

Cyclone Aila and Coping Strategies of the Coastal Households in Southern Bangladesh*

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Abstract: *Cyclones always affect the livelihood patterns of the human being. Although several studies measured only the immense impact of cyclone Aila which hit in the southern part of Bangladesh in 2009, very few studies concentrated on exploring impacts of the cyclone together with its coping strategies. The aim of this study is to explore the impacts and coping strategies of the Aila affected households located in the coastal region of southern Bangladesh. A total of 240 randomly selected households in the study area were surveyed through an interview schedule to gather information. Both descriptive and inferential statistics were used to analyze data. The results show that Aila affected households faced multifarious impacts such as the displacement of dwelling place, the loss of subsistence economy, the fall of income, the disruption of children's study and the disorder of health. In order to mitigate the impacts of the cyclone Aila, various coping strategies of the households were observed in the study area. A significant portion (86%) of the household-dwellers, who experienced the full-damage of house, chose the embankment for building a new house as a coping strategy. While in the families confronted with the financial crisis following Aila, children of the 52 percent of households had to manage their study at home instead of attending school. Three obvious dichotomies such as formal and informal, strategic and nonstrategic, and traditional and scientific are underpinning to explain the nature of coping strategies. The present study recommends recognizing the vulnerable households and promoting coordinated disaster risk reduction programs to mitigate cyclone impacts and providing support for rebuilding post-cyclone livelihoods.*

Keywords: Cyclone Aila, Bangladesh, Coping strategies, Infrastructure reconstruction
Socioeconomic need, Agriculture

Introduction

A cyclone carries the changes characteristics of gradual change of phenomenon and natural hazards which consequences changes in the physical, social and production system. Now in the age of industrial aggression nature and society are deeply intertwined. Sociologist Ritzer (2008) identified that changes in society often affect the natural environment, and those changes, in turn, affect society. Thus, in a broad way, today "nature is society and society is also 'nature'" (Beck, 1992:80). Moreover, in the extent of the climatic impact, still developing countries are more vulnerable compared to developed countries (CCC,

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2010). Impact of cyclone in the rural society of Bangladesh is an enduring phenomenon and it has become significant after the beginning of the 21st century. Frequency and intensity of natural disasters are likely to increase especially in the coastal part of Bangladesh. The socioeconomic condition of the cyclone-affected region devastated enormously. Several early pieces of evidence of the above phenomenon and its associated impacts in the agriculture, health, water and sanitation, biodiversity is already visible in Bangladesh (Islam, 2011; Azad & Khan, 2015). It is estimated that cyclone could affect more than 70 million people of Bangladesh due to its geographic location, low elevation, high population density, and poor infrastructure, high levels of poverty and high dependency on natural resources (UNDP, 2007). It is evident that the population living in the coastal area is more vulnerable compared with the population in other areas (Alam & Murray, 2005). Coastal resources upon which most people depend are likely to be affected severally due to climate variability and change (OECD, 2003).

At present, in the world, Bangladesh is marked as the most cyclone-prone country, which experienced above 36 cyclones since 1970 ensuing over 450,000 deaths and enormous economic losses (DDM, 2009). Furthermore, the regularity of natural hazards has been increased significantly over the last decades mostly in the Bangladesh coast which is assumed as the impact of climatic change (IPCC, 2007; Karim & Mimura, 2008) although there are several opposite views against the incidence of cyclones due to climate change (Bengtsson et al., 2007; Knutson et al., 2010). The Bay of Bengal being an ideal breeding ground for tropical cyclones; the coastal areas have been facing frequent severe disasters every year (Islam, 2011) and cyclone Aila is a suitable example of it. Cyclone Aila as a leading climate disaster has affected in the south-west coastal region of Bangladesh. It is formed as a deep depression in the west central Bay. It has been hitting in the south-west coast from 4.30 pm to 7.45 pm on 25 May 2009 (Shushilan, 2009). Several studies reported that around 190 deaths, 7100 injuries and vast damages of property were the immediate impacts of that cyclone (DDM, 2009; IFRC, 2010). South-west region of Bangladesh was seriously affected as Aila founded a tidal surge to break through embankments, destroying hundreds of thousands of homes and outnumber of people were killed and injured (Ahmed et al., 2009). Similarly, MoHFW (2009) reported that no household of three districts of the southern part of Bangladesh left to be severely affected by the cyclone Aila in 2009. Moreover, several problems including physical illness, food crisis, and breaking down the family life are identified in the coastal area after Aila (Azad & Khan, 2015). It is observed the high-risk situation of the coastal people along with the infrastructure, agriculture, livestock and economic development due to the low-lying areas of Bangladesh coast, which is frequently prone to cyclones (Alam, 2017; Mallick et al., 2017).

In case of coping strategies, persons in a cyclone affected locality adopt diverse measures to minimize the consequences (Paul & Routray, 2010). Bangladesh utilizes structural (embankment, levee, polder, for instance) and nonstructural (awareness raising, flood warning, for example) measures for flood prevention and mitigation (Paul, 1997). Moreover, the planning of top-down approaches of Bangladesh has repeatedly not succeeded to deliver timely and effective cyclone mitigation (Mirza et al., 2001). Subsequently, now, importance is being placed increasingly on incorporating local people's indigenous cyclone mitigating

strategies (Blaikie et al., 1994; Sanderson, 2000) and in other public/external efforts to achieve effective flood mitigation (Twigg, Benson & Myers, 2000; Few, 2003). However, there is very limited and narrowly focused literature available on local people's traditional means of coping with cyclones (Rasid & Mallik, 1995; Rashid, 2000). The studies which are concerning with household coping strategies are minimally emphasized on famine and food security (de Waal, 2004; Smucker & Wisner, 2008). In Bangladesh, the actions against riverine hazards are highly marked, for example, how diverse groups of individuals and communities respond to flooding or inundating (Delap, 2000; Rasid & Haider, 2003; Few, 2003; Brouwer et al., 2007); indigenous adjustment strategies to flooding (Khandker, 2007; Paul & Routray, 2010) adjustment strategies to farming cropping patterns in village (Islam, 1980; Paul, 1984; Rasid & Mallik, 1995). Very few studies were attentive on the warning of the cyclone, dissemination of forecast information, and adaptation responses (Haque, 1997), and cyclone disaster reduction, preparedness and management issues (Paul & Rahman, 2006; Khan, 2008).

In Bangladesh, a number of studies during last decades were conducted on various issues of natural disasters, such as cyclone or flood but there are still shortages of the formal documentation of how identified local knowledge and practices influence coping behavior during a crisis.

Hence, the main concern of Bangladesh is to mitigate the cyclone-induced disaster. It is highly pronounced that if immediate actions are not taken to address cyclone, it will weaken most of the development gains, increase resource scarcity and inequality in different regions of the world that will delay achieving Sustainable Development Goals (SDGs) in Bangladesh (Rahman, 2017). Addressing the impact of the cyclone on the livelihoods of people and the capacity and opportunities for quick recovery and increased resilience to future events is a vital part of the response to the disaster (Chowdhury, 2012). But Aila affected people, at present, have shown poor capacity to cope with the deep consequences of disaster risks and residents still live with critical vulnerable conditions, namely social (waning social togetherness), economic (declining of plants, shrimps and fisheries) and institutional (seldom access to community clinics) (Saha, 2013). Similarly, Rahman (2015) reported that long years after cyclone Aila killed at least 200 people in Bangladesh and households in coastal districts of Khulna and Bagerhat are suffering from different problems, drinking water crisis is one of them.

In response to the impending critical condition, this study has been carried out in the cyclone Aila affected area in Bangladesh. Decision makers need to know the extent of impact and the coping strategies people use to avert increased vulnerability to formulate an effective program of action in the infrastructure, socioeconomic and agriculture for household-dwellers. This study objective includes explaining the impact of cyclone Aila and coping strategies of coastal affected households in Bangladesh. Finally, this objective has been broken down three research specific questions: (a) what coping strategies are taken by households for infrastructure reconstruction after Aila?; (b) what coping strategies are determined to recover socioeconomic need?; and (c) what coping strategies are observed for agriculture?

Theoretical frameworks

Two theoretical frameworks including a sociological understanding of cyclone and the access model are used to explain the study findings.

Sociological understanding of cyclone

While cyclone extremes are natural processes, the responses to such events depend on the societal factors. Theoretically, the impact of cyclone Aila can be understood from the ground of both basic (economic) and superstructure (social, political, cultural, etc.) in the Marxian term. Earlier studies support a long history within the sociology of discovering multifarious results at the household level (Entwisle, 2007; Sampson et al., 2002). In addition, sociological theory, tools and techniques also support finding out how people respond in local settings. The classical sociologist Emile Durkheim addresses that the social world constitutes a reality of its own, above and beyond the lives and experiences of individual persons. In view of that, macro-sociological theories have been interested in explaining collective rather than individual behavior (Siegrist & Marmot, 2004). Both classical and contemporary sociologists have contributed emphasizing this approach to find social fact in society. So, considering the importance of collective vision, I try to incorporate the prime concern of sociology lingers at the level of collective phenomena from the household perspective in Bangladesh. Reducing vulnerability, it needs group action from 'collective conscience' (Durkheim, 1893/1964).

The impact of cyclone Aila can be explained with "capitals" (Bourdieu, 1984) for example, direct impact observes on physical capital like disease and injury as well as indirectly through affecting economic, social and cultural capital such as lower income, loss of integration and absence of knowledge respectively. These impacts reduce the capabilities of victims to improve their conditions. When people cope with the adverse situation, they maintain some sets of logic that are rooted consciously or unconsciously, which is related to the concept of habitus and Bourdieu explains it as "structured structuring structure" (Bourdieu, 1990:53). The Social Capital Theory enables individuals and/or groups through collective action to reach desirable outcomes (Silici, n.d:2). The Social Capital Theory is "about the value of social networks, bonding similar people and bridging between diverse people, with norms of reciprocity" (Claridge, 2004). Public awareness is linked to 'The Social Capital Theory' which describes the pattern and intensity of networks amongst people and shared values which arise from those networks. United Nation International Strategy Disaster Risk (UNISDR, 2009) defines public awareness as the extent of common knowledge about disaster risks, the factors that lead to disasters and the actions that can be taken individually and collectively to reduce exposure and vulnerability to hazards.

Cyclone can cause both physical damage and losses incurred by social units and the disruption of the unit's routine functioning and within its network of other social units. Whenever there is a natural and man-made disaster, people help one another before they are supported or replaced by government entities (Schellong, 2007). It emphasizes the importance of being there for one another as people to work and help one another, even during the cyclone. This sense of moral responsibility produces collective action in times of threat to the community. Schellong (2007) indicates that if there are problems or dissatisfaction among residents,

they would not be able to help each other during emergencies. So, the Social Capital Theory therefore clearly links with disaster coping strategies of local people.

The access model

The access model has been emerged for the analysis of disaster with an aim to analyze the people's access to the capabilities, assets and livelihood opportunities that qualify them to minimize their vulnerabilities. Following a disaster, the term access has become a key issue to the analysis of vulnerability and adaptation (Wisner et al., 2004). Access is defined as "access involves the ability of an individual, family, group, class or community to use resources which are directly required to secure a livelihood in normal, pre-disaster times, and their ability to adapt to new and threatening situations". (ibid:94). The 'access model' emphasizes the scope of livelihood as the key to recognizing coping behavior during a disaster. For example, the persons who have better access to means of production, information, tools and social relations are considered as less vulnerable as they can use these opportunities during a crisis. This model highlights on the three related agents: (i) the agency of the individuals and households, (ii) the impacts of hazards on victims, and (iii) how victims develop strategies for adaption. In explaining this process, a linking between three agents are observed indicating livelihood of households depends on the individual decisions and this personal decision are generally shaped by the external setting called the political-economic that shapes the pattern of access and utilization to resources. In this analysis, political economy includes a couple of systems, such as (i) social relations and (ii) structure of domination, which are the main factors of vulnerability and determine the coping strategies of cyclone victims. The former system refers to the influx of goods, money and surplus between different actors, whereas the latter means to the politics of relations between individuals and groups that depict relations within households, kinship ties, ethnic groups and relationships between individuals and the state. Hence, the 'access model' signifies a thorough understanding of the underlying factors that influence the coping and recovery strategies.

Using these models, the analysis of this research includes the coping and recovery strategies of the households of Kamarkhola union under Batiaghata *Upazila*¹ in response to the cyclone Aila in Bangladesh.

Methods and materials

Study type

This is a quantitative study and exploratory in nature. Inferential statistics were used to measure an association between groups and subgroups of variables. In the epistemological sense, this study shows how the variables have a relationship with each other. Here it provides an opportunity to measure variables through determining a scale to increase validity and reliability. In this phase, the survey method was used

¹ An administrative unit that functions as a sub-unit of the district of Bangladesh.

as it connected the information of variables from different angles to respond designed research questions and allowing the power of generalization.

Study area and sampling

A few previous pieces of research on disasters were conducted by selecting the study area purposively which indicated that each location was severely affected by the several natural calamities namely cyclones, storm surges, salinity intrusion and tidal flooding (Huq et al., 1996; Ali and Chowdhury, 1997; Ali Khan et al., 2000; World Bank, 2000; Singh et al., 2001). Ward No. 1 of Kamarkhola union under Batiaghata Upazila of Khulna district in Bangladesh was selected purposively as it was documented as a full cyclone Aila affected among all nine wards of this union. Afterward, a list of all Aila affected households of the ward No. 1 was collected from the union Parishad- a local administrative unit, and the number of affected households were counted 467 (Six No Kamarkhola Union Parishad, 2015). Then, a lottery technique of random sampling was followed to select a sample of 240 that represents 51 percent of the total Aila affected households of that ward.

Variables and measures

Variables of this study were identified from the different aspects of impact and coping strategies as well as the relation of specific coping strategy to the specific impact of cyclone Aila in Bangladesh. With a view to maintaining validity and reliability, statistical measurements were used to measure every variable for this study. Table 1 depicts the name of variables with its codes and values.

Instrument and procedure

An interview schedule as an instrument was developed to collect data in the process of personal contact with the head of 240 households of the Kamarkhola village. A pilot survey was conducted to check the validity of measurement scales and scrutiny of irrelevant questions before making a final interview schedule. To explore the answer of research questions of the study, data about respective concepts were collected by incorporating relevant cases in the interview schedule contained both opened and closed-ended items. Data were collected by four trained interviewers for two months from November to December of 2010. An oral consensus of the respondents was ensured to maintain an ethical issue before gathering information. Moreover, few times were spent to build up a rapport with the respondents and then the interview started.

Statistical analysis

Field data were analyzed using SPSS (statistical package 20) and Excel. Both descriptive (percentage) and inferential (chi-square) statistics were used for data analysis. Results were presented in the cross tables and figures. The statistical analysis was conducted at a 95 percent confidence level and a P value less than 0.05 was considered statistically significant.

Table 1: Name of variables, codes and values

Variables	Codes and values					
	1	2	3	4	5	6
i. House damage	Full	partial	-	-	-	-
ii. New places for coping	embankment	relative house	community shelter	own broken house	-	-
iii. Coping strategies for rebuilding houses	GO & NGO support	relatives' support	own effort	involvement with politics	illegal connection with aid distributor	loan taking
iv. Factors hindering school attendance	disruption of communication	money shortage	lack of logistic support	-	-	-
v. Coping strategies for continuing study	home studying	boat using	late schooling	paying less tuition fee	group sharing	-
vi. Types of illness	Malaria	<i>kalazar</i> ¹	injury	skin disease		
vii. Coping strategies for recovering from illness	depending on traditional medicine	depending on modern medicine	no treatment	-	-	-
viii. Income after Aila	\$1-\$60	\$61-\$120	\$121-\$180	-	-	-
ix. Coping strategies for surviving	minimizing food bundles	stopping child education	borrowing money	taking aid	depending on relatives	-
x. Coping strategies for overcoming the loss of fish	raising pond embankment	changing species	fencing pond by net	-	-	-
xi. Factors of no crops yielding	Submerging	salting	lacking tools	decreasing land fertility	-	-
xii. Coping strategies to grow crops	cultivating hybrid crops	using traditional knowledge	using modern technology	receiving GO & NGOs instructions	following no strategy	
xiii. Damage of trees	Full	partial	-	-	-	-
xiv. Coping strategies to grow trees	afforestation	plantation of deep-rooted trees	plantation in Highland	dike plantation	-	-

¹ *Kalazar*= One kind of fever.

Sources: Azad & Khan, 2015; Chowdhury, 2012; Ghorpade, 2012; Islam, 2011; CCC, 2009; Rahman, 2008; Habibullah et al., 1998

Results

In this section, empirical results are presented that contain the information of both impacts and coping strategies in the aspects of (1) infrastructure such as houses, (2) socioeconomic such as child education, health and income, and (3) agriculture such as fish, crops and forest.

Background of the respondents

Data in Table 2 show that 85 percent of the respondents were male, and 15 percent were female in the study area. In the age category, the highest percentages (30% and 29.2%) of the respondent belonged to the age group of 30-39 and 40-49 respectively that represent the middle-aged head of the household. In contrast, the age group of 20-29 and 60-69 made up 10.8 percent, the lowest, for each, and the age group 50-59 consisted of 19.2 percent head of the households in the study area.

Table 2 Characteristics of the subjects

Demographic & socioeconomic data	Number (%)	Demographic & socioeconomic data	Number (%)
Sex		Occupation	
Male	204 (85%)	Farmer	116 (48.3%)
Female	36 (15%)	Day laborer	76 (31.7%)
Age (years)		Housemaid	16 (6.7%)
20-29	26 (10.8%)	Van Puller	16 (6.7%)
30-39	72 (30%)	Business	10 (4.1%)
40-49	70 (29.2%)	Service	6 (2.5%)
50-59	46 (19.2%)	Religion	
60-69	26 (10.8%)	Muslim	144 (60%)
Education		Hindu	86 (35.9%)
Illiterate (0)	60 (25%)	Christian	8 (3.3%)
Primary (I-IV)	90 (37.5%)	Buddhist	2 (0.8%)
Secondary (VI-XII)	74 (30.8%)		
Higher (XIII-XIII+)	16 (6.7%)		

Source: Household survey, 2010

The mean age was counted 34. In education, the same table depicted that the greatest number of the respondents (37.5%) had a primary level of education with the following 30.8 percent for a secondary level of education whereas the lowest percentage (6.7%) of the respondents had the higher level of education. It is also observed that 25 percent of the respondents were illiterate in the study area. Professionally respondents were occupied in six categories: agriculture, day laborer, business, service, housemaid and van puller. Around half (48.3%) of the respondents were farmers and 31.7 percent day laborer. Most of them (60%) were Muslim and 35.9 percent were Hindus.

House damage and coping strategies

In many cases, Bangladesh makes use of structural (e.g., embankment, levee and polder) and non-structural (e.g., awareness building and flood warning) measures for the prevention of flood and mitigation (Paul 1997). House as infrastructure is the basic requirement for the people to survive.

Table 3: Places chosen to adapt after Aila by types of the damages of household

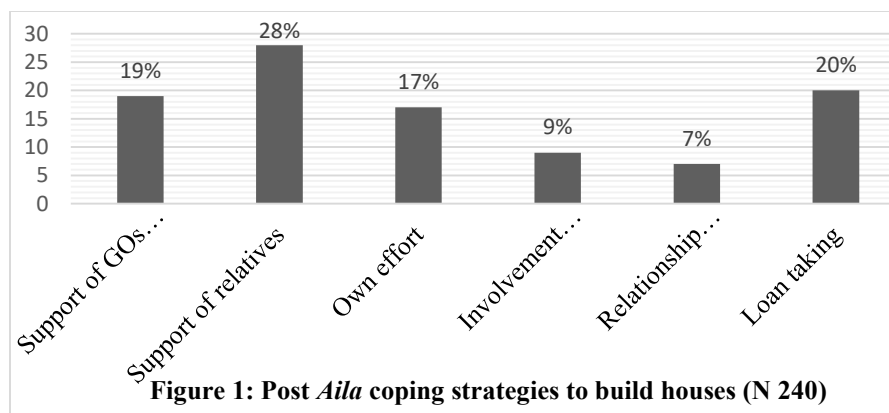
Types of damage	Places for coping				Total
	Embankment	Community shelter	Relative house	Own broken house	
Full	135 (67%)	22 (11%)	25 (13%)	18 (9%)	200 (100%)
Partial	7 (17%)	9 (23%)	6 (15%)	18 (45%)	40 (100%)
Total	142 (59%)	31 (13%)	31 (13%)	36 (15%)	240 (100%)

Pearson Chi-square 45.459 (p <0.000)

Source: Household survey, 2010

Cyclone Aila damaged all the houses of Kamarkhola village in Bangladesh. Data in Table 3 indicate that the maximum (67%) households shifted on the embankment for living place as a coping strategy when they experienced complete damage of house by Aila, while few had scope to stay in their own house. On the other hand, the highest 45 percent of the total households by partial damage of house preferred own broken house to cope with living, with the following 23 percent went to the community center. Therefore, results from the empirical study show that coping strategies of households vary according to the intensity of damage, and it is statistically significant at $p < 0.000$.

Coping strategies of making a new house



Source: Household survey, 2010

The findings reveal that the maximum 28 percent of the sampled households took the support of their relatives (Fig.1). Taking a loan, support of government organizations (GOs) and nongovernmental organizations (NGOs), and own effort were almost the same based on percentages that were counted 20 percent, 19 percent and 17 percent respectively. Moreover, the political involvement (9%) and the unfair connection with foreign aid distributor (7%) were observed as strategies to have money of households.

Barriers to child education and coping strategies

D'Oley et al. in 1994 observed that to cope for supporting survival and improving the quality of life of human being in a critical situation, education is identified as an important determinant. In this study, children from 198 (83%) of 240 sampled households of Kumarkhola experienced various challenges commencing their study after cyclone Aila and children from remaining 42 (17%) households did not face difficulty to attend school. So, children took the coping strategies against the adverse conditions after Aila so that they could overcome the loss of study. Children in the study area had to continue their study at home instead of attending school due to a couple of factors such as the shortage of money of families (52%) after Aila and the disruption of communication (43%) (Table 4). Again, the highest 41 percent cases, children dropped their studies while they encountered a lack of logistic support, with the following 33 percent cases for studying at home. Moreover, the tendency of using a boat as a traditional vehicle, paying the lower tuition fee, support from the village elders and peer groups, sharing of the study were observed to mitigate the loss of study as well. In addition, the coping strategies of children to recover studying vary according to the hindering factors of school going after Aila, and it is statistically significant at $p < 0.001$.

Table 4: Coping strategies for recovering the loss of study by the barriers of attending a school of children after Aila

Barriers to attending school	Coping strategies					Total
	Studying at home	Using boat	Late schooling	Help from elders & peer groups	Group sharing	

Disruption of Communication	58 (43%)	24 (18%)	24 (18%)	20 (15%)	8 (6%)	134 (100%)
Money Shortage	24 (52%)	6 (13%)	6 (13%)	8 (18%)	2 (4%)	46 (100%)
Lack of Logistic Support	6 (33%)	2 (11%)	7 (41%)	1 (5%)	2 (10%)	18 (100%)
Total	88 (45%)	32 (16%)	37 (19%)	29 (14%)	12 (6%)	198 (100%)

Pearson Chi-Square Value: 6.452; P<0.001

Source: Household survey, 2010

Disruption of health and coping strategies

Health as another social category has an immense impact on human life. A total of 226 (94%) households experienced the disruption of health were shown in various types of diseases following Aila. Data contained in Table 5 show that the households having four types of health effects of cyclone Aila took three types of coping strategies, and traditional medicine was counted the highest on an average among all strategies. However, for injury and skin disease, households could not depend on all types of coping strategies. In the case of skin disease, the households mostly depended on two strategies such as traditional medicine and no treatment. Here $p < 0.000$ represents the significant relationship between coping strategies to overcome the health conditions and types of health effects. Here it is also alarming that total 23 percent could not participate in any treatment.

Table 5: Coping strategies to overcome the bad health conditions by types of health effects after Aila

Health Effects	Coping strategies			Total
	Depended on traditional medicine	Depended on modern medicine	No treatment	
Malaria	50 (46%)	36 (33%)	24 (22%)	110 (100%)
Kalazar	30 (44%)	20 (30%)	18 (27%)	68 (100%)
Injury	12 (35%)	16 (47%)	6 (18%)	34 (100%)
Skin disease	8 (67%)	2 (5%)	4 (28%)	14 (100%)
Total	100 (44%)	74 (33%)	52 (23%)	226 (100%)

Pearson Chi-square value: 26.344; P<0 .000

Source: Household survey, 2010

Monthly income after Aila and coping strategies

Households usually undertook a variety of strategies to overcome the adverse impact of disaster when they fall in a crisis of income during or post-disaster period (Paul & Routray, 2011). The income of households is assumed to have an influence on the coping strategies of the individuals as it is the complex determinant reflecting socioeconomic characteristics (Haque, 1997). Various coping strategies were taken by the households in the study area to sustain according to the different ranges of monthly income after Aila. Table 6 illustrates that the highest 39 percent, who had income within the income group of \$1- \$60, took a lower amount food for the daily meal as a coping strategy to manage a family, with the following 28 percent and

23 percent reported for taking a loan and aid respectively. Additionally, 7 percent and 3 percent people of the same income group stopped their child education and depended on relatives correspondingly. Again, the maximum 44 percent respondents, who had income within the income group of \$61-\$120, took a lower amount of food for the daily meals that were counted double compared with the borrowing money and depending on the support of relatives. In the final group of income (\$121 and \$180), households utilized only two strategies such as taking a lower amount of daily food and taking foreign aid, and the percentages were equally divided. It is important that households ranking in the lowest category (\$1-\$60) relied on all kinds of coping strategies whereas the middle-income group applied four strategies and the highest income group was limited to apply only two strategies to cope. So, the findings represent that as the income level of households decreases, the application of the number of strategies increases in the cyclone-affected regions in Bangladesh.

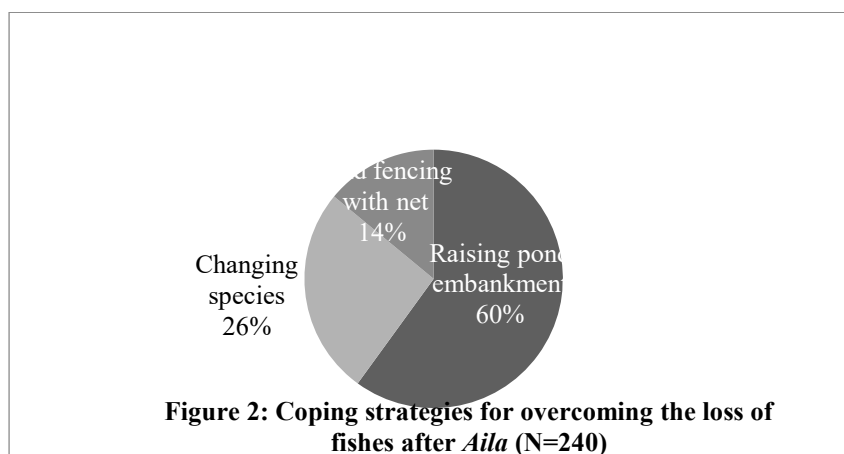
Table 6: Coping strategies for maintaining the family by the monthly income of household-dwellers after Aila

Monthly income after Aila (USD)	Coping strategies					Total
	Taking of a daily lower food	Stopping of children's education	Taking of loan	Taking of foreign aid	Depending on relatives' support	
\$1-\$60	84 (39%)	16 (7%)	60 (28%)	48 (23%)	6 (3%)	214 (100%)
\$61-\$120	8 (44%)	0 (0%)	4 (22%)	2 (12%)	4 (22%)	18 (100%)
\$121-\$180	4 (50%)	0 (0%)	0 (0%)	4 (50%)	0 (0%)	8 (100%)
Total	92 (40%)	16 (7%)	70 (25%)	54 (24%)	9 (4%)	240 (100%)

Source: Household survey, 2010

Coping strategies to overcome the loss of fishes

The fish cultivation was considered as money accumulating business of the villagers. Cyclone Aila severely affected all kinds of fish-farms in which fishes included the shrimp- 'white gold' and common fishes (labeo rohita, catla catla) which were the key sources of income of the southern people of Bangladesh.



Source: Household survey, 2010

The households of the Aila affected area took three coping strategies such as raising an embankment surrounding a pond, changing of species- generating of salinity tolerant, and introducing the pond fencing by the net to overcome the loss of fishes. Data in Figure 2 depict that the uppermost 60 percent of the households accepted to raise the embankment of the pond so that water could not overflow during the cyclone, with the following 26 percent for altering fish species with the taste of water. Remaining 14 percent of the households also used the net fencing surround the pond to keep the fishes inside when the water overflows.

Decreasing of crops yielding and coping strategies

Cultivable land is important to produce crops for surviving of the households. Data in Table 7 contain information about the coping strategies by the factors of decreasing crops growing. The same table contains data from 172 households as the land of all households was not decreased. The same table depicts that the households took all four coping strategies when the crops yielding was impossible for the factors of the submerging of land and the insufficiency of tools for production. Moreover, three mitigation strategies were applied when the salt water entered the land during Aila, and only one

Table 7: Coping strategies for overcoming the loss of production by the factors of decreasing crops yielding

Factors of decreasing crops yielding	Coping Strategies					Total
	Cultivation of hybrid crops	Using of traditional knowledge	Using of modern technology	Receiving GO & NGOs instructions	No strategy	
Submerging	42 (41%)	18 (17%)	10 (9%)	18 (17%)	18 (17%)	106 (100%)
Salting	14 (54%)	0 (0%)	4 (15%)	2 (8%)	6 (23%)	26 (100%)
Lacking tools	4 (18%)	2 (9%)	10 (46%)	4 (18%)	2 (9%)	22 (100%)
Losing land Fertility	14 (89%)	0 (0%)	0 (0%)	0 (0%)	4 (11%)	18 (100%)
Total	74 (51%)	20 (5%)	24 (14%)	24 (14%)	30 (16%)	172 (100%)

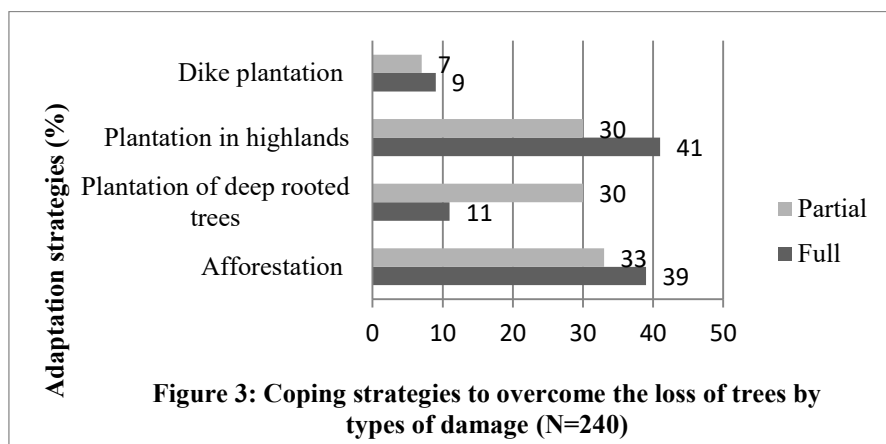
Source: Household Survey 2010

strategy was taken for reducing the land fertility. Furthermore, the cultivation of hybrid crops as a coping strategy was counted the maximum among all strategies against the factors of decreasing crops yielding except in the case of a lack of tools where the highest (46%) portion of the households used the modern technology. Finally, 16 percent of households could not take any strategy and it was applicable for every factor of declining crops yielding.

Damaging of forests and coping strategies

Figure 3 includes the information of all (240) households as the forest of all households was affected by cyclone Aila. Data in the same figure show that the highest percentage of the households (41%) planted

trees on the highland when they experienced full damage of the forest, with the following 39 percent was counted for afforestation. As is observed, the coping strategies including the plantation of the deep-rooted trees and the highland plantation were counted 30 percent for each when the households faced partial damage of the forest in Kamarkhola village. Finally, the percentages of dike plantation were almost the same for both types of damages of forests.



Source: Household survey, 2010

Discussion

The impact of cyclone Aila on infrastructure is clear at Batiaghata *Upazila* in Bangladesh. Maximum houses are identified as fully damaged after cyclone Aila, and people had very few places left for living. Very helpless condition of the cyclone-affected households is monitored. Family members following Aila had to spend a risky life that has a similarity with the concept of idiosyncratic risk- risks faced by households (Ghorpade, 2012). To rescue from the backward situation, the dwellers of households have taken coping strategies for two collective aspects: (1) searching for a shelter, and (2) reconstructing a house. Searching for shelter, dwellers chose to live on the embankment, house of the relatives, community shelter, and own broken house. It indicates the variation in the places of living. Additionally, variations are observed based on their household vulnerabilities. Empirical data suffice that the maximum percentage (67%) of the people who lost all their households chose the embankment than other types of damage groups. Moreover, people who build their new households on the embankment get supporting from the formal and informal mechanisms. The former mechanism has an exchange relation that includes taking a loan especially from the bank, microcredit organization and *mahajans*¹ in the village. The latter mechanism- informal- includes the supports of GO and NGOs, the assistance of relatives, involvement with politics and illegal connection of the household-dwellers. A widespread relief intervention was initiated by the GO, NGOs and national and international humanitarian agencies in the immediate aftermath of the cyclone. A relief intervention provided by GO and NGOs incorporates relief materials (foods, household goods, tools, clothes, etc.) and

¹ Moneylender of the village

these were distributed for about a couple of years ago to reduce the sufferings of the Aila affected people (Masud-All-Kamal, 2013). Moreover, the assistance of the relatives (28%) of the households is considered another informal social mechanism to recover after cyclone Aila. Societies of Bangladesh are based on a strong kinship system (Quisumbing & Maluccio, 2003; Mozumder et al., 2008) and the kinship networks tend to offer support to the relatives in a crisis. It is important that coping strategies of households as collective actions are originated from the existing social structure in the study area what sociologist Blau (1964) termed "particularistic"- integrative bonds enhancing unifying function.

In this paper, the socioeconomic aspect includes three variables, namely child education, health and income. We find a social vulnerability that creates differences in the human capacity responding to cyclone Aila in child education, health, and economic vulnerability in income. Education is a social factor for the development of any country. Being Bangladesh as a developing country, she must face many difficulties to build educational institutions. Unfortunately, natural hazard triggered disasters in different times in Bangladesh destroy the educational infrastructures. Cyclone Aila created three key barriers of education access of the children: (1) transportation barrier- the roads of the affected region are fully submerged, and no public vehicle is available except boat; (2) money shortage of guardians- the parents and other head of the households do not have enough money; and (3) lack of logistic support-it includes shortage of books, pen, bag, cloth and so on. Parents in households try to overcome the barriers to train their children by taking different coping strategies. Children are commonly found studying at home rather than attending school. Such action reduces communication and interaction with the teachers and classmates. Few children are trying to use indigenous logistic supports like a boat as a vehicle to arrive at school. Sometimes boat cannot reach the destination on time due to having bad weather or other disruptions. The delay of study starting of children is also noticeably observed in the affected region. Young students from 41 percent of the households, who lacked logistic support, could not continue their studies in time. It creates discontinuity and dropping out of students from the school. This study has similarity with the recent cyclone Idai which hit in Mozambique. It is estimated that around 305,000 children in Mozambique have had their education interrupted because of damage caused by Cyclone Idai that might connect dropping out of children from school for both the short and long term (UNICEF, 2019).

The second impact on the socioeconomic facet of cyclone Aila is fully understood as unfamiliar, serious and increasing risk to public health. Mainly four types of health impacts of cyclone Aila at Kamarkhola village are explored: wounded, malaria, *kalazar* and skin diseases. Most of the identified health effects were the result of infectious and waterborne germs of post-cyclone. About this World Bank (2000) suggested that Bangladesh is vulnerable to outbreaks of infectious, waterborne and other types of diseases. The damage to homes, water and sanitation facilities was particularly significant given that the population of Bangladesh are generally prone to contagious diseases, with respiratory and diarrheal diseases being the leading causes of death (GoB, 2008). Health problems increase vulnerability and reduce the capacity of individuals and groups to adapt to climate change (Rahman, 2008). In Kamarkhola village, mainly two coping strategies

were taken by the affected households: (1) dependence on traditional medicine given by the inefficient village doctor, and (2) dependence on the modern medicine mainly supplied by the open service of NGOs and the *Upazila* health complex. Moreover, a noticeable portion of the victims for all types of health condition never took any treatment. They depended on the natural settings of the body as a coping strategy. It could produce a result of chronic health burden in the future and reduce their working capability. It indicates the institutional lacking opportunities for coping strategies.

The income of households is identified as the final category of the socioeconomic aspect to be affected by cyclone Aila in various ways. It is observed that most of the households belong to the lowest income group (\$1-\$60) after Aila. It represents the economic vulnerability in the cyclone-affected area as the average monthly income of the day laborer in Bangladesh is around \$122 (BBS, 2011) that is still double than the existing income range of \$1-\$60 at Kamarkhola village. The households reduce their daily meal, stop their children's education, take a loan, receive aid and even get support from the relatives to survive with the poor income. These strategies are threatening to ensure the basic needs of a human being. It can be explained as materialistic deprivation and human being need to take such nonstrategic coping strategies for this deprivation comes when people do not have enough money to pay social participation as well as food (Bartley, 2004).

Agriculture includes three sectors in the study area: (1) fish, (2) forest and (3) crops. Firstly, cyclone Aila devastated the cultivation of fishes. The shrimp known as white gold is the key source of income in Bangladesh but now all *ghers*¹ are demolished and inundated. People cannot produce white gold and other fishes again until the water is removed from that area. People have made different strategies like raising pond embankment, changing species and net fencing. Secondly, a lower number of crops especially rice production is observed following Aila due to inundation, salinity, lacking logistic support and loss of land fertility these affect enormous economic progress. In most of the cases land was submerged and gone under saline condition. Due to salinity 0.2 million ton of rice production is reducing in Bangladesh (Ayers and Huq, 2010). The effects of soil salinity on Aus² production would be detrimental and Aman³ also suffers over two-fold yield reduction when grown under a severe climate change scenario (Habibullah et al., 1998). Such land decreasing reduced food production also. The affected households of Kamarkhola village took four strategies to overcome the decreasing of crops. They started to use hybrid paddy (BR), using traditional knowledge (using ash), using modern technology (tractor) and implications of GO and NGOs instructions. Moreover, coping strategies have a relation to the factors of decreasing crops. Having the intention to gain bumper crops, the households decided to produce hybrid paddy as a coping strategy when submerging, salting and loss of land fertility come into account for decreasing of land crops. Thirdly, the same impact is monitored on the forest at Kamarkhola village. Considering the situation of damage, it has been divided

¹ Where fish is cultivated seasonally.

² A kind of rice that is grown in the rainy season in Bangladesh.

³ A kind of rice that is grown in the autumn season in Bangladesh.

into two types comprising (1) full and (2) partial damage. People lunched several coping strategies like afforestation, plantation of deep-rooted trees, and plantation in highland and dike plantation. Afforestation (39%) and plantation in highland (41%) are counted more as coping strategies for the full type of forest damages. These strategies reflect the usages of their traditional and scientific knowledge. Having traditional knowledge, households make an embankment or net fencing to protect fishes, use ash to fertile land growing crops, and practice afforestation and plantation in highland to grow the forest. But the households express scientific knowledge in practicing the changing of species especially nurturing new fishes for salty water, cultivating hybrid paddies (e.g. BR) and using of technology, and dike plantation after Aila. Finally, the interventions of GO and NGOs have been considered as social support to recover from damage. Furthermore, in the economic category, it is found a reciprocal relationship to cope with the cyclone-affected society from two angles. In the first case, households cope with the hazardous situation getting the sense from the existing structure. That is, people apparently depend on the tractor to plow land quickly that is already existed. Additionally, the second outlook of the dwellers related to the invention of some strategies these are not uncovered earlier, and now works as a new element for the structure of Bangladeshi society. For example, changing species to adjust with the saline water in the coastal area is remarkable.

Conclusion

The objective of this paper is to identify the impacts and coping strategies of the cyclone Aila affected households in southern Bangladesh. The southern people of Bangladesh experienced many incredible impacts due to cyclone Aila. These impacts are observed on the infrastructure-house; socioeconomic issues-child education, health and income; and agriculture-fish, crops and forest. Every household-dweller depicts their collective action during and post-Aila to recover from climate impact. Victims had to determine strategies for managing a secured place for building a house. For doing these, they showed formal-exchange, and informal-non-exchange mechanism. In socioeconomic issues, home study, late schooling, and using of boat to go school are frequently observed to cope with the study barrier of household's children; depending on traditional and scientific medicines are taken to cope health burden; and reducing daily food at family, cancelling of child study, taking a loan and aid, and even enjoying support from the relatives are observed to cope with the daily life in case of negligible income of family. Finally, in agriculture, traditional (e.g. using ash to fertile land) and scientific knowledge (e.g. changing species with the taste of water) are used to cope with the devastation of fish, crops and forest. An important issue is that the coping strategy in every aspect varies according to the nature of the impact of cyclone Aila. To assist the cyclone-affected households with their existing coping strategies, the findings from the study identify the need to recognize the vulnerable households and promote coordinated disaster risk reduction programs to mitigate cyclone impacts and provide support for rebuilding post-cyclone livelihoods. As this study was conducted by following a survey method, it might posit the limitation of an in-depth study of all the aspects. While expanding a reality, one might select an in-depth study to have a detailed picture and to include a community level study.

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