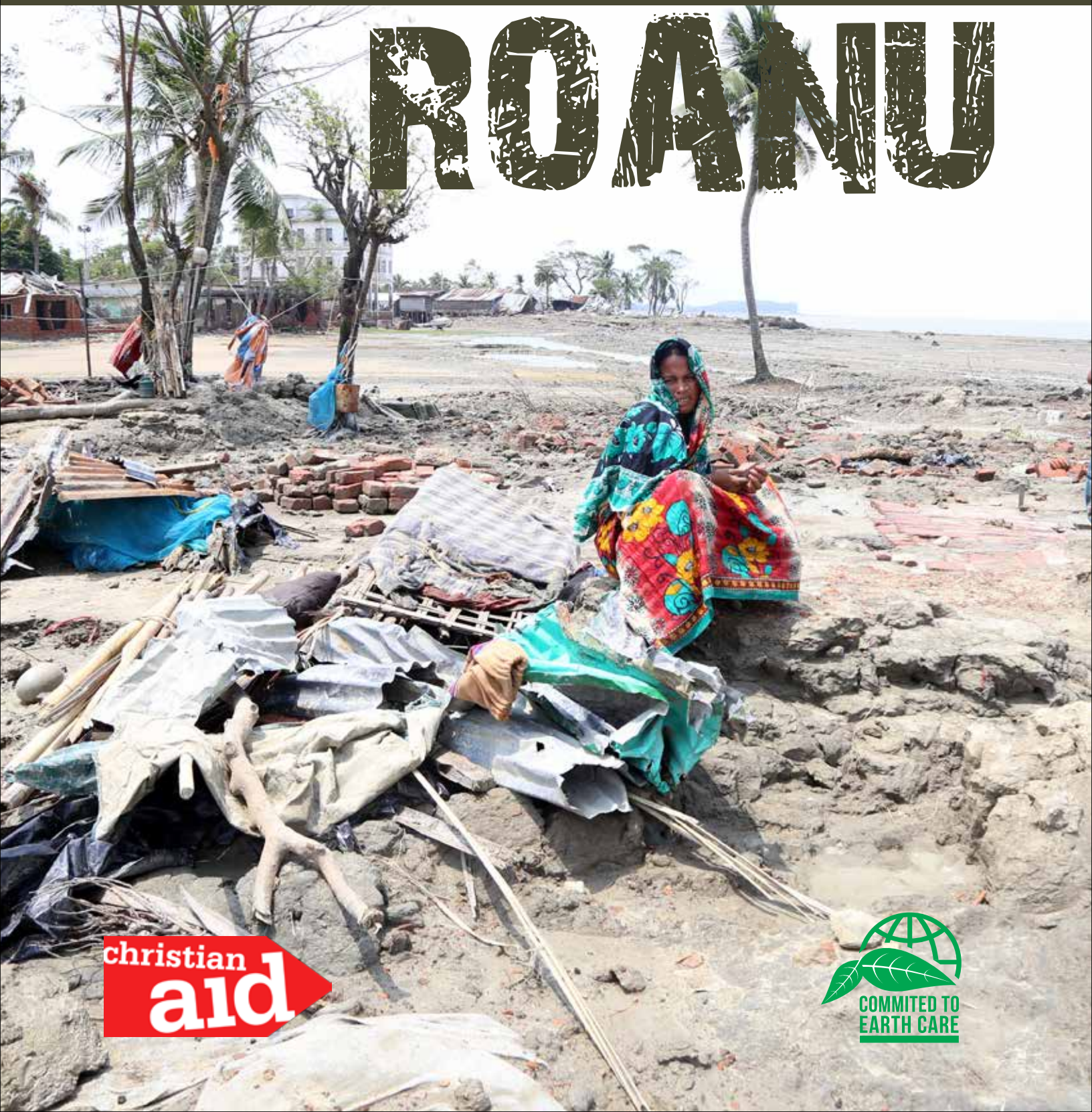
Loss and damage perspective of

Tropical Storm ROANU



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Loss and damage perspective of

Tropical Storm ROANU

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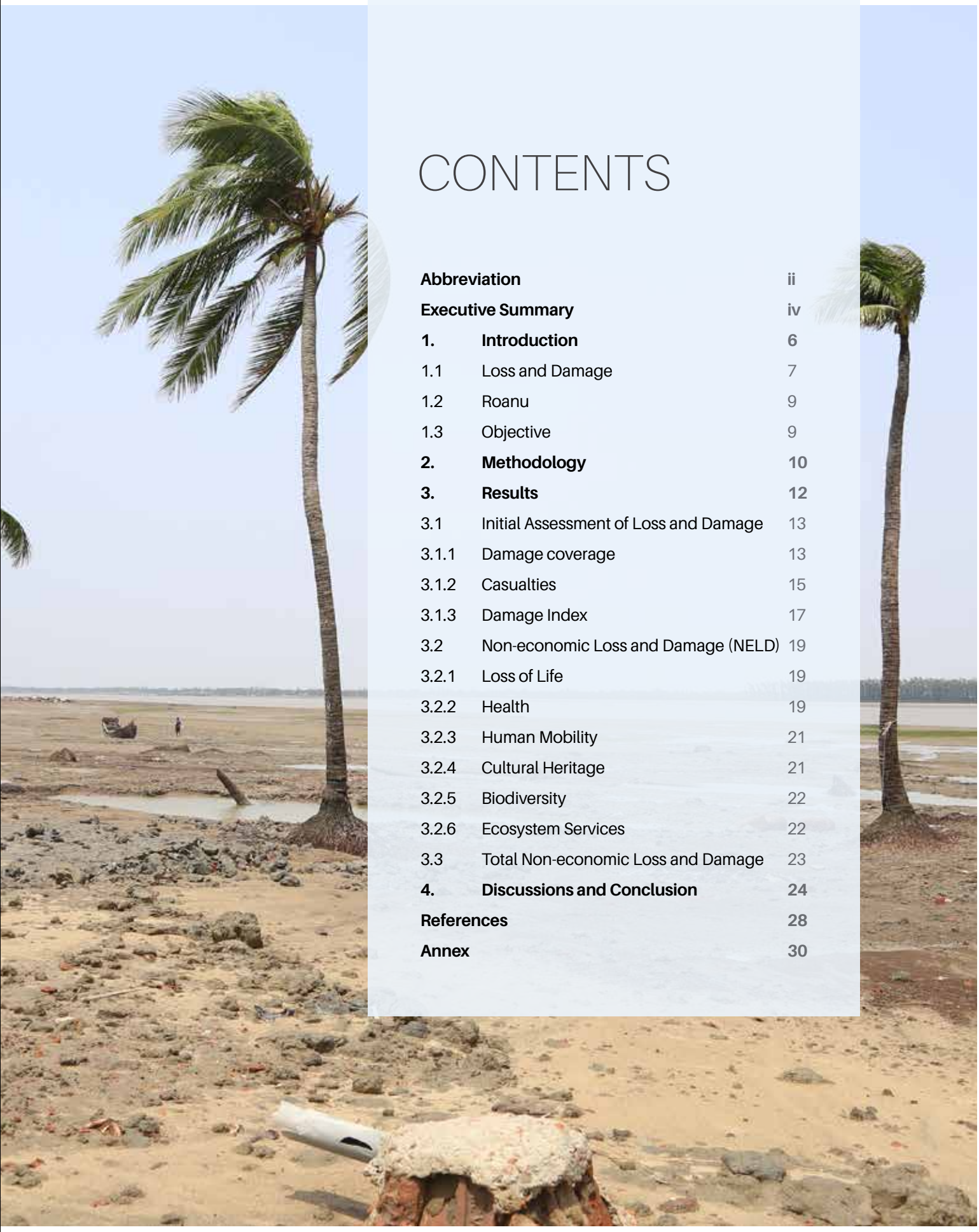
ABBREVIATION

BAU	Business As Usual
BCCRF	Bangladesh Climate Change Resilient Fund
BCCSAP	Bangladesh Climate Change Strategic Action Plan
CoP	Conference of the Parties
CPP	Cyclone Preparedness Programme
EWS	Early Warning System
FGD	Focus Group Discussion
INDC	Intended Nationally Determined Contributions
JNA	Joint Needs Assessment
KII	Key Informant Interview
LaD	Loss and Damage
LULUCF	Land Use, Land-Use Change and Forestry
NELD	Non-economic Loss and Damage
SSNP	Social Safety Net Programme
TS	Tropical Storm
UNFCCC	United Nations Framework Convention on Climate Change
WIM	Warsaw International Mechanism



CONTENTS

EXECUTIVE **SUMMARY**

Climate induced calamities around the world is an alarming threat to mankind due to the unpredictable and uncontrollable loss and damage issues. Although the disputes regarding loss and damage has caused irrecoverable destruction to the socio-economic condition, the issue was officially unaddressed until 2010. After developing some implements at the COP19 in 2013, the Warsaw mechanism was established to address the adverse consequences of loss and damage when mitigation and adaptation measures are insufficient. Included among the most vulnerable countries for climate change effects, Bangladesh's efforts to combat loss and damage are very limited.

Geographical position, socio-economic condition, lack of resources are some of the main reasons Bangladesh is suffering from severe loss and damage resulted from climate disasters. While the economic loss devours the country's development, non-economic loss and damage

puts the country in an irretrievable situation stricken with loss of life, health, biodiversity, human mobility, ecosystem services along with damage in infrastructure, cultural heritage etc. Bangladesh was hit by several deadly disasters (e.g. cyclones, floods etc.) over the past few decades causing severe NELD and none of them included a loss and damage criteria, and thus this study focuses on the NELD scenario of a recent cyclone event named 'Roanu.'

The study followed the guidelines of the NELD framework by UNFCC (2013) to analyze the loss and damage issues with the support of government data, Key Informant Interview (KII), Focus Group Discussion (FGD), Case Studies, research papers, UNFCCC documents, Joint Needs Assessment (JNA) reports, news clips from national and local newspapers, legal documents and other policy papers and Field Observation.

NELD assessed for Roanu has been found as very high, compare to conventional concept of the extent of economic loss from a similar disaster. Total NELD caused by Roanu is US$ 508.83 million. About half of the NELD has been found in Ecosystem services sector. Estimating losses in human life sector is very difficult, but has been estimated as US$ 0.80 million. NELD in human mobility, cultural heritage, loss of biodiversity and health sectors have been calculated as US$ 104.08 million, US$ 94.04 million, US$ 52.87 million, and US$ 4.26 million, respectively.

Sector	Uttor Dhurang	Chandpur	Magnama	Total for 3 Unions	Average Loss for 1 Union	Total Loss for 244 Unions
Death	-	-	-	-	-	803,556
Health	11,750	15,625	25,000	52,375	17,458	4,259,833
Human Mobility	750,000	154,688	375,000	1,279,688	426,563	104,081,291
Cultural Heritage	318,750	687,500	150,000	1,156,250	385,417	94,041,667
Loss of Biodiversity	125,000	200,000	325,000	650,000	216,667	52,866,667
Ecosystem Services	1,470,365	387,555	1,250,000	3,107,920	1,035,973	252,777,493
Total	**10,065,467**	**2,658,655**	**3,503,185**	**16,227,306**	**5,409,102**	**508,830,507**

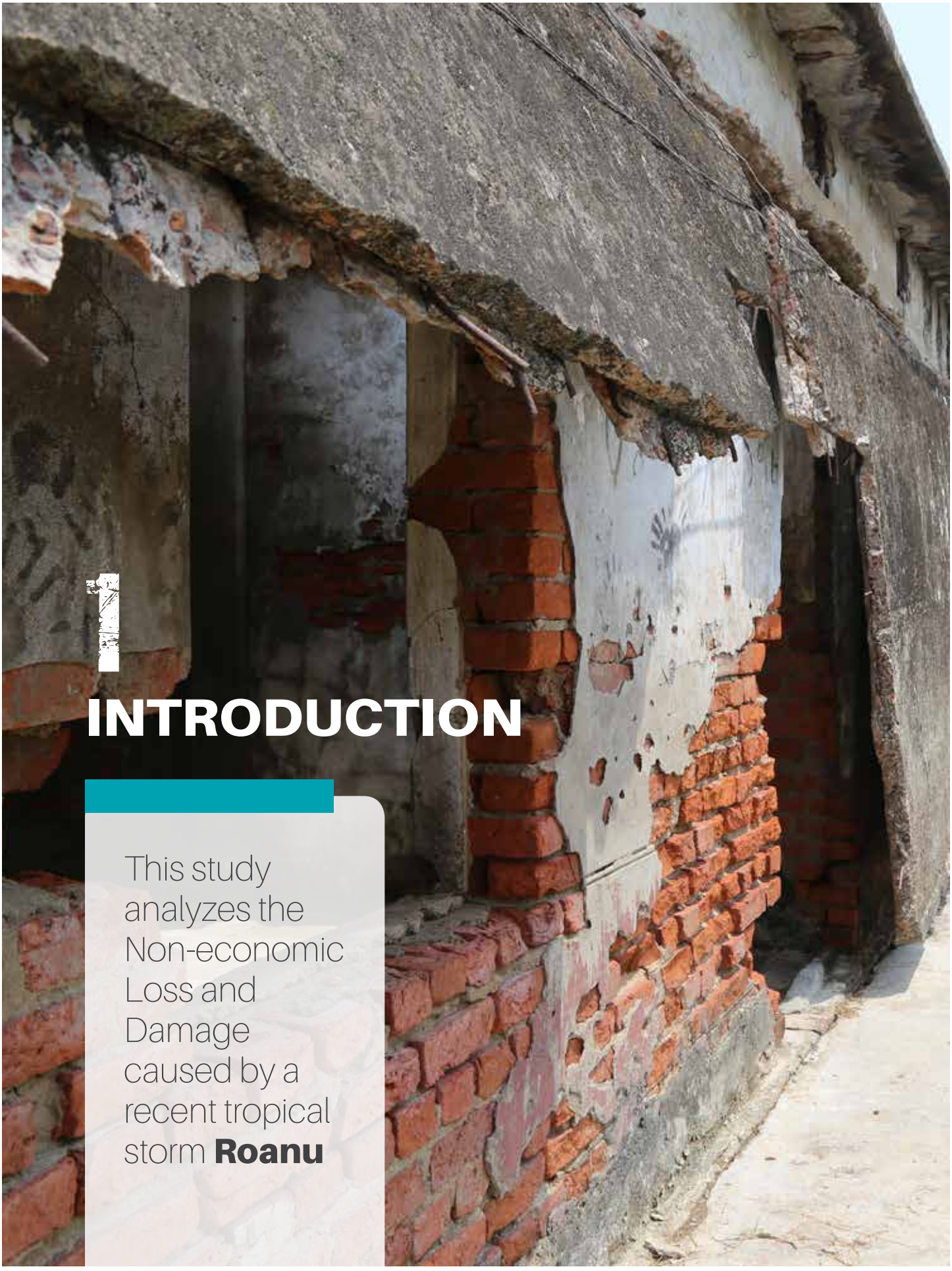
Although there are some mitigation and adaptation schemes ongoing, the uncertainty of impacts by a climatic event makes it very difficult for Bangladesh to address loss and damage issues. Therefore, it takes indeterminate amount of time for Bangladesh to cope with the loss and damage issues, while recovery is next to impossible with continuous natural calamities.

In order to address loss and damage, following steps are recommended.

A). Risk transfer is the biggest solution for loss and damage. Risk transfer through i) Catastrophe bonds, ii) Insurance, iii) Insurance-credit, iv) Compensation, v) Microfinance, and vi) Social Protection offer a wide range of adjustment to recover the losses and damages burdened from a disaster.

B). A reliable dissemination of EWS needed. There are enormous opportunity for an improved dissemination and developing community confidence in EWS. An effective communication through the existing early warning system is very necessary in order to reduce loss and damage.

C). Stronger construction needed. Substandard construction of houses, road and other infrastructures are major cause of greater loss. Stronger construction of shelter will reduce loss from cyclone or any other disaster.



1 INTRODUCTION

This study analyzes the Non-economic Loss and Damage caused by a recent tropical storm **Roanu**

1.1 LOSS AND DAMAGE

The current world is well aware of the fact that the effects of climate change is inevitable and due to inadequate ability to adapt to changes in climate patterns the human society suffers loss and damage as the consequences. Although, climate experts changed the direction of world's development process by imposing their research findings and predictions to direct the focus on mitigation and adaptation strategies during the the past two decades (Hasemann et al.2014), the main dispute remained with the response towards climate stressors causing unavoidable and immediate loss and damage. The concept of loss and damage is a newly approached notion in the field of disaster risk reduction and climate change effects that requires understanding of the impacts, developing risk assessment tools, enhancing immediate response, and most importantly effective adaptation strategies for inevitable impacts. The topic emerged in climate negotiations by establishing a work program on loss and damage at the 16th UNFCCC Conference, Mexico in December 2010, and continued to emphasize the necessity of adaptive strategies that are more target oriented for sudden climate hazards (Geest et al. 2014; Birkmann and Welle 2015). Followed by COP19 (November 2013), the Warsaw International Mechanism (WIM) was established by UNFCCC (2014) for the "implementation of approaches to address loss and damage associated with the adverse effects of climate change in a comprehensive, integrated and coherent manner."

The mechanism widens the prospects to address the adverse consequences of climate change when the mitigation and adaptation strategies do not suffice the required measures for coping with immediate loss and damage (Geest et al. 2014).

Loss and Damage became central focus in the Conference of the Parties (CoP) of the United Nations Framework Convention on Climate Change (UNFCCC) in Warsaw. Key focus of the agenda is clear from its official document, stating-"..... to address loss and damage associated with the impacts of climate change from extreme events [e.g. cyclone] and slow onset events associated with the adverse effects of climate change" (CoP 2013, UNFCCC 2016).

Key functions of Warsaw International Mechanism (WIM) were i) Enhancing knowledge and understanding of comprehensive risk management approaches to address loss and damage associated with the adverse effects of climate change, including slow onset impacts; ii) Strengthening dialogue, coordination, coherence and synergies among relevant stakeholders; and iii) Enhancing action and support, including finance, technology and capacity-building, to address loss and damage associated with the adverse effects of climate change. Finally, it was addressed clearly in Article 8 of Paris Agreement 2015 (UNFCCC 2016).

Given the underlying vulnerability, developing countries are under acute risk of loss and damage due to irreversible climate change and unavoidable natural disasters (Asaduzzaman et al. 2013). On the other hand, with the advantages of technology and available resources, effective prevention, mitigation, and vulnerability reduction measures implemented in the developed world has increased the level of protection against extreme climate events (ECLAC 2003). The developed countries suffer great economic losses whereas, almost 90 percent of the casualties and other non-economic losses are more substantial in developing countries (Ranger et al. 2011; Nishat et al.2013). Estimates show that there has been almost 1,200,000 fatalities and US$610 billion worth loss and damages in developing countries since 1980 due to extreme climate events (Ranger et al. 2011). Situated at the extremely vulnerable zone of climate impacts, Bangladesh has prioritized approaches to combat climate issues according to its national capability (Nishat et al., 2013). Nonetheless, the adaptation efforts are hinderedby the continuous occurrence of climatic hazards causing immediate damage to the infrastructure, altering human mobility, loss of biodiversity, interfering ecosystem services and so on. As a result, the country is forced to halt the development processes, undermine the economic losses, and interrupt the poverty reduction schemes in order to address the immediate loss and damage (Ranger et al. 2011).

The geographical position of Bangladesh devours a large coastal belt at the 'Bay of Bengal' and a riverine landscape which makes it a disaster prone area as well as vulnerable to climate impacts (Rabbani et al. 2013). Recent research

confirms the risk of several impacts altogether or double threats that may result from rapid onset events (e.g. cyclone, flood) and slow onset processes, such as, sea level rise and salinity intrusion (Hasemann et al. 2014). While 97.1% of the coastal areas with over 35 million people are exposed to climate change hazards, Bangladesh suffers enormous economic, infrastructural, agricultural, and human losses very frequently (Huq et al. 2015). An earlier study estimates that climate induced damage in Bangladesh can be as high as a scale of USD 4-14 Billion in economic value (Haque 2009). This indicates the lack of capacity to cope and vulnerability of coastal socio-ecological community to climate stressors including productive agricultural lands, mangrove forests, tidal estuaries, and economic activities such as shrimp farming (MoEF, 2015). Moreover, with the burden of high population and extreme poverty, the adaptive capacity to withstand climate effects are very low (Huq et al. 2015). The main issue remains dealing

with loss and damage after each extreme climate events and Bangladesh is in no position economically or socially to recover from loss and damage.

As loss and damage is rather a newly prioritized notion globally, there are lack of adequate research to associate long term effects especially in a developing region like Bangladesh. Very few of the disaster research include loss and damage due to inadequate approaches of Bangladesh to address post disaster loss and damage issues.

Some facts about the current loss and damage condition in Bangladesh have been documented by Hasemann et al. (2014) in Climate Induced Loss and Damage in South Asia study, but it lacked in real evidence to explain the actual picture. Another study by Warner and Geest (2013) explains loss and damage from the victim's perspectives with examples from nine vulnerable countries including Bangladesh. On the other hand, native researchers in collaboration with international support have developed a clearer picture of loss and damage focusing on specific sectors like agriculture, salinity intrusion, cyclone effects etc.

Experience of extreme climatic events at local level approaches applied to facilitate recovery from loss and damage, after cyclones in particular, has been highlighted by Shamsuddoha et al. (2013). Enhancing the existing methodologies to address loss and damage issues has been discussed by Asaduzzaman et al. (2013). Furthermore, climate change induced salinity intrusion that affects coastal farming and causes of loss and damage to the community has been addressed by Rabbani et al. (2013). However, none of the studies has concentrated on the non-economic perspective of loss and damage.

Non-economic loss and damage is a subset of total coast of climate change, which can be more noteworthy than an easily countable economic loss. In a developing country, like Bangladesh, the NELD of a disaster event can be the most significant part associated with climate change (Fankhauser et al. 2014). Therefore, NELD requires adequate attention from all stakeholders to reduce the vulnerability as prevention and cope with a post-disaster situation addressing the victims.

Besides, Bangladesh lacks adequate research regarding this issue and hence, it is very crucial to criticize the current adaptation and mitigation measures. Against these backdrops, this study analyzes the NELD of a recent occurrence, a tropical cyclone named 'Roanu.'

1.2 ROANU

Bangladesh is highly vulnerable to cyclone and storm surge. Research suggests that the frequency of cyclones land-falling the Bangladesh coast has been increasing over time in the past few decades (Islam and Peterson 2009). The country was highly affected by a super cyclone in 1970 (Islam and Chowdhury 1999), super cyclone Gorky in 1991 (DMB 2010), cyclone Sidr in 2007 (GoB 2008, Sarwar and Islam 2013) and cyclone Aila in 2009 (UN 2010, Sarwar and Islam 2013). However, none of the cyclones were put under the lens of 'Loss and Damage,'and this resulted in an extreme catastrophe for the victims.Bangladesh is among the top listed vulnerable countries to be affected by climate change phenomena. Climate change induced loss in the country was estimated as 2% of GDP by 2050 that could rise as high as 9.4% of its GDP by 2100 (INDC 2015). The frequent occurrences of cyclones, floods, and other disasters causes extreme damage to the socio-economic situation.

A tropical storm, named Roanu, hit the Bangladesh coast around the noon of 21 May 2016. It affected 38 Upazilas along the Bangladesh coast (Figure 1). The storm caused severe damage including 27 casualties due to floods, storm surge and rain-triggered landslides. The storm damaged tens of thousands of rural houses, mostly built by mud or tin, in the underprivileged southern districts, with many low-lying villages inundated by a storm surge that swelled up to seven feet (two metres) high (ReliefWeb, 2016). As a result, several hundred thousand people were marooned even though authorities took more than 500,000 people into shelters (ibid.). Peripheral winds and heavy downpours brought on by the impending cyclone caused widespread devastation before the storm had even made landfall. The proposed study will explore loss and damage perspective of tropical storm Roanu.

1.3 Objective

i. to develop an inventory on non-economic losses caused by tropical storm Roanu;
ii. to have a policy analysis of Bangladesh in respect to non-economic losses.

2 METHODOLOGY

KII

FGD

Field Observation

Government Data

JNA Report

News Clips

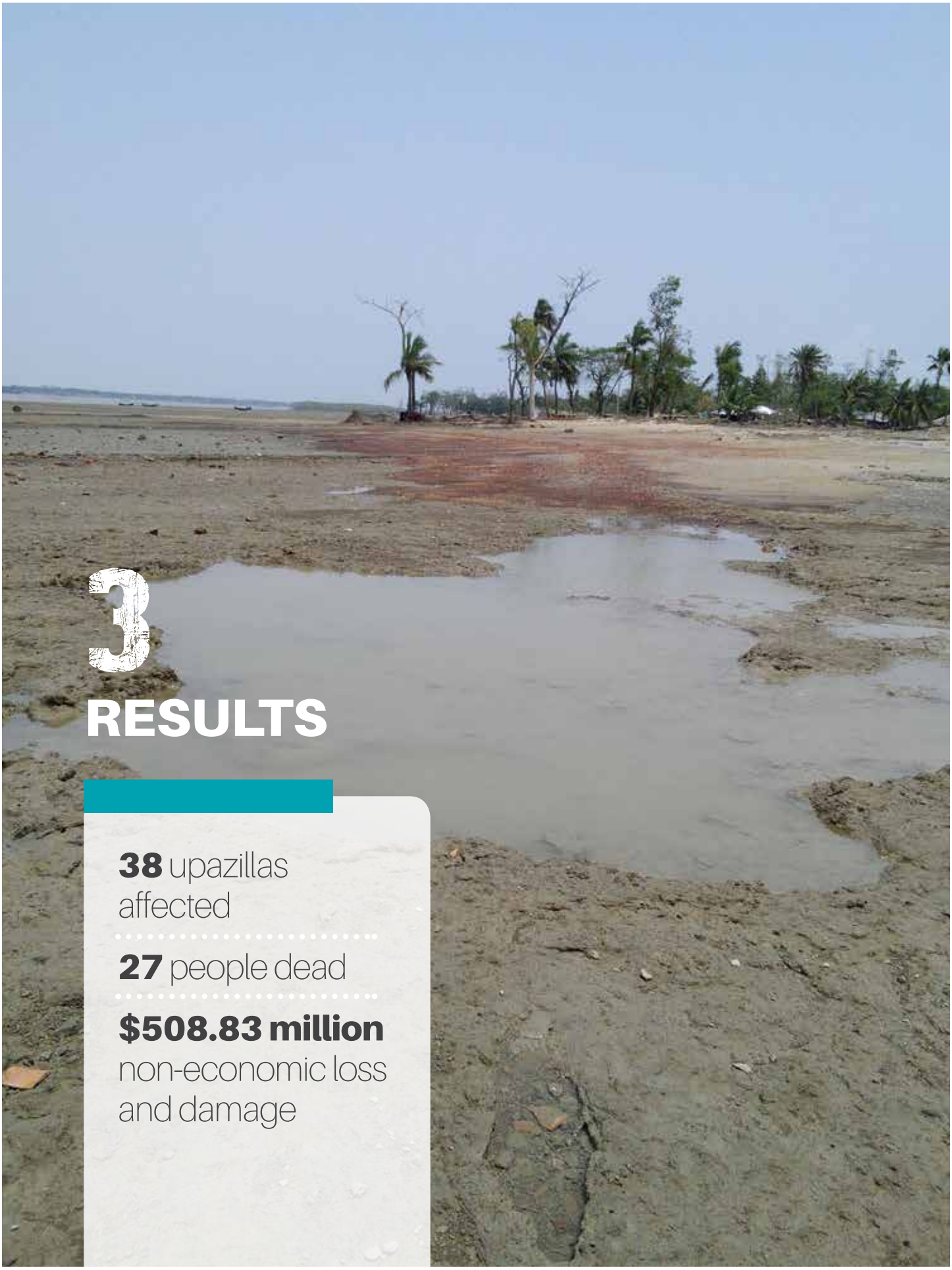
This study followed the guidelines of a technical Paper developed by UNFCCC (2013) that regulated scopes and methods of estimating non-economic losses. There are many frameworks for the understanding of NEL, however, the Technical Paper has indicated 8 outlines, listed below:

(a) Environmental impact assessment;
(b) Strategic environmental assessment;
(c) Environmental risk assessment;
(d) Economic appraisal/CBA;
(e) Wealth/capital accounting;
(f) Vulnerability assessment;
(g) Disaster loss/damage assessment;
(h) Climate change impacts, adaptation and vulnerability assessment.

The research focused on the framework of (g) Disaster loss/damage assessment and followed the similar factors as the UNFCC technical paper. The guidelines by UNFCCC (2013) indicated NEL as loss of life, health, human mobility, territory, cultural heritage, biodiversity and ecosystem services. All the aspects are included in this study except for territorial change as it is very small in this particular case and calculation might be difficult because of the unavailability of precise data.

Primary Data was collected using Key Informant Interview (KII), Focus Group Discussion (FGD), Case Studies, and Field Observation. Pre designed tools (checklist) were used for KII and FGD. The key source of secondary data is government data, specifically the damage list prepared by Ministry of Disaster Management and Relief (MoDMR). Other sources of secondary information include research papers, UNFCCC documents, Joint Needs Assessment (JNA) report, news clips from national and local newspapers, legal documents and other policy papers. Case studies, field observation, KII and FGDs were conducted at Anowara and Banshkhali upazila in Chittagong district. Furthermore, KII and field observation were conducted in Kutubdia and Pekua upazilas in Cox's Bazar and Tazumuddin upazila in Bhola district.

Data sorting and analysis was conducted using statistical packages Excel. Primary data was integrated with secondary information. Results and findings were interpreted using spatial analysis and presented in the form of maps and scientific images using Geographic Information Systems (GIS) package (ArcGIS).



3 RESULTS

38 upazillas affected

27 people dead

$508.83 million non-economic loss and damage

3.1 INITIAL ASSESSMENT OF LOSS AND DAMAGE

3.1.1 Damage Coverage

The devastation trail of a cyclone generally follows its track and the situation is same in case of Roanu. After entering the Exclusive Economic Zone (EEZ) in the offshore of the country, the track forwarded to land straight towards northeast direction and affected upazilas in the both sides of the track (Figure 1).

Kutubdia, Pekua, Chakaria, Maheshkhali, and Cox's Bazar Sadar have been identified as mostly affected upazilas in Cox's Bazar district. In addition, Banshkhali, Anowara, Patenga and Sandwip upazilas have also been impacted very high. Moreover, very highly damaged upazilas in other parts of the coastal zone are Hatiya Companyganj and Subarnachar in Noakhali; Manpura, Tazumuddin, Lalmohon and Char Fasson in Bhola; Galachipa, Rangabali and Kalapara in Patuakhali; Patharghata and Taltoli in Barguna districts. Moderately affected upazilas have also been shown in Figure 1. Clearly, the storm was weakened as it moved landward. Although, the storm made landfall at Sitakunda upazila in Chittagong district in mainland, the devastation in the upazila was not very high because of high elevated landform of the upazila, mostly covered with hills and hillocks.

According a report by MoDMR (2016), a total of 352 upazilas in 11 coastal districts were affected by the tropical storm (Table 1). However, the report by JNA (2016) indicated that a total of 244 unions along the

Table 1: Roanu affected geographic coverage, causality and inventory of affected HH, people and shelter (data source: MoDMR 2016)

District	No. of Affected Upazilas	No. of Affected Unions	affected area (km^2)	Causality	Affected HH		Affected People		Affected Shelter	
					Fully	Partially	Fully	Partially	Fully	Partially
Chittagong	9	163	1,636	13	-	115,908	-	463,632	20,765	29,655
Cox's Bazar	6	39	549	5	55,625	24,489	315,060	163,295	23,350	59,595
Noakhali	3	14	260	3	7,400	14,514	38,000	76,765	1,655	3,275
Lakshmipur	3	9	62	1	20	400	100	1,600	20	411
Feni	1	9	32	1	70	133	-	262,547	20	55
Chandpur	5	28	438	0	238	18,380	1,175	86,875	235	2,047
Barisal	16	16	6,331	0	-	18,315	-	73,260	-	18,315
Bhola	7	68	133	3	2,009	4,457	-	25,864	4,409	6,511
Patuakhali	0	0	0	1	-	2,000	-	-	7	1,500
Pirojpur	2	6	0	0	7,000	520	28,000	2,080	-	10
Khulna	4	0	0	0	-	1,100	-	-	40	120
Total	**56**	**352**	**9,441**	**27**	**72,362**	**200,216**	**382,335**	**1,155,918**	**50,501**	**121,494**

southeast and central coast were affected by Roanu. The storm affected a total area of 9,441 km2 and caused causality for 27 lives. The number of fully affected household is 72,362. The definition of 'fully affected' could not be recovered, however, it is generally perceived that, either the shelter or livelihood options of the household has been severely affected. Chittagong district was the most affected area compared to other parts of the country. Cox's Bazar and Bhola districts are among the maximum affected areas in the country.

According to the estimated data in Table 2, number of dead cattle and poultry are 2,601 and 35,942 respectively. Additionally, a total of 15,942 acres of crop field and 89 educational institutes were fully affected. Furthermore, 342 km of road and 119 km of polder were fully damaged. Chittagong, Cox's Bazar and Bhola districts are among the highly damaged districts.

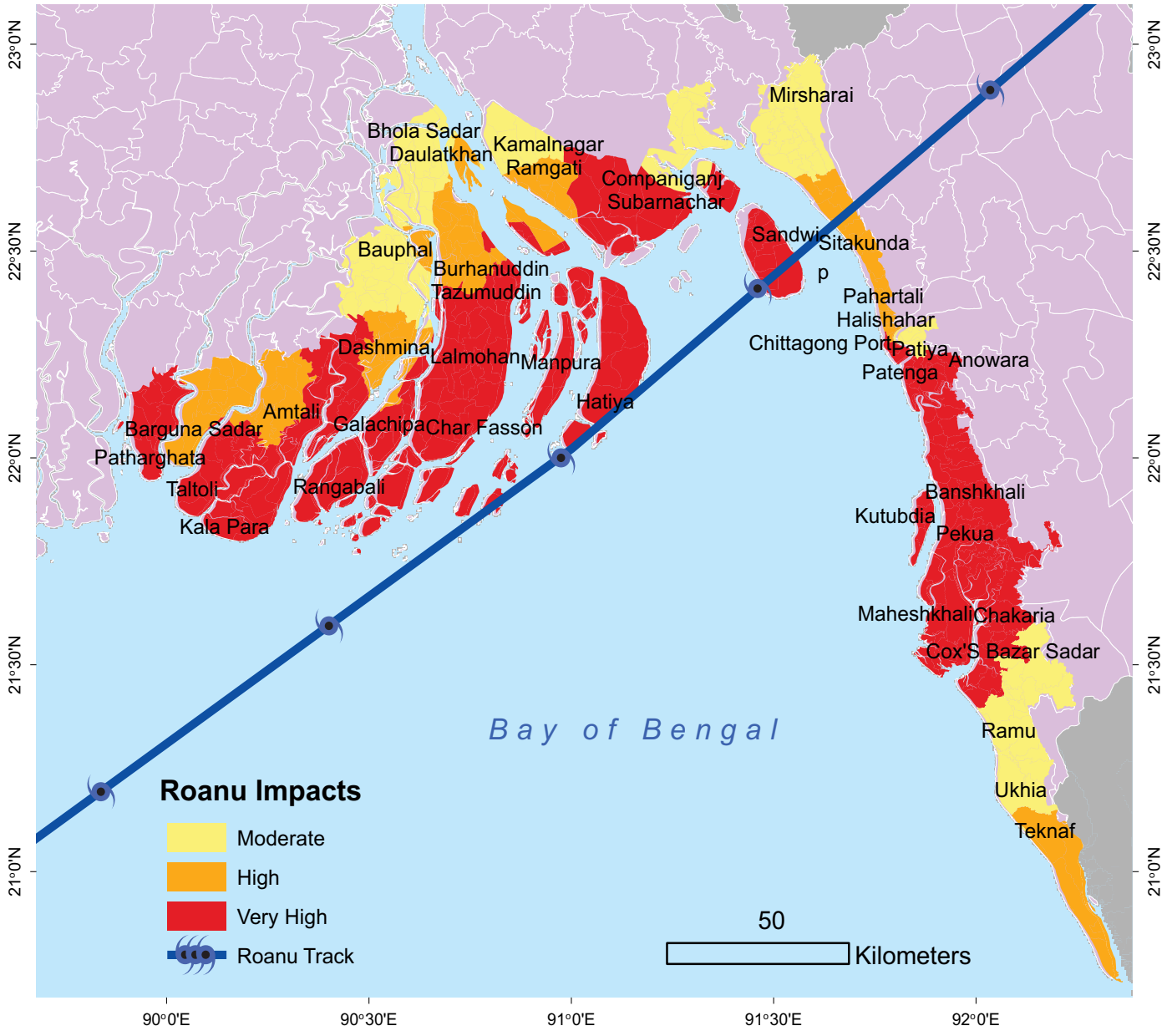


Figure 1: Damage of Tropical Storm Roanu

Table 2: Inventory of Roanu affected bovine, crop field, education and religious institutes, roads and polders (data source: MoDMR 2016)

District	Dead cattle	Dead poultry	Affect crops (Acre)		Affected Institutes (E&R)		Affect road (km)		Affected Polder (km)
			Fully	Partially	Fully	Partially	Fully	Partially	
Chittagong	163	25,050	9,788	5,404	0	0	0	0	0
Cox's Bazar	482	3,962	823	13,280	0	5	214	169	65
Noakhali	0	0	-	-	0	0	0	0	0
Lakshmipur	104	0	-	140	0	0	0	0	0
Feni	2	0	-	997	0	0	0	0	10
Chandpur	0	0	-	-	3	35	0	27	0
Barisal	0	0	-	4,767	0	0	0	0	7
Bhola	1,850	6,930	4,818	14,832	86	100	128	50	32
Patuakhali	0	0	-	-	0	0	0	0	0
Pirojpur	0	0	-	-	0	0	0	0	0
Khulna	0	0	-	-	0	8	0	0	5
Total	**2,601**	**35,942**	**15,429**	**39,420**	**89**	**148**	**342**	**246**	**119**

3.1.2 Casualties

It was reported that a total of 27 people lost their lives due to the devastating acts of Roanu (Annex 1). The storm generated giant surges that wiped out people on their way to cyclone shelter centers.

Southeast coast became the deadliest in the tropical storm. The highest lives were lost in the Chittagong coast causing death to 13 people, which was followed by Cox's Bazar with a death record of 5 persons (Figure 2). Death of three people were reported in Bhola and Noakhali district each, whereas, one people lost life in each of Patuakhali, Lakshmipur and Feni districts.

Research during the data collection process suggests that women and Children are more vulnerable to natural disaster than men. Among the listed 27 people, the death of children and women represent 30% and 29%, respectively (Figure 3). Causality for male is 41% compare to 59% of the total of women and children. The main reasons for higher death tolls of women and children are weaker physical ability and indecisive mental capability.

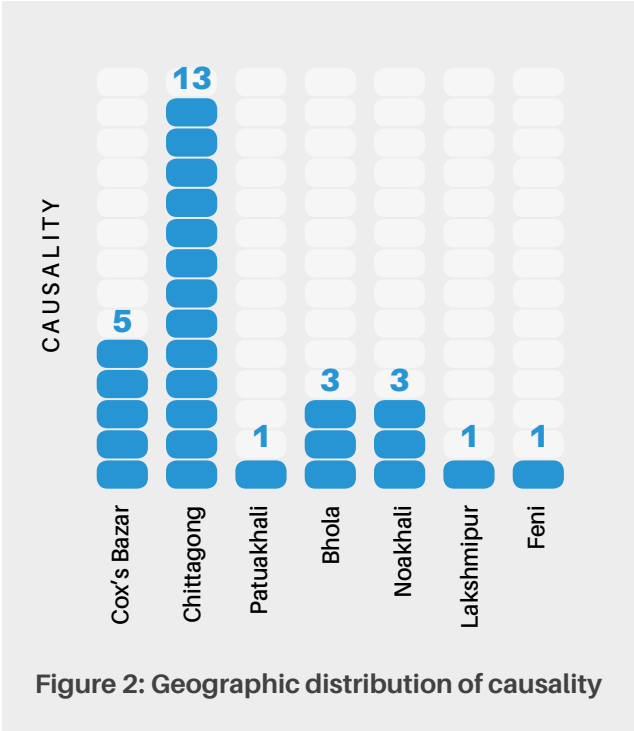


Figure 2: Geographic distribution of causality

3.1.3 Damage Index

Generally, a cyclone approaching land area of a country meet the shoreline first. Frontline of land of a densely populated country is largely protected by polder or seawall. Devastation due to a disaster starts with the destruction of these infrastructures, which are very critical for land protection. Joint Needs Assessment (JNA 2016) has listed upazilas based on damage, affected population and household, including sectoral loss caused by Roanu. The same report also has reported upazila with over 50,000 affected people. MoDRM has produced series of bulletins on Roanu. Newspapers and electronic medias covered the tropical storm with details of the impacts. Considering all these reports and field observations by this assessment team, sectoral damages of upazilas were indexed in 5 categories, viz. Very High, High, Moderate, Low. Very Low, implying Very High as the top list of damage and Very Low as the minimum loss and damage.

Cyclone Roanu damaged critical infrastructures of 17 upazilas in seven districts as well as altered livelihood of people in some upazilas in Cox's Bazar, Noakhali, Bhola and Patuakhali Shelter, water and sanitation (WASH) sectors in some upazila have been found as very highly damaged resulting in health hazards. However, loss in health and education sector is not as high as infrastructure, livelihood, shelter and WASH. Damage extent across sectors have been indicated in Figure 4.

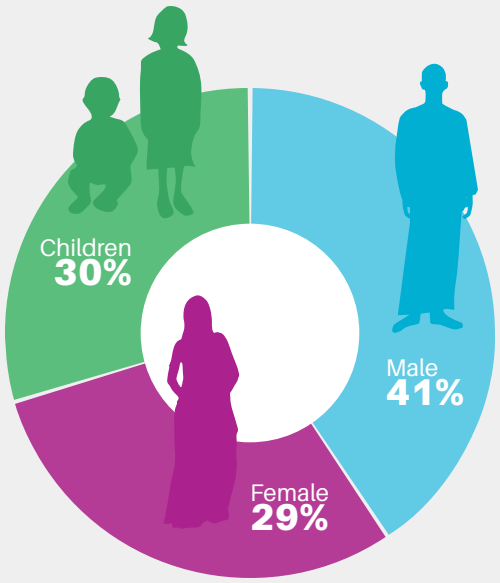
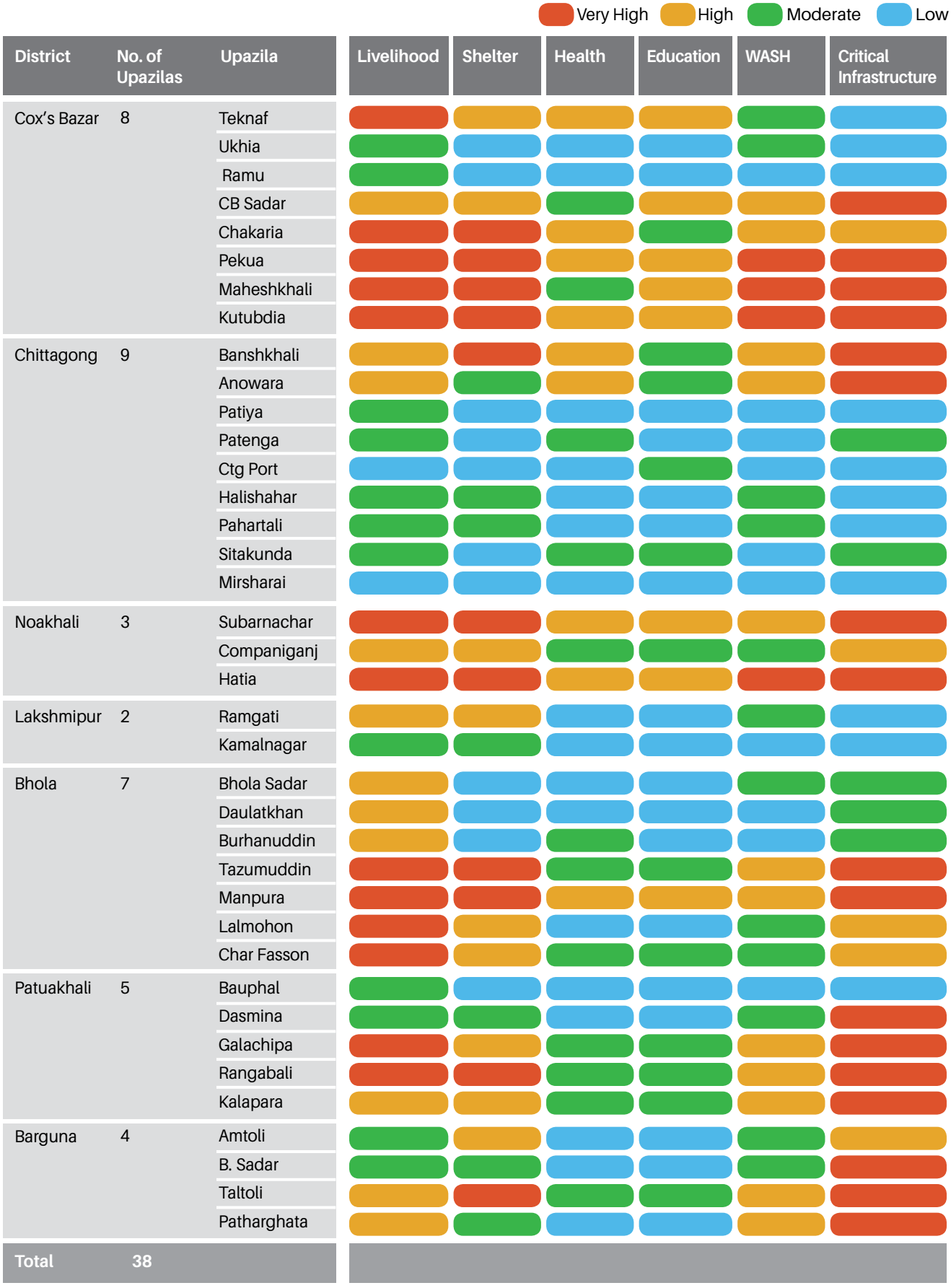


Figure 3: Causality by gender



District	No. of Upazilas	Upazila	Livelihood	Shelter	Health	Education	WASH	Critical Infrastructure
Cox's Bazar	8	Teknaf						
		Ukhia						
		Ramu						
		CB Sadar						
		Chakaria						
		Pekua						
		Maheshkhali						
		Kutubdia						
Chittagong	9	Banshkhali						
		Anowara						
		Patiya						
		Patenga						
		Ctg Port						
		Halishahar						
		Pahartali						
		Sitakunda						
		Mirsharai						
Noakhali	3	Subarnachar						
		Companiganj						
		Hatia						
Lakshmipur	2	Ramgati						
		Kamalnagar						
Bhola	7	Bhola Sadar						
		Daulatkhan						
		Burhanuddin						
		Tazumuddin						
		Manpura						
		Lalmohon						
		Char Fasson						
Patuakhali	5	Bauphal						
		Dasmina						
		Galachipa						
		Rangabali						
		Kalapara						
Barguna	4	Amtoli						
		B. Sadar						
		Taltoli						
		Patharghata						
Total	38							

Figure 4: Upazila Based Damage Index

3.2 NON-ECONOMIC LOSS AND DAMAGE (NELD)

The need to understand non-economic losses has been highlighted at various discussions at the regional and international level (Nishat et al., 2013). It is widely accepted that climate change will have adverse effects on socio-economic-environmental settings of a country. Economic loss and also non-economic loss and damage (NELD) can be caused by climate change. Economic losses and damages refer to commonly traded goods and services and can be calculated easily using market price of the quantity of damaged products. Non-economic losses are the other side of the coin. i.e. losses from the sectors those are not commonly traded. Because of the absence of trading properties, the calculation of NELD is difficult, but not impossible. However, impacts of NELD is as important as direct economic losses. Ironically, for some developing countries, it could be even higher than direct economic losses (Fankhauser et al. 2014).

Non-economic loss and damage has significant repercussions for sustainable development and resilience building efforts and needs to be addressed. However, there exist difficulties and uncertainties with assessing the extent and impact of non-economic loss and damage as it is not easily measurable and risk assessment methodologies are generally not designed to include those (Asaduzzaman et al., 2013). Nonetheless, it is ultimately those impacts that are assessed that get addressed (Morissey and Oliver-Smith, 2013). Sector wise NELD caused by TS Roanu has been presented in the following sections.

3.2.1 Loss of Life

Human life is one of the most ethically questionable, immeasurable and irreversible loss that falls under NELD (non-economic loss and damage) (Serdeczny et al. 2016). Studies show that large part of human losses occur in low income countries. On the other hand, middle income countries account for major economic impacts. A human life not only causes emotional loss for the family, but also potential loss of income if the lost member was employed or a chance of future earning source in-case of a child. It also poses risk for the wellbeing of mental health of surviving members as it changes their lifestyle and hampers their social life. Moreover, the community loses manpower, and in time the government suffers massive economic loses as the development achievements and poverty reduction efforts are at halt indefinitely.

The wrath of TS Roanu killed a total of 27 people (Annex 1), leaving many injured. Even though there were early warning systems, some people couldn't make it to the cyclone shelter centers and were hit by huge storm surges on their way (case study). In addition, some fishermen who were sailing the east coast were also hit by the storm surges (case study). Therefore, the highest number of people (13) lost their lives near the southeast coast in Chittagong area along with 5 in Cox's Bazar and 3 in Noakhali (Annex 1).

It is very difficult to calculate loss and damage in association with human life. However, national per capita income and life expectancy can indicate a generalized prospect of financial loss caused by the death of a person. Per capita GDP in Bangladesh is US$ 1,212 for 2015 (World Bank 2016). On the other hand, healthy life expectancy at birth in Bangladesh is 60 years (WHO 2015). Considering national life expectancy and per capita GDB, a generalized income can be estimated. NELD resulted from the causality by Roanu has been estimated as US$ 0.80 million (Table 3)

3.2.2 Health

One of the major impacts of disasters falls upon human health in post-hazard period. Health issues due to extreme climate events may fall under direct or indirect NELD (Serdeczny et al. 2016). For instance, people who are injured because of Roanu induced heavy rain, enormous wind speed, tree fall, landslide or storm surges are the victim of direct NELD on health sector. On the other hand, disease outbreaks and mental trauma due to unavailability of immediate relief and medical support are considered indirect NELD. In any case, the negative impacts on human health is long term and costly in terms of treatment process. Moreover, if the victim is an earning source, the family may suffer severe economic loss along with potential permanent health damage.

The after effect of Roanu left 4,400 people injured and thousands of people became sick due to lack of fresh water and other resources, and outbreaks of infectious diseases. The estimated income loss (assumed by community) incurred by a person due to physical injury over a year was considered as NELD of health sector for that person. The health sector's NELD in Magnama is the highest because of a large number of people (4000) were injured in that union. The estimated average NELD for 1 union is US$ 17,45.00 (Table 4). Thus, total NELD of health sector is US$ 4.26 million for the affected 244 unions (Table 4).

Table 3: NELD caused from the loss of life by Tropical Storm Roanu

Name	Age	Working life to become 60 years old (year)	Per capita GDP (US$)	Total loss because of human death (US$)	Comments
Md. Iqbal	32	28	1,212	33,936	1. Workable age has been considered as 18-60 years. 2. Minimum workable age has been considered as 18 years. 3. Income of people having age more than 60 years has been ignored.
A K Fazlul Haque	55	5		6,060	
Shafiul Alam	36	24		29,088	
Fakir Alam	50	10		12,120	
Ladu Mia	45	15		18,180	
Abu Siddiq	70	0		0	
Bulbul Aktar	50	10		12,120	
Jannatul Maowa	3	40		48,480	
Jalal	3	40		48,480	
Morzan Begum	3	40		48,480	
Sahera Sultana	10 m	40		48,480	
Nurul Kader	55	5		6,060	
Abul Hossain	40	20		24,240	
Tahera Begum	35	25		30,300	
Kabir Bhuttu	28	32		38,784	
Rakib	11	40		48,480	
Kazal Begum	50	10		12,120	
Belal alias Abu	10	40		48,480	
Nayabibi	52	8		9,696	
Akram	15	40		48,480	
Rekha Begum	35	25		30,300	
Ranu Begum	50	10		12,120	
Minara Begum	34	26		31,512	
Rumana Akter	10	40		48,480	
Masuda Begum	50	10		12,120	
Anowar Ullah	-	40		48,480	
Nurul Alam Hiron	-	40		48,480	
Total				**803,556**	

Table 4: NELD in health sector caused by Roanu

Sector	Union wise NELD (US$)			Total Loss for 3 Unions (US$)	Average Loss for 1 Union (US$)	Total Loss for 244 Unions (US$)
	Uttor Dhurang	Chandpur	Magnama			
Health	11,750.00	15,625.00	25,000.00	52,375.00	17,458.00	4259,833.00

3.2.3 Human Mobility

A natural disaster is a great threat to human mobility as it hinders the processes within daily lives and forces people to move leaving their very own lifestyle. The main impacts on human mobility are due to health injuries or diseases resulted from the cyclone. Also, the damage in infrastructure impairs the communication system which hinders human mobility. The negative impacts on human mobility can cause displacements, loss of health, distressed security, disrupted social networks, affected economic activities, and so on. As the regular movement of a person is altered due to the devastating damages of disasters, it affects the mental health of affected people along with the discomfort. For instance, to avoid displacement the people of Pekua, Cox's Bazar chose to continue living in the damaged houses after TS Roanu destroyed the roads in that area. Therefore, the effects of climate related disasters on human mobility is an immeasurable NELD.

The estimated economic loss (assumed by community) incurred by a person due to mobility loss over a year was considered as NELD in human mobility sector for that person. TS Roanu affected around 12,000; 2,250 and 10,000 people in Uttar Dhurang, Chandpur and Magnama unions, respectively, causing a total of about US$1,28 million NELD in the three unions (Table 5), resulting in the NELD for human mobility for the entire country as US$ 104.08 million. A small portion of NELD in Human Mobility sector could overshoot be repeated with Health sector's NELD. However, it was ignored because of insufficient differentiate techniques.

3.2.4 Cultural Heritage

A society is based on communication and network among people where traditions are practiced and cultures are formed. However, when these networks or other public cultural goods are damaged due to climate change induced events, the loss is immeasurable and irrecoverable in financial terms. These heritages include places with historical value, religion practice centers, cultural training centers as well as the customs followed by the community. Even though Roanu didn't have much effect on the cultural heritage sector, there are certain delay in the social/cultural events due to loss and damage. In addition to conventional monetary value of a cultural site, it has enormous emotional significance, which could be a few times more than its physical economic importance.

Calculating NELD for a cultural heritage site has considered two components of economic value. The money required for the renovation of the affected site has been included in the study. Additionally, emotional value to local people for that site has also been considered. Although it is very difficult to figure out emotional cost, it has been assumed based on the financial conversion of peoples' sensation for that site, as stated by themselves. Thus, NELD for cultural sites in Uttar Dhurang, Chandpur and Magnama unions have been found as US$1.16 million and that for the 244 unions is US$94.04 million (Table 6).

Table 5: NELD because of the disturbance in human mobility caused by Roanu

Sector	Union wise NELD (US$)			Total Loss for 3 Unions (US$)	Average Loss for 1 Union (US$)	Total Loss for 244 Unions (US$)
	Uttor Dhurang	Chandpur	Magnama			
Human Mobility	750,000.00	154,688.00	375,000.00	1,279,688.00	426,563.00	104,081,250.00

Table 6: NELD in Cultural Heritage sector caused by Roanu

Sector	Union wise NELD (US$)			Total Loss for 3 Unions (US$)	Average Loss for 1 Union (US$)	Total Loss for 244 Unions (US$)
	Uttor Dhurang	Chandpur	Magnama			
Cultural Heritage	318,750.00	687,500.00	150,000.00	1,156,250.00	385,417.00	94,041,667.00

3.2.5 Biodiversity

The most affected and vulnerable sector of climate induced events is the biodiversity, but remains unaddressed in impacts assessments. Several animals die or get injured during natural disasters and forests and trees suffer the wrath of high wind speed. As a result, the pattern and population of biodiversity and habitat in the affected area changes drastically. The loss of biodiversity imbalances the food chain and affects the ecosystem. Thus, biodiversity remain one of the most important factor in estimating NELD. It is very difficult to estimate biodiversity related NELD.

Loss of biodiversity has affected livelihood options of many people who were dependent on natural resources for their subsistence activities. For example, Roanu has affected breeding ground of fish and shrimp species, resulting in a reduced fish production in open water aquatic environment. Livelihood of a rural fisherman could thus be affected. However, it is very difficult to translate those losses into monetary language. In order to have good assumptions on those losses, community were consulted and NELD estimation was performed based on that information. The NELD in biodiversity sector caused by TS Roanu has been estimated as US$ 52.87 million (Table 7).

Table 7: NELD because of loss in biodiversity, caused by Roanu

Sector	Union wise NELD (US$)			Total Loss for 3 Unions (US$)	Average Loss for 1 Union (US$)	Total Loss for 244 Unions (US$)
	Uttor Dhurang	Chandpur	Magnama			
Loss of Biodiversity	125,000.00	200,000.00	325,000.00	650,000.00	216,667.00	52,866,667.00

3.2.6 Ecosystem Services

The highest amount of loss and damage due to natural disasters occur under ecosystem services. The damage of crops in agricultural field impacts the food supply, saline intrusion into water sources leads to unavailability of fresh water. Roanu has damaged 15,429 acres of agriculture crops fully and the area of partially damaged agro-field have been reported as 39,420 acres. In addition to agriculture field, Roanu has affected salt pans in affected upazilas in Chittagong and Cox's Bazar coastal zones. Fish and shrimp ponds and mangrove forests have also been affected.

Area of Roanu affected agriculture field, salt pan and coastal forests are 8,300 ha; 3,500 ha and 355 ha, respectively (Table 8). A total of 750 ponds have also been affected. Products and services of these fields caused huge losses.

Valuation of ecosystem services from crop fields, salt pan, and water body (ponds) have been calculated based on the market value suggested by community. However, it has been calculated as US$ 1,092.3 / hectare / year for mangrove forest, as indicated in UNEP (2011). Estimated NELD in ecosystem services sector could be as high as US$252.78 million (Table 9).

Table 8: Sector wise NELD in Ecosystems Services (US$)

Union	Agriculture field (ha)	Salt pan (ha)	Forest (ha)	No, of ponds
Dhurang	3,000	1,500	100	400
Chandpur	2,300	0	255	250
Magnama	3,000	2,000	0	100
Total	**8,300**	**3,500**	**355**	**750**

Table 9: NELD in ecosystem services sector, caused by Roanu.

Union	Agriculture field	Salt pan	Forest	No, of ponds	Total
Dhurang	750,000.00	562,500.00	107,864.63	50,000.00	1,470,365
Chandpur	50,000.00	0.00	275,054.79	62,500.00	387,555
Magnama	250,000.00	750,000.00	0.00	250,000.00	1,250,000.00
				Total	**3,107,920**
				Average loss in one union (US$)	**1,035,973**
				Total loss in 244 unions	**252,777,493**

3.3 TOTAL NON-ECONOMIC LOSS AND DAMAGE

After assessing NELD for 6 different sectors, it was aggregated to obtain total loss and damage caused by the storm. Estimated NELD caused by Roanu is US$508.83 million (Table 10). About half of the NELD has been found in Ecosystem services sector. Estimating losses in human life sector is very difficult, but has been estimated as US$ 0.80 million. NELD in human mobility, cultural heritage, loss of biodiversity and health sectors have been calculated as US$ 104.08 million, US$ 94.04 million, US$ 52.87 million, and US$ 4.26 million, respectively.

Table 10: Sector wise NELD, caused by Tropical Storm Roanu

Sector	Uttor Dhurang	Chandpur	Magnama	Total for 3 Unions	Average Loss for 1 Union	Total Loss for 244 Unions
Death	-	-	-	-	-	803,556
Health	11,750	15,625	25,000	52,375	17,458	4,259,833
Human Mobility	750,000	154,688	375,000	1,279,688	426,563	104,081,291
Cultural Heritage	318,750	687,500	150,000	1,156,250	385,417	94,041,667
Loss of Biodiversity	125,000	200,000	325,000	650,000	216,667	52,866,667
Ecosystem Services	1,470,365	387,555	1,250,000	3,107,920	1,035,973	252,777,493
Total	**10,065,467**	**2,658,655**	**3,503,185**	**16,227,306**	**5,409,102**	**508,830,507**

4 DISCUSSIONS AND **CONCLUSION**

- Early Warning Systems (EWS)
- Physical and infrastructural assets
- Risk transfer
- Microfinance
- Social protection

Bangladesh suffers frequent occurrences of cyclone, flood and other climatic disasters. There are adverse impacts from slow onset disaster, like, sea-level rise and drought along with immediate loss and damage issues. Yet, the country has shown good efficiency in handling some of the disasters and thus, Bangladesh is considered as a successful example in managing natural disaster events. Ironically, non-economic loss and damage is fully under addressed in the country.

Several research and discussions at regional and international level have emphasized the necessity of addressing non-economic losses, as it is very important to build climate resilience and induce sustainable development. However, the proper assessment of the intensity of the effects is very challenging as the previous methods of risk assessment did not include loss and damage (Hasemann et al. 2014). Therefore, understanding the criteria and developing strategies for uncertain situations of loss and damage is highly recommended.

Super cyclone Sidr hit the Bangladesh coast in November 2007 and caused a financial loss of US$ 2.3 billion. Though Roanu is a very minor storm compare to Sidr, but NELD caused by Roanu is about one-fifth of financial losses from Sidr. Estimation of NELD is a newly conceived way of looking at losses from natural disasters, should the NELD was calculated for Sidr, it would exceed a few hundred billion dollars. While Economic losses provide only instant financial loss from a disaster event, NELD gives a details of pictures for the potential losses from a natural disaster. Several factors could be considered to address NELD, and some have been highlighted below:

Bangladesh has developed national capacity to survive during natural calamities, and Early Warning Systems (EWS) is one of the most important risk reduction strategies to prepare for upcoming hazards. However, these warnings have proven their effectiveness at district level, whereas the access is reduced at sub-district level (Nishat et al., 2013). As a result, people in danger zones have lesser access to early warnings.

Insufficient awareness among people regarding the warning is also a great issue, and responses to such signals are followed by only 42.9% of the vulnerable community There is a huge lack of awareness about how to respond to these different warnings and consequently, many people (38.5%) seek shelter after the disaster has taken place (Dhar and Ansary, 2008). Volunteers of Cyclone Preparedness Programme (CPP) play a key role in disseminating early warning to grassroots but lack sufficient tools and resources. Bangladesh has improved a lot in terms of developing early warning systems, but there are enormous opportunity for an improved dissemination and developing community confidence in EWS. Therefore, effective communication through the existing early warning system is very necessary in order to reduce loss and damage.

A poor socio-economic condition and frequent exposure to natural disasters have caused severe damage to the necessary infrastructures of Bangladesh over the years. Rural structures like fisheries, poultry, dairy, farms, irrigation of agricultural lands are very susceptible to natural disasters along with the engineering infrastructures such as roads, embankments (Hossain et al., 2008). The most noticeable damages occur to households as pile of broken and overturned structures are commonly seen after a cyclone or flood and they are often used for reconstruction by the extremely poor population. Therefore, the structure becomes weaker and is not sustainable to face another disaster. Transportation and road communications are affected by damaged roads, uprooted trees, electric poles, and other debris (ibid). These damages to infrastructure are very time consuming to recover and due to lack of resources, Bangladesh cannot rebuild strong structures to survive in upcoming disasters. Improved infrastructures will reduce loss and damage from a disaster.

The immediate impacts of a disaster primarily affect the physical and infrastructural assets of the people in an area. Communities with inadequate resources may take longer course of time to recover from the impacts. A second or third order revisit of the similar disaster increases the residual impacts, and a further disaster, even with a very low extent will dismantle the healing efforts for the recovery from the first one. Thus, a second or third order disaster would affect people more severely, and traditional adaptation initiatives become an ineffective tool to meet such situation (Huq et al. 2015). It is very evident that Bangladesh is suffering from climate induced loss and damage in almost every sectors, including but not limited to transportation, economy, agriculture, food security, livelihood activities and public health. However, the efforts to address loss and damage directly are very limited due to poor economic condition, lack of resources, and expert methodologies. Moreover, it is very challenging to design proper strategies

to deal with loss and damage while the predicted impacts vary with the indefinite magnitude of each climate events. For instance, though the pathway and magnitude was known during cyclone Roanu, the Bangladesh government couldn't even manage to properly initiate the prevention measures and provide immediate relief. In this situation, addressing loss and damage by designing strategies for rebuilding and rehabilitation couldn't be a priority. Therefore, it takes indeterminate amount of time for Bangladesh to cope with the loss and damage issues, while recovery is next to impossible with continuous natural calamities. This research effort is the first of its kind to see a natural disaster of Bangladesh under NELD lens. A detailed assessment process needs to be developed for a better understanding of non-economic loss and damage of a natural disaster.

The opportunity for a transfer of risk immerges, if the cost of a risk management appears to be too wide to handle by a system. In such situation, shifting risk to another capable source can be termed as risk transfer (UNFCCC 2012; Warner et al. 2013). Risk transfer can be a viable option for Bangladesh that can help the country in handling bigger catastrophes. From loss and damage perspective, some of the UNFCCC (2012) prescribed tools are insurance, catastrophe bonds, conditional risk transfers, insurance-credit, etc. programs. Implementation of any, or many of the tools can support the protection of the nation from devastating disasters. Additionally, it can help Bangladesh to continue its development trend, even in the bad shift of post disaster period.

There is hardly any compensation for disaster victims, although Bangladesh faces irrecoverable loss and damage, including numerous loss of life and properties (World Bank 2006). Some private NGOs run a disaster compensation scheme for flood victims and successfully provides 10% of property insurance and 25% of life insurance around the whole country (Hasemann et al. 2014). However, the situation is reversed for the victims of cyclones near coastal area as they hardly get relief or shelters after relocation, let alone property or life insurance (Haque 2012). Furthermore, there is a significant lack of donors and re-insuring processes that diminishes the existing compensation scheme during major disasters (Hasemann et al. 2014). The number of rehabilitation houses for cyclone victims are far less than the number of homeless people. On top of that, unemployment aggravates the situation (Haque 2012). The socio-economic condition does not allow the government to provide adequate compensation for the victims, and thus the social protection for adaptation and mitigation fails. Possible compensation scopes should be explored to overcome loss and damage caused by a disaster.

Microfinance scheme for Microfinance is a blessing for the people living below the poverty line. This loaning system allows extremely poor people to accumulate their savings or properties and expand their incomes in order to rehabilitate and reduce vulnerability (Hasemann et al. 2014). There are several schemes introduced like climate-proof loans and micro-insurance for disaster management; however, the repayment process should be more flexible that allows suspension of payments during the impact period (ibid). Implementation of these possibilities by developing more schemes like micro-insurance programs is a practical need. Also, proper monitoring on borrowers and lenders along with capacity building and survival training are required for utilizing the full potential of microfinance for disaster risk reduction in Bangladesh.

Social protection is a good way of helping people in deserving situation. Disaster risk reduction efforts largely depend on the social protection programs that aim to prepare vulnerable communities to cope with the impacts of loss and damage (Nishat et al. 2013). Though there is a substantial improvement in poverty reduction sector, the existing programs are not sufficient in case of disaster risk reduction, as they are mostly focused on rural areas with very limited resources and coverage (Titumir 2014). In order to utilize the full potentiality of the social development strategies for addressing vulnerability and mitigate risks, a systematic and equipped design with low opportunity costs is required (World Bank 2006). Therefore, to sustain during future calamities an improved effort is required on social development in order to increase income, gender equity and empowerment. An increased access to Social Safety Net Programme (SSNP) could help vulnerable communities to face post disaster hard times.

Bangladesh Climate Change Strategic Action Plan (BCCSAP 2009) was developed to address climate change related issues and concerns in an organized way. The key objective of the plan is to mainstream climate change in the development process of the country. BCCSAP addresses the following six thematic areas(i) food security, social protection and health, (ii) comprehensive disaster management, (iii) infrastructure, (iv) research and knowledge management, (v) mitigation

and low-carbon development, and (vi) capacity building and institutional strengthening. The 4th focus area of theme-2 (comprehensive disaster management) implies that the country's key concentration is adaptation, and loss and damage left beyond the country's attention. The Seventh Five Year Plan (2016 – 2021) of the country has been developed in line with six development pillars addressed in the Bangladesh Climate Change Strategic Action Plan (BCCSAP). The implementation of the plan will address different aspects of climate change vulnerabilities of the country. However, taking inadequate measures for Loss and Damage may push the country to a 'Vicious Cycle of Disaster'.

The loss and damage due to these extreme events does not limit to immediate impacts on health, infrastructure and economy as the long-term impacts on agriculture, food supply and development processes are more acute. The ongoing adaptation measures to combat climate change effects are hindered and becomes insufficient when the 'situation is aggravated by extreme weather event' (Warner and Geest 2013). For instance, farmers along the south west coastal belt grew saline-tolerant rice crops in order to adapt to extreme saline intrusion in the area until cyclone Aila in 2009 increased the soil salinity level drastically destroying the whole year's harvest along with an estimated loss of US $1.9 million (ibid), but there were no immediate adaptive measures available as the damage in other non-economic sectors were more severe and needed to be addressed instantly with limited resources. Thus, the socio-economic condition of Bangladesh does not allow the government to address loss and damage issues effectively and the amount and severity just increases day by day diminishing the development processes.

NELD from the most recent TS Roanu is as high as US$ 508.83 million, which is about one-fifth of the financial losses caused by super cyclone Sidr. The existing socio-economic condition and disaster prone environment is already a drawback and the lack of adequate international support just adds in to the menace. Moreover, the government already lacks support and resources to deal with the immediate relief and health hazard which delays the process of addressing loss and damage, and in the meantime the condition deteriorates with long term effects. In case of Roanu, the houses, roads and protective dams which were damaged by the cyclone caused severe discomfort for the victims but, by the time people started to rebuild, they were already sick from the outbreaks and their land was water clogged. Furthermore, economic losses of disasters have always been prioritized in Bangladesh than NELD, regardless of the fact that Non-economic Loss and Damage could be a few times higher than economic losses caused by a disaster.

The country needs a strong focus in assessing these non-economic losses and develop ways of recovering these huge damages, and also, expedite more ways of claiming compensation from global funds.

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ANNEX

Annex 1: Casualty caused by TS Roanu

Name	Age	Sex	Village	Union	Upazila	District	No.	Comments
Md. Iqbal	32	m	Chular Par	North Dhurang	Kutubdia	Cox's Bazar	5	Wall Collapse
A K Fazlul Haque	55	m	North Koydi	Koyarbil	Kutubdia			Teacher, caused by boat crash
Shafiul Alam	36	m	Tabalchar	Ali Akber Dail	Kutubdia			
Fakir Alam	50	m	Noyapara	North Dhurang	Kutubdia			Tree Crash
Ladu Mia	45	m	Fakir Jhumpar	7 No. Kalar Mathchara	Maheshkhali			-
Abu Siddiq	70	m	Premashia, Roshangipara	Khankhanabad	Banshkhali	Chittagong	13	Drown in water
Bulbul Aktar	50	f	Roychata, ward 7	Khankhanabad	Banshkhali			Drown in water
Jannatul Maowa	3	c	Premashia, Ward 7	Khankhanabad	Banshkhali			Drown in water
Jalal	3	c	Premashia, Ward 7	Khankhanabad	Banshkhali			Drown in water
Morzan Begum	3	c	Premashia, Ward 7	Khankhanabad	Banshkhali			Drown in water
Sahera Sultana	10 m	c	Premashia, Ward 7	Khankhanabad	Banshkhali			Drown in water
Nurul Kader	55	m	Gondamara,	1 no ward	Banshakhali			Drown in water
Abul Hossain	40	m	Gondamara,	1 no ward	Banshakhali			Drown in water
Tahera Begum	35	f	West Khadukkhali (ward 8)	Chonua	Banshakhali			House collapse
Kabir Bhuttu	28	M	West Kadurkhil	Kadurkhil	Boalkhali			-
Rakib	11	c		Sholoshahar	Panchlaish			Street boy hit by brick flown by strong wind
Kazal Begum	50	f	Lokmaner Gona	Jungle Solimpur	Sitakunda			-
Belal alias Abu	10	c	Lokmaner Gona	Jungle Solimpur	Sitakunda			Son of Kazol Begum
Nayabibi	52	f	North Lakshmipur		Dashmina	Patuakhali	1	-
Akram	15	c	Shashiganj	Chandpur	Tazumuddin	Bhola		-
Rekha Begum	35	f	Shashiganj	Chandpur	Tazumuddin			-
Mst. Ranu Begum	50	f	8 No Ward	South Joynagar	Daulatkhan			-
Minara Begum	34	f	Alighat	Boyarchar	Hatiya	Noakhali	3	-
Rumana Akter	10	c	Alighat	Boyarchar	Hatiya			Minara's daughter
Masuda Begum	50	f	Charhere (8 no ward)	Jahajmara	Hatiya			-
Anowar Ullah	-	m	Shahar Kashba	Tewariganj	LP Sadar	Lakshmipur	1	-
Nurul Alam Hiron	-	m	East Bordali	Charchandia (Ward 6)	Sonagazi	Feni	1	-
Total							**27**	

Authors

Md Golam Mahbub Sarwar

Dr. Md. Golam Mahabub Sarwar has about 15 years job/research experience in Environment and Development sector, with particular focus on the coastal zone of Bangladesh. He developed coastal vulnerability index (CVI) for the Bangladesh coast. He worked with Universities, Research Organization, NGO and Government agencies and served as individual consultant for UN agency and INGOs. He posses professional expertise in Geographic Information Systems (GIS) and used the techniques for several studies on Bangladesh environment. His articles were published in peer-reviewed journals and books. His paper on impacts of sea-level rise on Bangladesh is one of the frequently cited articles on climate change issues of the country. Dr. Sarwar was awarded the degree of Doctor of Philosophy (PhD) by University of Wollongong, Australia. He is an MS in Environmental Sciences from Lund University Sweden, with a second Masters in ICZM from World Maritime University (WMU), Sweden.

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Shakeb Nabi

Shakeb is a seasoned development and climate change professional, leader and an executive with more than 18 years of diversified experience across South and South East Asia. His areas of interest includes climate resilience, livelihoods promotion, private sector engagement, community led rights based approaches to development, decentralized planning & resourcing, innovation and intersectionality.

He holds a post graduate diploma (equivalent to MBA) from Indian Institute of Forest Management followed by a Masters in International Development Management from UK. He also has a Masters in Humanitarian Action (NOHA) from Uppsala University, Sweden which was supported by Erasmus Mundus Fellowship. Currently Shakeb is the Country Director for Christian Aid in Bangladesh.

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Marzia Shafin is a young environmentalist with a keen interest to work for sustainable development sector of Bangladesh. Her research endeavors include coastal zone vulnerability analysis, sustainable building design, water efficiency, and so on. She completed her bachelor in Environmental Sciences from Asian University for Women where she developed strong leadership qualities and outstanding team work experiences. Recently, she completed Masters in Environmental Science from State University of Bangladesh with good academic performance. Facilitating training and workshops, data analyzing, scientific report writing, organizing events are some of her very strong capabilities. She is an advocate of volunteer and community service with great interpersonal skills.

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