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Disaster risk reduction in conflict contexts: Lessons learned from the lived experiences of Rohingya refugees in Cox's Bazar, Bangladesh

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ABSTRACT

Bangladesh is currently hosting more than one million stateless Rohingya refugees, who fled from the Rakhine State to avoid genocide and serious crimes against humanity persecuted by the Myanmar Army. The newly arrived Rohingyas were accommodated in overcrowded refugee camps in Cox's Bazar District (CBD). The camps are highly vulnerable to landslides, tropical cyclones, flash-flooding, and communicable disease outbreak. Although a number of improvement measures are ongoing, however, no study to date has addressed Rohingyas' self-adopted strategies to mitigate disaster risks. Consequently, this paper aims to explore how refugees cope with risks associated with environmental hazards in the Kutupalong Rohingya Camp in CBD. A mixed-methods research strategy incorporating both quantitative household questionnaire survey and qualitative focus group discussions (FGDs) techniques were applied. In total 250 Rohingya refugees were selected for the questionnaire survey using a stratified random sampling method from camps 17 and 19, and two FGDs (male and female-only) were carried out in camp 13 involving 21 Rohingya participants. Results derived from the study show that responding to early warning systems, storing dried food and medicine, utilising available resources, relocating to safer shelters, and keeping hopes high were some of the coping strategies practised by the respondents. Literacy level imposed a significant impact over respondents' perception to accept various measures. For instance, the probability of storing dried food in preparation for disasters was 4 times higher among literate Rohingya compared to their illiterate counterparts. Similarly, for literate respondents, the probability was 20 times higher to store medicine than for illiterate. Guaranteed distribution of shelter strengthening kits among all refugee households, the inclusion of disaster risk awareness and preparedness training, ensuring safe and dignified return in Myanmar, and global and regional cooperation to address the refugee crisis are some of the propositions recommended in this study for improving Rohingyas' future adaptation strategies in a humanitarian context.

1. Introduction

Disasters triggered by natural hazards cause loss of life, property damage, forced displacement, hunger, and disease outbreaks. The world's poorer or less-resilient nations and especially marginalised groups such as minorities, displaced people and refugees are also highly impacted by natural hazards [1]. Considerable emphasis has been given by the scientific community to identifying traditional coping strategies practised by the urban or rural poor in a disaster context [2–6]. However, there is a gap in conducting research solely on refugees in such a meticulous way. The present study attempts to focus on exactly this point by considering the Rohingya refugees crisis in Cox's Bazar District (CBD), Bangladesh as an example.

By definition, refugees are persons "someone who is unable or unwilling to return to their country of origin owing to a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group, or political opinion" [7]. From this definition, the arrival of refugees is considered as a temporary phenomenon for the host country. The durable solution regarding refugees is that they will be able to return to their homeland voluntarily as soon as the situation, which forced them to flee from their territory, ends [8]. But the real situation is quite different. A study by the United Nations (UN) High Commissioner for Refugees (UNHCR) reported that around 70.8 million individuals, including 25.9 million refugees (registered only), were forcibly displaced worldwide at the end of 2018. Currently, 33% of the global total refugees are being hosted by the least developed

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countries where they live very distressing lives. Bangladesh is ranked 8th, accommodating nearly 1 million Rohingya refugees from Myanmar [9].

Fragile camp settings with limited access to the basic provision of infrastructures and aid, difficult camp locations (e.g., too arid or too hilly), overpopulation and rickety shelters are some of the common phenomena with which the refugees are forced to deal with recurrently. Such fragile physical settings act as a driver to increased vulnerability to

natural hazards [10]. For instance, communications between the Leitchuor refugee camp in Ethiopia and the surrounding community were interrupted for a month because of the disruption of the camp's main access road due to flooding in July 2014. Again, 250 shelters on steep hillslopes in refugee camps in Rwanda were destroyed due to a landslide in 2014. A survey conducted by UNHCR in 16 countries suggested that out of 3.2 million refugees, 200,000 were affected and 100,000 were displaced by disasters associated with natural hazards during
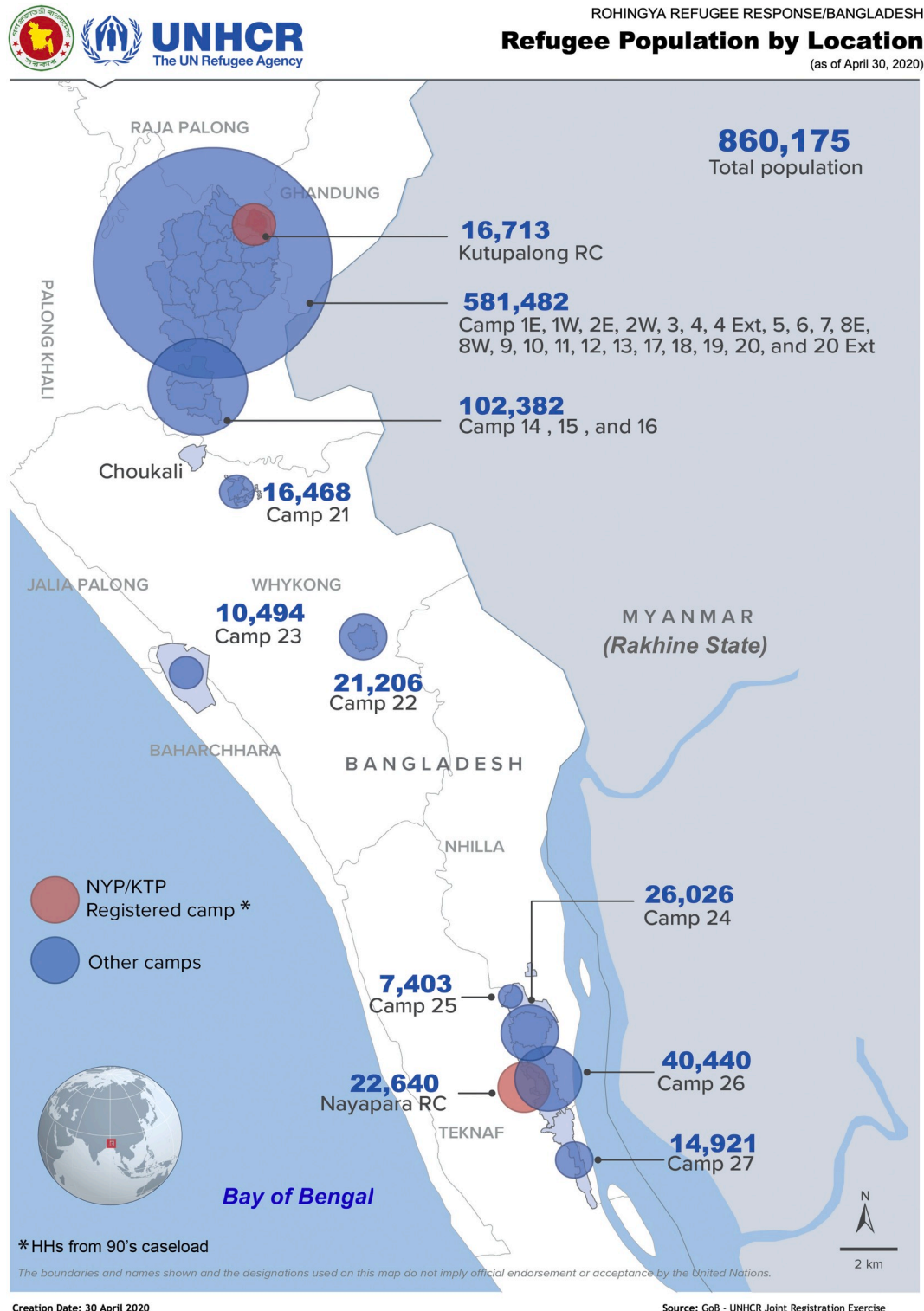

Fig. 1. The geographical location of the refugee camps and the number of Rohingya refugees in each camp in Cox's Bazar District (CBD), Bangladesh [15].

2013 and 2014 owing to living in vulnerable camp settings [10].

Consequently, the question is how the refugee communities can build coping strategies to respond to potential disaster risks. The vulnerability of the poor in their own territory and vulnerability of refugees in a host country are not similar phenomena. The vulnerable in their own country may enjoy the freedom of movement, better access to relief aid, alternative livelihoods, access to evacuation shelters, internet, telecommunications, vaccines and so on, to mitigate disaster risks, which typically are denied for refugees.

Rohingyas are the second largest ethnic group of the Rakhine State in Myanmar [11]. They have distinguished culture, heritage, language and religion [8]. Their citizenship was denied by the Myanmar government in 1982 [11,12]. Being targeted by the state-sponsored persecution, Rohingyas fled from Myanmar and started arriving in Bangladesh chronologically, first in 1978, then in 1991–1992, 2012, 2016, and lastly in late August 2017. Nevertheless, it was August 2017 when Bangladesh experienced by far the largest and fastest refugee influx [13]. The International Court of Justice (ICJ) has instructed Myanmar to take actions to stop the genocide of the Rohingyas on January 23, 2020, and the final verdict on the punishment of the crime of genocide is still pending [14]. Nearly 711,369 Rohingya refugees (officially known as Forcibly Displaced Myanmar Nationals) including more than 460,000 children (27.3% boys and 26.2% girls) and 217,000 adult women have fled into CBD since August 2017, and they are now settled in two main camps – Kutupalong and Nayapara [13]. CBD is currently hosting 860,175 Rohingyas (Fig. 1) who are officially registered by the UNHCR [15].

In addition, the crisis has adversely impacted more than 444,000 host community members. The 2020 Joint Response Plan (JRP) is seeking US$ 877 million to respond to the critical humanitarian needs in CBD [13]. The Rohingya refugees are not only unique in terms of their great numbers, but also in the sense of their exposure to adverse weather condition in the refugee camps [16]. Every year, the Rohingyas are facing catastrophic impacts of natural hazards in CBD. For instance, heavy downpour for five consecutive days with landslides in July 2019 affected more than 3000 Rohingya families and took away the lives of two people [17]. Again, a total of 55,057 Rohingyas were affected by the rainfall-triggered landslides, flash floods and waterlogging during May–December in 2018. Moreover, the devastation caused by the Cyclone Fani in May 2019 recognised the need for better preparedness against extreme storm events in the Rohingya camps [18].

In this context, the paper aims to assess refugees' adopted strategies to cope with the shifting risks (i.e., the type of risks associated with natural hazards that have changed over time with the change of location) and also, the level of organisational involvement in implementing disaster resilience interventions in the camps. The central argument of the paper is that a new dimension can be added to the studies of coping strategies for the physical and built environment field by exploring disaster risk reduction (DRR) strategies developed and practised by a refugee community. Accordingly, the research question is 'despite facing many challenges, how do Rohingya refugees sustain their existence against the growing vulnerability raised by extreme weather events'? The alternative hypothesis of this study states that Rohingyas have developed their own coping mechanisms, in an attempt, to protect themselves against shifting risks posed by natural hazards. The null hypothesis is that no such coping mechanisms have been developed by the Rohingyas.

2. Methodology

2.1. Study area – Kutupalong Rohingya camp

The study area, Kutupalong Balukhali Expansion Site or here in short Kutupalong Rohingya Camp (located in between 21°10′20″ and 21°13′ north latitudes and in between 92°8′ and 92°10′15″ east longitudes), is bounded by Bandarban district on the northeast, Teknaf Upazila (sub-district) on the south, the Rakhine State (formerly known as Arakan) of

Myanmar on the east, and the Bay of Bengal on the southwest. The Kutupalong camp is the largest refugee settlement in the world which is sheltering over 40,000 Rohingya per square kilometre (e.g. population density of London, Tokyo, and New York cities are respectively 4542, 6263, and 10,194 per km^2). The study area is mostly composed of small hillocks and valleys. The surface geology is primarily composed of sandstone, clay and siltstone. The average temperature of CBD is 25.6 °C and the average annual rainfall is 4200 mm. The total area of the main Kutupalong camp is approx. 14.57 km^2 and around 30% and 17% of areas are highly susceptible to flooding and landslides, respectively. Camps 13, 17, and 19 were selected for this study (Fig. 2) because of their high exposure to different natural hazards [19–21]. For example, from April to November 2019, over 1400 landslide incidents impacted 3184 households, 499 wind/storm incidents impacted 10,127 households, and 68 flooding incidents impacted 5706 households across all camps. Overall, the incidents were responsible for 76 individual refugee injuries and 10 fatalities, and 3972 households were displaced [21]. Some basic information about the selected camps is described in Table 1.

2.2. Data collection and analysis

The study deployed a mixed-methods research strategy combining both quantitative household-based questionnaire survey and qualitative focus group discussions (FGDs) techniques. FGDs were conducted followed by the household questionnaire survey to verify the results obtained from the fieldwork. It is well-accepted that the integration of quantitative and qualitative data analysis is necessary to capture the overall vulnerability scenario of a community. While questionnaire surveying enables to extract information regarding socio-economic and demographic issues of a community, FGDs enable the participants to share their perception, knowledge and future plans [23].

First, household questionnaire surveying was conducted with the newly arrived adult Rohingyas (over 18 years old) who entered into Bangladesh following the August 2017 violence. The survey was administered face-to-face individually with 250 Rohingyas in camps 17 and 19 in order to acquire reliable primary data. A 'stratified random sampling' method (also known as a random walk process) was adopted in this research because it offers greater precision than a simple random or systematic sample. Only participants living on extremely vulnerable hill slopes or floodplains were selected by ensuring gender balance. The questionnaire consisted of both open and close-ended questions yielding quantitative data, highlighting Rohingyas' exposure to hazards, adopted ways to cope with shifting risks, organisational response to hazards, and the scopes and challenges of implementing good practice. A draft questionnaire was piloted and tested in April 2019. The first draft of the questionnaire had some issues related to redundancy, length, selecting appropriate options for different questions, adjusting cultural understanding and contextualisation. The overall testing performance was satisfactory. A revised questionnaire (see Appendix-I) was prepared for the final round of fieldwork which was carried out in May 2019. All the field surveyors were given the necessary training and background instructions prior to conducting the survey, covering issues such as the selection of survey participants, gender balance, due diligence, taking field notes, transcription and translations, risk assessment, research ethics, principles of reliability and validity, permissions, security and safety, unconscious bias, data protection, and professional code of conduct. Participants were informed about anonymity and project objectives, and their consent was sought beforehand. Fieldwork permissions were officially granted by the Office of the Refugee Relief and Repatriation Commission (RRRC) in Cox's Bazar. Five field surveyors (three males and two females) conducted the whole survey who were selected based on their fluency in Rohingya and Bengali languages, and successful completion of the training.

Second, two FGDs were conducted in camp 13 on February 16, 2020 to address the limitations in quantitative methods and validate the results obtained from the questionnaire survey. The FGD participants were
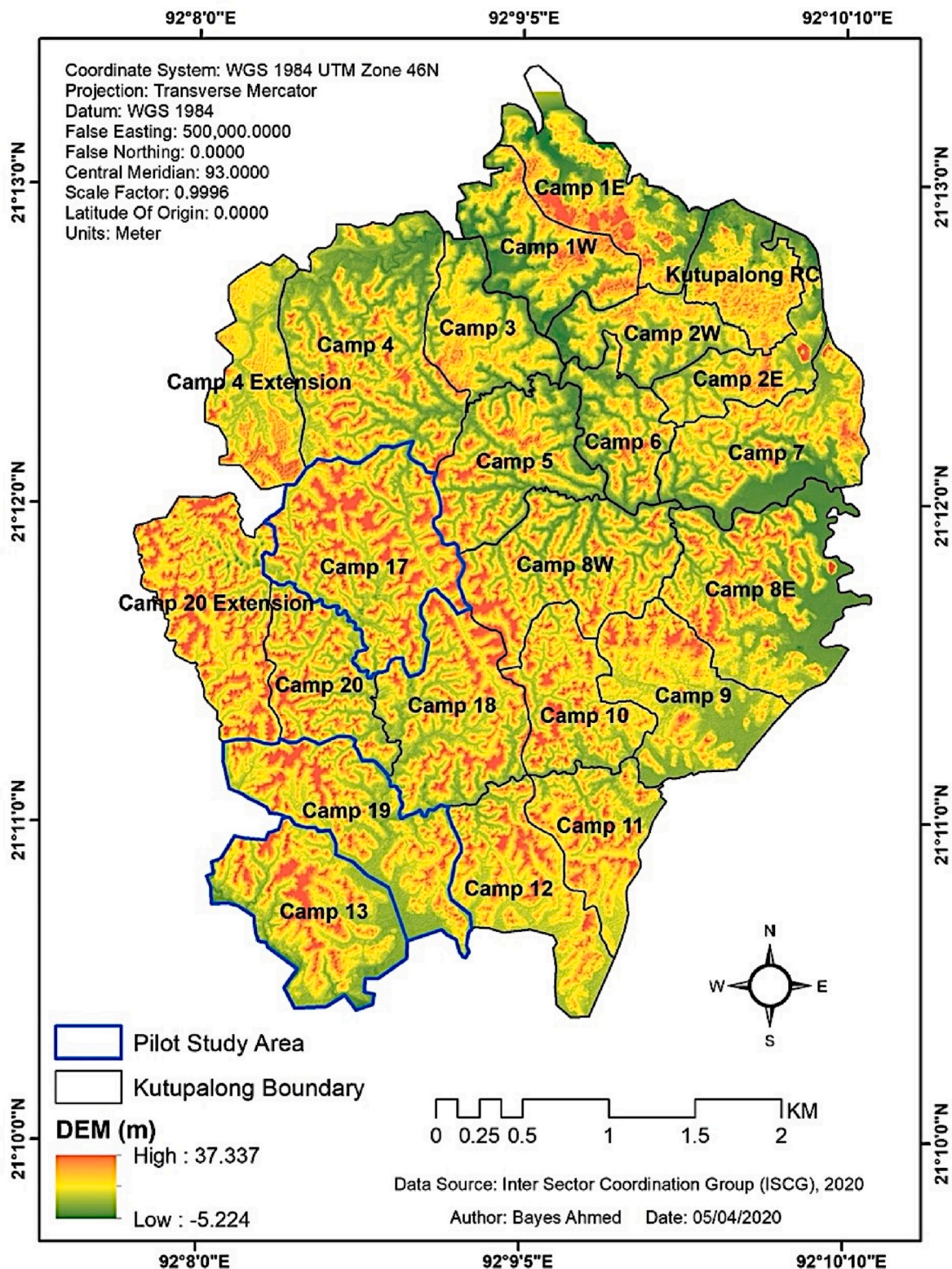
Fig. 2. Location map of the selected case study areas in the Kutupalong Rohingya Camp in CBD.

divided into men-only (aged between 35 and 50) and women-only (aged between 25 and 35) groups comprising ten and eleven members respectively. The reason behind forming gender-specific group was to understand their gendered experiences. Particular time schedule and suitable location were fixed beforehand. The FGDs were conducted in the Heath Management BD (HMBD) Foundation's premise inside camp 13 by maintaining all relevant fieldwork ethics and regulations. Two trained field enumerators (one male and one female) conducted the FGDs with the presence of HMBD doctors and nurses.

As the study involved human participation, institutional ethical approval (UCL project ID: 15,843/001, and data protection ID: Z6364106/2019/05/20) and risk assessment were in place before the commencement of the face-to-face questionnaire surveying and FGDs in the camps.

Table 1
Settlement profiling of the selected Rohingya camps in Cox's Bazar.

Camp information	Camp 13	Camp 17	Camp 19
Area (km^2)	0.75	0.95	0.77
Population (individuals)	41,770	17,534	20,833
Women and children (<18 years) [% of individuals]	75	76	78
Population density (individuals/km^2)	54,468	16,216	27,198
Average household size (individuals)	4.8	4.4	5
Families with persons of special needs (%)	29	30	29

Source: UNHCR, 2020 [22].

Responses from complete questionnaires were compiled preparing a database in SPSS software [24] and used for the statistical analyses. Test of two proportions, chi-square test of homogeneity (2 X C) and binomial logistic regression are three powerful statistical tests that were used in this study. The test of two proportions and chi-square test of homogeneity (2 X C) were used to determine whether the difference between the binomial proportions of independent variables on a dichotomous dependent variable is statistically significant or not. The basics of these two tests are mostly similar except the nature of dealing with the number of independent categories. Test of two proportions is applicable where the experiment demands to explore statistical significance between two independent categories [25,26], whereas the chi-square test of homogeneity (2 X C) is applicable if the independent variable contains three or more categories [25,27]. Binomial logistic regression is another test that was used to predict the probability that an observation falls into one of two categories of a dichotomous dependent variable based on one or more independent variables [28–30]. Binomial logistic regression proved to be the best fit for examining the type of interaction that was sought between the dependent and independent variables in this study. During the FGDs, detailed notes were taken in the Bengali language, and later it was translated into English for further analysis.

3. Results

3.1. Demographic characteristics of the respondents

3.1.1. Population

Of the 250 Rohingyas surveyed, 41% were male and 59% were female. Respondents' age ranged from 20 to above 50 years old. Nearly 48% of the respondents were aged between 20 and 30, while about 39% were aged between 31 and 50, and the rest of 13% were above 50 years old. Approximately 80% of the respondents were from Maungdaw township of Rakhine State; others were from Akyab, Buthidaung and
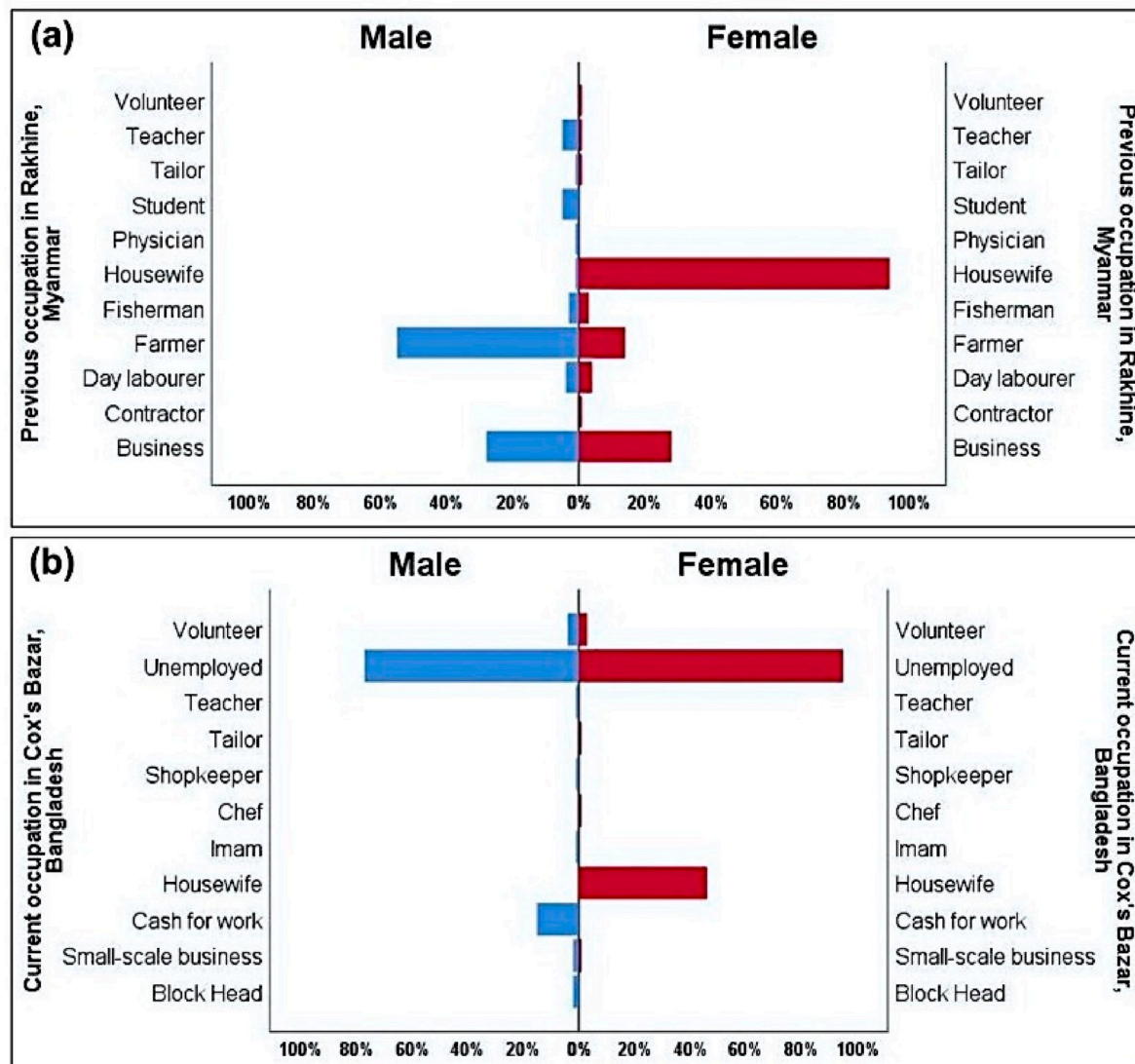

Fig. 3. The occupational pattern among the Rohingyas in (a) Rakhine State, Myanmar, and (b) in Cox's Bazar District, Bangladesh.

Rathedaung townships. Only 24% were literate which means that the literacy rate is very low in this community.

3.1.2. Economic activities

Rohingyas' primary source of income in Myanmar was agriculture and fishing. Other occupations were business, teaching, tailoring, day labouring, and so on (Fig. 3a). Male participants showed diversification in their livelihoods; while only a minority of women had varied livelihoods (e.g., farming, business) other than being a housewife. The average monthly income for those who did business or fishing was above 200,000 Kyat (Kyat is the currency of Myanmar; 1 USD = 1526 Kyat during this research). Other professionals, like physician, tailor, teacher and farmer had a monthly income of above 100,000 Kyat on an average.

In contrast, above 70% of men and 90% of women were found unemployed in the selected refugee camps (Fig. 3b) in CBD. Less than 20% of men were involved with 'cash for work' programmes run by the UN agencies or non-governmental organisations (NGOs). Both men and women described working as volunteers or running small-scale informal businesses. 'Block Head' *(Majhi* in Bengali*)* is a type of unpaid service with which male refugees were reported to be involved. The unemployed refugees are entirely dependent on aid, more specifically on food rations. The refugees, who have entered Bangladesh since August 2017, have not yet received any legal approval to work [31]. Such barrier to income generation has amplified their vulnerability to environmental disasters including communicable disease outbreak.

3.2. Rohingyas' perception of natural hazard exposure

Results suggest that more than 80% of the respondents came from Maungdaw township in Rakhine State. Around 62% of the respondents reported their exposure to cyclones, 45% to flooding (riverine and coastal) and only 2% stated their exposure to landslide hazards in Rakhine. During the FGDs, Rohingyas also recognised their low exposure to landslides in Rakhine as most of them lived in low-lying flat land. In contrast, Rohingyas are now highly exposed to rainfall-triggered landslide in the camps in CBD. The Rohingyas who participated in the survey confirmed three natural hazards to which they were vulnerable (Fig. 4), namely extensive rainfall, windstorm and landslides.

During the FGDs, Rohingyas living on steep slopes have expressed no fear to flash flooding but showed concern about the rainfall-triggered landslides. They gave credit to the spiritual power/almighty (Allah) for not having encountered any catastrophic cyclone in the last three years.
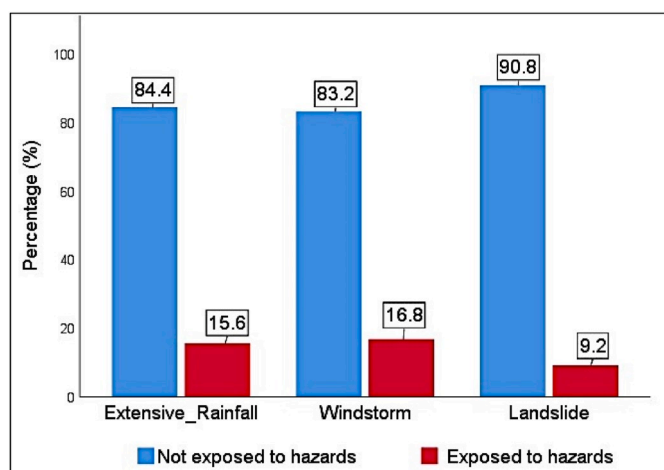
3.3. Adopted coping strategies by rohingyas

3.3.1. Coping strategies – adopted before the disaster

Rohingyas revealed through the survey that receiving an early warning message and acting accordingly, maintaining storage spaces above the ground to protect non-food items, storing of medicines and dry foods were a very common type of measures in preparation for a disaster. The study investigated whether demographic features such as age or education made an impact on adapting coping strategies or not.

Receiving and understanding early warnings among different age groups of Rohingya population produced mixed results. Respondents aged under 30 years old were more able to receive and understand early warning messages compared to other age groups (Fig. 5). A sensitivity analysis was conducted to split the respondents within several age clusters.

Using chi-square test of homogeneity (2 X C), the recorded proportional difference of receiving and understanding early warning messages within different age groups was found not to be statistically significant at the 0.05 level (p = 0.98). It indicates that irrespective of age groups, respondents had a similar ability in receiving and interpreting early warning messages. This hypothesis was supported by the fact that while in Rakhine, most Rohingya faced at least one type of natural hazard-induced disaster that taught them how to react after receiving early warnings in the event of a disaster [32]. While in Rakhine, about 58% of respondents of different age groups practised deliberate relocation to the nearest cyclone shelter or other *ad hoc* shelter (e.g., monastery, school) based on early warnings received. Apart from the relocation, they used to practise some other tactics in Rakhine based on the early warnings received, which they discussed in the FGDs. For instance, some of them used to take shelter on the higher ground before flooding and would come back to the plains after draining out of water. Again, some of them used to move all their furniture, kitchen utensils and necessary documents to the upper storey of a two-storied building before flooding.

The study also aimed at determining the impact of Rohingya literacy on the implementation of coping strategies before disasters. A binomial logistic regression model was used to predict the probability to store dried food before a disaster strikes based on Rohingya literacy status. It was important to know the overall model evaluation, the statistical significance of the individual predictors and validation of predicted probabilities to assess the soundness of the model [30] which are given in Table 2.

Rohingya literacy status was a significant predictor for storing dried foods as a coping mechanism before the disaster (p < 0.05). The logistic regression model was statistically significant ($\chi^2 = 19$). The model explained 10.8% (Nagelkerke R^2) of the variance in the storage of dried food and correctly classified 72.8% of cases. Sensitivity (the proportion
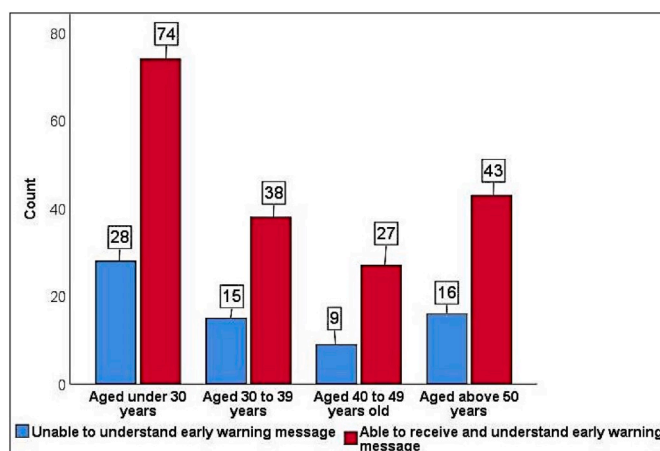

Fig. 4. Perception of the Rohingya towards hazards exposure in CBD, Bangladesh.

Fig. 5. The pattern of receiving and understanding early warning messages among various age groups in the Rohingya population in CBD.

Table 2

Binomial logistic regression analysis of 250 Rohingya referrals for the storage of dried foods based on their literacy status.

Predictor	B	S.E.	Wald's χ^2	df	Significance, p	Exp (B) (odds ratio)
Rohingyas' literacy status (literate = 1, illiterate = 0)	1.4	0.32	19	1	0.00	4.0
Constant	−1.4	0.18	57	1	0.00	0.7

of correctly classified events) was 43.5%, specificity (the proportion of correctly classified non-events) was 84%. The positive predicted value (the percentage of correctly predicted cases with the observed characteristic [29], i.e., participants responded as 'Yes' in case of storing dried food compared to the total number of cases predicted as 'Yes' in case of storing dried food in advance of the disaster) was 50.8% and the negative predicted value (the percentage of correctly predicted cases without the observed characteristic [29], i.e., participants responded as 'No' in case of storing dried food compared to the total number of cases predicted as 'No' in case of storing dried food in advance of the disaster) was 79.6%. Another important component is the odds ratio which deals with the change in the odds with the increase of one unit of the independent variable [29]. Here, for the Rohingya literacy status, an increase in one unit (i.e., being literate) increases the odds by 4. It means that the odds of storing dried food before disasters ('Yes' category) is 4 times higher for literate as against illiterate Rohingya (Table 2).

Similarly, another regression model was run to predict the probability of storing medicines in advance of disasters based on Rohingya literacy status. Results showed that the variable 'Rohingya literacy status' was statistically significant ($p < 0.05$). The logistic regression model was statistically significant ($\chi^2 = 79$). The model explained 39% (Nagelkerke R^2) of the variance in the storage of medicines before disasters and correctly classified 84% of cases. The sensitivity was 64%, specificity was 92%, the positive predicted value was 75%, and the negative predicted value was 87%. Literates have 19.5 times higher odds to exhibit storing medicines before disasters than illiterates.

3.3.2. Coping strategies – adopted during the disaster

The study also analysed how respondents perceived relocation to a safer shelter during the disaster period in the selected Rohingya camps. The majority of respondents were reluctant to evacuate to safer shelter; roughly 38% of them were willing to move in the case of any event. Further analysis indicated that literate Rohingya had the tendency to avoid relocation to safer shelters compared with their illiterate counterparts. Around 68% of literate Rohingya reported unwillingness to move to safer shelters/places while the figure was around 60% for the illiterate Rohingya.

Using the test of two proportions, the existing proportional difference between illiterate and literate Rohingyas in case of avoiding relocation was found to be not statistically significant at the 0.05 level ($p = 0.29$). This supported the hypothesis that irrespective of the literacy status, all the respondents were uncomfortable to leave their current shelter and relocate to a safer place during any disaster. Surveys revealed the reasons behind Rohingyas' tendency to avoid relocation to a safer shelter which include possible unsuitability of the relocation site, fear of losing the individual's own shelter, surrounding kinship bond, and weak relationship with the camp-in-charge and target population.

3.3.3. Coping strategies – adopted for the future disaster

The Rohingya respondents were asked about their perception of present shelter locations. About 94% of the respondents reported that they either live on unstable hilltops/slopes or at the edge of hills. Only 6% marked their shelter was located in safer zones. Among them, approximately 90% and 58% of respondents pointed out that their shelters are exposed to landslides and windstorms, respectively (Fig. 6).
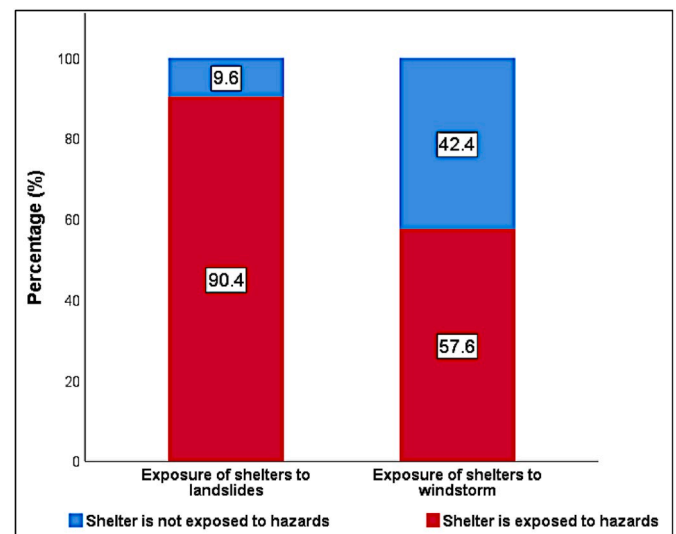

Fig. 6. Perception of Rohingya on shelters exposed to natural hazards.

Construction of permanent structures is strictly prohibited in the camps as instructed the Government of Bangladesh (GoB) and RRRC. Refugees' shelter condition was found unsatisfactory both in terms of living standards and structural integrity to withstand natural hazards. A number of humanitarian actors have initiated several steps for shelter improvements to protect the refugees. The distribution of emergency shelter kits (ESKs) and upgraded shelter kits (USKs) by humanitarian actors were ongoing in the camps. Each USK consists of 4 bamboo '*Borak*', 60 bamboo '*Mulli*' ('*Borak*' and '*Mulli*' are local categories of large and small-sized bamboos respectively, which are currently being used in the Rohingya camp for bamboo housing construction purpose), tarpaulin and ropes [13]. In this study, nearly 40% of respondents stated that they received USKs.

In addition, shelter tie-down kits (TDKs) were distributed on an emergency basis to provide additional strength to the shelters to withstand against the strong winds and cyclones. Each TDK consists of 60 m of 6 mm rope, steel pegs, 10 sandbags, printed infographic materials on how to use TDKs to secure shelters, and 2 pieces of waterproof plastic bags [13]. Around 70% of respondents of this study received shelter TDKs. During the FGDs, it was also found that while most of the refugees used TDKs, some of the recipients sold them to get some cash. Those who got TDKs used it in various ways to strengthen their shelters. For instance, respondents used the tie-down ropes to resist uplifting forces (Fig. 7a) from strong wind, placed bio-degradable sandbags at the edge of the cluster of shacks to prevent them from blown away (Fig. 7b), and used extra bamboos and plastic bags to reinforce the shelters to tackle monsoon rains and winds (Fig. 7c).

A binomial logistic regression model was run to predict the probability of respondents to use TDKs based on their capacity to receiving and interpreting early warning messages about upcoming disasters. Results showed that the variable 'receiving and interpreting early warning messages in the camp' was statistically significant ($p < 0.05$). The logistic regression model was statistically significant ($\chi^2 = 125$). The model explained 39% (Nagelkerke R^2) of the variance in the storage of medicines before the disasters and correctly classified 84% of cases. The model explained 55.7% (Nagelkerke R^2) of the variance in the use of TDKs and correctly classified 88% of cases. Sensitivity was 93.7%, specificity was 75%, the positive predicted value was 89.6%, and the negative predicted value was 83.8%. Rohingyas who were able to interpret early warning messages exhibited 44 times higher probability of using shelter TDKs than those who were unable to interpret the alerts.

Fig. 7. (a) Use of tie-down ropes to protect the roof of shelters from uplifting forces, **(b)** placement of the sandbags at the edge of fragile shelters to minimise the risk of blowing during a windstorm, and **(c)** use of extra bamboos and plastic bags to reinforce the shelters from the monsoon rain (Source: Fieldwork, May 2019).

3.4. Institutional cooperation

The stability of shelters in the hilly area is related to the stability of the hills itself. Respondents were asked about organisational strategies to stabilise the hills against rainfall-triggered landslides. They conferred some strategies that have been implemented in the camp such as placement of bamboos (Fig. 8a) and sandbags (Fig. 8b) on steep hill-slopes, construction of drainage system (Fig. 8c), retaining walls, large-scale mechanised work to level the steep hilltops, and plantation of vetiver grass across the hill slopes to avert soil erosion and the risk of landslides.

Around 85% of the participants stated that government officials take substantial measures to clear debris from roads or drainage system during the post-landslide period. Also, 84% of respondents did not get any DRR training. The participants in the FGDs reported that before the cyclone season, NGOs provided some training in the form of briefings. However, they wanted drill exercises in their blocks. Overall, participants expressed scepticism about the success of ongoing small-scale DRR training in the camp.

3.5. Perception of the Rohingya for future life

3.5.1. Relocation to Bhasan Char island

Space constraint in the refugee camp remains one of the greatest push factors increasing disaster vulnerability. Congested settlements, scarcity of open spaces, poor access to roads and other basic provisions, and restriction of movement are increasing disaster vulnerability. The availability of land has been expanded to a total of 6500 acres in the Ukhiya and Teknaf Upazilas [13]. Still, the GoB is struggling to resolve the overcrowded situation in the camp in order to meet basic international humanitarian standards for refugees. Relocation to safer places can only be a possible solution in such scenarios.

Bhasan Char Island (see Appendix-II) has been identified as a potential site to relocate around 100,000 refugees by the GoB. It is a 526-ha silted-up island floating in the Bay of Bengal and located in Hatiya Upazila of Noakhali District (22°22′05.68″ N and 91°22′38.96″ E, elevation -2m) in Bangladesh [13]. Nearly 88% of the respondents had heard about the relocation option to Bhasan Char Island. Approximately 6% of them were willing to move from their present location, and 4%

Fig. 8. Ongoing site development works **(a)** placement of bamboos, **(b)** sandbags to stabilise hill slope, and **(c)** construction of drainage system to channelize the flow of rainwater (Source: Fieldwork, May 2019).

were not sure about their decision. Those who wanted to relocate themselves to the island identified 4 factors that influenced their decision: access to safe drinking water, diversified income opportunities, permanent housing and more secured life in Bhasan Char than in Myanmar (Fig. 9). They believe that even though the island's situation is unfavourable, life on the island is much better than tolerating violence in Rakhine, Myanmar.

About 90% of respondents did not want to relocate in the island. They figured out 4 major factors (multiple answers were captured) in favour of their decisions: instability of the island, inappropriate for human settlement, adverse weather condition, and fear to lose surrounding neighbourhoods (Fig. 10).

3.5.2. Rohingya aspirations

A broader percentage (around 61%) of the respondents were inclined to repatriate to Myanmar with proper citizenship. Other top responses were access to proper housing, freedom of movement outside the camp, and access to diversified income opportunities (Fig. 11).

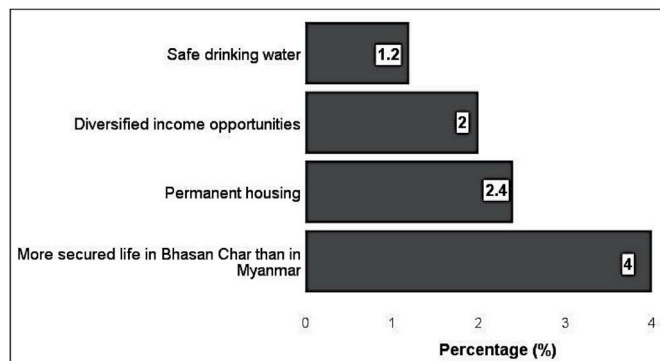Differences of opinion regarding repatriation to Myanmar between

Fig. 9. Perception of the Rohingya towards relocation to Bhasan Char in Noakhali district in Bangladesh.
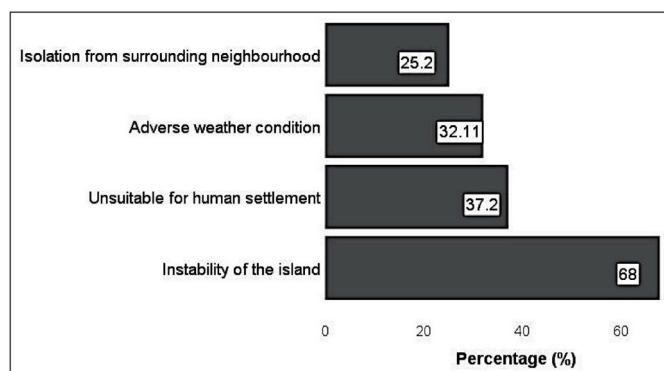
Fig. 10. Perception of the Rohingya in the context of avoiding relocation to Bhasan Char Island.

male and female groups emerged from the FGDs. Men emphasized on right to property, citizenship, justice, and freedom of movement. The women participants were very concerned regarding their safety and security in Rakhine. Similar findings were reported by the Department of Peace and Conflict Studies at the University of Dhaka in their recent publication on the 2017 Rohingya exodus [33].

4. Discussion

4.1. Narratives on existing scopes and challenges

Attempts to adapt to changing risks posed by natural hazards has become an integral part of Rohingyas' life since moving from the plain land in Rakhine to the mountainous regions in CBD. The findings clearly demonstrate a positive correlation between disaster coping strategies and literacy level of Rohingya refugees. Regression analysis shows that the educated community is far ahead compared to the illiterate community in dealing with disasters by adopting various strategies. Similar results were found by Ronan et al. (2010) who reported that youth involved in the hazards education programme had an increased level of disaster risk perception [34]. Mishra and Suar (2007) established that people having prior disaster education and experience were more prepared to tackle flooding and heatwave events in Orissa, India [35].

Education is essential to make the Rohingya community resilient to disasters. However, above 30% of children (aged 3–14 years) and 83% of adolescents and youths (aged 15–24 years) still do not have access to any

educational or skills development activities [13]. No formal education is permitted in the camps, and the learning centres neither follow the Bangladesh nor the Myanmar curriculums. In January 2019, the GoB has approved the UN partners to provide informal education through a newly designed programme known as the Learning Competency Framework and Approach (LCFA). The LCFA covers English and Burmese language, mathematics, life skills and science across levels 1 to 5. But more than 90% Rohingya children do not have learning competencies at LCFA grades 3 or above [13]. Some of the obstacles are socio-cultural norms of restricting girls' mobility after puberty (purdah), allocation of learning centres in highly disaster-prone zones, difficulties in achieving education facilities, and absence of educated Rohingya learning facilitators [13]. The humanitarian actors are addressing these issues by emphasizing on sustainable learning approaches, including the establishment of new learning centres, mainstreaming weather and disaster management related issues in learning materials, and alternative learning modalities (i.e., home-based learning, mobile learning, radio-based teaching) [13]. Marlowe and Bogen (2015) found that young people from refugee backgrounds in New Zealand can be leaders in DRR within their communities [36], which necessitates proving wider DRR education and training among the Rohingya children and adolescents.

The culture of using shelter strengthening kits and the involvement of humanitarian actors in distributing those kits suggest that institutional cooperation enables Rohingya to involve in DRR initiatives. Being able to understand the early warning message means to get a clear idea about the severity of the imminent disaster. Rohingya who got access and capacity to interpret early warning messages were most likely to use TDKs to increase the robustness of their shelter to withstand against natural hazard-induced disasters. Receiving early warning messages about impending disasters in time requires improved access to information systems, which is being addressed by the Communication with Communities Working Group [13].

4.2. The necessity of adopting improved DRR strategies

It should be noted that the Inter Sector Coordination Group (ISCG), in close association with the GoB, manages all the 117 active project partners and 160 currently ongoing projects in the Rohingya refugee camps in CBD. The Natural Hazard Risk Analysis Taskforce (NatHaz TF) operating under the ISCG produces and validates hazard maps, and provides guidelines on DRR strategies. The study reveals that about 84% of respondents did not receive any DRR training in the selected camps.
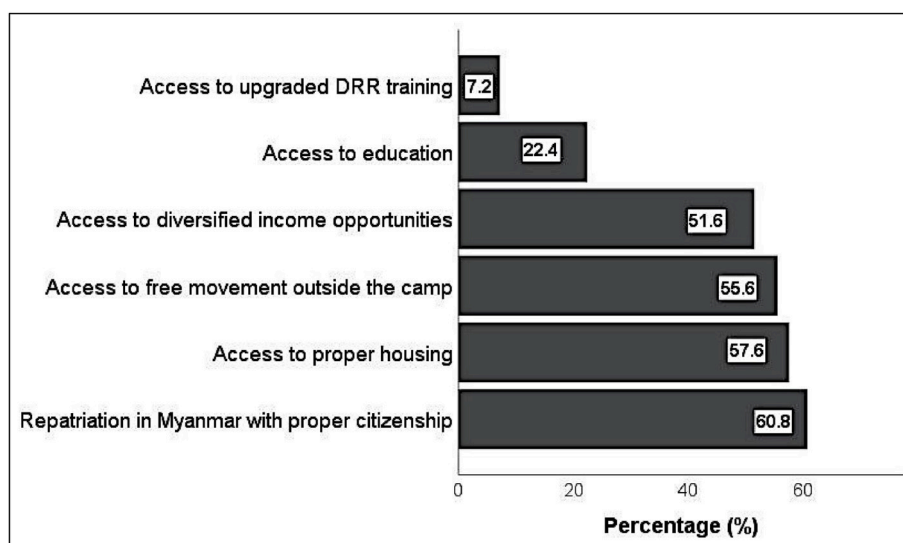

Fig. 11. Key priorities addressed by the Rohingya for the betterment of their future life.

There exists a growing necessity to integrate DRR and emergency preparedness through a community-based approach. The JRP 2020 reports that only 3% of shelters meet desired performance standard, 20% of households are benefitting from treated bamboo, and 0% of households have updated multi-hazard operational plan [13]. The 'Preparation and Contingency Plan' proposed by the JRP 2020 is based on a scenario where most camps and displaced Rohingyas are likely to be threatened by the landfall of a Category-1 cyclone in CBD. Conceptually it is a continuing process where the community learns how to respond to early warning, where to seek assistance and how to keep themselves protected during the disaster period. The simulation exercise plan also highlights prevailing limitations regarding evacuations. One limitation is that construction of permanent or semi-permanent structures for the purpose of evacuation, like cyclone shelters is strictly prohibited at any part of the camp [21]. Refugees are obliged to use transitional shelters or other types of houses for the evacuation purpose which are not robust as like a permanent cyclone shelter.

4.3. Strategies to deal with relocation and repatriation

Considering all the constraints stated above, the GoB decided to transfer about 100,000 Rohingyas to the island of Bhasan Char although there are many arguments for and against this proposition. The project with a construction cost of US$ 268.84 million has been implemented on Bhasan Char which includes facilities like concrete built houses, flood prevention systems, cyclone shelters, potable water and solar power systems, livelihood opportunities (fishing, agriculture, and raising livestock), hospital, police and fire station, and office premises for the partners [13]. However, about 90% of the respondents in this survey did not want to be relocated to Bhasan Char. The island is distinctively vulnerable in terms of its formation with silt, uneven ground with mangroves and flat land, frequent change of shoreline over the past 20 years, and extreme threats of cyclones, flooding and storm surges [13]. Some of these issues were raised by the respondents as a major cause to avoid relocation to Bhasan Char.

The respondents were also asked about how they aspire in the long-term for a better future. The answer to this question expresses their ultimate desire for repatriation to Myanmar. As per the signatory of the Memorandum of Understanding (MoU) between UNHCR and Bangladesh on April 13, 2018, no Rohingya are allowed to return until conditions in Myanmar are conducive for them. Rohingya return to Myanmar has to be voluntary, safe, dignified and sustainable in line with international standards. Failure of the recent repatriation plan on August 22, 2019 suggests that still, Rohingya are in fear of facing torture and violence in Myanmar [37].

4.4. New developments

The overall disaster context in the Rohingya camps in CBD is dynamic and scenarios change quite frequently. The GoB and humanitarian agencies have undertaken a number of emergency preparedness initiatives (as updated on March 2020) in each camp – such as the formation of a disaster management committee, identifying temporal communal shelters (existing learning centres) and emergency back-up distribution sites, reinforcing critical infrastructure, prepositioning adequate emergency shelter stock (tarpaulins, ropes and floor mats), providing emergency rapid food assistance, mapping infrastructure and services in high-risk zones, protection messaging and awareness-raising, ensuring minimal disruption to critical services like health, water, sanitation, and hygiene (WASH), and protection, and continued training for temporary learning centre facilitators, teachers and students [38].

The novel Coronavirus (COVID-19) pandemic is another major concern for the Rohingya refugees in CBD, as they do not have freedom of movement, are living in exceedingly overcrowded camps, and the existing health centres are not equipped with necessary testing and treatment facilities (e.g. intensive care unit, oxygen supply and

ventilators, and personal protective equipment for health workers). The COVID-19 outbreak, in addition to natural disasters, would result in a severe humanitarian crisis. As instructed by the UN COVID-19 Global Humanitarian Response Plan [39], the GoB, ISCG and partners are advancing with the construction of an isolation and treatment centres, reducing activities to essential services and assistances only, promoting hygiene activities, training healthcare workers, and ensuring social distancing inside the camps [40]. Few refugees were tested positive, but still, no major outbreak is reported. As of June 1, 2020, the entire CBD including the camps are now locked down, and no Rohingya is even allowed to move between two camps until further notice. The super cyclone Amphan made landfall on May 20, 2020, in the west-coast of Bangladesh, but it damaged hundreds of shelters partially and some minor flooding and land erosion events were reported. No casualties were reported because of intensive preparedness.

Unprecedented deforestation and indiscriminate hill cutting activities took place in CBD to build makeshift shelters and supply cooking materials (wood) for the Rohingya refugees. Because of it, nearly 5800 ha of forest land cover disappeared [41] that has also increased landslide disaster risk significantly. To address this matter, the partners are now providing liquid petroleum gas (LPG) cylinders and refilling them monthly. Almost 92% of Rohingya households are now covered under this scheme for the purpose of cooking and household-level lighting [13]. The GoB is also considering to initiate the Myanmar national curriculum framework in 2020 to ensure more formal education for the Rohingya children and adolescents and facilitate their sustainable repatriation in Myanmar [13].

Regarding the Rohingya relocation to Bhasan Char, the GoB is not insisting to implement the plan as it will be voluntary. The UN desires to assess the overall situation in Bhasan Char in terms of its safety and sustainability, exposure to natural hazards, freshwater availability and the standard of protection facilities. As of today, there is no further progress on the UN assessment and the decision of relocating the Rohingyas is halted [13]. In the meantime, on March 23, 2020, the GoB has instructed low-income Bangladeshi citizens, who are unable to maintain their livelihood in urban or rural areas, to take refuge or use the facilities in Bhasan Char amid the growing threats of Coronavirus (COVID-19) outbreak.

4.5. Recommendations

To withstand during the cyclone and monsoon season (May to October), immediate steps should include strengthening and reinforcing refugees' makeshift shelters and critical infrastructures. In the short-term, wider level and continuing education should be in place to promote good practices, skill development training and education on DRR.

This is a protection crisis, and the Rohingya refugees especially women and girls face extreme gender-based violence, many of them are subject to human trafficking, and the Rohingyas' top priorities are shelter materials, food, clean drinking water, fuel and electricity [13]. Therefore, in the long-run, it is necessary to safeguard them, continue life-saving assistance, promote peaceful co-existence with host communities, and achieve sustainable solutions in Myanmar to create an environment for their voluntary, dignified, and safe repatriation.

Fig. 12 illustrates Rohingyas' physical, social, economic, environmental, cultural and institutional dimensions of vulnerability to environmental hazards. The outcomes validate that disasters are not exclusively natural [42]. It is the (flawed) decision making process and blending of complex socio-economic and socio-cultural aspects [43] that are accountable for converting hazards into catastrophic disasters. The decision-makers, camp-in-charge (CiC) and emergency managers should have in-depth knowledge on the root-causes of disaster vulnerability for achieving a sustainable solution them.
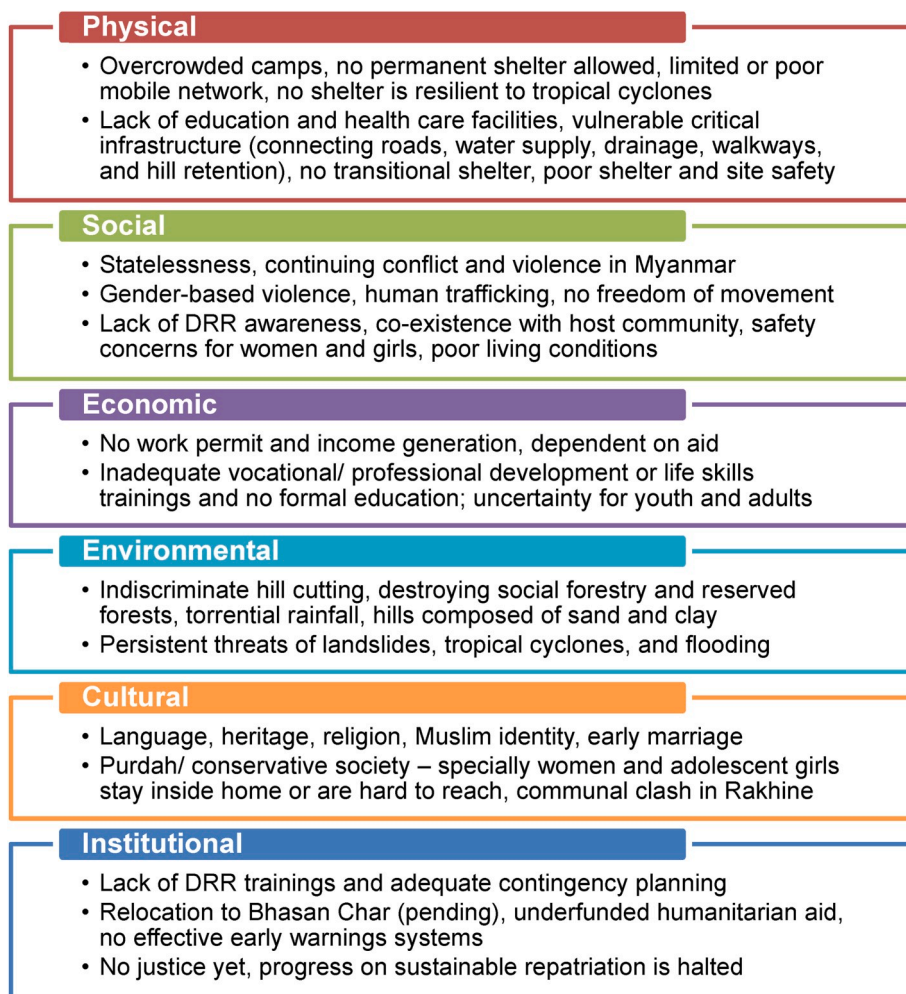
Physical

- Overcrowded camps, no permanent shelter allowed, limited or poor mobile network, no shelter is resilient to tropical cyclones
- Lack of education and health care facilities, vulnerable critical infrastructure (connecting roads, water supply, drainage, walkways, and hill retention), no transitional shelter, poor shelter and site safety

Social

- Statelessness, continuing conflict and violence in Myanmar
- Gender-based violence, human trafficking, no freedom of movement
- Lack of DRR awareness, co-existence with host community, safety concerns for women and girls, poor living conditions

Economic

- No work permit and income generation, dependent on aid
- Inadequate vocational/ professional development or life skills trainings and no formal education; uncertainty for youth and adults

Environmental

- Indiscriminate hill cutting, destroying social forestry and reserved forests, torrential rainfall, hills composed of sand and clay
- Persistent threats of landslides, tropical cyclones, and flooding

Cultural

- Language, heritage, religion, Muslim identity, early marriage
- Purdah/ conservative society – specially women and adolescent girls stay inside home or are hard to reach, communal clash in Rakhine

Institutional

- Lack of DRR trainings and adequate contingency planning
- Relocation to Bhasan Char (pending), underfunded humanitarian aid, no effective early warnings systems
- No justice yet, progress on sustainable repatriation is halted

Fig. 12. Multi-dimensional disaster vulnerability in the Kutupalong Rohingya Camp, Cox's Bazar District.

5. Conclusion

The study aims to find out how Rohingya are coping with extreme weather events, such as floods, heavy rains, landslides, and windstorms in the Kutupalong camp in Cox's Bazar District. The results show some preventive and impact minimising strategies developed and adopted by the Rohingyas to withstand disasters. These include practices in the individual household (e.g., receiving multi-hazard early warning messages and acting accordingly, maintaining storage spaces above the ground to protect non-food items, storing medicine and dry foods before any impending disaster) to collective efforts (e.g., strengthening shelters by means of shelter improvement kits distributed by the humanitarian actors). Furthermore, slope stabilisation works such as placement of bamboos or sandbags on the hillslopes, construction of retaining walls and drainage, implementation of mechanised work to level steep hilltops, and plantation of vetiver grass are some examples undertaken to make the camps resilient to natural hazards. It is understood that Rohingyas have adopted several risk mitigation strategies to sustain their existence with the paradigm of shifting risks posed by natural hazards. Consequently, the study gets enough evidence to accept the alternative hypothesis of this study.

The study has three major contributions in the field of DRR. First, it provides a solid baseline on how a refugee community in a humanitarian context might differ compared to other grassroot communities in terms of coping with disasters. Second, it contributes in achieving some of the priorities outlined by the Sendai Framework for Disaster Risk Reduction (understanding disaster risk) [44], and the UN Sustainable

Developments Goals (ensuring education for all, leaving no one behind, promoting peaceful and inclusive societies, and making cities and human settlements resilient) [45]. Lastly, the findings and recommendations would support the Government of Bangladesh, United Nations and humanitarian stakeholders to identify some of the gaps in mitigating disaster risks from extreme natural hazards in the Rohingya camps in Bangladesh.

Declaration of competing interest

The authors have no competing interests to declare.

enter the Rohingya camps in Cox's Bazar. We are also indebted to the respective Rohingya refugees and members of the host communities for assisting us on numerous occasions.

Appendix-A

Appendix-I. Questionnaire for the household survey in the Rohingya camps in Cox's Bazar, Bangladesh

Survey date:
Survey time:
Survey location (camp and block number):
Survey reference number:

| Household location | I. *Landslide* risk zone |
| | II. *Flood* risk zone |

GPS location of the household
Photo identity number

SECTION A – DEMOGRAPHIC INFORMATION

1. What is your gender?
    I. Male
    II. Female
    III. Other, please specify

2. Specify your:
  Education (class) or illiterate?
  Where you live in Burma?
  (Village, District/state)
  Previous occupation (in Rakhine)
  Your avg. monthly income in Rakhine (in Kyat):
  Current occupation (if any)
  If not, mention no work/not allowed to work/unemployed

3. Specify your age (year) –

4. When did you arrive in Bangladesh?

SECTION B – ROHINGYA REFUGEES′ PERCEPTION ON NATURAL HAZARDS AND DISASTER RISK REDUCTION (DRR)

5. Have you ever faced any natural disaster in Rakhine?
    I. Yes
    II. No

6. If yes, what were the natural disasters to which you were exposed in the Rakhine state of Burma? [You can choose more than one option]
    I. Extreme rainfall
    II. Flooding
    III. Windstorm
    IV. Landslide
    V. Others, please specify
    VI. All of the above

7. What protective measures you had undertaken at that time in Rakhine to tackle disaster-
    I. I had received education on 'Disaster Risk Reduction (DRR)'
    II. I got access to early warning systems and was able to interpret the message
    III. I used the nearest cyclone shelter or other ad-hoc disaster shelters (i.e., monasteries, madrasa, schools) for evacuation purpose
    IV. I stayed at my house when it was waterlogged
    V. I was, totally, dependent on humanitarian assistance
    VI. I was involved in reforestation and managing mangroves
    VII. Others, please specify

8. Have you faced any natural disasters while staying in the Cox's Bazar refugee camp?
    I. Yes
    II. No

8.1 If Yes, can you tell me what was that?
    I. Extreme rainfall
    II. Flooding
    III. Windstorm
    IV. Landslide
    V. Others, please specify
    VI. All of the above

9. Do you receive timely early warning (i.e., cyclone/Rainfall) message about upcoming disaster?
    I. Yes
    II. No

10. Do you have any storage space (wooden-framed loft or shelf) above the ground where you can keep your Non-food items protected in case of waterlogging? Non-food items are blankets, floor mats, firewood, kitchen sets, winter clothing, etc.
    I. Yes
    II. No

11. Do you store dried food in an advance before the disaster (i.e., cyclone/rainfall)?
    I. Yes
    II. No

12. Do you store medicines in an advance before the disaster?
    I. Yes
    II. No

13. Specify your shelter location after coming to Bangladesh this time-
    I. In the low-lying area
    II. On the steep, unstable hillside
    III. At the edge of the hill
   IV. In a fairly well-inhabited place

(*continued*)

	V. Safer from natural hazards
13.1 Do you think, the location of your shelter is prone to hazard?	I. Yes
	II. No
13.2 If Yes, which hazard your shelter is susceptible to?	I. Flooding
[you can choose more than one option and Please mark with circles]	II. Landslides/soil erosion
	III. Strong wind
	IV. Waterlogging
	V. All of the above
	VI. Others, please specify
13.3 If you are offered to be relocated to a safer place (to avoid natural disaster),	I. Yes.
would you leave your current home?	II. No.
13.4 If Yes, What will be the type of evacuation shelter?	I. Robust emergency shelters (in Camp 20 extension)
	II. Community shelter (Mosque)
	III. Safe place plain Land
	IV. Others, specify please
13.5 From whom you expect rapid assistance regarding this evacuation procedure?	I. Blockheads
	II. Government
	III. Camp officials
	IV. NGO officials
	V. Community volunteers
	VI. Neighbours.
	VII. Others, please specify
14. Have you received tarpaulins, rope, bamboo, timber, wire, sandbag and a tool kit to	I. Yes
strengthen shelter before upcoming monsoon?	II. No
14.1 If Yes, how did you use those materials to rebuild shelters? [You can choose more than one option]	I. Raising plinth level above flood-level
	II. Substituting rickety shelters with a reinforced structure using extra bamboos.
	III. Placing sandbags at the edge of a cluster of shacks
	IV. All of the above
	V. Others, please specify
15. Have you received and used rope, steel pegs, sandbags, IEC Material and plastic bags to	I. Yes
provide extra security to the shelters against winds and rain?	II. No
16. Are you aware of the landslide risk in the camp?	I. Yes
	II. No
17. Which of the following measure has been taken in the camp to prevent the threat of landslides?	I. Building bamboo-reinforced footpaths and stairs across the slope
	II. Deploying sandbags over the slope-ground
	III. Constructing irrigation ditches to divert water flow over the slopes
	IV. Constructing retaining walls
	V. Preventing the construction of shelters in hazard areas
	VI. Planting trees and grass
	VII. Levelling some of the steep hilltops
	VIII. All of the above
	IX. Others, please specify
18. Do government take any measures to clear the debris from roads/drains after the disaster?	I. I. Yes
	II. II. No
19. Have you got any disaster risk reduction (DRR) training?	I. I. Yes
	II. II. No
19.1 If Yes, who is the training body?	I. Government
	II. International Organization for Migration (IOM)
	III. UN Refugee Agency (UNHCR)
	IV. Caritas Bangladesh and Catholic Relief Services (CRS)
	V. Others, please specify
20. Overall, are you satisfied with the undertaken DRR initiatives in the camp?	I. Yes
	II. No
	III. Not sure

SECTION C – ROHINGYA REFUGEES′ PERCEPTION ON CURRENT LIFE-STANDARD IN COX'S BAZAR REFUGEE CAMP AND RELOCATION TO BHASHAN CHAR, HATIYA UPAZILA, NOAKHALI DISTRICT, BANGLADESH

21. Have you heard about relocating to Bhasan Char Island?	I. Yes
	II. No
21.1 Are you or your family voluntarily willing to move in the island?	I. Yes
	II. No
	III. Not sure
21.2 If Yes, what are the reasons for taking the decision to relocate to Bhasan Char?	I. Permanent structured house
	II. Deep tube-wells
	III. Availability of flood defence embankment and cyclone shelter
	IV. The ground floor of both living places and cyclone shelters are above high tide level
	V. Diversified income opportunities
	VI. Island life is far better than to return Myanmar without citizenship
	VII. All of the above
	VIII. Others, please specify

(*continued*)

21.3 If No, Why you do not want to go there?	I. Unsuitable for human habitation
	II. Erratic weather
	III. Short-lived island which can be washed away by tidal surges
	IV. Isolation from neighbourhoods
	V. All of the above
	VI. Others, please specify
22. Are you satisfied in living here in the camp?	I. Yes
	II. No
22.1 If yes, why? What additional benefits are you getting in the camp?	I. More peaceful and secure than our habitats in Rakhine
	II. I receive aids from humanitarian agencies
	III. I receive food without doing any work
	IV. We are treated here with dignity; not as an illegal immigrant or danger
	V. All of the above
	VI. Others, please specify
22.2 If no, why? What were the benefits in Rakhine?	I. Property
	II. Access to formal schooling
	III. Access to health facilities
	IV. Employment
	V. It was our own land
	VI. All of the above
	VII. Others, please specify
23. What else could be provided to make things better for you?	I. Repatriation with proper citizenship of Myanmar
	II. Freedom of movement in Bangladesh
	III. If proper housing is provided, I will stay in Bangladesh
	IV. Access to schooling in Bangladesh
	V. Diversified livelihood opportunity
	VI. More upgraded DRR training
	VII. All of the above
	VIII. Others, please specify

Appendix-II. Chronological development of settlements (2016–2020) in the Bhasan Char Island in Bangladesh.Source: Google Earth Images, 2020
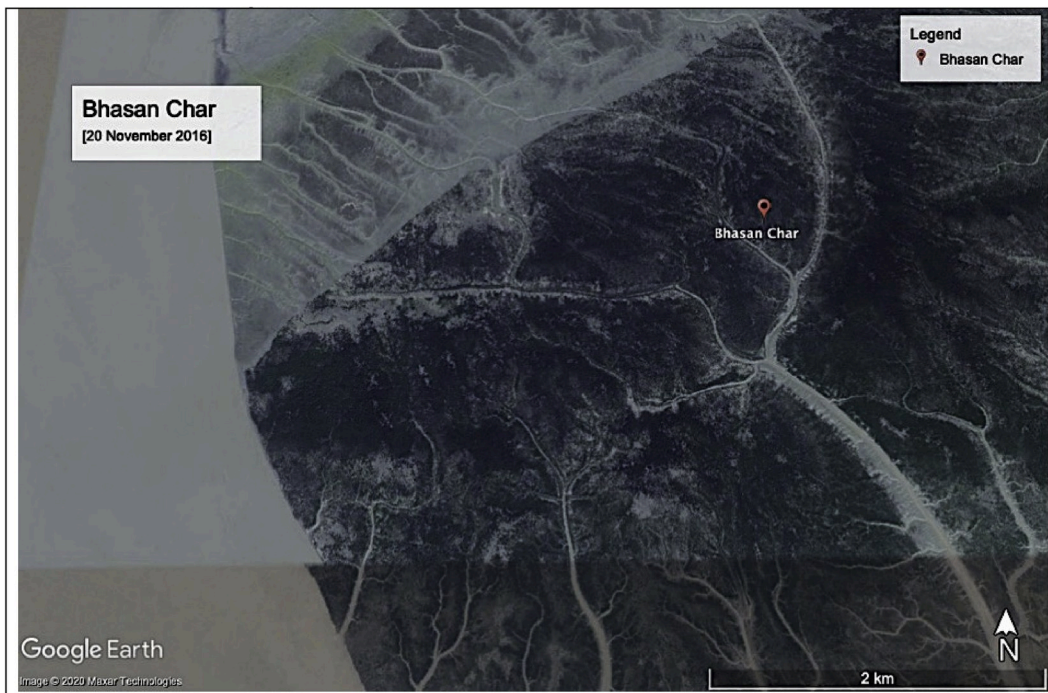
(*continued*)

Appendix C. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijdrr.2020.101694.

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