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Chakma, Swarnali
北後, 明彦

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Paper:

Evacuation Behavior: Why Do Some People Never Evacuate to a Cyclone Shelter During an Emergency? A Case Study of Coastal Bangladesh

Swarnali Chakma[*,†] **and Akihiko Hokugo**[**]

[*]Graduate School of International Cooperation Studies, Kobe University
2-1 Rokkodai-cho, Nada-ku, Kobe, Hyogo 657-8501, Japan
[†]Corresponding author, E-mail: chakma.swarnali@gmail.com
[**]Research Center for Urban Safety and Security, Kobe University, Hyogo, Japan
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According to the World Risk Report in 2018, Bangladesh has been identified as the most vulnerable country in the world. Among the 64 districts of this country, 19 districts are known as coastal districts 36.8 million people live in high-risk areas. The main objective of this paper is to investigate the reasons and factors why many residents do not comply with evacuation orders to cyclone shelters in an emergency period. Based on survey data collected from the survivors this paper finds that prior to the landfall of cyclone Komen in 2015 the majority of the respondents in Kutubdia Upazila had received cyclone warning either from Cyclone Preparedness Program volunteers or the radio, but only 61% of respondents in this village responded to the warning by seeking protection in the nearby shelter. The major identified reasons for 39% of respondent's non-compliance with evacuation orders are the long distance of a cyclone shelter from home, an absence of the head of the family, gender-related concerns, not enough space in the shelter, the poor road network and no space for livestock in the shelter. It is also found that people did not start evacuation until observing the symptom of risk. To improve cyclone preparedness and response to evacuation orders from residents, an educational campaign by Government and Non-Government Organizations (NGOs) is needed in coastal zones to improve the use of public cyclone shelters. Finally, to reduce risk Government should take the initiative for infrastructural development in the coastal areas of Bangladesh.

Keywords: cyclone, emergency response, evacuation, disaster preparedness, cyclone shelter

1. Introduction

Bangladesh is located on the Bay of Bengal in the delta of the Ganges, Brahmaputra and Meghna rivers. The geographical location and other physiographic characteristics have made this country vulnerable to disasters. The impacts of climate change are visible in the form of erratic rainfalls, increased number of intensified floods, cyclones, droughts, and landslides [1]. The Bay of Bengal has ideal rising ground for tropical cyclones and is one of the most dangerous cyclone basins in the world [2]. From 1991 to 2000 at least 93 large-scale disasters hit Bangladesh and nearly 0.2 million people died [3–5]. In recent years, the impacts of climate change have caused more intense and frequent natural disasters. The 2011 Climate Change Vulnerability Index put Bangladesh at top of the list of 170 vulnerable countries to the impacts of climate change [6]. Suffering due to extreme climatic events by climate change have already been experienced by Bangladesh, for instance cyclone Sidr (15 November 2007), cyclone Nargis (2 May 2008), cyclone Rashmi (27 October 2008), cyclone Aila (26 May 2009), cyclone Mohasen (14 May 2013), cyclone Komen (30 July 2015) [7], and cyclone Mora (30 May 2017) [5, 8–10].

According to Global Climate Risk Index 2010, extreme weather conditions of Bangladesh cause damage amounting to over US$ 2 billion a year and a Gross Domestic Product loss of 1.81% between 1990 and 2008 [11]. The coastal people of Bangladesh suffer from extreme poverty, inequality and marginalization in income compared to other areas. This makes the coastal communities particularly vulnerable to any extreme climatic events.

The cyclone warning system of Bangladesh has improved its efficiency after the occurrence of the 1991 cyclone as a result of improved macroeconomic management, increased the resilience of the poor, and progress in disaster management and flood protection infrastructure [12, 13]. However, existing cyclone warnings are still criticized for uncertainties in the warning message, identifying the accurate location and landfall timing, etc.

2. Evacuation Related to Early Warning

According to the UNISDR, 2006 it measures that for the effective early warning system it must include some disaster risk reduction elements such as; risk information, observing, early warning, dissemination information and

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Table 1. Evacuation behavior to cyclones in Bangladesh.

	Did not evacuated *N*	Evacuated *N*	Total *N*	Region
Cyclone Gorky [22]	1390 (69.5%)	610 (30.5%)	2000 (100%)	Chakoria Bashkhali Swandip Kutubdia
Cyclone Sidr [12]	185 (66.8%)	92 (33.2%)	277 (100%)	Bagerhat Patuakhali Pirojpur Borguna
Cyclone Komen (This study)	39 (39%)	61 (61%)	100 (100%)	Kutubdia Coxsbazar

Table 2. Early warning related reasons.

Early warning related reasons	
No cyclone warning issued	Paul and Dutt [12]
Issuance of evacuation order prematurely	Paul and Dutt [12], Paul [21], Bisson [23]
Warning message was incomplete	Roy et al. [30], Paul and Dutt [12], Paul [21]
Disbelief in the warning	Haque [26], Haque and Blair [25], Paul et al. [27], Ikeda [31], Ahsan et al. [32], Bisson [23]
Complicacy in warning signals	Paul et al. [27], Paul and Routray [13]
Sudden changes in warning signals	Ikeda [31], Bisson [23]
Lack of understanding of cyclone warning signals	Paul and Routray [13], Haque [26]
Cyclone warning was too late	Ikeda [31]

communication [12, 14–16]. The early warning system and the dissemination of their information of Bangladesh has played an important role in saving lives during cyclones [17, 18]. In general, the Bangladesh Meteorological Department issues forewarning for any threatening cyclone and storm surge. "Television channels, newspapers, and radio stations broadcast the warnings; and the local government administration and the local Cyclone Preparedness Program (CPP) volunteers run by the Red Crescent Society lead the evacuation of the people" [19, 20]. To avoid the failure of early warning information multiple communication networks is necessary to ensure everyone gets the warning message. Therefore, warning systems need to be handled by community-level and understood in order to be effective. In this case, CPP volunteers need to broadcast the warning news in the local dialects to increase the awareness for the timely evacuation [21]. "During the 1991 cyclone, almost everyone on the offshore islands of Kutubdia and Sandwip heard the warnings, while only an estimated 60% of the coastal areas of Chakoria and Banshkhali heard the warnings" [22]. Another scholar Bisson also found that 70% of respondent's do not take shelter the reason was they did not trust the warning and did not imagine the size of the cyclone and storm surges of that would hit in their areas [23]. Haque and Blair indicate there is also a fear of theft if they left the house, not believe to the warning signals, this types of reaction make them more vulnerable people [24–26]. In the past, it is also found that the residents ignored the evacuation order until the last minute [27–29]. Based on the review of existing studies on evacuation behavior during cyclone Gorky, cyclone Sidr, and cyclone Komen in Bangladesh, the evacuation behaviors of each devastating cyclones are shown in **Tables 1** and **2**.

In the case of cyclone Gorky in 1991, it reveals that 30.5% of respondents had evacuated. Paul et al. found that 33.2% of respondents evacuated in safe places during cyclone Sidr. Compared to the case study of cyclone Gorky in 1991, cyclone Sidr in 2007, the evacuation rates during cyclone Komen in 2015 significantly higher than the cyclone Sidr and Gorky. This evacuation rate indicated that the improvement of cyclone warning dissemination system by Government. However, there are some difficulties in evacuation process. Reasons of non-evacuation related to early warning of each cyclone are presented in **Table 2**.

3. The Event of Cyclone Komen in 2015

The cyclonic storm "Komen" was an unusual tropical cyclone that originated near the southern coast of Bangladesh and later struck the same country while drifting over the northern Bay of Bengal. The cyclone Komen brought several days of heavy rainfall to Bangladesh, Myanmar, and India. It formed as a depression on July 26 over the Ganges delta and moved in a circular motion around the northern Bay of Bengal. Komen intensified into a 75 km/h (45 mph) cyclonic storm and moved ashore southeastern Bangladesh on July 30 and caused 187 fatalities [9]. **Fig. 1** shows that the low lying areas of the coastal districts of Cox's Bazar, Chittagong, Noakhali, Feni, Chadpur, Bhola, Barisal, Patuakhali, Khulna, Satkhira, and their offshore islands were afftected by cyclone Komen.

4. Research Objective and Methodology

The main objective of this research is to investigate the reasons why many residents do not comply with the evacuation orders to during emergency periods. The objectives of the study include the following:

- To evaluate the coastal communities evacuation behavior in case of cyclone Komen.

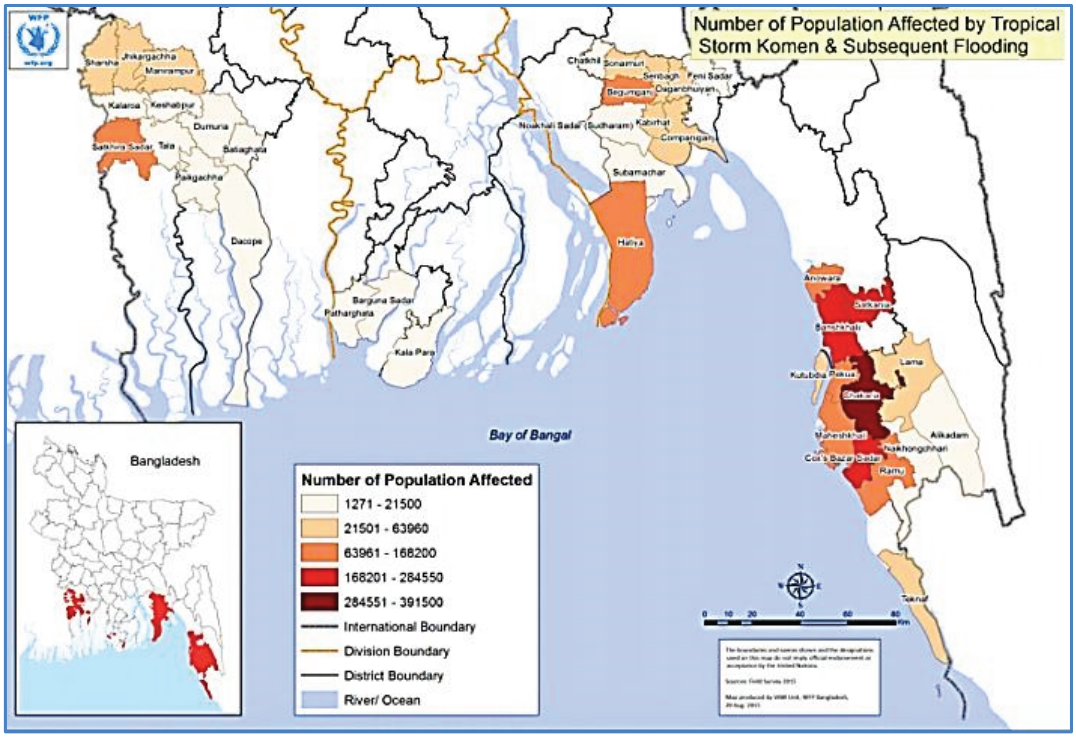

Fig. 1. Affected districts and population (HCTT, 31 July 2015).

- To identify the reasons and factors why people do not evacuate to cyclone shelters.

4.1. Methodology

The research plan used both primary and secondary data in order to achieve the objectives. Primary data were collected using a combination of approaches that included open, close-ended, and semi-structured interviews and focused group discussion (FGD). Random sampling was used for primary data collection by personal visits to the field from community people of the selected area. If the randomly selected household was absent during the survey, then the neighboring household was interviewed. Primary data were collected using questionnaires aimed at 100 households each on 332 households in 2 villages in the study area, who were affected by cyclone Komen in 2015. The survey of the local community was carried out during 1st to 10th March in 2017. The questionnaire consists of 4 sections and a total of 32 questions. Questionnaire sections are 1. General Information, 2. Experiences of Cyclone Komen, 3. Early Warning, and 4. Preparedness and Evacuation. The semi-structured interviews were conducted at the individual level. The objective of each interview was to obtain information about each person experiences in disaster. The semi-structured interview does not exactly follow the strict list of questions. One FGD was conducted at the community level to get the qualitative data of the study because participants were free to express their view under this process. Fifteen participants have attended the discussion. The participants were farmers, teachers, students, union chairman, household wives, and day labors.

The secondary data used different types of literature, mostly related to early warnings, evacuation to shelters, shelter management, Government and Non-Government Organizations (NGOs) documentations, assessment reports, reports of cyclone Komen, scholarly articles, journals, and books.

4.2. Description of the Study Area

Bangladesh is among the world's most disaster-prone countries and the frequency of natural disasters has increased in recent years. All the districts of Bangladesh are affected by natural disasters; however, Kutubdia Upazila (sub-district) is one of the worst affected among the other coastal belt areas of the country. The Island 'Kutubdia' has been developed in the basin of the Bay of Bengal through a process of continuous formation by alluvial soils flowing from the rivers [27]. The Upazila is under the Cox's Bazar district. The island has a long history of cyclone disasters. Every year during pre-monsoon (April–May) and post-monsoon (October–November) periods the inland faces cyclones, heavy rainfall, tidal surges, extreme high tide etc. During cyclone of 1991, one union of Jaliapalong experience 10-feet tidal surge, which inundated huge areas. Normally the areas are flooded with 3–4 feet surges during the rainy season [27, 28].

Table 3 shows the socio-economic status of the study area. To analyze the interview data, individual interviewees profiles was developed. It contained socio-economic status and livelihoods of communities.

Table 3. Socio-economic statuses of the respondents in the study area.

Characteristics	Number of respondents ($N = 100$)	Total respondents [%]
Gender		
• Male	55	55
• Female	45	45
Age		
• 20–29	16	16
• 30–39	42	42
• 40–49	31	31
• Above 50	11	11
Family Size		
• 1–3 persons	25	25
• 4–5 persons	28	28
• Above 5	47	47
Education		
• Illiterate	18	18
• Primary	59	59
• Higher secondary	23	23
Dwelling		
• Bamboo and tree	6	6
• Bamboo and straw	75	75
• Mud and wood	19	19
Occupation		
• Day labors	43	43
• Farmer	7	7
• Fisherman	19	19
• Salt cultivation	12	12
• Others (housewife, seasonal work)	19	19

All of the respondents are marginalized people and they are well known about their risk of cyclone. About 16% of the respondents were young age (20–29 years) group. However, the majority (73%) of the respondents were of middle age group (30–49 years). Education status plays an important role in understating the attitudes and motivation of the human being. 59% respondents had primary level, 23% had higher secondary level of education and 18% respondents are illiterate (**Table 3**). According to the survey, it has found that maximum people are day labors and fisherman. Among them 43% of them were engaged in day laborer activities; which also mean that majority of them are lower income people. Also respondents have 1–3 family members and 47% of them have above 5 family members. The housing condition of the study area is not suitable to live with a disaster. About 75% of houses are made with bamboo with straw, which is vulnerable due to wind and storm surge. People know that they live in risky area but they did not have any choice to move other places because of their occupation and land.

Table 4. Received an evacuation order during cyclone Komen.

Gender	Received	Not received	Total
Total	59 (59%)	41 (41%)	100 (100%)
Male	38 (69%)	17 (31%)	55 (100%)
Female	21 (47%)	24 (53%)	45 (100%)

5. Results

The result of survey classified into main three categories: (1) Evacuation behavior in case of cyclone Komen, (2) Reasons not to evacuate cyclone shelter during cyclone Komen, and (3) Factors associated with evacuation behavior during cyclone Komen. Under the main categories there are also some sub-categories.

5.1. Evacuation Behavior in Case of Cyclone Komen

In the study area, the following methods of field observation and questionnaire survey have been carried out to understand the evacuation behavior during cyclone Komen and the present condition and practices of the affected areas. The cyclone Komen made landfall in the southeastern part of Kutubdia, Bangladesh, which is an island. The Bangladesh government began to broadcast warnings on television and radio and issued an emergency situation. Local authorities, CPP volunteers, NGOs and emergency officers advised the people to evacuate to shelters. In this section, the questionnaire survey results explain how people reacted to cyclone warnings and evacuation orders.

The results of the questionnaire survey revealed that 59% of respondents were aware of the cyclone warning and evacuation order prior to cyclone Komen landfall. The number of responders is 100. **Table 4** shows that 38 men (69%) out of a total of 55 men received evacuation orders during Komen. Men those who did not receive evacuation order they did not get time to evacuate because maximum are fishermen and they did not come to inland on time. Because of their occupation, they were far from the community and cannot be heard the evacuation order. This result shows the limitation of CPP endeavor siren and signal flag system.

The percentage of women who receive the evacuation order was smaller than men. The rate was 47%. Those who did not receive an evacuation order (41%) took shelter without evacuation order. These residents are self-evacuee who leaves for safe places even though they did not get the early warning. They follow the others and the relatives and neighbors help them to evacuate.

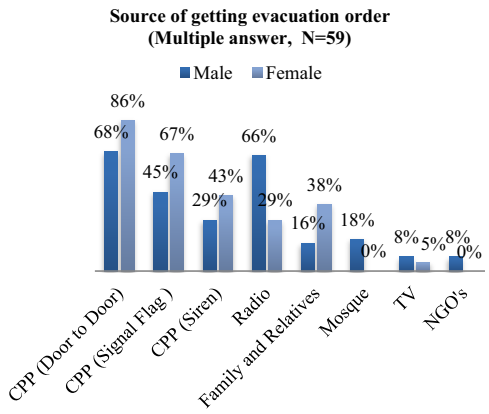

Fig. 2. Source of the evacuation order.

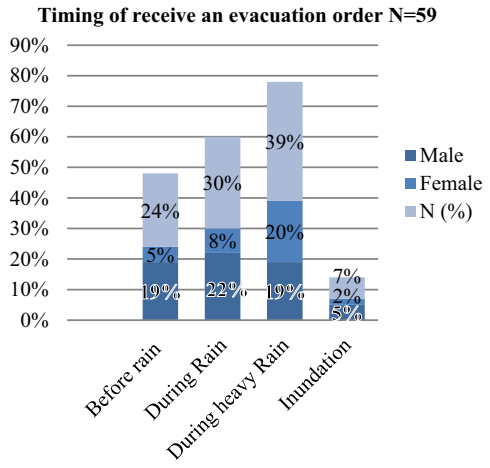

Fig. 3. Timing of receive an evacuation order.

5.2. Source of Evacuation Order

The total number of residents receiving an evacuation order was 59 people. According to the graph (**Fig. 2**), many respondents received cyclone warnings and evacuation orders from CPP volunteers, who disseminate the information door to door. The CPP activities such as using signal flags and sirens were very effective in the coastal area. Mass media also played an important role to disseminate information. Almost 66% of male and 29% of female respondents received evacuation orders from the radio. Nearly 54% of respondents get warning information from family and relatives. For example; cyclone warning messages via mobile phones from family members or head of the family. Also, people act on evacuation to be together with their family, relatives or another "in-group." Therefore, they inform evacuation information to each other. A high level of trust in early warning information from the relatives helps them to evacuate to safe places. Most of the men (18%) got evacuation order by the mosque. Normally, in religious customs men has access to mosque rather than women. By TV media 8% of men and 5% of women were received the evacuation information. Also, 8% of men received evacuation information from NGO's officials. That means men's received evacuation order quickly rather than women from different sources.

Figure 2 shows maximum female respondents followed the CPP activities. Especially they received an evacuation order from CPP volunteers who disseminate door-to-door information. So, it is observed that women are more vulnerable than men if CPP volunteer is late for disseminating the information of evacuation order timely. In case of cyclone Komen, CPP volunteer was late to disseminate the information because maximum people received the evacuation order during rain and heavy raining time (**Fig. 3**).

5.3. Timing of Receive an Evacuation Order

Timing of receive an evacuation order is very important for safe evacuation. **Fig. 3** shows that only 24% of people received an evacuation order before the rain started. 30% of people received evacuation orders while it was raining. Additionally, 39% of people received orders during heavy rainfall and 7% of people received orders after inundation in affected areas. According to the figure, men received the evacuation orders earlier than women. A majority of women (28%) received evacuation orders during rain and heavy rain times. Before rain 19% of men received the evacuation order. The reason why many women was late to receive evacuation order because of Bangladeshi culture; in this area maximum women is mostly housewife and they do not have to go outside compared than men.

Table 5. Evacuation during cyclone Komen.

Gender	Yes	No	Total
Total	61 (61%)	39 (39%)	100 (100%)
Male	26 (47%)	29 (53%)	55 (100%)
Female	35 (78%)	10 (22%)	45 (100%)

5.4. Evacuation During Cyclone Komen

During cyclone Komen almost 61% of people was evacuated (**Table 5**). The evacuation rate was 47% of men and women are 78%, which means a majority of women left their house. Other 39% of all respondents who did not take emergency action after receiving evacuation orders. Among them 21% they simply stayed home. They feared that their homes could be looted. The remaining 18% took shelter either in the fishing boat, embankment and high land areas.

6. Reasons Not to Evacuate Cyclone Shelter During Cyclone Komen

According to the **Fig. 4**, resident responses for the reasons for not following to evacuation orders fell into different cases. 39 of the respondents reported that the distance to the nearest cyclone shelter was the main reason for not

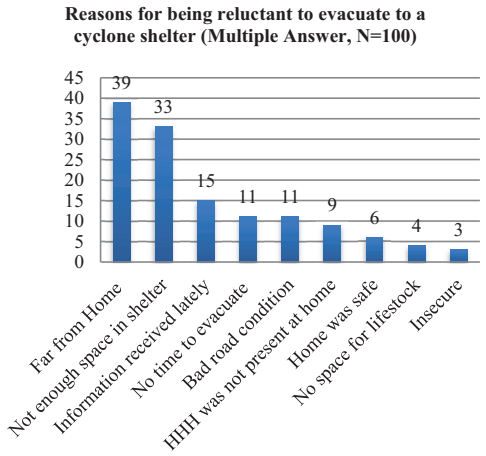

Fig. 4. Timing of receive an evacuation order.

leaving their home. Respondents answered that the distance to a cyclone shelter posed a barrier, and they were unwilling to walk roads in bad condition. And insufficient numbers of shelters is also evident from the fact that 33 respondents rushed to such shelters but were denied entry because of limited space. An informal conversation with respondents reveals that some respondents decided to take refuge in the nearest public building after water entered their area. Unfortunately, they could not reach the cyclone shelter because of high winds, extreme rain and poor road network. 11 of non-evacuees reported that they received the evacuation orders when the cyclone hit and they did not have enough time to evacuate to a cyclone shelter. During cyclone Komen, one of the most serious concerns about not evacuating to a cyclone shelter was the family's "Head of Household" (HHH) was not present at home. This was particularly true for women because in Bangladeshi culture, placing men and women who do not know each other under the same roof together is not comfortable or suitable for women. This reason also makes women feel insecure to evacuate to a cyclone shelter. Nearly 6 of all non-evacuated respondents stated that they thought the home was safe because they believed the cyclone was not strong or severe.

7. Factors Associated with Evacuation Behavior During Cyclone Komen

In this study a socio-cultural approach is applied to explain the variation of human evacuation response to cyclone. To present the evacuation responses, various factors are included, which are considered to have significant influence on the process towards evacuation decisions. The factors are: trust of warnings, cattle ownership demographic, and other relevant variables such as age, year of education.

Table 6 shows the six factors considered in this study. The socioeconomic factor education levels have significant influence on decisions to stay or leave home for a cyclone shelter. It also shows that, socioeconomic factor monthly incomes have no significant influence on the decision for safe places. The field survey reveals one interesting factor to be cattle ownership. The evacuation percentage was higher among respondents who owned cattle (78%) compared to respondents who did not have own cattle. This factor appears as a significant reason that is linked with evacuation. Since some public shelters and killas (shelter for human and cattle) are located in the same compound, they found moving to one place for their own safety as well as keeping livestock in the same place is sensible. A majority of the respondents (74%) in the study area trust the existing cyclone forecasting. The evacuation rate was higher among respondents who trusted the warning message compared to those who did not. A significant difference exists in terms of respondent's belief in existing cyclone forecasting, however, before the occurrence of cyclone Komen most of the respondents in this area did not trust the cyclone forecasting. So, it is clear that among the six factors analyzed, distance to shelter, cattle ownership, and trust of warning has the most significant followed by other factors. It shows that 81% respondents lived within a mile of nearest safe places. The corresponding rate was 43% (23 respondents) who lived in more than a mile they did not evacuate for a safe places. This difference in evacuate rate is highly significant.

Table 6. Factors associated with evacuation behavior.

	Evacuation Status		
Factors	**Evacuated ($N = 61$)**	**Not evacuated ($N = 39$)**	**Total**
Education level			
0	6 (33%)	12 (67%)	18 (100%)
1–5	37 (63%)	22 (37%)	59 (100%)
> 5	18 (78%)	5 (22%)	23 (100%)
Age			
20–39	35 (60%)	23 (40%)	58 (100%)
> 40	26 (62%)	16 (38%)	42 (100%)
Monthly income			
1000–5000	37 (59%)	26 (41%)	63 (100%)
5001–10000	24 (65%)	13 (35%)	67 (100%)
Distance			
One mile	38 (81%)	9 (19%)	47 (100%)
$>$ One mile	23 (43%)	30 (57%)	53 (100%)
Cattle ownership			
Have cattle	14 (78%)	4 (22%)	18 (100%)
Do not have cattle	47 (57%)	35 (43%)	82 (100%)
Trust in warning			
Yes	40 (74%)	14 (26%)	54 (100%)
No	21 (46%)	25 (54%)	46 (100%)

8. Discussion and Findings

The study examined coastal resident responses to warning and evacuation orders issued before the landfall of cyclone Komen, 2015 and identified the factors associated with respondents' evacuation behavior. From the observation of evacuation behavior, it is found that people did not start evacuation until observing the evidence of risk. These types of behavior expose the general evacuation behavior of coastal communities in Bangladesh. However, according to the results of the questionnaire survey, the key findings are mention in broad headed.

8.1. Early Warning and Cyclone Preparedness Program (CPP)

In Bangladesh CPP plays an important role to disseminate the early warning information to communities [30, 33, 34]. Cyclone Komen case, many respondents received cyclone warnings and evacuation orders information from CPP volunteers. Maximum respondents followed the CPP activities. However, many people failed to receive a warning due to various reasons. Few respondents complained that they couldn't evacuate because the warning messages delivered by the CPP volunteers and government was not timely delivered. On the other hand, socioeconomic demographic factors such as education, income, occupation, lack of awareness, and communication problems mean that some people do not understand the warnings itself. So, there was a gap between the provider and receiver in the case of cyclone Komen. In order to enhance early warning information, we need to find out how and when evacuation orders are disseminated based on the local context [30].

On the other hand, the use of megaphones and hand mikes by CPP volunteers was not always effective during cyclone time because of heavy wind; the sound of megaphones did not reach the community [28]. Nowadays, mobile telecommunication networks reached whole over the country Bangladesh; in this case, distributing cyclone-warning messages via mobile phones will be a good option to disseminate early warnings information.

8.2. Gender Issues and Security Concern

Gender is an important concern in relation to evacuation behavior in Bangladesh. In 1991 cyclone Gorky in Bangladesh causing an estimated 140,000 who died, 90% are women [31]. Basically, there are so many reasons women's are vulnerable during a disaster [31, 34]. The survey found that culture contributed to their perception of evacuation to cyclone shelters insecure without men. In evacuation centers, the lack of privacy led to concerns to unsafely for women. In FGD some women share their experiences that, the sanitary facility is one of the major issues for not to evacuate to cyclone shelter. They have to share the same toilet with men and there is not sufficient privacy for women. A lack of facilities such as separate space, water supply, enough light in the shelter, and security for women in shelters also discourages evacuation behavior [27, 31]. Sometimes women cannot take the decision to leave the house because of the absence of the head of the family (male-headed family). Because the male members were decided to leave home or not and women have to fear of detached from their family and fear the loss of property.

8.3. Cyclone Shelter Related Reasons

Despite improvements in early warning systems, evacuation to cyclone shelter remains a challenge in this area. People's reactions regarding a cyclone's early warning and response of evacuation orders differed. People in coastal regions still consider in a wait-and-see approach than decided to move the shelters. Lack of local shelters, previous false warnings, and fear of property loss also limit the numbers who evacuate to shelters. Others refuse to evacuate because cyclone shelters are far from the locality, features of the warning message, individual perceptions and beliefs, including thinking that their house can withstand a cyclone [12, 27, 34–36]. The results prove that easy access to a cyclone shelter plays an important role in evacuation behavior. 39 of respondents (**Fig. 4**) reported that the distance to the nearest cyclone shelter was the main reasons for not to leave home. Especially for those people who live near the seaside area and have aged people. So, the results prove that easy access to a cyclone shelter plays an important role in evacuation behavior. Poor road network which linking to shelter also a barrier for the special group such as; handicapped, disable, aged group and children's faced difficulties to move the cyclone shelters. Moreover, sometimes people fear to evacuate to cyclone shelters because of the poor physical condition of shelters. Usually, during normal time (no disaster) the shelters are abandoned. So it is important to consider building multi-purpose cyclone shelters so that these can also be used as primary schools during the normal period of time. Finally, the study found that there are multiple reasons people for non-comply with evacuation order that associated with cyclone shelters such as the distance of cyclone shelter, poor network and lack of facilities of cyclone shelter, etc.

9. Conclusion

The overall finding of the study shows that the Bangladesh Meteorological Department works very conscientiously at continually providing forecasts and early warnings through TV and radio. However, present survey data show that dissemination of cyclone early warnings information did not reach to all vulnerable populations. There are still some critical issues in evacuation response. Firstly, in some areas, Cyclone Preparedness Program volunteers are unable to disseminate warning information timely because of their limitation, such as; lack of human resources, lack of modern gears, and have a poor transport system to reach remote areas. Secondly, as most residents in coastal areas of Bangladesh are low-income people and

have limited access to radio or television. Thus, it is recommended to increase the coverage of information dissemination systems through media and especially, the use of mobile telecommunications. The telecommunication network covers most of the coastal part of Bangladesh. In the emergency phase, cyclone warning text alerts through mobile phone will be the quick option to disseminate early warnings information.

The field survey results imply that response to evacuation orders was significantly higher in cyclone Komen than cyclones Gorky and Sidr. However, the poor road network, lack of facilities of cyclone shelters and long distance of cyclone shelters from home was the reason for the lack of evacuation to cyclone shelters. Especially, in the study area, present cyclone shelters are not distributed sufficiently for local residents to evacuate. It reveals that distance also an important factor in determining whether to evacuate or not. Considering this distance factor, construction of shelters must be done closer to vulnerable communities, especially within the distance of 1.5 km so that in times of disaster, people can reach the shelters quickly [27].

Data also shows that the evacuation rate was much higher among residents who trusted the warning message compared to those who did not. So, trust in cyclone warnings could also be increased by expanding educational opportunities for coastal residents. To make all coastal residents aware of the severity of a cyclone and to increase the trust in evacuation orders, emergency personnel must educate them about the benefits of taking refuge in a cyclone shelter. In order to enhance the effectiveness of evacuation behavior, it is very important to disseminate cyclone early warning information timely. Cyclone warnings should be placed according to the necessities and understanding of local communities. Additionally, an educational campaign by Government and NGO is required in coastal areas to improve the use of cyclone shelters for future events. Finally, these areas need a village level disaster mitigation strategy to encourage the community to evacuate to a cyclone shelter to minimize the loss of life.

Acknowledgements

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References:

[1] Ministry of Disaster Management and Relief (MoDMR), Government of Peoples Republic of Bangladesh, "Bangladesh Climate Change Strategy and Action Plan 2009," https://www.iucn.org/downloads/bangladesh_climate_change_strategy_and_action_plan_2009.pdf [accessed May 9, 2017]

[2] C. Bern, J. Sniezek, G. M. Mathbor, M. S. Siddiqi, C. Ronsmans, A. M. Chowdhury, A. E. Chowdhury, K. Islam, M. Bennish, and E. Noji, "Risk factors for mortality in the Bangladesh cyclone of 1991," Bull World Health Organ, Vol.71, No.1, pp. 73-78, 2008.

[3] Climate Change Cell, "Climate Change and Bangladesh published with support from Comprehensive Disaster Management Programme of the Government of the People's Republic of Bangladesh and its development partners, UNDP and DFID," 2009.

[4] A. Anwar, "Climate change impacts and adaptation assessment in Bangladesh," Climate Research, Vol.12, pp. 109-116, 1999.

[5] EM-DAT, "Top 10 natural disasters in Bangladesh from 1900–2014," The Int. Disaster Database, Centre for Research on the Epidomology of Disasters (CRED), http://www.emdat.be/result-country-profile [accessed February 25, 2017]

[6] Maplecroft, "World's fastest growing populations increasingly vulnerable to the Impacts of climate change – 4th global atlas reports," 2011, http://maplecroft.com/about/news/ccvi_2012.html [accessed April 4, 2017]

[7] Bangladesh Meteorological Department, "Historical cyclones," 2016, http://www.bmd.gov.bd/weather_forecast.php [accessed July 16, 2018]

[8] Asian Disaster Reduction Center (ADRC), "Cyclone Prediction and Forecasting, Weather Warning System and Dissemination Methods: The Bangladesh Perspective," http://www.adrc.asia/publications/TDRM2005/TDRM_Good_Practices/PDF/PDF-2005e/Chapter3_3.3.2-1.pdf [accessed April 7, 2016]

[9] Needs Assessment Working Group, "HCTT Rapid Impact Assessment: Cyclone Komen in South Bangladesh," https://www.sheltercluster.org/sites/default/files/docs/150821_komen_impact_assessment_report-final_2.pdf [accessed July 19, 2017]

[10] M. Nadiruzzaman and B. K. Paul, "Post-Sidr public housing assistance in Bangladesh: A case study," Environmental Hazards, Vol.12, No.2, pp. 166-179, doi: 10.1080/17477891.2012.759523, 2013.

[11] S. Harmeling, "Global climate risk index 2010: Who is the most vulnerable? Weather-related loss events 1990 and how Copenhagen needs to respond," Germanwatch, 2009.

[12] B. K. Paul and S. Dutt, "Hazard warnings and responses to evacuation orders: The case of Bangladesh's cyclone Sidr," Geographical Review, Vol.100, No.3, pp. 336-355, doi: 10.1111/j.1931-0846.2010.00040.x, 2010.

[13] S. K. Paul and J. K. Routray, "An Analysis of the Causes of Non-Responses to Cyclone Warnings and the Use of Indigenous Knowledge for Cyclone Forecasting in Bangladesh," W. L. Filho (Ed.), "Climate Change and Disaster Risk Management," pp. 15-39, Springer, 2013.

[14] E. L. Quarantelli, "Disaster Studies: The consequences of the historical use of a sociological approach in the development of research," Int. J. of Mass Emergencies and Disasters, Vol.12, No.1, pp. 25-49, 1994.

[15] N. Dash and B. H. Morrow, "Return delays and evacuation order compliance: The case of Hurricane Georges and the Florida Keys," Global Environmental Change Part B: Environmental Hazards, Vol.2, No.3, pp. 119-128, doi: 10.1016/S1464-2867(01)00008-0, 2000.

[16] Z. Yang, K. Inagaki, H. Yagi, S. Yoshida, and S. Sadohara, "Emergency evacuation and shelter-seeking behavior of foreign residents in Kumamoto earthquake," J. Disaster Res., Vol.12, No.sp, pp. 678-687, doi: 10.20965/jdr.2017.p0678, 2017.

[17] United Nations Development Program (UNDP), "Cyclone Aila: Joint UN multi-sector assessment and response framework," http://www.scribd.com/doc/79662690/Aila-UN-Assessment-Framework-FINAL [accessed June 22, 2016]

[18] World Bank, "Emergency 2007 Cyclone Recovery and Restoration Project," http://www.worldbank.org/projects/P111272/emergency-2007 [accessed April 20, 2017]

[19] Bangladesh Red Crescent Society, "Cyclone Preparedness Programme (CPP) at a glance," 2007.

[20] M. Huq, M. F. Khan, K. Pandey, M. M. Z. Ahmed, Z. H. Khan, S. Dasgupta, and N. Mukherjee, "Vulnerability of Bangladesh to Cyclones in a Changing Climate: Potential Damages and Adaptation Cost," Policy Research Working Paper 5280, World Bank, 2010.

[21] B. K. Paul, "Why relatively fewer people died? The case of Bangladesh's Cyclone Sidr," Natural Hazards, Vol.50, No.2, pp. 289-304, 2009.

[22] A. M. R. Chowdhury, A. U. Bhuyia, A. Y. Choudhury, and R. Sen, "The Bangladesh cyclone of 1991: why so many people died," Disasters, Vol.17, No.4, pp. 291-304, 1993.

[23] T. Bisson, "An Assessment of Cyclone Mitigation and Management Policies of Bangladesh: A Focus on Early Warning Systems," Master's degree thesis, University of Manitoba, 2012.

[24] M. K. Lindell and R. W. Perry, "Behavioral foundations of community emergency planning," Hemisphere Publishing Co., 1992.

[25] C. E. Haque and D. Blair, "Vulnerability to tropical cyclones: evidence from the April 1991 cyclone in coastal Bangladesh," Disasters, Vol.16, No.3, pp. 217-229, 1992.

[26] C. E. Haque, "Atmospheric hazards preparedness in Bangladesh: A study of warning, adjustments and recovery from the April 1991 Cyclone," Nat. Haz., Vol.16, No.2-3, pp. 181-202, 1997.

[27] B. K. Paul, H. Rashid, M. S. Islam, and L. M. Hunt, "Cyclone evacuation in Bangladesh: Tropical cyclones Gorky (1991) vs. Sidr (2007)," Environmental Hazards, Vol.9, No.1, pp. 89-101, doi: 10.3763/ehaz.2010.SI04, 2010.

[28] Ministry of Disaster Management and Relief (MoDMR), Government of People's Republic of Bangladesh, "Cyclone Emergency Preparedness Plan, Bangladesh (in Bengali)," http://old.ddm.gov.bd/pdf/Small%20size%20Emergency%20Preparedness%20Plan_Cyclone_DDM_%20March.pdf [accessed July 16, 2016]

[29] J. H. Sorensen and B. V. Sorensen, "Community Processes: Warning and Evacuation," H. Rodriguez, E. L. Quarantelli, and R. R. Dynes (Eds.), "Handbook of Disaster Research," pp. 183-199, Springer, 2007.

[30] C. Roy, S. K. Sarkar, J. Åberg, and R. Kovordanyi, "The current cyclone early warning system in Bangladesh: Providers and receivers' views," Int. J. of Disaster Risk Reduct., Vol.12, pp. 285-299, doi: 10.1016/j.ijdrr.2015.02.004, 2015.

[31] K. Ikeda, "Gender Differences in Human Loss and Vulnerability in Natural Disasters: A Case Study from Bangladesh," Indian J. of Gender Studies, Vol.2, No.2, pp. 171-193, doi: 10.1177/097152159500200202, 1995.

[32] N. Ahsan, K. Takeuchi, K. Vink, and M. Ohara, "A systematic review of the factors affecting the cyclone evacuation decision process in Bangladesh," J. Disaster Res., Vol.11, No.4, pp. 742-753, doi: 10.20965/jdr.2016.p0742, 2016.

[33] R. Ramesh, "Bangladesh cyclone death toll passes 3000," https://www.theguardian.com/world/2007/nov/19/naturaldisasters.bangladesh, 2007 [accessed October 7, 2018]

[34] A. S. Dhar and M. A. Ansary, "Community-based evaluation for the development of a sustainable disaster early warning system," J. of Emergency Management, Vol.10, No.4, pp. 293-302, doi: 10.5055/jem.2012.0107, 2012.

[35] G. A. Parvin, F. Takahashi, and R. Shaw, "Coastal hazards and community-coping methods in Bangladesh," J. of coastal Conservation, Vol.12, No.4, pp. 181-193, 2008.

[36] E. Alam and A. E. Collins, "Cyclone disaster vulnerability and response experiences in coastal Bangladesh," Vol.34, No.4, pp. 931-954, Disasters, doi: 10.1111/j.1467-7717.2010.01176.x, 2010.

Name:
Swarnali Chakma

Affiliation:
Doctoral Student, Graduate School of International Cooperation Studies, Kobe University

Address:
2-1 Rokkodai-cho, Nada-ku, Kobe, Hyogo 657-8501, Japan

Brief Career:

2009 Joined Bangladesh Rural Advancement Committee (BRAC)
Disaster Environment and Climate Change Program
2017- Doctoral Student, Graduate School of International Cooperation Studies, Kobe University

Selected Publications:

• "Community Participation in Disaster Risk Reduction: A study focusing on Cyclone Preparedness Program (CPP) in Bangladesh and a comparative study of Syobo-dan and CPP volunteers activities in disaster response," Global Conf. on the Int. Network of Disaster Studies in Iwate, Japan (Iwate Conf.), 2018.

Academic Societies & Scientific Organizations:

• Japan Society for International Development (JASID)

Name:
Akihiko Hokugo

Affiliation:
Professor, Research Centre for Urban Safety and Security, Kobe University

Address:
1-1 Rokkodai-cho, Nada-ku, Kobe, Hyogo 657-8501, Japan

Brief Career:

1985 Institute for Fire Safety and Disaster Preparedness
1990 Building Research Institute, Ministry of Construction
1997- Kobe University

Selected Publications:

• "Tsunami Fires after the Great East Japan Earthquake," J. Disaster Res., Vol.8, No.4, pp. 584-593, 2013.
• "Understanding Household Mobilization Time During Natech Accident Evacuation," J. Disaster Res., Vol.10, No.5, pp. 973-980, 2015.

Academic Societies & Scientific Organizations:

• Architectural Institute of Japan (AIJ)
• Japan Association for Fire Science and Engineering (JAFSE)
• International Association for Fire Safety Science (IAFSS)
• Japan Society for Disaster Recovery and Revitalization (JSDRR)