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Evacuation scenarios of cyclone Aila in Bangladesh: Investigating the factors influencing evacuation decision and destination

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ABSTRACT

It is well known that Bangladesh is one of the most disaster-prone countries in the world. Especially, climate related disasters like flood and cyclone are most common in Bangladesh. Among all disasters, considering the loss of lives cyclones impose the most severe impacts in Bangladesh. There are number of studies focusing loss and damages associated with different cyclones in Bangladesh. Researchers also identified different factors related to evacuation decision making process. However, in case of Bangladesh, analyzing people's experience during devastating cyclone, only a few researches tried to identify the factors that guided them to take evacuation decision and to select evacuation destination. With empirical study on 200 people of Gabura Union that were the worst affected during cyclone Aila, this research analyzes how different groups of people are influenced by different factors and take evacuation decision and finally choose their evacuation destination. Further, unlike the other researches, in addition to the examination of evacuation influencing factors, this research attempts to categorize people into different groups based on their risk perception attitude and actions during evacuation. It noticed four types of people termed as serious, reluctant, undecided and non-evacuee. Evacuation behavior or actions, factors leading to evacuation destination and final evacuation destination of all these four groups are identified. Analyzing the actions and experiences of different groups of people this study explore that content of cyclone warning and evacuation order, timing of evacuation order, evacuation preparation time, people's risk perception, weather condition, condition of roads and cyclone shelters and finally the distance of cyclone shelters are important factors to influence people's evacuation decision and selecting evacuation destination. In fact, different groups of people are needed to be treated differently during designing and implementing different evacuation awareness programs, trainings, drills and actions. Therefore, this type of grouping of people based on their evacuation behavior and influencing factors would greatly serve further policy actions related to evacuation.

1. Introduction

Bangladesh is one of the largest delta areas, which is composed of three big rivers, Ganges, Brahmaputra and Meghna. An elevation of plain area is mostly below 10 m above mean sea level [1]. Due to the geo-physical and topographical condition Bangladesh is one of the most disaster prone countries in the world. Especially, climate related disasters like flood and cyclone are most common in Bangladesh. All over the world Bangladesh has an image of a country of natural disasters. In spite of having many impressive histories, achievements and success, Bangladesh often come to the news heading due its natural disasters, especially flood and cyclone.

Among all disasters, considering the loss of lives, cyclone is the most severe natural disaster in Bangladesh. Tropical cyclones with high winds and storm surges hit Bangladesh every three years on an average [2]. Based on historical records Shamsuddoha and Chowdhury [3] also found that Bangladesh experiences severe cyclone every four and one-half years. So, cyclone is a common phenomenon for the coastal community of Bangladesh. About 6–10% of the world's tropical cyclones generate at the Bay of Bengal, which is bordered with Bangladesh, India, Sri Lanka and Myanmar. This tropical cyclone is considered as the most devastating weather systems [4]. Along with the high wind speed, cyclones induced storm surge is also occurred [5] often in Bangladesh, because of the geographical feature of the country. These high wind speed along with storm surges caused huge loss of lives and properties. According to Nicholls [6] during the past two centuries 42% of tropical cyclone-associated deaths have occurred in Bangladesh. Since 1877 when record keeping commenced, >1 million people died in Bangladesh because of cyclones [7].

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From the records of cyclone in Bangladesh, three catastrophic cyclones were recorded as the devastated cyclones accompanied with the number of death. In 1970 and 1991 cyclones, approximately 500,000 and 138,000 people died respectively [8]. Cyclone Sidr in 2007 caused deaths of about 3460 people [9]. After Sidr, the latest severe cyclone Aila hit southwest coast of Bangladesh on 25th May in 2009. Approximately 190 people were died across 11 districts and 4.8 million people and 77,000 acres of farm land were affected by cyclone Aila [10,11].

After the devastating cyclone of 1970, the Bangladesh government initiated measures against the impacts of cyclones and associated storm surges [5]. One of the projects for disaster preparedness is Cyclone Preparedness Program (CPP). The CPP was established in 1972 for the sake of effective preparation of residents in coastal areas [12]. It was collaborated by Bangladesh Ministry of Disaster Management and Relief (MDMR) and the Bangladesh Red Crescent Society (BDRCS). CPP is a program with about 49,365 trained volunteers, 16,455 of these are women [2]. This program is designed and dedicatedly working to disseminate cyclone warning signal, assist people in taking shelter, rescue distressed people and provide first aid to the injured people. However, in spite of having active and dedicated CPP volunteers and quite accurate warning issued before 15 h of landfall, in 1991 cyclone there was loss of about 130,000 lives [13]. Unavailability of adequate cyclone shelters is considered as one of the prime reasons behind such large number of death. Since after that, construction of Multipurpose Cyclone Shelter was accelerated in coastal belt of Bangladesh to protect coastal residents from inundation associated the cyclone and storm surge. During the time of cyclone Sidr landfall, the number of cyclone shelters was 2000, which could give shelter only 1.5% of coastal population [3].

Bangladesh Government is appreciated for its different efforts and significant progress on disaster risk reduction, which is considered as the reason of decreasing number of death. Especially, in the case of cyclone Sidr in 2007, successful evacuation of coastal residents can be observed [5]. Even though, the death toll of 3460 during cyclone Sidr is considered as quite high in this century of science and technology. More frustrating matter revealed by Paul [9] is during cyclone Sidr only about 10% of residents evacuated to cyclone shelter even though 90% people received cyclone warning. In the case of evacuation during cyclone Aila similar situation is noticed and found that very less number of people evacuated to cyclone shelters, even though majority were evacuated.

Observing the evacuation pattern of the two recent cyclones named cyclone Sidr and cyclone Aila of Bangladesh it is assumed that there are a number of different factors that combinedly guide people during evacuation. Along with CPP volunteers' efforts, early warning, cyclone shelters, there are other socio-economic, physical and personal factors and situation too that can shape the evacuation decision and evacuation pattern of people during cyclone.

There are a number of researches, which focus on the impact and damage of cyclone in coastal Bangladesh [11,14]. Some recent researches also investigated situation of cyclone shelters, warning systems and people's evacuation behavior [2,7,15–18]. Recently, some researches investigated the behaviors of people who do not evacuate to the shelters [2,17,19]. Among these different studies, Ahsan et al. [15] has mentioned a clear statistic about evacuation related researches and found that there are 16 research papers that focused on cyclone evacuation of Bangladesh. Based on the literature review Ahsan's paper identified about 30 factors that affect evacuation decision process. Apart from Ahsan, a number of researches investigate the factors that influence people not to evacuate to cyclone shelter. However, field level researches that investigated cyclone affected people's experiences and decision making process are not so common. Till now factors guiding evacuation decision making process and selection of evacuation destination during cyclone are not clearly identified or listed. During cyclone people's decision making and evacuation behavior are guided by different factors. Examining people's actions and experiences during cyclone Aila this research intends to explore people's decision making process and factors that guided them to take evacuation decision and to select evacuation destination during cyclone. It examines how different factors like content of cyclone warning and evacuation order, timing of

evacuation order, evacuation preparation time, people's risk perception, weather condition, condition of roads and cyclone shelters and distance of cyclone shelters influenced people's evacuation decision making process and guided them to choose their final evacuation destination. This research aims to identify different factors that can influence efficient and effective evacuation decision and guide people to reach safe evacuation destination or shelter during future cyclone time. In addition, it is noticed that being influenced by different socio-economic, physical and personal factors different people show different evacuation attitude and select different evacuation destinations. However, people are not yet categorized into different groups analyzing their evacuation behavior, risk perception time, evacuation preparation and such other different factors. Nonetheless, this type of grouping is crucial in order to design and implement evacuation plan, drill, training and education program. Therefore, unlike the other researches, in addition to the examination of evacuation influencing factors, this research attempts to categorize people into different groups based on their risk perception attitude and actions during evacuation. Based on evacuation behavior or actions, factors leading to evacuation decision and final selection of evacuation destination different groups are identified.

2. Approach of the study- study area and methodology

2.1. Study area

Cyclone Aila is the latest devastating cyclone, which caused a number of deaths in Bangladesh. This cyclone landed in southwest side of Bangladesh in May 2009. A part of West Bengal of India and southwestern district named Satkhira of Bangladesh faced severe loss and damages due to this cyclone. According to Walton-Ellery [10], one of the unions that was identified as the worst affected union, is Gabura Union in Satkhira District of Bangladesh. This union is located in Shyamnagar Upazila, which is adjacent to Sundarbans (Fig. 1), the largest mangrove forest. In this union, a total of 37,666 numbers of people live in an area of 41 km². More than one fourth (28%) of the population is within the age of 10 years. Compare to the whole country the literacy rate of the union is very low, which is 31.40% [20]. Gabura Union is surrounded by big rivers. Thus, the characteristic of the union is like a small island. From socio-economic and physical perspectives, Gabura is one of the most disaster vulnerable unions in Bangladesh.

Whole Gabura union is surrounded by embankment to protect inundation from the river overflow. However, during cyclone Aila in 2009, different parts of this embankment were collapsed and water of river entered into the union and washed away number of villages. Whole union was affected by cyclone Aila and aftermath of cyclone by water-logging. Death toll was counted as 24 persons, crops and fisheries damages counted as US\$ 1,328,571 and in total 35.25 km roads were damaged [21,22]. Since Gabura union was the worst affected area by devastating cyclone Aila, this union is selected as the study area and the experiences and perception of local people related to cyclone evacuation have been analyzed to identify the factors influence people's evacuation behavior and selecting evacuation destination.

2.2. Methodology

Amin [23] estimated that unless a cyclone shelter is within 1 mile (1.6 km) of residences, it may be too far for coastal residents to travel during an emergency. Considering this standard distance of cyclone shelter, respondents were selected from the area located within 2 km radius from a cyclone shelter. For this study two cyclone shelters of Gabura Union were selected (Fig. 1). Name of these shelters is 68 No. Khalishalunia Primary School, which is constructed as Multipurpose Cyclone Shelter and another cyclone shelter is Gabura GLM Secondary School. According to Mallick [24] there are seven cyclone shelters in Gabura Union. Out of these seven, these selected two cyclone shelters were actually used at the time of cyclone Aila in 2009. Therefore, people living within 2 km radius of these two cyclone shelters were considered as the sample population and respondents were selected from them randomly. In order to have better

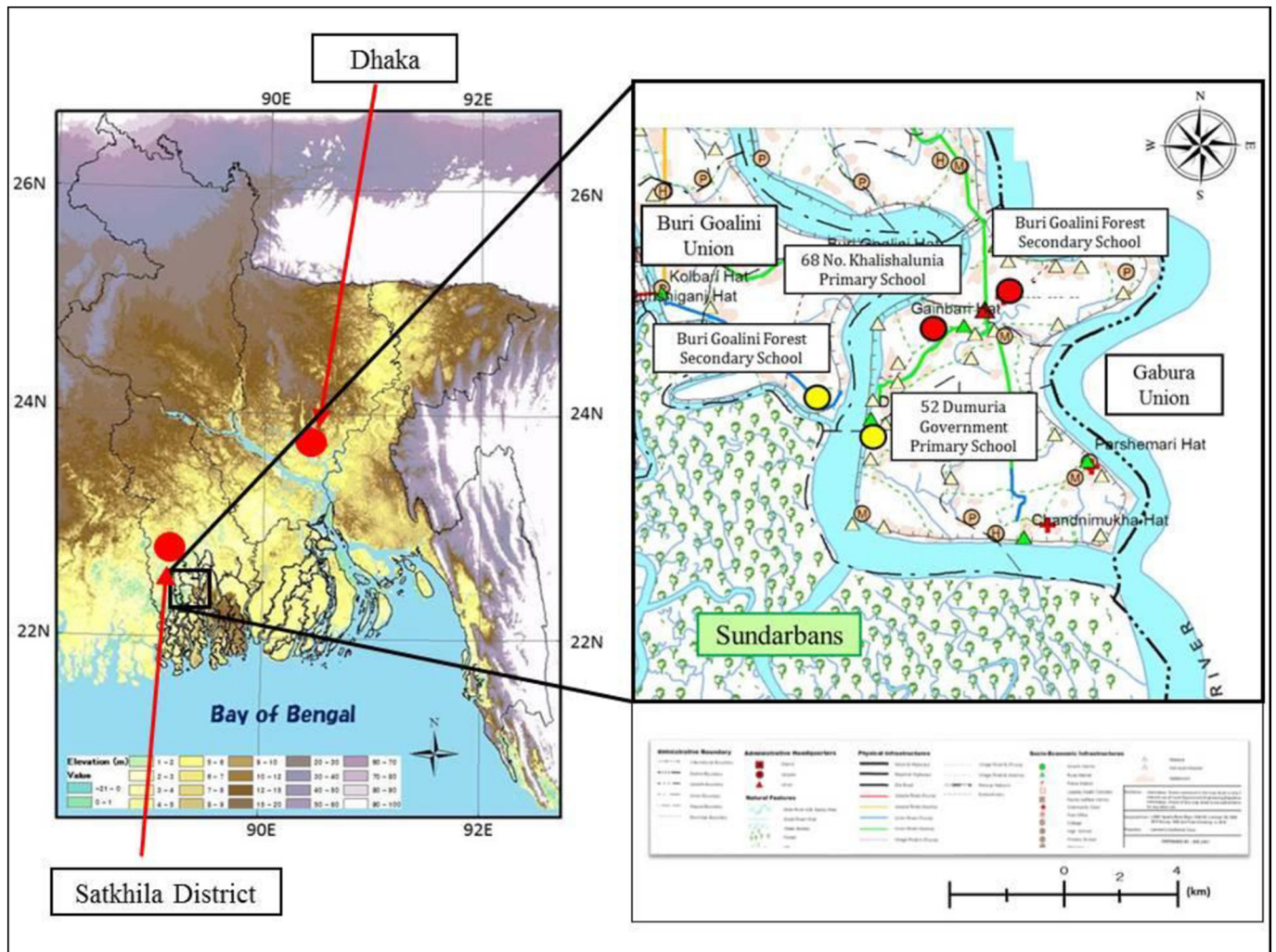


Fig. 1. Map of study area.

representation of the whole community, sample respondents were selected from local community living in both near to cyclone shelter and far from cyclone shelter. This way of sample selection helps to compare the evacuation behavior and influencing factors associated with the distance from cyclone shelter.

At community level, structured questionnaire survey was conducted in Gabura Union of Satkhira district in September 2015. Due to limitation of time and budget, ignoring statically sound sample number, total 200 respondents were interviewed for this study. Among 200 respondents 149 respondents were men and 51 were women. Each of these respondents (mostly the household head) represents a household's picture and evacuation decision and behavior of the household members. Questionnaire used for these respondents was comprised of different variables that lead to different questions related to evacuation order, evacuation preparation, evacuation destination and evacuation decision making issues. Since statistically sound sampling method is not followed here, a triangulation approach is applied in addition to the structured questionnaire survey. Field observation, key-informants discussion and informal discussion with the local people and volunteers of Cyclone Preparedness Program (CPP) were conducted. Among key informants mainly school teachers, Imam (leader) of mosques, Union Parishad Chairman were included. All such discussions were conducted in order to have clear picture of the field situation. All data collected by questionnaires were analyzed by using descriptive statistical analysis. Frequency distribution, bar diagram, pie chart and chi-square test were the main tools for data analysis. Reception of cyclone evacuation order, sources of evacuation order, trustworthiness of the sources of

evacuation order, timing of risk perception and time of evacuation preparation, evacuation destination and finally evacuation decision making factors are analyzed based on the collected data.

3. Cyclone evacuation scenario- order, preparation, place, and path

Absence of an early-warning and cyclone-tracking system in Bangladesh was considered as the primary reasons for the huge loss of life caused by the 1970 cyclone. Thereafter, Bangladesh government has made significant improvement to construct coastal embankments and developed an early-warning system to protect coastal residents from future cyclones [3]. The Storm Warning Center (SWC) of Bangladesh Meteorological Department (BMD) is currently responsible for preparing weather forecasts and disaster warnings. Launching Cyclone Preparedness Program (CPP) in 1972 is one of the great initiatives of Bangladesh Red Crescent Society and Bangladesh Government to disseminate cyclone warning, prepare, response and recover from the devastating cyclone [7]. At local community level, CPP teams disseminate cyclone warnings among villagers via mega-phones and house-to-house visits and assist in their evacuation. Due to different initiatives of Government and Non-Government Organizations (NGOs), death and loss caused by cyclone reduced significantly [25]. However, till the recent cyclone Aila around 200 people died due to different problems associated with evacuation order dissemination, decision making process and evacuation destination selection. There are numerous reasons or factors behind these deaths. Focusing the recent cyclones, different studies identified various reasons and factors related to non-compliance with the evacuation

order [2,15]. Evacuation behavior of coastal community has been analyzed by different scholars. Here in this study, evacuation order, preparation and evacuation place selection during cyclone Aila have been analyzed in order to identify the factors, influence people to take evacuation decision and to select evacuation destination.

3.1. Evacuation order

Storm Warning Center (SWC) of Bangladesh Meteorological Department issues cyclone warning at 4 stages. These stages are

- cyclone alert stage,
- cyclone warning stage,
- cyclone disaster stage and
- cyclone great danger stage.

Evacuation order is given at the last stage. Last stage is initiated at least 10 h before the predicted landfall. If the wind speed exceeds 89 km/h, a cyclone great-danger warning message is issued and the residents are urged to evacuate at this point. Updates to a great-danger warning message are usually disseminated every 15 min [18]. In spite of such having different stages of warning and evacuation order, till the recent cyclone Aila it is noticed that majority of the people do not evacuate timely and to the right place. Analyzing the experience of cyclone Aila this section illustrates the issues of how people get evacuation order, how they prepare and where they evacuate.

On May 22, 2009, Tropical Cyclone Formation Alert was issued and on May 25 this cyclone Aila became a severe cyclonic storm and landfall at its peak intensity on West Bengal and West part of Bangladesh. Even though, cyclone warning was disseminated at different stages within these 3 days, findings from field survey reveal that majority of the people did not get evacuation order. Only less than half of the respondents (44%) got an evacuation order during cyclone Aila.

Table 1 shows the composition of respondents according to their gender and reception of evacuation order during cyclone Aila. After conducting chi-squared test, the difference between genders can be seen in receiving the evacuation order during cyclone Aila ($p < 0.10$). Out of total 149 men respondents, 72 men (48%) got the evacuation order. On the other hand, only one third of women (33%) received the evacuation order. Since mosque was the main source of evacuation order during cyclone Aila (Fig. 2), compare to the number of men less women received evacuation order. In Bangladeshi culture, usually men go to mosque several times (ideal is 5 times/day) in a day for prayer; but women do not go to mosque for prayer. Hence, during cyclone Aila the rate of women who got the evacuation order is smaller than that of men. Men and women also had noticeable variation in the case of their sources of receiving evacuation order.

Fig. 2 shows the source from which people got the evacuation order. Most of men got evacuation order by mosque. Mass media such as radio and TV were also relatively useful tool. CPP volunteer also played an important role to disseminate the evacuation order. Especially, most of women got evacuation order from CPP volunteer. During cyclone Aila, CPP volunteers disseminated evacuation order by visiting house to house. However, it is claimed that during cyclone Aila CPP volunteers were late to disseminate evacuation order. Since women do not go to mosque, they did not get

Table 1

Gender based distribution of people according to their reception of evacuation order.

(Source: Field Survey, 2015.)

Gender	Evacuation order receive (%)	Evacuation order did not receive (%)
Male	48*	52
Female	33	67
Total	45	55

Note: Here chi-square value = 2.71 which means the difference is significant at 90% confidence level.

* $p < 0.10$ (chi-square test).

evacuation order timely. It was found that there is limitation of CPP's endeavor. Siren and flag, which are the main tools of warning and evacuation order dissemination were identified as not so effective. A lot of people pointed out that the sound of siren cannot be heard and flag cannot be seen from their house.

With the sources of evacuation order there is critical issue of trustworthiness. Findings reveal that people basically trust the information broadcasted by mass media such as radio and TV. Adding to the mass media, mosque is one of the most trusted source (Fig. 3).

CPP volunteer is recognized as effective source of disseminate warning. However, the result shows that some people do not have high trust to the information received from CPP volunteers (Fig. 3). It can be considered that cyclone warnings were disseminated different times but cyclone did not actually happen. Different mistakes during disseminating cyclone warning lead people not to trust the warning. Similar to this study other research also claims that disbelief in the warning is one of the prime reasons for not evacuating during cyclone [2].

In addition to the disbelief, there are many limitations within the warning system that influence people's decision for non-evacuation. These limitations are pointed as incomplete warning message; lack of understanding of cyclone warning signals/warning (complicated warning signals); late warnings; sudden change of warning signals and issuance of premature evacuation order [2]. Paul and Sohini [7] also finds that the credibility of a hazard warning message depends on different factors, such as the warning message content and message characteristics, source(s) of the warning message, and compatibility of the message with the receiver's existing beliefs and past experience with similar warnings. Findings from this study support Paul's findings. Field investigation reveals that for better understanding and to facilitate right decision for evacuation people expect a wide range of information (Fig. 4).

Mallick et al. [26] has argued that in spite of improvement in early warning systems in Bangladesh, many people still do not know how to interpret the warnings. He has found though 78% received a warning 6 h before the cyclone, one third of them were not able to understand the early warning message. Present cyclone warning system in Bangladesh is related to sea port and river port. Different terms that are used are confusing to the local people. Sometimes when the warning signal No. changes there is lack of adequate information, such as, change in intensity, height of tidal surges. Sometimes change of cyclone warning signal no. indicates the change of cyclone track. These kinds of limitations confused the local people and hinder their right decision making for evacuation.

Based on the cyclone Aila experience local people stated their expectation in the contents of cyclone early warning. Main information which people need is related to natural phenomenon like weather forecast. Especially, locality specific expected height of storm surge and probable inundation are identified as one of the most important information during cyclone warning. Cyclone intensity or wind speed, time of landfall, and time of evacuation are also pointed as crucial content of cyclone warning. It is also found that the information like location of cyclone shelter, way to cyclone shelter and action of evacuation behavior are relatively important so that local people can judge by themselves whether they need to evacuate or not, when they should start preparation for evacuation, where they should evacuate and how to reach there.

3.2. Evacuation preparation

Cyclone warning containing local area specific detail information can guide to take right and timely decision for evacuation. In addition to the warning and evacuation order, people's risk perception is also an important facilitator of evaluation decision [27]. Risk perception is considered as one of the important factors that influence disaster preparedness. However, in addition to risk perception, sense of place, and other psychological factors, the individual and household socioeconomic characteristics of people also have important role on their disaster preparedness [28]. Similarly, Park and Reisinger [29], noticed that risk perception is a multi-faceted phenomenon, where individual traits such as gender, education, and location of

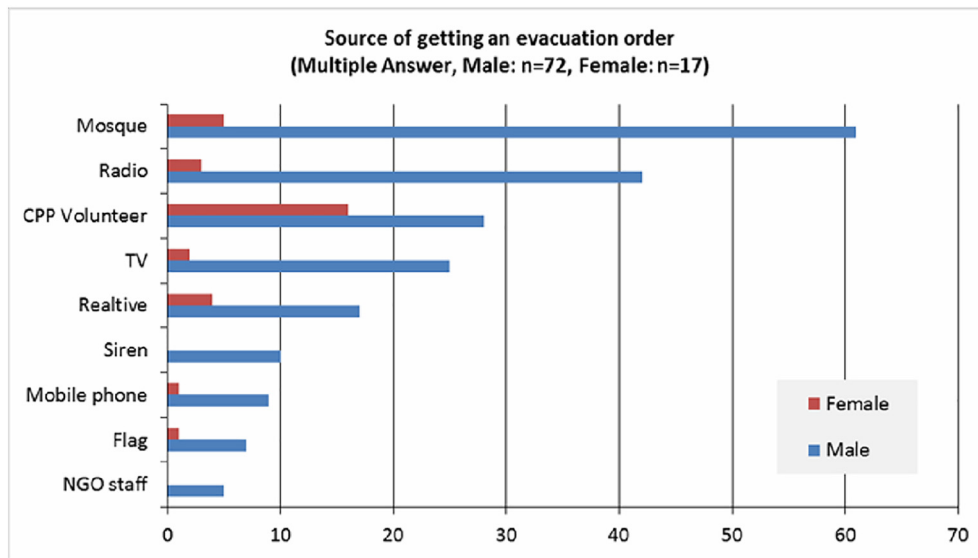


Fig. 2. Sources of evacuation order received during cyclone Aila.

residence have a large impact on the levels of risk perceptions and evacuation decision. This section of the study reveals people's risk perception and their preparation for evacuation.

At different weather condition and to different warning messages people have different feelings of risk that influence to take evacuation decision and to start evacuation. Thus, different people take preparation, evacuation decision and at different time period starting from initial announcement of warning to cyclone landfall. Fig. 5 shows the timing when people feel danger, when people decide to evacuate and when people start to evacuate. When the warning is disseminated, above half of people feel dangerous but about 25% people do not feel dangerous until inundation started. Even it is noticed that evacuation decision is not taken till inundation started in case of 42% people. In this study, definition of inundation is that water inundates the respondents' house. In the phase of 'start of evacuation', it is found that overwhelming majority (70% i.e. 141 persons out of 200) people start evacuation after inundation. Further, those who rely on the warning information are small in number. Analyzing Fig. 5 four aspects can be observed. First one is the role of warning. Although warning is effective for people to aware the risk of cyclone, the rate of dependence

on warning is decreasing in the phase of decision making. Second aspect is that natural phenomena such as cyclone and precipitation do not affect people to change their perception of awareness of risk. The rate of dependence on precipitation and cyclone is almost same in each phase. As third aspect, it is noticed that the evacuation order does not play much strong role in any phase of risk perception starting from feeling dangerous, decide to evacuate and start to evacuate. The results in Fig. 5 show that those who depend on the announcement of evacuation order is almost same at each phase. Lastly it can be mentioned that most of the people do not start to evacuate until inundation. Thus, not evacuation order but weather condition and specially, inundation is the trigger, which urges people to evacuate.

Even though it is dangerous, quite a large number of people take evacuation decision when the weather condition turns to the worst, such as precipitation becomes high and start inundation. After taking evacuation decision people need relatively longer time to prepare for evacuation.

Fig. 6 shows different time period that people need for preparation to evacuate. According to the findings women need more time than men for evacuation preparation. Average preparation time for men is 99.2 min. On the other hand, women need 125.2 min on an average. Significant

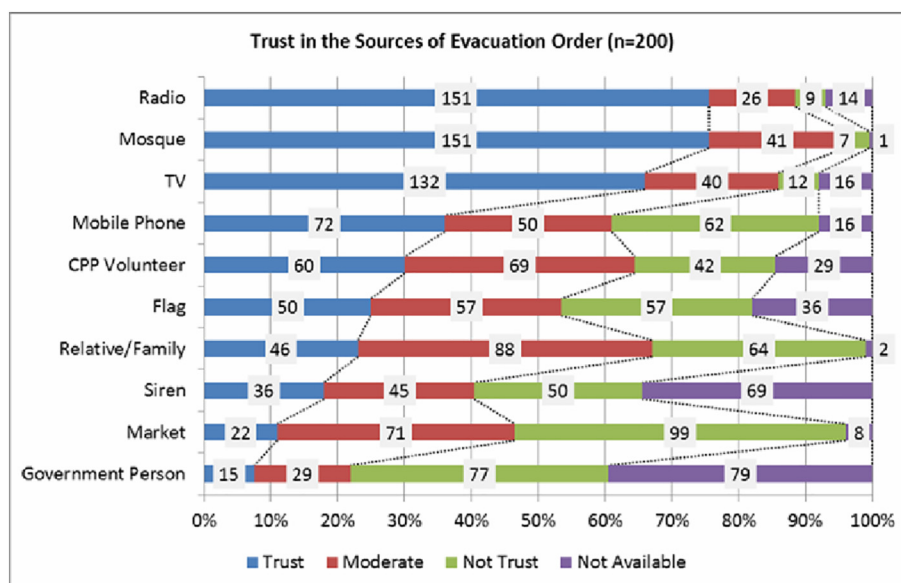


Fig. 3. Distribution of sources of evacuation order according to their trustworthiness.

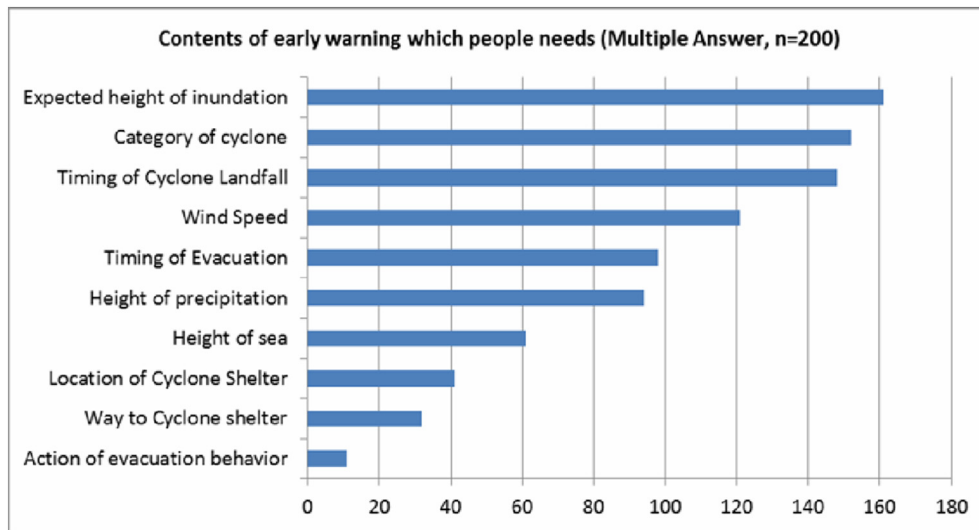


Fig. 4. People's perception regarding content of early warning.

difference can be seen after conducting *t*-test ($p < 0.01$). Generally, most of the Bangladeshi women have the sole responsibility of safety and take care of children, all household assets and belongings. Therefore, women take time to prepare for themselves, children, livestock, elders at their home and for important and valuable materials and assets. Approximately 1–2 h is considered as adequate time for preparation. Therefore, the highest concentration is found at 120 min and second most preferable time for evacuation preparation is 60 min. According to the interview to respondents, a lot

of people try to prepare their livestock and want to carry those with them. Sometimes people try to keep their livestock at the first or second floor or even on the top of roof. One after another they carry their livestock up to the cyclone shelter and keep those at higher level, which takes long time to reach final stage of evacuation. Further, people start to collect necessary and emergency goods, which they need to use after cyclone hitting. These are the preparations that people do after deciding evacuation. All these arrangements and preparation require 1–2 h.

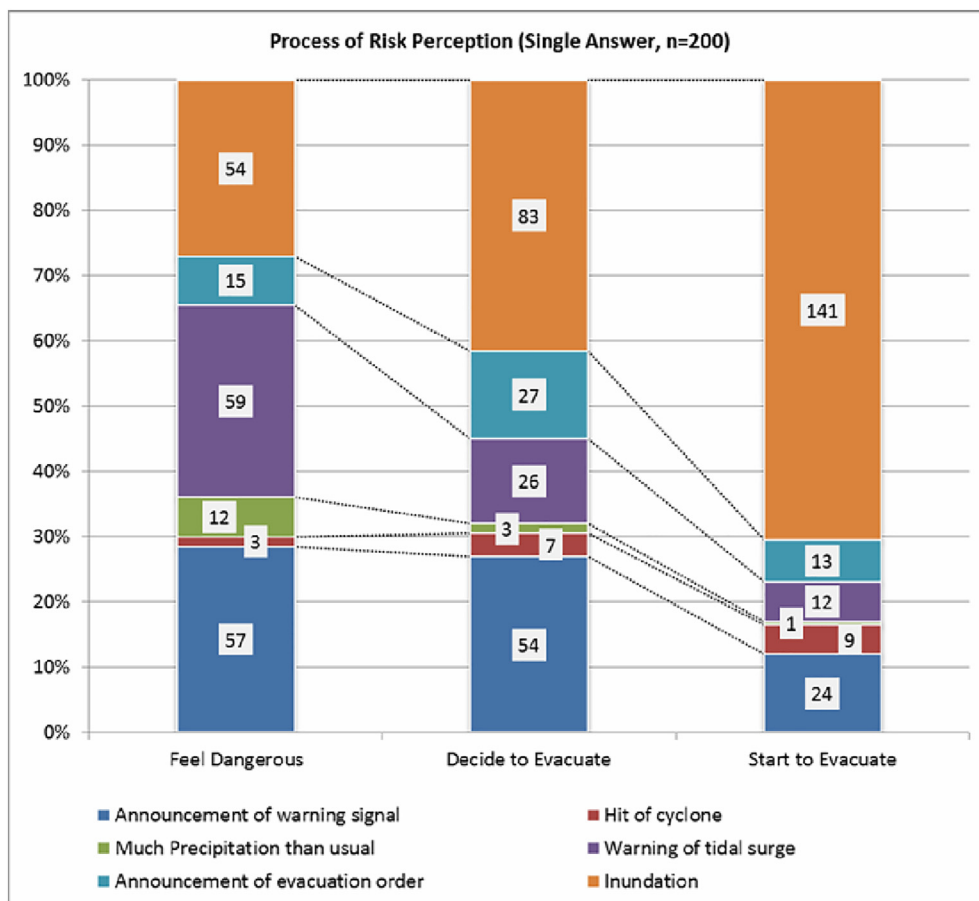


Fig. 5. Risk perception of people at different weather condition and warning during cyclone.

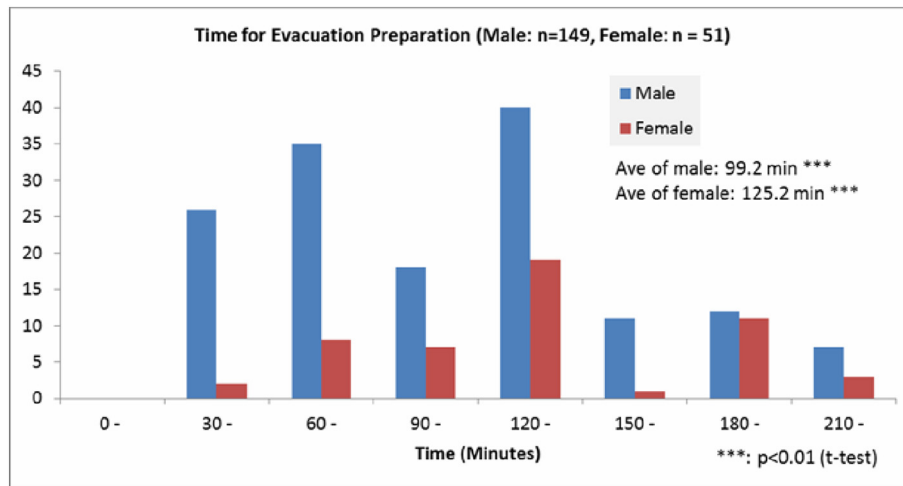


Fig. 6. Gender based evacuation preparation time.

Since evacuation preparation requires reasonable longer time, it is necessary to take evacuation decision a bit before than the weather condition becomes severe and cyclone landfall time comes closer. Previous results show that rather evacuation order, bad weather and inundation trigger people's evacuation decision. However, based on the experience of cyclone Aila a number of people claim that if the evacuation order was given earlier, which means before the weather condition turned to the worst it could save more lives and properties from loss and damage. During cyclone Aila about 49% people received evacuation order after starting of rain, 36% and 14% people got the evacuation order during heavy rain and after inundation respectively. This study attempts to know people's perception to the ideal time of receiving evacuation order so that they can have better preparation and can safely reach to the cyclone shelters. Fig. 7 indicates people's opinion regarding the expected time of evacuation order.

Keeping similarity with the evacuation preparation time most of the people think that 1–3 h before starting of inundation is the best timing to receive evacuation order. Here, according to the local people inundation means the starting of storm surge, heavy rain and cyclone landfall. This ideal time of evacuation order declaration is decided considering the evacuation preparation time too. A lot of respondents think that they need 1–2 h for evacuation preparation (Fig. 6). Therefore, respondents stated that if they need to evacuate safely to the safe place they must need to receive evacuation order around 2–3 h before the cyclone landfall and storm surges. Forecasting overall weather condition and considering evacuation preparation time, evacuation order should be given. Further, responsible authorities that declare evacuation order they should consider the required time to reach nearest cyclone shelter and thus local area specific evacuation order should be given.

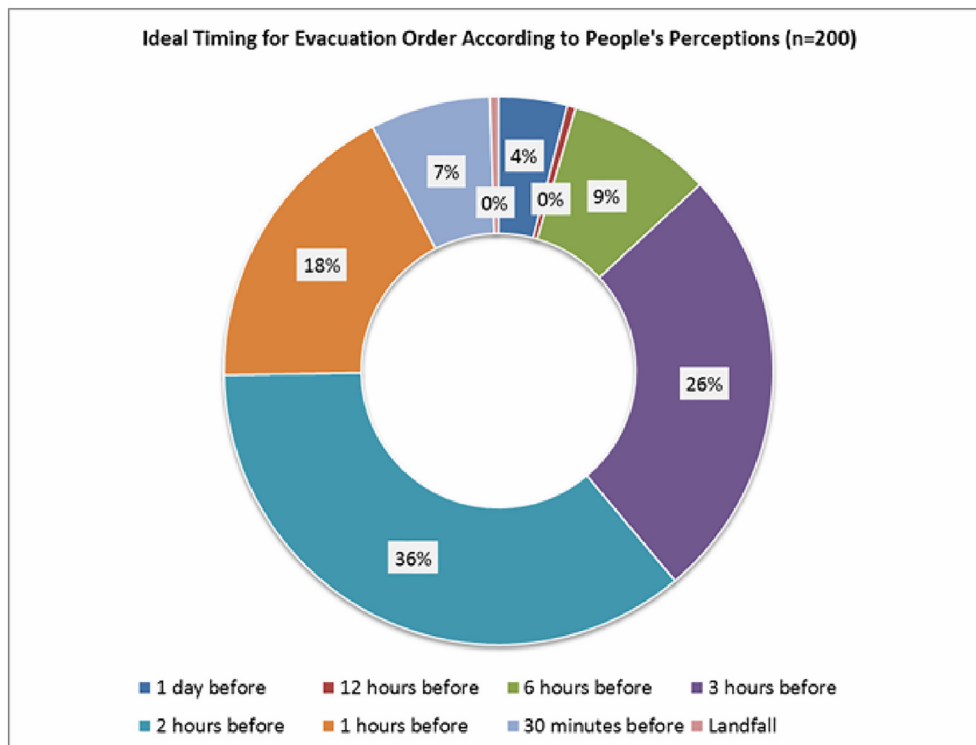


Fig. 7. People's perception related to the ideal time for declaring evacuation order.

During cyclone having easily understandable early warning, receiving timely evacuation order, better evacuation preparation are important to take shelter to the safer places. Due to different problems and limitation associated with these issues coastal people of Bangladesh often fail to take shelter in the safer places before cyclone landfall. Where people take shelters and why they do not go to the designated shelters during cyclone are important issues to analyze.

3.3. Evacuation destination

Experience and study results show that in the case of two devastating cyclone, cyclone Sidr and Aila, only around 10–20% people took shelter to the cyclone shelters. Rest of the people evacuated on high land like high ways, school, mosques or relatively safer places. A large number of people stayed at home without following evacuation order [9]. Evacuation place of the local people and the reasons behind not evacuating to cyclone shelters are analyzed using response of cyclone Aila affected people of Gabura Union.

Findings show that majority of the people (55%) did not receive any evacuation order (Table 1). However, 84% people evacuated during cyclone Aila. Among these evacuees 69% took shelter on higher level open space, like road and embankment. By other research also, it is noticed that embankments or high roads often give a false sense of security to some people who wrongly imagine they can take refugee on them [20]. Therefore, majority of them took shelter on embankment and only 10% took shelters at cyclone shelters and rest of the evacuees took shelters at neighbors' house, mosque and school (Fig. 8). Even few people (around 2%) took shelter on boat. Even though there are designated evacuation shelter in the coastal areas why do people do not evacuate to cyclone shelters is investigated here (Fig. 9).

There are different reasons that influence people to take shelters rather than cyclone shelters. Among 10 reasons identified in this study three are main reasons for not to evacuate to cyclone shelter. Distance of cyclone shelter, inadequate accommodation of cyclone shelters and poor road conditions are the three most important reasons for not evacuating at cyclone shelters. Around 60% people claim about lack of adequate space in cyclone shelter as their reason of not evacuating to cyclone shelter. Paul [17] in his study related to cyclone Sidr also found that about 17% people returned to their home, as the cyclone shelter was overcrowded. Similar to the findings

of Paul [17] and Mallick et al. [20] this study identified that distance of cyclone shelter and road condition demotivated people not to evacuate to the cyclone shelters. About 55–65% people of studied community blamed to the distance and poor road condition for not evacuating to cyclone shelter during cyclone Aila. Even though the number is not so large, a bit >10% people did not evacuate to cyclone shelter thinking the measurable condition and poor facilities of cyclone shelters. Sadik et al. [30] also investigated that the inadequate number of cyclone shelters, no space for livelihood shelters, and lack of gender consideration in cyclone shelters were critical sources of vulnerabilities before Cyclone Aila. Similar to the findings of this, earlier study on cyclone Aila [11], also identified that insufficient accommodation, over crowdedness, no facilities for sanitation, drinking water, food storage, electricity and livestock and even no separate room for women are the main problems of cyclone shelters in the study area.

Apart from these problems in cyclone shelter, interestingly noticed that some persons did not evacuate to cyclone shelters or any other place thinking that cyclone and storm surge is Allah's will and Allah will save them. Mostly these people considered home as the safe place and stayed there.

According to Social Cognitive Theory (cited in [17]) people's behavior is guided by personal and environmental factors. Different studies also show that in case of cyclone people's evacuation decisions are influenced by many social, individual and surrounding factors. In Fig. 8 it is found that people do not evacuate at cyclone shelters due to different environmental, social and individual factors. In Table 2 shows how distance of cyclone shelter affects people's motivation of evacuation to cyclone shelter.

After conducting chi-squared test significant difference between the motivation of people who live within 1500 m from cyclone shelter and those who live above 1500 m from cyclone shelter can be noticed. People who live within 1500 m from cyclone shelters, among them >60% are highly motivated and willing to take shelter in cyclone shelters. In contrast, those who live far from cyclone shelters (above 1500 m), among them >60% are not so willing to take shelter to cyclone shelter. It is already noticed by the other scholar that a cyclone shelter has to be within 1 mile (1.6 km) of residences [23]. More than this distance is considered to be too far for coastal residents to travel during an emergency. Another research also found the positive correlation between the distance to the cyclone shelter and place of taking shelter during cyclone [20]. Even though, such crucial relation exists between the distance of cyclone shelter

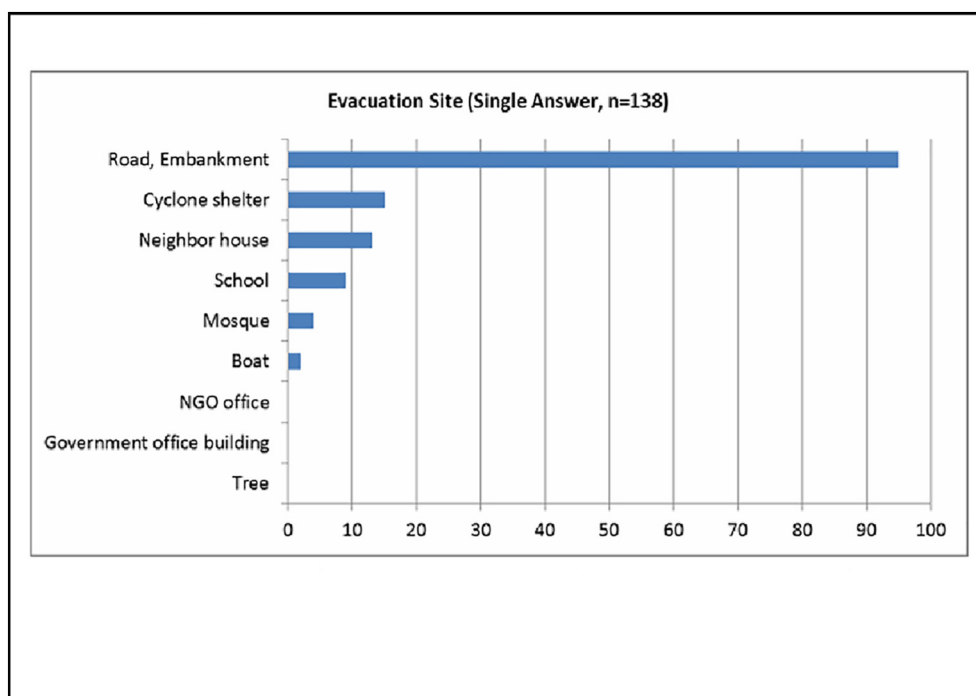


Fig. 8. Evacuation place during cyclone Aila.

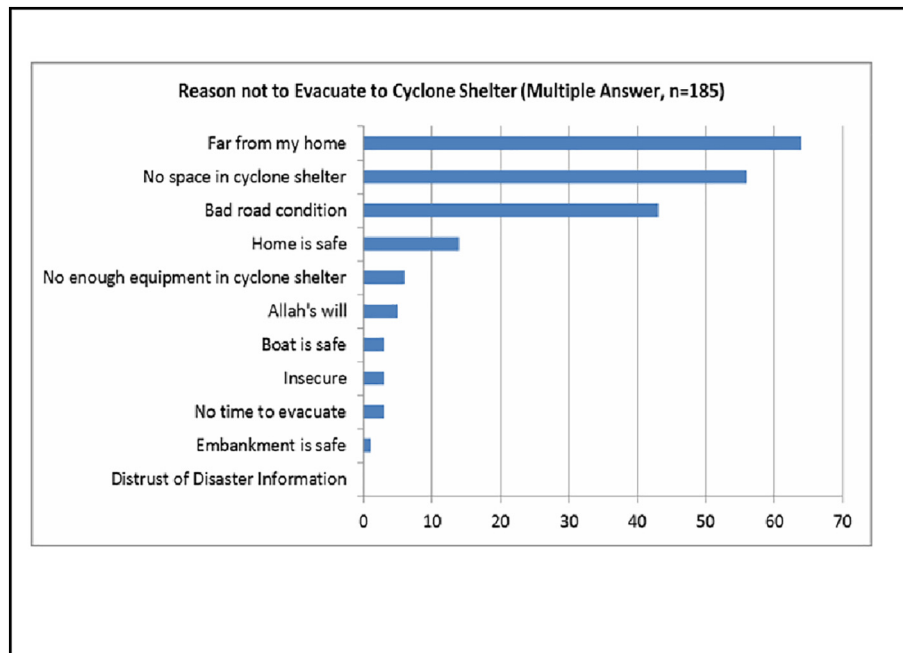


Fig. 9. Reasons for not evacuating to cyclone shelter.

and evacuation to cyclone shelters, still in some coastal areas cyclone shelters are located at a distance of >5.6 km apart [5].

Shamsuddoha and Chowdhury [3] estimated that cyclone shelters in coastal areas can accommodate only about 15% of the total coastal population of Bangladesh. In case of availability of space in cyclone shelter, similar situation exists in the study area too. Therefore, not only the distance but also scarcity of enough accommodation space in shelters was mentioned as an important reason for not taking shelter there. According to [7] by the mid of 2000s, about 3976 cyclone shelters had been constructed. However, out of these about 1576 have been damaged by river erosion or abandoned due to dilapidated conditions, the result of the lack of proper maintenance and repair.

4. Evacuation decision and destination- guiding factors

During cyclone Aila majority of the people (55%) did not receive evacuation order. Nonetheless, 84% people evacuated. But overwhelming majority did not evacuate to cyclone shelters. Considering this situation, it can be said that this was not just the personal choice that is suddenly taken by individuals. Analyzing all the different stages starting from dissemination of cyclone warning to finally evacuating to a safer place during cyclone Aila following key steps can be understood.

Table 2

Distance of house from cyclone shelter and motivation of evacuation to cyclone shelter.

(Source: Field Survey, 2015.)

	Motivation of evacuation to cyclone shelter					n
	Not at all	A little	Neither	Quite a lot	Very much	
Near to cyclone shelter*** (<1500 m)	4	15	16	29	32	96
	4%	16%	17%	30%	33%	100%
Far from cyclone shelter*** (1500 m<)	27	26	18	18	15	104
	26%	25%	17%	17%	14%	100%

Note: chi-square value $p(<0.01) = 13.3$, It means the difference is significant at 99% confidence level.

*** $p < 0.01$.

- How people react to the cyclone warning and evacuation order.
- People's risk perception stages.
- How and when they start evacuation preparation.
- How they take evacuation decision and
- Finally, where they go for evacuation.

It is noticed that there are different attitudinal and external factors that guide whole evacuation process and influence people's evacuation behavior. A number of researchers have identified these guiding factors in evacuation process [15]. During cyclone Aila what were the factors that guided people to take different evacuation decisions and to select evacuation sites are tried to investigate in following section.

4.1. Evacuation decision and destination during cyclone Aila-influencing factors

Analyzing people's behavior and actions starting from normal, cyclone warning to evacuation order period during cyclone Aila, this research listed various factors associated with evacuation decision and selecting evacuation destination during cyclone Aila (Table 3). Considering the limitations and problems during cyclone Aila evacuation, what should be the condition or factors to ensure efficient and effective evacuation decision and to select safe evacuation destination have been listed in Fig. 10.

Analyzing the experience of cyclone Aila it is noticed that different people had different behavioral pattern at different time period of weather and warning conditions. There were number of factors that influence their decision making process and guided them to select the destination for evacuation. In the normal time period, generally there were two groups of people, where group A used to listen to daily weather information and get some knowledge about weather; but group B had no concern to get weather news. Field survey reveals that in the study area during normal time about 70% of the respondent do not check or listen to weather news on a daily basis. However, during warning period of cyclone Aila, group A started to listen weather news with high attention and more frequently, collected more information and observed weather changes and started to become careful. At the same time, group B started to listen to weather news from other people, observed weather but took no action or preparation. During normal time period to cyclone warning period nobody took any decision or action related to evacuation. After dissemination of cyclone Aila evacuation order, there were four groups of people (A, B, C and D) who

Table 3

Evacuation behavior of different people at different time period, and factors leading to evacuation destination during cyclone Aila.

Time Period	Group of people	Evacuation Behavior/Actions	Factors Leading to Evacuation Destination	Evacuation Destination
Normal Period	A	Listen daily weather news	N/A	N/A
	B	No concern to weather news	N/A	N/A
Cyclone Warning Period	A	<ul style="list-style-type: none"> Listen weather news with high attention and more frequently, Collect more information, Observe weather changes and start to become careful 	N/A	N/A
	B	<ul style="list-style-type: none"> Listen weather news from other people, Observe weather, No action or preparation 	N/A	N/A
Cyclone Evacuation Order Period	A (Serious Group)	<ul style="list-style-type: none"> Felt Dangerous Decided to Evacuate Decided evacuation site and route 	<ul style="list-style-type: none"> CS was relatively close to home Adequate accommodation was available in the CS Facilities in the CS were considered as better 	Cyclone Shelter (CS)
		<ul style="list-style-type: none"> Started evacuation 	<ul style="list-style-type: none"> Weather was relatively better Road condition was better or ignored it Started evacuation a bit earlier before the landfall of cyclone CS was relatively far from home Not adequate accommodation available in the CS Facilities in the CS were considered as poor Weather was relatively worse Road condition was poor Was late to start evacuation 	Road/Embankment
	B (Reluctant Group)	<ul style="list-style-type: none"> Felt Dangerous Decided to Evacuate Decided evacuation site and route Started to take preparation for food, water, emergency needs, livestock etc. Started evacuation 	<ul style="list-style-type: none"> Embankment/road was relatively close to home Weather condition became severe with heavy rain and wind Inundation become relatively high 	Backed to home to stay
	C (Undecided Group)	<ul style="list-style-type: none"> Felt Dangerous Tried to collect more information Took time to decide whether evacuate or not Started evacuation without any preparation 	<ul style="list-style-type: none"> Embankment/road was relatively close to home Weather condition became the worst Inundation level was very high 	Backed to Home
	D (Non-Evacuee)	<ul style="list-style-type: none"> Felt Dangerous Passed long time to take evacuation decision Decided not to evacuate 	<ul style="list-style-type: none"> Trust on Allah's mercy and decided to stay at home 	Stayed at home

Note: In this table group A is colored as blue which indicate that it is distinct group of people who are serious group and do evacuation right time at right place. Different colors of text indicate new task that other group did not do. So new tasks of groups B, C and D are indicated with different colors. During cyclone evacuation order period, the difference of evacuation behavior between A and B is shown with Blue color, between B and C is with Green Color and between C and D with Purple Color.

showed different evacuation behaviors and were guided by different factors to select final evacuation destination (Table 3).

4.1.1. A (serious group)

Group A, were generally serious about weather news and natural disaster in their daily life and they put high level attention to the weather update during cyclone warning period. After hearing evacuation order, started to feel dangerous, decided for evacuation, selected evacuation site and route and started evacuation. This group took decision and started evacuation without enough preparation. In fact, as they were relatively sincere and serious regarding cyclone and disaster, they had mental and to some extent physical preparation for evacuation from the warning stage. Evacuation destination of this group was either cyclone shelter of road/embankment. This

evacuation destination was guided by different factors like distance, accommodation space and facilities of cyclone shelters (Table 3). Road and weather conditions and availability of time before cyclone landfall were also influential factors to reach a better and safe evacuation destination. For most of the people evacuation site was mostly embankment and road, since the road and weather condition was poor and cyclone shelter were far from the house. Only those who lived relatively close to cyclone shelter they could reach there for evacuation. Among this group who could reach to the cyclone shelter are shaded as blue in order to indicate them as the ideal situation.

4.1.2. B (reluctant group)

Second group of people (B) were reluctant to listen daily weather news and also were not so serious to listen weather update during warning

period. After having evacuation order from the other sources, they started preparation for emergency food, water, livestock and such other emergency and important items and got ready for evacuation. The difference between evacuation behavior of group A and B was this preparation stage. After evacuation preparedness, they decided evacuation site and route. At last they started evacuation by using road or others mode of transport such as boat. However, by that time inundation level became high and deep. In case of severe inundation and weather condition they had to go back and stay home. Among these people only those who lived near to embankment they evacuated to embankment. None of this group of people could reach to cyclone shelter.

4.1.3. C (undecided group)

Another group of people tried to collect more information after receiving evacuation order. This group of people was a bit confused about their action and was taking time to observe weather condition and collect more information about cyclone. They passed long time with indecision. When they received enough information, already long time passed and it was already deep inundation period. At that time, they started to judge whether they should evacuate or not. If they decided to evacuate, they had to start evacuation without enough preparation due to deep inundation. At last they started to come to road or got on boat for evacuation. But in case of severe inundation, they had to go back and stay home. In spite of the worst weather condition and very high inundation level, some people who lived near to embankment they could evacuate to embankment.

4.1.4. D (non-evacuee)

This group of people (D) took long time to observe the situation and to decide whether do evacuation or not. Finally, the weather condition and overall situation was the worst and they decided not to evacuate. They trusted on Allah's mercy and stayed at home.

As a whole, the prime features noticed from the findings of this study imply that receiving information, warning and evacuation order are not

playing important role to people. Evacuation decision and destination were influenced by different factors. Several studies related to previous cyclones also show similar outcomes and claimed that evacuation decision of households was influenced more by social, individual, and household attributes than by the actual warning messages themselves [15].

From the standpoint of provider, the problem is that most of people did not receive or did not realize importance of evacuation order even provider disseminate it before 26 h of the landfall of cyclone Aila. This was the gap between the provider and receiver. To bridge this gap, efficient and effective approaches of warning and evacuation order dissemination is crucial. Factors that influence warning system, decision making and selecting evacuation destination are needed to be considered in order to have efficient and effective evacuation decision and destination.

4.2. Discussion

People's evacuation behavior during cyclone Aila implies different constraints and limitations that hinder people not to evacuate to cyclone shelter. Even though 84% people evacuated only about 10% took shelter at cyclone shelters. As mentioned and analyzed from previous findings, there are different reasons that demotivated or thwarted people to take evacuation decision and selecting cyclone shelter as evacuation destination. Limitation in timely dissemination of evacuation order among all in the community (Table 1), lack of imposing importance to evacuation order, limitation in risk perceptions, timely evacuation decision making and preparation (Fig. 5) and finally, distance of cyclone shelters (Table 2), inadequate accommodation and poor facilities at cyclone shelters (Fig. 9) are found as the main reasons of inefficient evacuation decision and destination selection.

Analyzing different aspects starting from evacuation order, evacuation preparation, place and evacuation decision or behavior, it is revealed that there are two gaps. First gap is seen between provider and receiver. Another gap is seen between risk perception time and actual time of preparation and evacuation. To fill these gaps, four points are discussed.

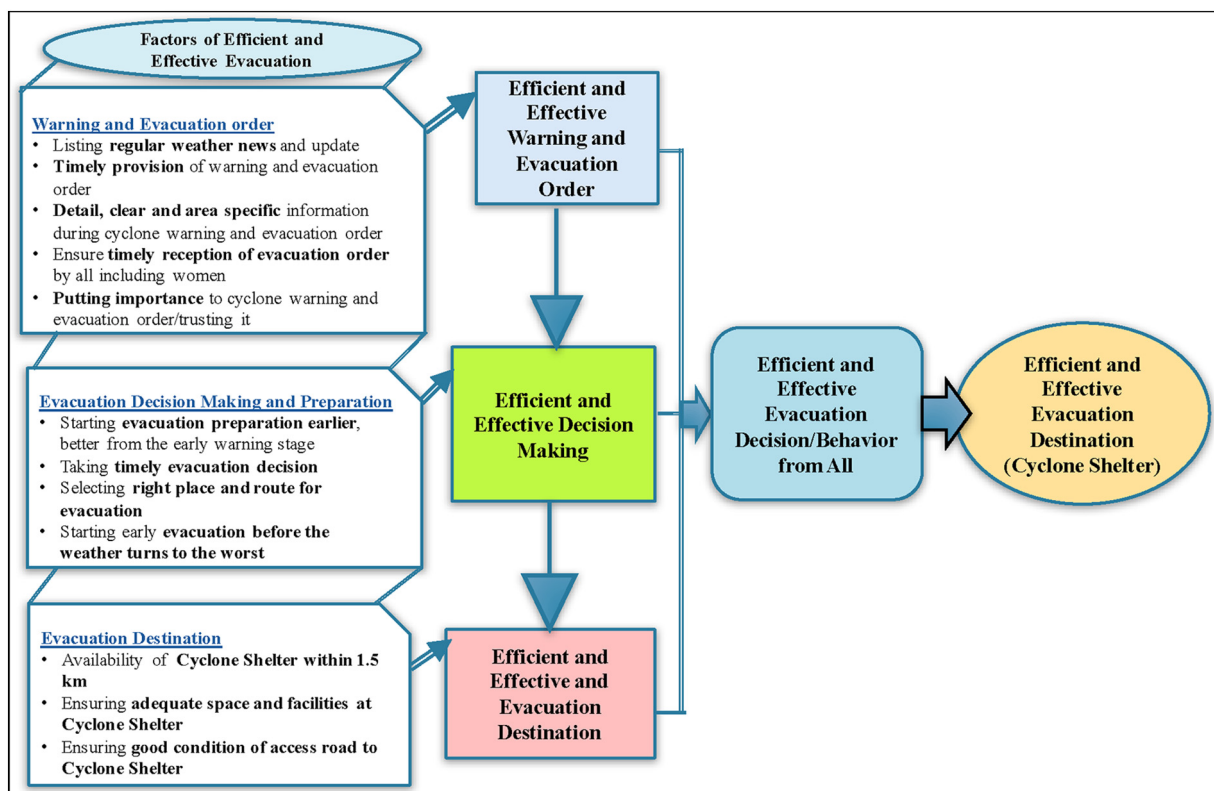


Fig. 10. Factors associated with efficient and effective decision and destination. Note: Here according to Cambridge Dictionary, efficient means- working or operating quickly and effectively in an organized way; effective means- successful or achieving the results that a person wants.

- First point is how the weather news, warning and evacuation order should be disseminated.
- Second point is what types of information is needed for people.
- Third point is when evacuation order should be disseminated.
- Fourth point is what are the influential factors behind evacuation decision and destination.

At first, how the weather news, warning and evacuation order should be disseminated is discussed. Coastal people's attitude to get weather information has increased, especially during cyclone. Nonetheless, during cyclone Aila, more than half of the respondents did not receive the evacuation order. Therefore, in normal period, public media like radio and TV need to play important role and take attractive approaches to enhance people's interests to weather news and train them how to reduce their disaster risks with their daily activities and efforts. Local Government and Non-Government Organizations (NGOs) should have priority to conduct workshop and training on disaster risk reduction. In the all types of regular programs and projects of Government and NGOs there should have disaster risk, preparedness and efficient response related component for the beneficiaries and for the general people as a whole. In adding to the conventional methods, the participations of mosque and CPP volunteer in disaster risk reduction should be increased in normal period. In case of cyclone Aila, a lot of people evacuated without receiving evacuation order. Based on the risk perception of people they judged that they had to start evacuation by themselves. But the risk perception and evacuation timing were not perfect. Therefore, during heavy rain and inundation they started evacuation and fail to reach at the cyclone shelters or better place. Only the a part of group A who were serious about evacuation, risk perception time was earlier and lived close to evacuation shelter could reach cyclone shelter.

These types of wrong perception of different groups of people should be corrected by the disaster risk reduction education. On the other hand, people do not have 100% trust to CPP volunteer, since in spite of warning or evacuation order, severe cyclone did not happen sometimes before. Different weather related factors may change cyclone path and intensity and that may lead the cyclone not to happen or landfall in a form as severe as warning was given. CPP volunteers and other organizations need to make people aware of this nature of cyclone and build their trust in the community. The strong point of CPP volunteers is their direct approach and they are able to urge people to evacuate. So, CPP volunteer is also recommended for disseminating evacuation order. In addition to CPP volunteers, evacuation order should be disseminated by mass media and mosque, which are the most trustworthy in the community.

Secondly, what types of information is needed for community is discussed. From the observation of evacuation behavior, it is found that people do not start evacuation until observing the proof of risk. Therefore, media and other sources of weather news disseminators have to focus on dissemination of the risk level to people. According to the results of questionnaire survey, it is found that people need the information with which they can judge the risk by themselves. For example, expected height of inundation, category of cyclone, timing of cyclone landfall and wind speed are top of the rank of information, from which people can understand the risk of cyclone. Thus, the most important point whether people will start evacuation or not is the conclusive evidence. In order to give the conclusive evidence, the contents of information should be considered well. In national mass media level, it is difficult to inform local information such as inundation height, which is different in each area. Thus, it is important what types of information should be included in the evacuation order, which is disseminate by each source. For national mass media, it should be more emphasis on disseminating large scale information such as the category of cyclone, the timing of inundation and wind speed. On the other hand, the evacuation order should include local information such as the height of inundation, the amount of precipitation and the timing of evacuation. These differences of role in each scale can be considered to enhance the risk perception of people. Localize sources such as CPP volunteer and mosque are very precious to inform local information. In adding to these sources, important role of community radio should not be forgotten. Thus, each source

of cyclone warning and evacuation order dissemination should understand the role of their disseminated information to the evacuation behavior.

As third point, when the evacuation order should be disseminated is discussed here. From the questionnaire survey, it is revealed that those who live near to cyclone shelter and can quickly evacuate to cyclone shelter without much preparation they also need at least 3 h before evacuation. On the other hand, those who live far from cyclone shelter but want to evacuate to cyclone shelter and need a bit long and slow preparation, they need >6 h before evacuation. Thus, the timing of emphasizing the evacuation should be separated for area near to cyclone shelter and area far from cyclone shelter. Zhao et al. [31] has found powerful relation between total weighted evacuation time and total shelter area. Therefore, it can be expected that if the number of shelter or area of shelter increase evacuation time would be reduced. When evacuation order should be disseminated can be decided by considering evacuation preparation time, availability of cyclone shelters and average distance of cyclone shelters from different households.

Different gaps and limitations that are discussed in first, second and third points in discussion section are summarized as the factors to be considered for efficient and effective warning and evacuation order, evacuation decision making and evacuation destination (Fig. 10). Factors in these three different aspects should be considered with importance to have efficient and effective evacuation decision and destination during future cyclone in coastal areas of Bangladesh. Efficient and effective evacuation to a safe place is the key of saving lives during cyclone. In Bangladesh, most of initiatives related to cyclone risk reduction have focused on saving lives. Therefore, number of death has been reduced sufficiently [25]. Nonetheless, 190 people lost their lives during cyclone Aila. It is expected that during future cyclone if the listed factors are efficiently considered in advance then the number of death would be zero.

Early warning plays a crucial role in cyclone evacuation [32]. In addition to early warning, in case of early warning and evacuation order, practice of regular listing and becoming aware of weather news, timely dissemination of easily understandable and detail early warning and evacuation order, timely and sincerely reception of the order by all residents and trusting the order are the key factors. In order to take effective evacuation decision efficiently the factors or condition that are important are starting evacuation preparation earlier, taking evacuation decision timely, selecting evacuation route and place properly and starting evacuation a quite earlier than the cyclone landfall, especially, earlier than the weather become bad. For efficient and effective evacuation destination, distance of cyclone shelter, space and facilities within the shelters and road condition are playing the key role. By recalling the experience, majority of the people mentioned about infrastructural condition, which is considered as one of the main factors of reaching to the safe evacuation destination. Infrastructural condition (including road and cyclone shelter) plays key role in taking evacuation decision and selecting evacuation destination. During future cyclone, along with evacuation order and decision related factors, these infrastructural factors would act as the crucial factors to achieve the success in reducing the cyclone death number to the zero. This infrastructural condition includes easy accessibility and connectivity of road to the cyclone shelters. Government and relevant authorities that are responsible for rural road they need to ensure that all these road condition has to be good enough to use during rainy reason and especially during cyclone season. Poor road condition is claimed as one of the main reasons of not evacuating to cyclone shelter (Fig. 9). Infrastructure condition also includes issues related to cyclone shelters. Availability of cyclone shelters within close proximity (maximum 2 km from each house) for all people should get the highest priority in case of any initiative related to cyclone and coastal disasters. In a cyclone shelter adequate space for all, proper utilities and facilities for all, privacy and security for all genders, especially for women are also needed to be ensured.

5. Conclusion

Based on the cyclone Aila related experiences this research tries to find out the factors that guide people to take evacuation decision and select evacuation destination. Any kind of experience gradually becomes blurred

with the passing of time. So, it could have been better to conduct this kind of experienced based study immediately after cyclone Aila. However, due to lack of timely fund availability and accessibility to the research institution, this research was conducted >5 years after the cyclone Aila. Fortunately, since cyclone Aila induced very remarkable experiences, during field survey it seemed that people remember everything very clearly. Based on people's experiences during cyclone Aila, it identified different people's evacuation behavior, risk perception time, evacuation preparation time and selection of evacuation destination. It identified different factors that guide and influence people to take evacuation decision and select evacuation destination. In addition to the examination of evacuation influencing factors, this research attempts to categorize people into different groups based on their risk perception attitude and actions during evacuation. It noticed four types of people termed as serious, reluctant, undecided and non-evacuee. Evacuation behavior or actions, factors leading to evacuation destination and final evacuation destination of all these four groups are identified. Analyzing the actions and experiences of different groups of people this study explore that content of cyclone warning and evacuation order, timing of evacuation order, evacuation preparation time, people's risk perception, weather condition, condition of roads and cyclone shelters and finally the distance of cyclone shelters are important factors to influence people's evacuation decision and selecting evacuation destination. In fact, different groups of people are needed to be treated differently during designing and implementing different evacuation awareness programs, trainings, drills and actions. Therefore, this type of grouping of people based on their evacuation behavior and influencing factors would greatly serve further policy actions related to evacuation.

Declaration of Competing Interest

There is no conflict of interest related to this paper/research.

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References

- [1] Department of Disaster Management. Flood response preparedness plan of Bangladesh. Ministry of Disaster Management and Relief; 2014.
- [2] Saha SK, James H. Reasons for non-compliance with cyclone evacuation orders in Bangladesh. *Int J Disaster Risk Reduct* 2017;21:196–204.
- [3] Shamsuddoha M, Chowdhury RK. Climate change impact and disaster vulnerabilities in the coastal areas of Bangladesh. Dhaka: Coast Trust; 2007.
- [4] Malilay J. Tropical cyclones. In: Noji Eric K, editor. *The public health consequences of disasters*. Oxford University Press; 1997. p. 207–27.
- [5] Paul BK. Why relatively fewer people died? The case of Bangladesh's cyclone Sidr. *Nat Hazards* 2009;50(2):289–304.
- [6] Nicholls RJ. Synthesis of vulnerability analysis studies. In: Beukenkamp P, et al, editors. *Proceedings of the world coast conference 1993*. The Hague: National institute for coastal and marine management, Coastal zone management center publication; 1995. p. 181–216.
- [7] Paul BK, Dutt S. Hazard warnings and responses to evacuation orders: the case of Bangladesh's cyclone Sidr. *Geogr Rev* 2010;100(3):336–55.
- [8] GoB. Cyclone Sidr in Bangladesh: Damage, loss, and needs assessment for disaster recovery and reconstruction. A report prepared by the government of Bangladesh assisted by the international development community with financial support from the European Commission; 2008.
- [9] Paul SK. Determinants of evacuation response to cyclone warning in coastal areas of Bangladesh: comparative study. *Orient Geogr* 2011;55(1,2):57–84.
- [10] Walton-Ellery Sandie. A review of the cyclone Aila response 2009: IFRC-led emergency shelter coordination group. Dhaka; 2009.
- [11] Saha CK. Dynamics of disaster-induced risk in southwestern coastal Bangladesh: an analysis on tropical cyclone Aila 2009. *Nat Hazards* 2015;75(1):727–54.
- [12] Khan MR, Rhaman A. Relationship approach to disaster management in Bangladesh: critical policy assessment. *Nat Hazards* 2007;41(1):359–78.
- [13] Chowdhury A Mushtaque R, Bhuyia Abbas U, Choudhury A Yusuf, Sen Rita. The Bangladesh cyclone of 1991: why so many people died. *Disasters* 1993;17(4):291–304.
- [14] Haque CE, Blair D. Vulnerability to tropical cyclones: evidence from the April 1991 cyclone in coastal Bangladesh. *Disasters* 1992;16(3):217–29.
- [15] Ahsan NMD, Takeuchi K, Vink K, Ohara M. A systematic review of the factors affecting the cyclone evacuation decision process in Bangladesh. *J Disaster Res* 2016;11(4):741–51.
- [16] Paul BK, Rashid H, Islam MS, Hunt LM. Cyclone evacuation in Bangladesh: tropical cyclones Gorky (1991) vs. Sidr (2007). *Environ Hazards* 2010;9(1):89–101.
- [17] Paul BK. Factors affecting evacuation behavior: the case of 2007 cyclone Sidr, Bangladesh. *Prof Geogr* 2012;64(3):401–14.
- [18] Roy C, Sarkar SK, Åberg J, Kovordanyi R. The current cyclone early warning system in Bangladesh: providers' and receivers' views. *Int J Disaster Risk Reduct* 2015;12:285–99.
- [19] Ahsan NMD, Takeuch K, Vink K, Warner J. Factors affecting the evacuation decisions of coastal households during cyclone Aila in Bangladesh. *Environ Hazards* 2015;15(1):16–42.
- [20] Mallick B, Rahaman KR, Vogt J. Coastal livelihood and physical infrastructure in Bangladesh after cyclone Aila. *Mitig Adapt Strat Glob Chang* 2011;16(6):629–48.
- [21] CRF. Living with cyclone Aila. Khulna: Coastal Research Foundation (CRF); 2010.
- [22] DMB-GoB. National plan for disaster management 2010–2015. Disaster Management Bureau, Disaster Management and Relief Division, Government of Bangladesh; 2010.
- [23] Amin Zulfiquer Ahmed. Learning to live with disasters, daily star, 12:00 AM, December 02, 2007/LAST MODIFIED: 12:00 AM. <https://www.thedailystar.net/news-detail-13827>; December 02, 2007, Accessed date: 14 December 2018.
- [24] Mallick Bishawjit. Cyclone shelters and their locational suitability: an empirical analysis from coastal Bangladesh. *Disasters* 2014;38(3):654–71.
- [25] Haque U, Hashizume M, Kolivras KN, Overgaard HJ, Das B, Yamamoto T. Reduced death rates from cyclones in Bangladesh: what more needs to be done? *Bull World Health Organ* 2012;90(2):150–6.
- [26] Mallick B, Ahmed B, Vogt J. Living with the risks of cyclone disasters in the southwestern coastal region of Bangladesh. *Environments* 2017;4(1):13.
- [27] Matyas C, Srinivasan S, Cahyanto I, Thapa B, Pennington-Gray L, Villegas J. Risk perception and evacuation decisions of Florida tourists under hurricane threats: a stated preference analysis. *Nat Hazards* 2011;59(2):871–90.
- [28] Xu D, Peng L, Liu S, Wang X. Influences of risk perception and sense of place on landslide disaster preparedness in southwestern China. *Int J Disaster Risk Sci* 2018:1–14.
- [29] Park K, Reisinger Y. Differences in the perceived influence of natural disasters and travel risk on international travel. *Tour Geogr* 2010;12(1):1–24.
- [30] Sadik MS, Nakagawa H, Rahman MR, Shaw R, Kawaike K, Fujita K, et al. Systematic study of cyclone Aila recovery efforts in Koyra, Bangladesh highlighting the possible contribution to vulnerability reduction. *J Jpn Soc Nat Dis Sci* 2017;36:107–19.
- [31] Zhao X, Xu W, Ma Y, Qin L, Zhang J, Wang Y. Relationships between evacuation population size, earthquake emergency shelter capacity, and evacuation time. *Int J Disaster Risk Sci* 2017:1–14.
- [32] Raj SJ, Ullah SMD, Akhuter R. From dissemination to response: in search of new strategies for broadcast media in terms of cyclone warning for Bangladesh. *J Sci Commun* 2010;9(4):03.