

## PLANNING INTERVENTION FOR FLOOD CONTROL AND RISK MANAGEMENT IN CHILMARI UPAZILA, KURIGRAM, BANGLADESH

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### ABSTRACT

Water related natural hazards and climate change issue such as flood has become a serious threat to the lives, livelihoods and sustainable development of Bangladesh. Among the flood prone areas of Bangladesh, the Chilmari Upazila of Kurigram district is one of the most seriously affected areas as it has been taken as the study area. Bangladesh is already known as a role model for flood risk management around the world. But as the situation is not the same all around the country. The objective of this research is to find out the main problems in the flood control and risk management system in the upazila. The interactive approach of the research involves participation of both citizen and stakeholders and objectives to develop local solutions to the flood problems. The empirical part of this research is conducted by semi-structured in-depth interviews with questions regarding flood control and risk management in Chilmari Upazila. The main finding of the research states that the floods in Chilmari are managed in ad hoc manner. A coordinated and comprehensive management approach along with strong institutional framework is very important for sustainable development in flood control and risk management of Chilmari.

**Keywords:** Flood control, flood risk management, flood vulnerabilty, water resource management

### 1. INTRODUCTION

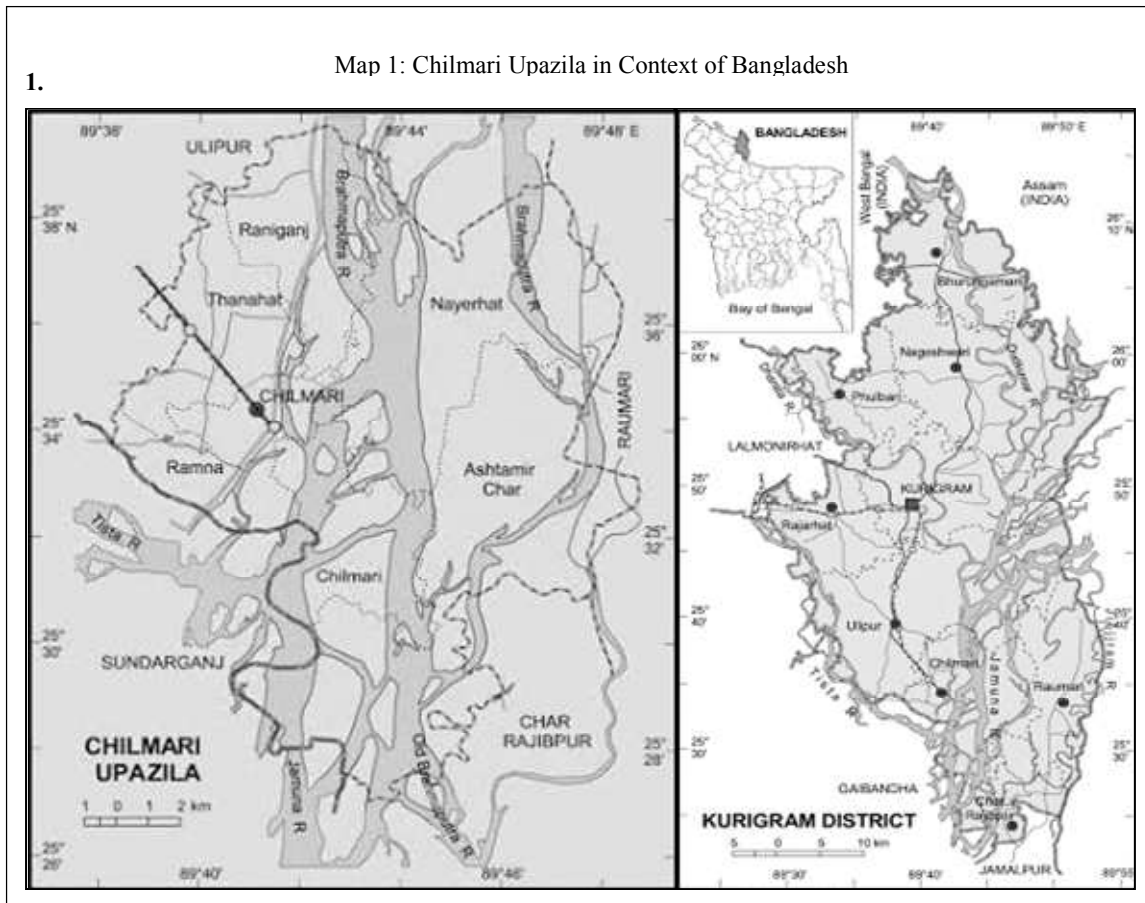
Bangladesh is probably the most flood prone country in the world, and some authors are arguing it is the most disaster prone nation in the world (Cutter, 1996; Zaman, 1999). Among natural disasters in Bangladesh, flood is the preeminent one. Every year a large portion of the country becomes flooded due to heavy rainfall and spilling water from the major rivers. The effects of flood are manifold in Bangladesh since flood water remains long time onto the land. For example, all means of communication viz. roads, railways, highways, and even runways become paralyzed due to flooding. It causes widespread damage to crops, stored food grains, domestic animals, homesteads, development infrastructures, and human lives. People remain maroon in water without having food and drinking water until relief arrives. The consequences of such recurring floods are really well beyond the capacity of a developing country like Bangladesh to bear.

The factors that contribute to these calamitous inundations are varied and complex and some of these are natural, like heavy monsoon downpour, melting snows in the Himalayas, and geophysical instabilities in the northern regions. But some of the factors that responsible for floods are human work such as deforestation and unplanned development works.

### 2. STUDY AREA

Study area for the study is one of the most seriously flood affected Upazila in Bangladesh. The Upazila is Chilmari Upazila in Kurigram district. Chilmari Upazila is situated in the northern part of Bangladesh. Area of the Upazila is 224.97 square km. According to Bangladesh National Web- Portal, 2012, total population of the Upazila is 140165 and total household is 31,689. Literacy rate of the upazila population is 50 percent. Most of the people live on agriculture.

Chilmari is located at 25.5667°N 89.6917°E. It is located by the Indo-Bangladesh frontier. Chilmari Upazila is intersected by the mighty Brahmaputra River. There are six unions in Chilmari Upazila. The unions are: Ashtamir Char, Chilmari, Thanahat, Nayerhat, Ramna and Raniganj.

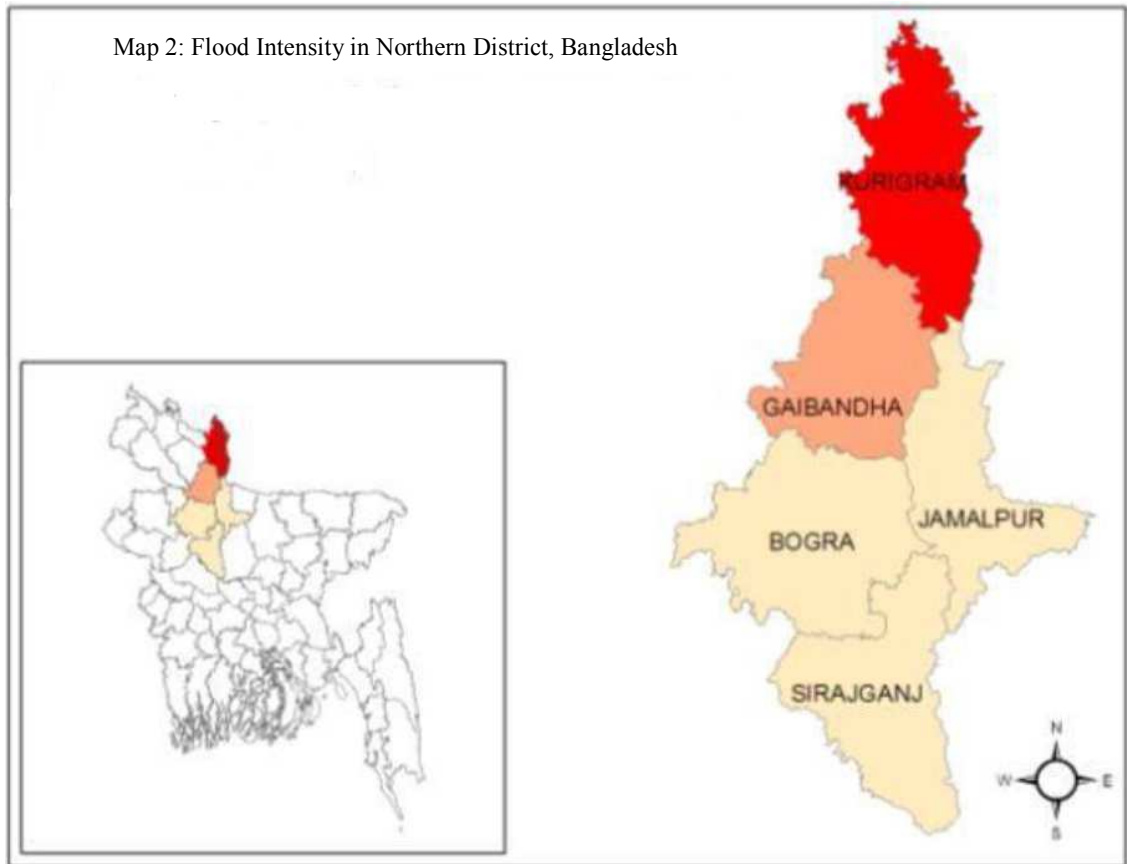


### 3. LITERATURE REVIEW

The causes of floods in Bangladesh have been studied by many researchers from different perspectives (Ahmed, 1989; Khalil, 1990). An abridge overview of the causes of floods in Bangladesh is presented below:

- a) Extremely flat topography. The average height of the land is 25 feet or 8 meters (Huq, 1986).
- b) Synchronization of peak flows of the major rivers.
- c) Excessive monsoon rainfall in the plains and catchment areas of three major river systems.
- d) River bed siltation which is reducing river carrying capacity.
- e) Back water or tidal effect from the Bay of Bengal during monsoon which is an impediment to recede water from rivers.
- f) Deforestation and ecological imbalance.
- g) Increasing population pressure which is resulting encroachment and filling up of lakes and canals.
- h) Drainage congestion due to unplanned construction of infrastructures.
- i) Flood control activities such as flood wall, embankment, artificial levee, dykes.
- j) Probable sea level rise and land subsidence.

Kurigram is a district of Northern part of Bangladesh. It has in total nine upazilas. Chilmari is one of the upazilas of Kurigram district. The flood affected districts of northern part of Bangladesh are Kurigram, Gaibandha, Jamalpur, Bogra and Sirajgang. Among these five districts Kurigram is the most seriously affected district. The map below indicates the degree of severity of floods in the Northern districts, showing that Kurigram was the most affected district, particularly because of the large number of low lying sand banks (chars) in this region which were most severely affected by thicker sediments than is usual. In the Kurigram district, the most seriously flood affected upazila is Chilmari. Floods cause huge damage almost every year.



Kurigram district with all of its upazilas are in high vulnerable condition towards floods because of its geographical and socio- economic condition. In Kurigram district, both the number of households and number of individual affected by the recent flood are high. Here the percentage of people living with extreme poverty is also very high and Number of areas that are hard to reach during and after the flood for relief and recovery is also high. So, all the upazilas in Kurigram district are in very vulnerable condition to floods.

#### 4. METHODOLOGY OF THE STUDY

This is a qualitative exploratory and descriptive type of research, which may lead to the development of planning intervention guideline for flood control and flood risk management in Chilmari Upazila under Kurigram district.

In this study, some relevant data and information of flood control and risk management measures practiced in Bangladesh have been reviewed from both primary and secondary sources. The planning intervention guideline for flood control and risk management has been developed by identifying the gaps and constraints of present flood management system from the face to face interviews of the flood affected people of Chilmari. According to the latest flood management techniques around the world and considering the suggestions of the upazila people, some recommendations have been thrown in order to promote a more interactive, feasible and effective flood control and risk management that is improvement in overall flood management system.

This qualitative research is based on primary and secondary data collection to understand the trends of the flood management in Bangladesh and Chilmari and to analyze the feasible and effective approaches towards flood management and how such approaches can improve flood management in Chilmari.

The primary data are collected through fieldwork in the month of October 2014 in Chilmari, Bangladesh. The data are collected through Household Survey, Focus Group Discussion (FGD) and Key Informant Interviews (KII) and observational study. For Household survey, according to the research methodology formula, the required number of household has been calculated and as per the calculation 389 household have been surveyed in total upazila where the total household in the upazila is 31689.

The secondary data source for the research is literature study. Literature study includes published papers, theses, journal articles, and government reports, books on water resources management, flood management, water governance, newspaper articles and internet sources.

This qualitative data analysis of the study has two stages:

- First stage: At this stage the factors are identified that constrain or facilitate the effective and efficient management of flood protection activities in the light of flood control and risk management
- Second stage: The SWOT analysis is carried out to identify the potentials and limits of the current Flood Management based on literature study and in-depth interviews.

## 5. IMPACT OF FLOODS IN CHILMARI

Chilmari suffers from two types of flooding: river floods and storm water floods. Every year, floods cause a great damage in the upazila. For understanding the impact of floods in Chilmari a survey was conducted for identifying the loss in the upazila due to flood in 2014.

The recent flood has a great impact on the living of the people of Chilmari. Almost all of the unions of the upazila went under water and the people of the upazila lost their living as most of the people of the upazila are farmer. For analyzing the impact, 64 household surveys have been done in each union, in total 384 household surveys have been completed within the upazila. The impact of recent flood on agriculture in Chilmari Upazila is represented by the table below-

Table 1: Impact of Recent Flood 2014 on Agricultural Properties

| Name of the Union | Number of Household Affected by Agricultural Loss | Number of Respondent Household | Percentage | Average Income in taka (per Household) | Average Loss in taka (per Household) |
|-------------------|---|--------------------------------|------------|--|--------------------------------------|
| Ashtamir Char     | 58  | 64                             | 23.67      | 5000                                   | 5200                                 |
| Nayer hat         | 50  | 64                             | 20.41      | 5200                                   | 4800                                 |
| Chilmari          | 43  | 64                             | 17.55      | 5500                                   | 4300                                 |
| Thanahat          | 38  | 64                             | 15.51      | 5200                                   | 4200                                 |
| Ramna             | 23  | 64                             | 9.39       | 5000                                   | 3400                                 |
| Raniganj          | 33  | 64                             | 13.47      | 5200                                   | 3700                                 |
| <b>Total</b>      | 245   | 384                            | 63.80      | 5183                                   | 4266                                 |

Source: Field Survey, 2014

Most of the people of Chilmari Upazila are poor and lower middle class. So damage to their residential house has a great impact to their livelihood. They can hardly afford to rebuild the house or repair it. Most of the houses are katcha or semi pucca. As a result the velocity of flood water and long duration of flood water can easily damage the house of the people. Many houses on the mainland and chars were inundated with flood waters and shelter items were widely lost (blankets, clothes, cooking pots and utensils etc).

The percentage of households affected by damage to residential properties in each union of the upazila is shown by the figure 1.

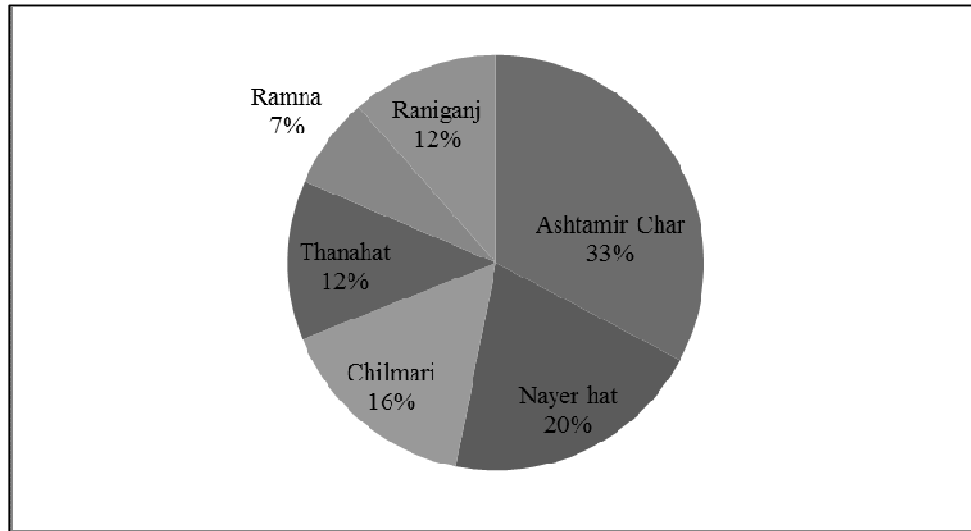


Figure 1: Percentage of Households Affected by Losing Residential Properties

Figure 1 shows that most number of houses has been affected by the recent flood in Ashtamir Char union. In Chilmari upazila about 29 percent households have been affected by damages to their houses. Among the total affected households with damage to their houses in Chilmari upazila, 33 percent households have been affected in Ashtamir Char, 20 percent households have been affected in Nayerhat, 16 percent in Chilmari, 12 percent in Thanahat, 12 percent in Raniganj and 7 percent households have been affected in Ramna union.

The people of the Upazila lost their work as the agricultural land went under water due to the recent floods. The people who have no land of their own have suffered much. Because they live on others' agricultural land to work and live on. As the agricultural land was under water, there was no work for a certain time. The number of people losing works due to the flood in the upazila is represented by the below table.

Table 2: Number of People Lost Works in 2014 Flood

| Name of the Union | Number of People Loosing Work | Total Respondent Households | Percentage | No. of Days Remaining Workless |
|-------------------|-------------------------------|-----------------------------|------------|--------------------------------|
| Ashtamir Char     | 18                            | 64                          | 23.68      | 60                             |
| Nayer hat         | 15                            | 64                          | 19.74      | 50                             |
| Chilmari          | 13                            | 64                          | 17.11      | 45                             |
| Thanahat          | 11                            | 64                          | 14.47      | 44                             |
| Ramna             | 9                             | 64                          | 11.84      | 30                             |
| Raniganj          | 10                            | 64                          | 13.16      | 45                             |
| Total             | 76                            | 384                         | 19.79      |                                |

Source: Field Survey, 2014

Table 2 shows that about 24 percent people in Ashtamir Char union lost their work in the flood in 2014

Due to agricultural loss and loss to business properties and loss of work of the day laborers cause a great decrease in the average monthly income of the household of the upazila. The average household monthly income before and after the crisis of recent floods of 2014 in Chilmari is shown in the Table 3.

Table 3: Monthly Incomes of Households before and after Flood

| Name of the Union | Monthly Incomes of Households |             |           |
|-------------------|-------------------------------|-------------|-----------|
|                   | Before Flood                  | After Flood | % Decline |
| Ashtamir Char     | 5000                          | 2500        | 50.00     |
| Nayerhat          | 5200                          | 3000        | 42.31     |
| Chilmari          | 5500                          | 3800        | 30.91     |
| Thanahat          | 5200                          | 3800        | 26.92     |
| Ramna             | 5000                          | 4000        | 20.00     |
| Raniganj          | 5200                          | 3900        | 25.00     |

Source: Field Survey, 2014

Due to the recent flood the source of income of the upazila people have been changed. As the farmers lost their land the source of income from farming decreased significantly. The change in source of income after the flood of 2014 in Chilmari is shown in the Figure 2.

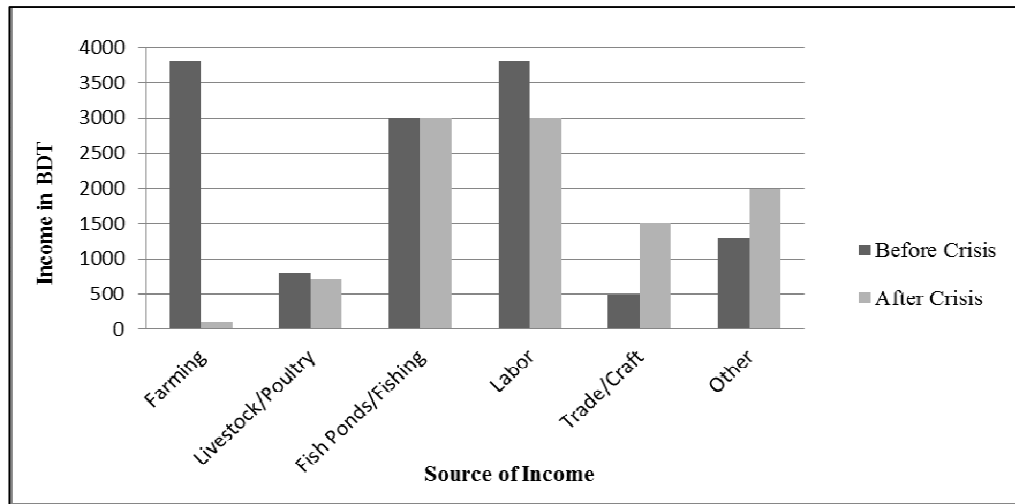


Figure 2: Change in Source of Income before and after the Flood

The disastrous floods affect physical settings, environment, quality of life and most importantly the economy of the community. Both flooding and water logging cause serious damage to infrastructure like roads, railways, formal and informal housing and institutions. They also disrupt communication, slow down economic activities. The field survey analysis states that during the flood of 2014, storm water flooding affected 11 schools within six unions of the upazila. The result is shown in the Table 4.

Table 4: Number of Educational Institutions Affected

| Name of the Union | Number of Institution Affected | Disruption in Study (days) |
|-------------------|--------------------------------|----------------------------|
| Ashtamir Char     | 3                              | 30                         |
| Nayer hat         | 2                              | 20                         |
| Chilmari          | 2                              | 15                         |
| Thanahat          | 2                              | 15                         |
| Ramna             | 1                              | 10                         |
| Raniganj          | 1                              | 10                         |

Source: Field Survey, 2014

- ❖ The recent flood has also disrupted communication, slow down economic activities by affecting small business, hat bazars and other business properties.
- ❖ During the flood people faced serious want of pure drinking water as most of the tub wells went under water. Low lying char islands and the mainland riverbank areas that lost land entirely due to the floods lost tube wells, latrines. This decline in numbers has increased the use of water and sanitation facilities that remain and is causing some disaffection and arguments within communities. Communities share facilities during the day, but at night people and women and children in particular do not make the relatively short distances to the latrines (average distance is 10 minute walk).
- ❖ Water borne diseases like diarrhea, cholera etc. spread over the affected area. 90% of HHs reported that their general health was worse than prior to the floods and 50% said that stomach problems and diarrheas were worse with 18% stating that mosquito borne disease incidence was worse.
- ❖ A number of char communities report that the teachers are not willing to travel over to the islands to teach the children and that in effect there is no primary aged education. Chars children able to attend secondary school on the mainland are usually lodged with extended family or take the daily trip by boat (very few). Many do not attend.

## 6. FLOOD VULNERABILITY COMPARISON AMONG THE UNIONS OF CHILMARI UPAZILA

The vulnerability of six unions of Chilmari upazila to flood is determined by analyzing the collected data and different kind of damages to various properties due to the recent flood of 2014. For determining the level of damage, some factors have been given importance value within 1 to 3. Where, 3 is representing the most important factor, 1 representing less important and 2 representing important factor. These factors were selected according to the damage to various properties due to flood.

Table 5: Factors of Calculating Flood Vulnerability

| Factor                      | Importance |
|-----------------------------|------------|
| Agricultural Damage         | 3          |
| Damage to House             | 3          |
| Damage to Business Property | 2          |
| Loss of Work                | 3          |
| Hamper to Education         | 1          |
| Duration of Water Stay      | 2          |

According to the collected data level of loss of the six unions due to flood has been determined. Level of loss has been classified into five categories. The five categories are most seriously affected, moderately serious, seriously affected, less seriously affected and not affected. This level of loss has been given score from 0 to -4.

Table 6: Scores for Different Levels of Damage

| Level of Loss           | Score |
|-------------------------|-------|
| Most Seriously affected | -4    |
| Seriously affected      | -3    |
| Moderately affected     | -2    |
| Less seriously affected | -1    |
| Not affected            | 0     |

From the score of level of loss and importance of factor, total score of damaged level due to flood for each union has been calculated, Where the most negative value would represent the worst condition of any union.

Total score of damaged level = Importance Score × Level of loss score

After analyzing all the collected data we have calculated the overall score of flood damage for six unions of the upazila individually. Overall score of flood damage in 2014 for the six union has been represented in the table 7.

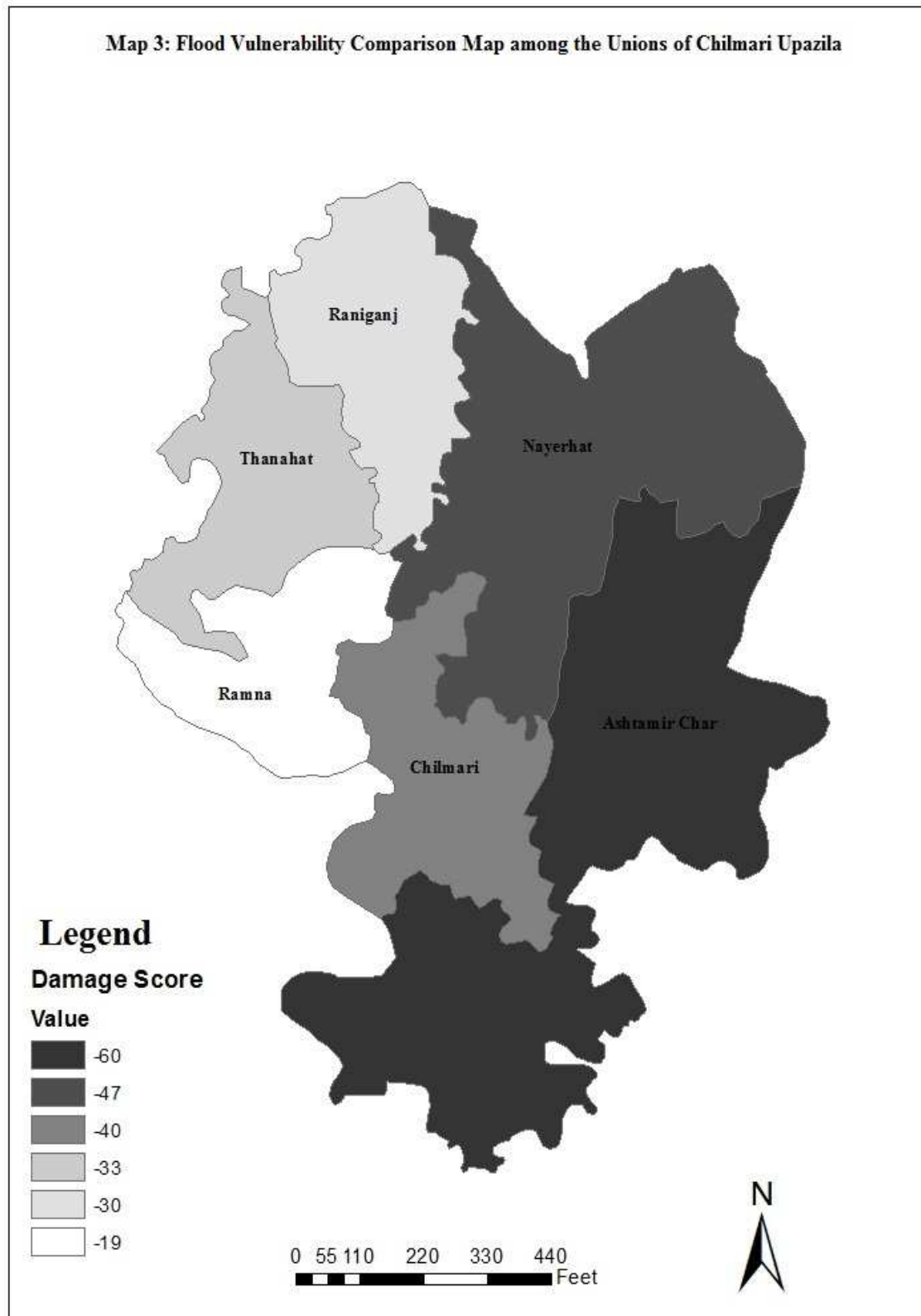
Table 7: Flood Vulnerability of Six Unions of Chilmari Upazila

| Name of Union | Total Score of Damaged Level to Agriculture | Total Score of Damaged Level to Residential House | Total score of Damaged Level to Nonagricultural Properties | Total Score of Damaged Level to Loss of Work for Laborer | Total Score of Hamper to Education | Total score for level of Water duration | Overall Score | Remarks               |
|---------------|---|---|--|--|------------------------------------|---|---------------|-----------------------|
| Ashtamir Char | -12   | -12   | -8   | -12  | -8                                 | -8                                      | -60           | Most vulnerable       |
| Nayer hat     | -9  | -9  | -8   | -9   | -6                                 | -6                                      | -47           | Moderately vulnerable |
| Chilmari      | -9  | -9  | -6   | -6   | -6                                 | -4                                      | -40           | Vulnerable            |
| Thanahat      | -9  | -6  | -6   | -6   | -4                                 | -2                                      | -33           | Less vulnerable       |
| Ramna         | -3  | -3  | -4   | -3   | -4                                 | -2                                      | -19           | Least vulnerable      |
| Raniganj      | -6  | -6  | -6   | -6   | -4                                 | -2                                      | -30           | Less vulnerable       |

Source: Calculation by Researcher

The table shows that, overall score of flood damage in Ashtamir Char is far higher than the other unions. So it is the most flood vulnerable union in the Upazila. The least score is in Ramna union. And the condition is comparatively better than the other unions. So Ramna is the least flood vulnerable union in Chilmari Upazila. Below, a map has been given which represents the comparison of flood vulnerability of six unions of Chilmari upazila where the vulnerability scale is represented by color intensity.





## **7. GAPS AND CONSTRAINTS OF FLOOD MANAGEMENT SYSTEM IN CHILMARI**

### **7.1 Lack of Institutional Integration**

A Good institutional framework stands out as a prime factor for proper flood management. This includes proper institutional arrangement, organizational structures and strong legislative framework. Different ministries with local government bodies like upazila parishad, union parishad are involved in river flood and storm water flooding management in Chilmari upazila. It is evident in the research that there is hardly any cooperation/coordination exists among these organizations. The rigid institutional framework has hindered the effort for coordination as well as information sharing which often leads to undesirable conflicts among the organizations. Implementation of any development requires coordination among the central and local government bodies. The implementation of plans also depends on the ability to enforce plans in terms of financial and institutional capacity. In general, all these organizations suffer from inadequate manpower, funding and logistics. The existing strength of these organizations is inadequate to cope with the immediate crisis of serious flood.

### **7.2 Lack of Fund**

Being a developing country, fund constraints are a common phenomenon for Bangladesh. The implementation of any development plan largely depends on the donor funding. Because of lack of funding the flood control project are taking longer time than the estimation. Permanent flood control projects need huge amount of cost. Flood protecting embankment has been failed because of lack of funding as the construction quality is not up to the mark. In general, the maintenance division of any development works occupies a small percentage of National Budget. In our economic system financial allocation for maintenance purpose does not exist. The Ministry of Finance and Planning Commission make financial arrangement only for implementation of the project work. But subsequent maintenance cost is not allocated for those projects. The proper maintenance and operation of the flood control structures are hindered due to shortage of fund.

### **7.3 Lack of Participatory Approach**

Rigid, inefficient bureaucratic practice, procedure orientation and lack of public participations all these events resist the formation of alternatives to manage floods. A guideline for Participatory Water Resource Management is prepared by WARPO. But it is not in practice. There is limited and in most cases no participation is evident in planning, policy and decision making phases. The flood management is driven by top-down decision-making. The flood control measures are planned without the participation of the affected people and other stakeholders. The conventional public participation can be perceived as consultation to improve the project details that the authority has designed them. The existing informal practice of participatory planning process is not based on principles of participation. Due to lack of participation, the development plans fail to address the people need and integrate their demand in the plan. The absence of public involvement in operation and maintenance of control measures and lack of awareness about their role often pose problem in proper management of the flood.

### **7.4 Flood Risk Management Strategies**

An integrated approach to flood management means the best mix of structural and non-structural measures. These measures are mostly physical in nature. Though, flood in Chilmari is managed by both the measures, integration between them is not noticeable. Flood control measures are emphasized than the non-structural measure.

### **7.5 Mismanagement in Warning System**

One of the major problems in the flood management system in Chilmari upazila is the provision of equal flood warning system within all the unions of the upazila. From the analysis, it is found that the char unions are the most flood vulnerable unions in the upazila. But from the field survey it is identified that the people of the union of char unions received no warning about the recent flood while the other three unions of the upazila received warning. The consequence of this mismanagement is very bad. In the char union, people saw their seeds just before a few days of the recent floods. If they received warning in due time a huge amount of agricultural losses could be reduced. The most surprising fact is that, in Ashtamir Char union, people saw their seeds without getting warning and the seeds washed away by flood water. When the water removed from the land, they saw their seeds for the second time. And even for the second time, all the seeds were washed away by second time flood water. This has been occurred only for the mismanagement by the government bodies.

### 7.6 Mismanagement in Relief Distribution

Another serious problem after the flood crisis is the mismanagement in the relief distribution program. In relief distribution, both public sector and NGOs are involved. But there is no co-ordination among the organizations. The main reason behind this problem is the corruption in the public sector.

Union Parishads generally distribute the relief to the flood affected people. But the main problem is not the lack of relief fund. The main problem is in the distribution system. Many respondents have questioned that they have not received any kind of relief while some people of any union have received relief two or three times. The process of list making of affected people is one of the most important steps of relief distribution. The list making of affected people is manipulated by the union parishad to distribute relief only to their relatives and known people. Even in some cases people who have not been totally affected by the flood, they also receive relief from union parishad because of their local power exercise. Thus the actually flood affected people are deprived of the government flood reliefs.

On the other hand, the relief distribution by the NGOs is better than the public sector. But the main problem is, the total distribution system is not always completed by the NGOs. The lists of affected people prepared by the NGOs are manipulated by the local government such as union parishad.

The third reason behind the relief distribution is the poor mentality by the people of the upazila. In general people of char areas are provided with most of the relief as they are affected seriously. There is a tendency among the people of outside the Char areas to build a katcha house in the char areas only for receiving reliefs from various organizations during the disaster periods. But they do not live in the char areas.

The most vulnerable union to flood in Chilmari is Ashtamir Char Union. So it should be provided with the maximum relief. But if analysing the relief distribution it is found that Ashtamir char union is provided with the least relief.

Table 8: Mismanagement in Relief Distribution

| Name of Union        | Total Damage score | Relief Receiving Percentage of Household | Remarks                |
|----------------------|--------------------|--|------------------------|
| <b>Ashtamir Char</b> | <b>-60</b>         | <b>30%</b>                               | <b>Most vulnerable</b> |
| Nayer hat            | -47                | 50%                                      | Moderately vulnerable  |
| Chilmari             | -40                | 55%                                      | Vulnerable             |
| Thanahat             | -33                | 50%                                      | Less vulnerable        |
| Ramna                | -19                | 65%                                      | Least vulnerable       |
| Raniganj             | -30                | 50%                                      | Less vulnerable        |

Source: Field Survey 2014

### 8. SWOT ANALYSIS OF FLOOD CONTROL AND RISK MANAGEMENT SYSTEM IN CHILMARI

The development of flood control and risk management requires an assessment of the existing flood management of Chilmari. As a result the SWOT analysis is carried out in the context of Flood Risk Management, within the framework of Interactive WRM. Based on the empirical findings, the internal strengths and weaknesses and external opportunities and threats of the present flood management practices are identified. Internal strengths and weaknesses consider a number of factors related to the capacity of the institutions involved in flood management, their interrelationships and management efficiency. The external opportunities and threats consider the outside factors that have an impact on its functioning.

Table 9: The SWOT Analysis

| <b>STRENGTH</b>   | <b>WEAKNESS</b>   |
|---|---|
| <ul style="list-style-type: none"> <li>• NWPo and NWMP</li> <li>• Drainage Plan in Chilmari</li> <li>• Structural and Non-Structural Measures taken in the area</li> <li>• Water Modeling &amp; Flood Mapping through the country</li> <li>• Skilled Water Managers in the country</li> </ul> | <ul style="list-style-type: none"> <li>• Lack of political good will &amp; commitment.</li> <li>• Top-down decision-making process</li> <li>• Corruption</li> <li>• Lack of Accountability</li> <li>• Lack of transparency of activities</li> <li>• Weak institutional arrangement</li> <li>• Lack of institutional integration</li> <li>• Less accessibility to information</li> <li>• Lack of land use planning</li> <li>• Lack of integration between land and water resource management</li> <li>• Lack of legal framework</li> <li>• Weak enforcement of law</li> <li>• Fund constraints</li> <li>• Weak monitoring of the physical system</li> <li>• Lack infrastructure maintenance</li> </ul> |
| <b>OPPORTUNITIES</b>  | <b>THREATS</b>  |
| <ul style="list-style-type: none"> <li>• Increasing public awareness</li> <li>• Policy advocacy of the civil society</li> <li>• Growing number of water professionals</li> </ul>  | <ul style="list-style-type: none"> <li>• Political Unrest</li> <li>• Land development through land filling process</li> <li>• Illegal encroachment of river, canals, khals</li> <li>• Climate change</li> <li>• Deforestation</li> </ul>  |

## 9. RECOMMENDATIONS

The research shows that the flood in Chilmari is managed in an ad hoc manner. Flood control and flood risk management inefficiency is the result of lack of integration and management inefficiencies of the relevant organizations. Hence, in the light of current situation, the following actions are recommended for flood control and risk management in Chilmari to achieve potential developments.

### 9.1 Strengthening Institutional Framework

A strong institutional framework is the prerequisite for efficient water management. Strong cooperation and a coordinated, comprehensive management approach towards floods are possible only with strong institutional arrangement and legislations. The current state of flood management in Chilmari strongly demands for the involvement of the national authority with strong, competent leadership.

### 9.2 Content of Flood Management Policies and Plans

The responsible organizations should give attention to the content and quality of flood management policies and plans from long-term perspectives. The beneficial aspects and negative socio-economic impacts of flood should be taken into consideration during the preparation of the flood management plan, for example, by optimizing long-term utilization of floodwater. This can be done by means of:

Construction of retention ponds to retain and store water flows during flood to reduce the flood damages as well as meet users need during dry seasons and thereby maintaining the aquatic ecosystem.

Stored water can also be used for hydropower generation, which may contribute to the dearth of the current electricity problems in Chilmari.

Rainwater harvesting can be adopted in Chilmari upazila to supplement the water supply, replenish the groundwater table and its quality improvement, and increase soil moisture levels for cultivation and above all to mitigate flooding.

### 9.3 Long Term Planning

For integrated flood control and risk management the long term and short term planning should be incorporated. The factors rendering the vulnerability to floods should be identified and prioritized concerning immediate response and planning should be carried out accordingly.

#### 9.3.1 Practice of Good Governance

The local government administration is very weak in Bangladesh. No matter what approach is employed for effective management it will not work unless the principles of good governance are being practiced. This includes transparency in actions, delegation of power, and decentralization of decision making through participation, optimal mix of bottom-up and top-down approaches, accountability and equity. These principles support the effectiveness and sustainability of responsible organizations.

### 9.4 Building Public Awareness

Environmental education should be emphasized to build civic responsibility among the citizens. There should be a regular awareness campaign to build up public awareness towards environment. Environmental education should get emphasis in the education system of Bangladesh. Environmental education and development of environmental expertise is needed for future sustainability of Bangladesh.

### 9.5 Improvement of the Future Relief Interventions

Future emergency interventions should bear in mind the importance of the preservation of livestock through emergency livestock shelter and fodder provision/cash to prevent crisis sale. "Future relief responses should be improved. Some recommendations in this regard are as follows:

Flooding in Bangladesh is common, so agencies should be prepared to provide a timely relief response. Pre-positioning of some key items may help to improve the timeliness of future responses.

Due consideration should be given to the minimum amount of food required for an average household per month (around 60kg rice). It is not appropriate to provide 20kg of rice on a one-off basis to households that are likely to require support for a number of months. Households will need increased relief items in order to prevent them from using distress coping mechanisms such as selling livestock or taking out high interest loans in order to meet their basic needs.

Future relief responses should also include coordination with other agencies in order to avoid duplication of relief efforts in some areas and exclusions in other areas". In addition to the points raised above; investing in supplier negotiations, training and registration of HHs for mobile cash distributions in readiness for future emergency cash distributions is advisable.

### 9.6 Reactivation of Disaster management Committee

One of the most important recommendations for the improvement of flood control and risk management in Chilmari upazila is to reactivate both union and upazila disaster management committee as early as possible. The existence of the disaster management committee is only in name only. The initiatives should be taken to reactivate the committees and pressures should be given on the committee members to perform their responsibilities for the better disaster management.

### 9.7 Specific Flood Risk Management Measures

- Environmentally protective fodder and other trees and shrubs around plinths, riverbanks and gardens
- Tree crops to improve income after floods more minor floods (food and timber)
- High value, quick growing market garden crops that can be grown quickly after floods and which have strong market
- Safer seed and fodder storage
- Roof platforms and hay lofts
- Family planning to reduce population and plot subdivisions.
- Conduct flash flood modeling and hazard mapping to identify hazard prone areas and develop land use guidelines and building codes, and implement these with the strong involvement of local stakeholders
- Develop a standard methodology and format for documenting flood events and for subsequent reflection on the causes, effects, and lessons that can be derived from such events.
- Promote effective early warning systems with the involvement of upstream and downstream communities to save lives and reduce the risk of floods in vulnerable areas of the Chilmari upazila.

- Develop trans-boundary collaboration, both international and national, for the management of flash floods including information exchange, joint implementation of mitigation projects, and establishment of flood early warning systems.
- Flood insurance is practiced in many countries in the developing countries around the world. But still it is not practiced in our country. It should be practiced immediately in the flood prone areas of the country to cope with the flood risk.
- Development of homestead raising projects in the char areas of the upazila.
- Retention of ponds to hold the flood water can reduce the flood risk.

## 10. CONCLUSIONS

Historically, the water resources management issues in Bangladesh are mainly flood control and agriculture oriented. The main objectives of these projects were to increase agriculture production (Aman, monsoon rice), controlling floodwater by constructing embankments on both banks of the river and establishing drainage facilities to drain out excessive rainfall during monsoons. Although, the instantaneous and short-term objectives of these projects have brought some positive impacts in certain sectors, the long-term perspectives of economic, social, ecological and environmental sustainability of the country were left behind. The management approach rather fragmented than integrated and holistic. So, for proper flood control and risk management immediately a more integrated and co-ordinated flood management system should be practiced in not only Chilmari but also all over the country.

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