is 23,686.

Road network and mode of transport: The road network is poor. The roads are mainly earthen and herringbone. Mode of transport is van, motorized van, motorcycle and bicycle^[21].

Major Infrastructures: Temporary Union Parishad (Figure B.11.2), educational institutes (primary, secondary school and madrasa) mosques, churches, and temples are the main infrastructures of the union^{[21] – [22]}.

Topographical and hydrological characteristics: The land is generally flat that gives the homogenous characteristics features to the union. Rivers (Kholpetua and Golghesia), canals, marshlands, ponds and ditches are the dominating hydrological features of Sreeula union^[21].

Cropping pattern: Shrimp (Baghda) has replaced massively the agricultural land. 99% of the total cultivated are is under shrimp farm (Gher) and only 1% is used for agriculture^[21].

Occupational group: 95% people are engaged in shrimp cultivation as their main occupation, 4% are fully engaged in agricultural activities and 1% with other occupation^[21].

Natural hazard: Mostly occurred natural hazards are riverine flood, shrimp virus, salinity, hail storm, riverbank erosion, cyclone, water logging, arsenic, riverbed siltation and dense fog.^{[21] – [22]}

Focus Group Discussion (FGD): One FGD was done in the union on 18 Feb 2008 by CEGIS to assess the natural hazards their magnitude, intensity, recurrence, impacts. Another main purpose of FGD was to validate the CRA report and to prepare Hazard Zoning Maps.

Stakeholder selection:

- ❑ UDMC members (UP Chairman, UP Secretary, UP Ward members)
- ❑ Representative from shrimp farmer from 3 old wards as major occupational group
- ❑ Farmer as second dominated occupational group
- ❑ Local elite persons (teacher, purohit/ Imam, social worker etc.)
- ❑ Government officer Sub- Assistant Agriculture Officer
- ❑ NGO representative

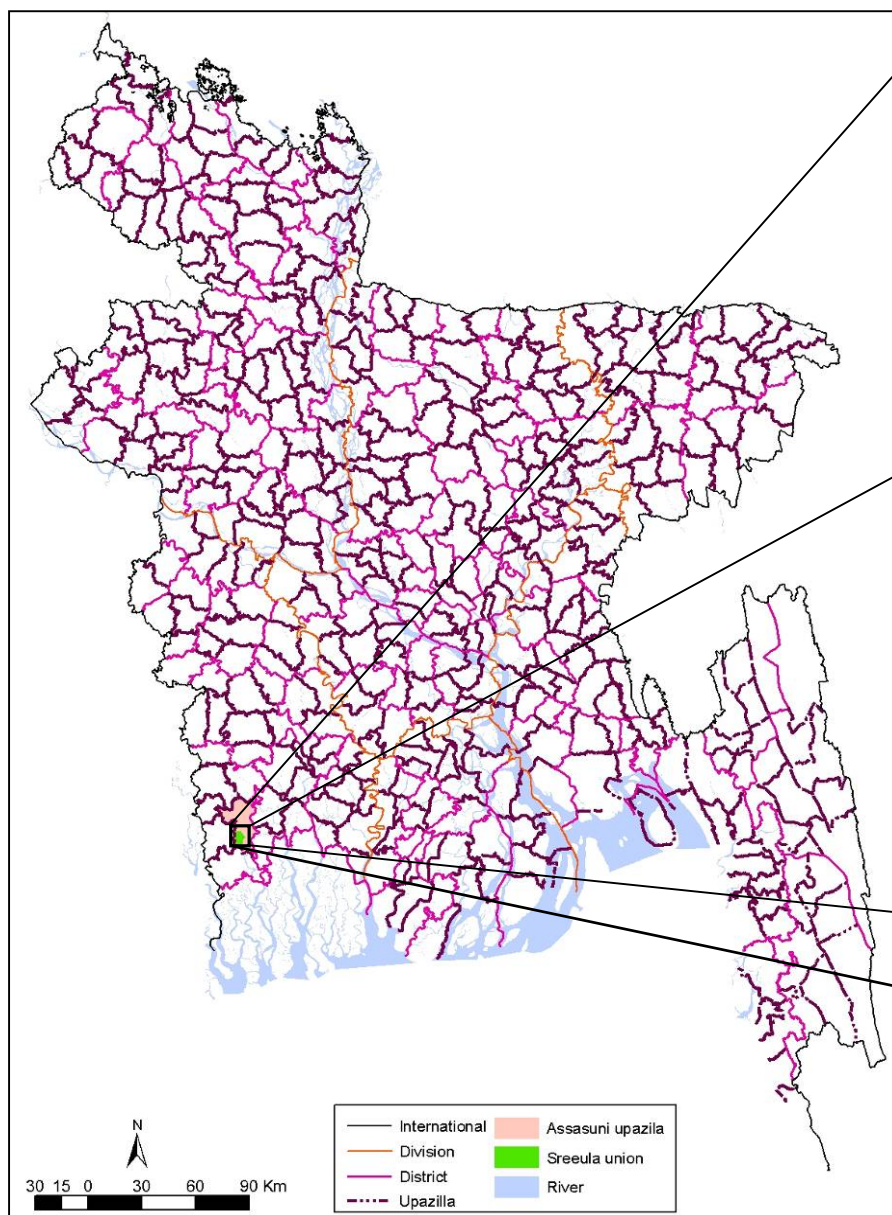


Figure B.11.1.a: Index map showing Sreeula Union

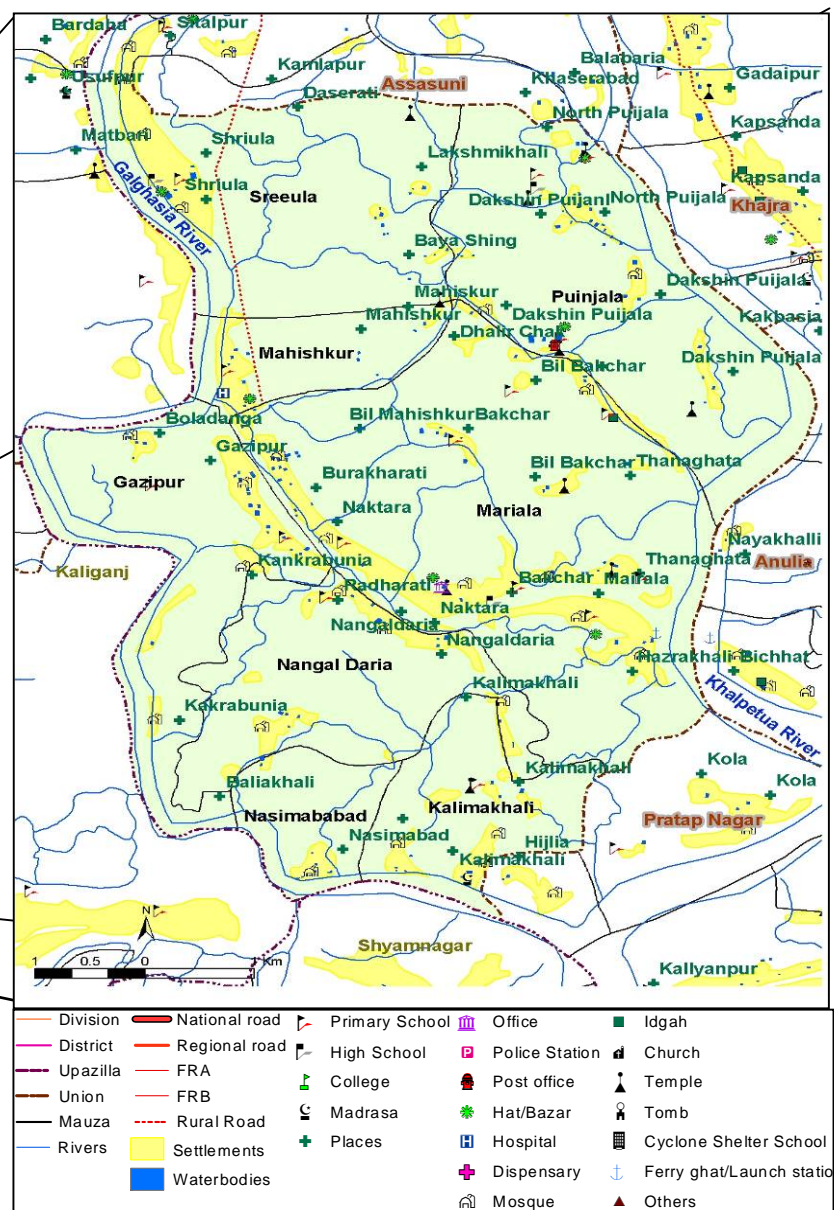


Figure B.11.1.b: Detail of Sreeula Union



Figure B.11.2: Temporary Union Parishad, Sreeula

General information on FGD meeting:

Address: Temporary Union Parishad (Village: Naktara, Ward: 5, Mauza: Mariala,)

GPS location: N 22° 25' 53.9" and E - 89° 10' 33"

Date: 18 – 02 – 2008,

Time: 12:00 pm

Participants:

Total: 17 (Male- 15 and Female- 2)

UDMC: 11(Chairman – 1, Secretary- 1 and Ward member- 9)

Shrimp farmer: 4

Farmer: 1

Teacher: 1

Figure B.11.3 shows some pictures of FGD at Sreeula was chaired by Union Parishad Chairman.





Figure B.11.3: Conducting FGD at Sreeula

Methodology:

The Focus Group Discussion (FGD) was carried out with the help of questionnaires (see Table B.11.1-4), maps, satellite images and open discussion with the local people. Field investigation was also done through interaction with local people.

Table B.11.1: Questionnaire 1- List of Hazards, Sreeula

Development of Hazard Zoning Maps using CRA
(List of Hazard)

Questionnaire-01

Name of key informants: *Shahria / Ragis / Alangir* Date: *18.01.08*
 Union: *Sreeula* Upazila: *Assasuni* District: *Satkhira*

Sl No	Hazards
1	Shrimp Virus
2	Salinity
3	Arsenic
4	River bank erosion
5	Riverine flood
6	Cyclone
7	Dense fog
8	Excess rainfall
9	River bed siltation
10	Water logging
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

CEGIS CDMP

Table B.11.2: Questionnaire 2 - Hazard information, Sreeula

Development of Hazard Zoning Maps using CRA Process

(Hazard information)

Name of key informant: <i>Shahriar, Ragib, Alamgir</i>	Date: <i>12 – 02- 08</i>
Union: <i>Sreeula</i>	Upazila: <i>Assasuni</i> District: <i>Satkhira</i>

Table: Stakeholder wise Hazard identification (Use ✓)

Hazards	Period of Occurrence (Months)	Stakeholder groups			Remarks
		UDMC	Farmer	Others	
<i>Arsenic</i>	January - December	✓	✓	✓	All group
Riverine flood	Mid July - September	✓	✓	✓	All group
Shrimp virus	March - Mid January	✓		Shrimp Farmer	
Water logging	Mid August – Mid February	✓	✓	Shrimp Farmer	
Cyclone	Mid March - Mid April & November	✓	✓	✓	All group
River bank erosion	Mid July - August	✓	✓	Shrimp Farmer	
Salinity	January - December	✓	✓	✓	All group
Dense fog	Mid December - Mid February	✓	✓	✓	All group
River bed Siltation	January - December	✓	✓	Shrimp Farmer	

Table B.11.3: Questionnaire 3 - Multi-hazard information, Sreeula

Development of Hazard Zoning Maps using CRA
(Multi Hazard Information)

Questionnaire-03-03

Name of key informant: <i>Shahriar / Ragib / Alamgir</i>		Date: <i>12.02.08</i>	
Union: <i>Sreeula</i>		Upazila: <i>Assasuni</i> District: <i>Satkhira</i>	

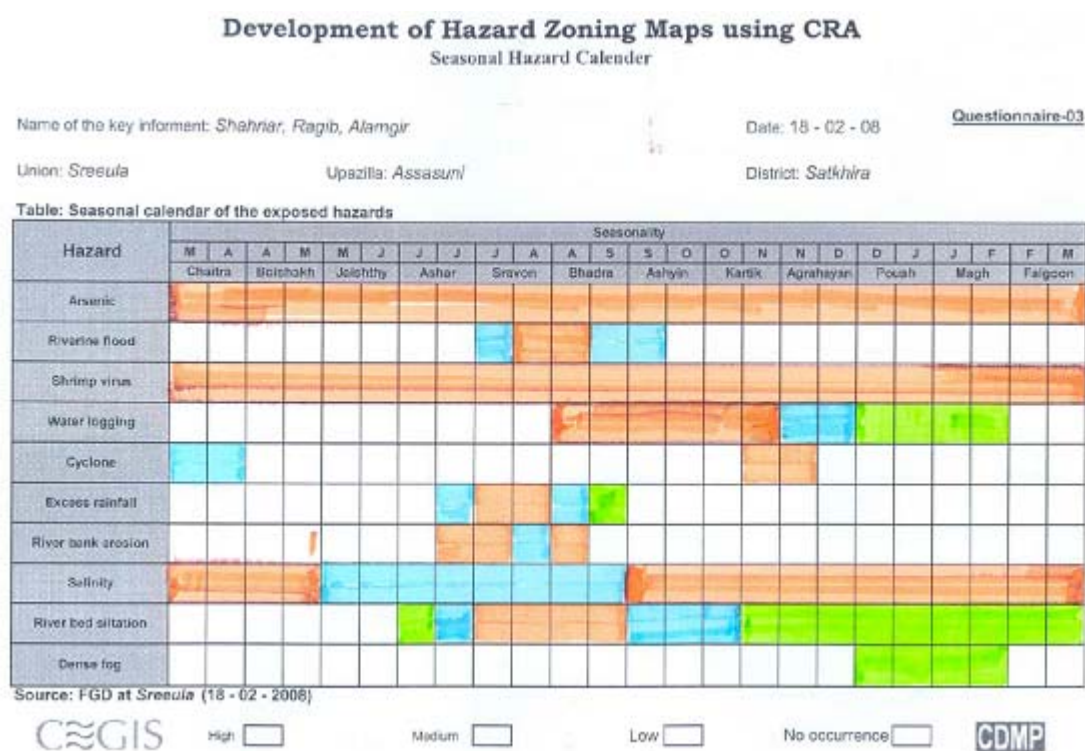
Table: Mauza wise Hazard intensity and frequency information

Ward No.	Parameter	Shrimp	Salinity	Arsenic	R. H. erosion	R. Flood	Cyclone	Dense fog	Shrimp virus	R. B. siltation	Water logging		
01	Intensity	H	H	H	—	L	H	M	M	H	H		
		H	H	H	—	L	H	M	H	H	H		
		H	H	H	—	M	H	M	H	H	H		
	Year of Occurrence	2007	2007	2007	—	2007	2007	2007	2007	2007	2007		
		2006	2006	2006	—	2004	1995	2006	2005	2006	2006		
		2005	2005	2005	—	1995	1988	2005	2001	2005	2005		
02	Intensity	H	H	H	H	M	H	M	M	—	L		
		H	H	H	H	M	H	M	H	—	L		
		H	H	H	H	H	H	M	H	—	L		
	Year of Occurrence	2007	2007	2007	2007	2007	2007	2007	2007	—	2007		
		2006	2006	2006	2006	2004	1995	2006	2005	—	2006		
		2005	2005	2005	2005	1995	1988	2005	2001	—	2005		

C≈GIS

CDMP

Table B.11.4: Questionnaire 4 - Hazard seasonality index, Sreeula



The hazard scenario of Sreeula union from FGD and field investigation is summarized as shown in Table B.11.5.

Table B.11.5: Summary of Field investigation, Sreeula

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Riverine flood	<ul style="list-style-type: none"> Embankment breach Overflow of Kholpetua and Golghesia rivers 	2, 3, 5 and 6	Medium	Infrastructure (homestead, roads, embankment, educational instituitues, religious centers, bazaars), shrimp farms, cropland, ponds, livestock	People become shelter less, scarcity of drinking water, suffering from water borne diseases, economic losses	
		1, 4, 7, 8 and 9	Low			

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Water logging	<ul style="list-style-type: none"> • Overflow of Khalpetua and Golghesia rivers • Poor drainage system • Closure of sluice gate, • Khal leasing 	1 and 5	High	Shrimp, vegetation, crops	Change in biodiversity, agriculture, and economic losses.	Local people's opinion is that water logging is a hazard because it changed them to shift their occupation from agriculture to shrimp. But from field investigation it came out that these waterlogged areas are now under the shrimp cultivation and people are economically benefited.
		Others	Low			
Shrimp virus	<ul style="list-style-type: none"> • Increase use of Hydrogen Sulphide, Methane and PH rate (> 9.6) • Lack of Oxygen, Zooplankton, food 	1 - 9	High	Shrimp loss	Economic loss	
Salinity	<ul style="list-style-type: none"> • Lack of fresh water flow from Khalpetua and Galghesia rivers • Excess shrimp cultivation • Saline water intrusion from Bay of Bengal 	1 - 9	High	Agriculture, scarcity of safe drinking water	Ecological degradation, agriculture loss, economic loss	

Hazard	Cause	Ward	Intensity	Damage	Consequences	Remarks
Cyclone	• Low pressure in the Bay of Bengal	1 - 9	High	Life, property, infrastructure, agriculture, shrimp	Loss of life and properties	
Riverbank erosion	• Excess pressure of tide on the embankment in the rainy season	2 - 3	High	Loss of land, inundation, loss of infrastructure life and property	Loss of property, people become homeless	
		Others	No occurrence			
Arsenic	• Due to excess withdrawal of ground water	1, 2 and 3	High	Skin disease (Arsenicosis)	Loss of life	
		Others	Medium			
Excess rainfall	•	1 - 9	High	Shrimp, crops, infrastructure	Loss of life, property, agricultural crops, shrimp	
Dense fog	•	1 - 9	Medium	Shrimp, crop	Loss of shrimp and crop	
Riverbed siltation	• Excess upstream erosion • Tidal effects	1, 4, 8 and 9	Medium		Flood, closure of sluice gate, water logging	Local people's opinion is the sluice gate is closed by silt due to riverbank siltation which creates flood, water logging
		Others	No occurrence			

Demarcation of the Ward boundary: The hand drawn ward boundary map was traced on tracing papers and also on the Base Map. Wards boundaries, mauza and villages names water bodies, settlements, river, educational institutions etc have been marked on the Base Maps. A list of new wards (9 nos), old wards (3 nos.), respective mauzas and villages were also prepared (see Table B.11.6). Figure B.11.4 -5 shows the demarcation of the ward boundary map by local community and Union Parishad members.

Table B.10.6: List of wards, mauzas and villages, Sreeula

New wards	Old wards	Mouzas	Villages
1	1	Sreeula	Sreeula
2	1	Puinjala	Laxmikhali, Bayasing, Uttar Puinjala
3	1	Puinjala	Dakshin Puinjala
4	2	Mahiskur Mariala	Mahiskur, Burakharati
5	2	Mariala	Naktana, Thanaghata, Bil Bakchar
6	2	Mariala	Bakchar, Mariala, Hazrakhali
7	3	Kalimakhali Nasimabad	Kalimakhali, Nasimabad
8	3	Nangaldaria	Baliakhali, Radharati, Nangaldaria
9	3	Gazipur	Gazipur, Boladanga, kankrabunia

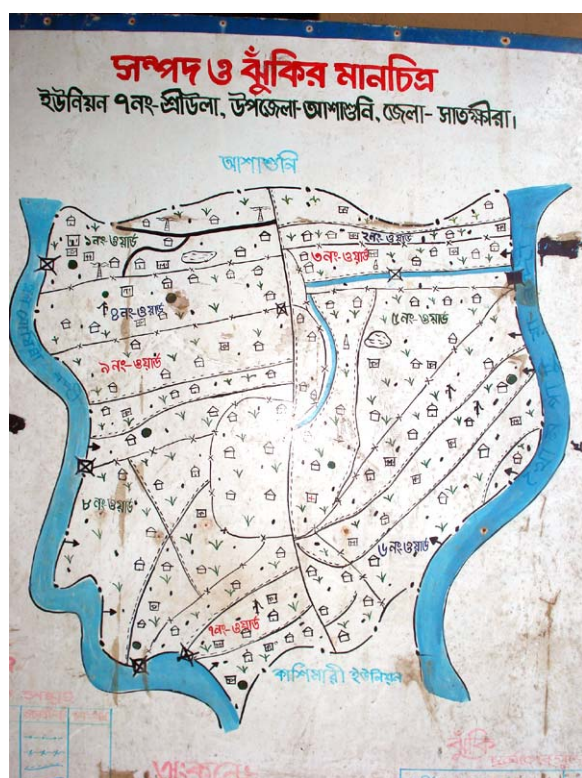


Figure B.11.4: Ward boundary map, Sreeula



Figure B.11.5: Demarcation of ward boundaries, Sreeula

Field investigation: After FGD, the team went around the union and collected GPS reading and photos of some important features of the union such as presence of hazards (see Figure B.11.5) at the time of FGD.



Figure B.10.5. Riverbed siltation, Sreeula

Important hazards:

Cyclone	-	1988 and 1995
Riverine flood	-	1995 and 2004

Observation: Dense fog and riverbed siltation are newly identified hazard, which are not in the CRA report.

Conclusion: Sreeula union is dominated by shrimp cultivation. According to the local community riverine flood and water logging are the major hazards but in the water logged areas shrimp is also being cultivated.

References:

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