Evacuation dilemmas of coastal households during cyclone Amphan and amidst the COVID-19 pandemic: a study of the Southwestern region of Bangladesh

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Abstract
Cyclone Amphan battered the coastal communities in the southwestern part of Bangladesh in 2020 during the COVID-19 pandemic. These coastal communities were experiencing such a situation for the first time and faced the dilemma of whether to stay at home and embrace the cyclone or be exposed to the COVID-19 virus in the cyclone shelters by evacuating. This article intends to explore individuals’ decisions regarding whether to evacuate in response to cyclone Amphan and in light of the risks of the COVID-19 pandemic. Consequently, this study investigated evacuation behaviors among the households and explored the impacts of COVID-19 during the evacuation procedures. We conducted household surveys to collect primary information and undertook 378 samples for interviews at a precision level of 0.05 in fourteen villages. Despite the utmost effort of the government, the results demonstrated that 96.6% of people in the coastal area received a cyclone evacuation order before the cyclone’s landfall, and only 42% of people followed the evacuation order. The majority of households chose to stay at home because of fear of COVID-19 exposure in the crowded shelters. Although half of the evacuees were housed in cyclone shelters, COVID-19 preventive measures were apparently not set in place. Thus, this study will assist in crafting future government policies to enhance disaster evacuation plans by providing insights from the pandemic that can inform disaster management plans in the Global South.

Keywords Evacuation decision · Cyclone Amphan · COVID-19 · Coastal communities · Bangladesh

1 Introduction
Understanding the complexity of human behavior before and during disaster is of paramount importance for countermeasures, preparedness, and recovery efforts by providing suitable and accessible sites for the evacuees, appropriate shelters, and emergency supplies.
(Yabe et al. 2019). Human decisions drastically change as emergencies progress and are influenced by multiple factors, ranging from risk perception to the source of early warning information (Morss et al. 2016; Hasan et al. 2011). Evacuation scenarios vary with the type of disaster, such as cyclones, tsunamis, and earthquakes. Despite the importance of the evacuation decision during disasters, few efforts have analyzed or predicted the factors influencing individuals’ choices to evacuate (Yabe et al. 2019; Lee et al. 2018). As a result, it is critical to consider the individual’s perception regarding available options for cyclone evacuation procedures during a pandemic (i.e., COVID-19). Although the scholarship of disaster management during the pandemic is limited, the literature has found some approaches to warrant further investigation:

- Stakeholders’ shared responsibilities should be prioritized during the evacuation that would protect the lives of evacuees and staff associated with the management regimes during disasters. In the time of an ongoing pandemic, responsible stakeholders may face trade-offs between saving people’s lives from disasters and curbing the risks of spreading COVID-19. The evacuation decision can be considered as a way of comparing the risks of flooding against the risks of spreading COVID-19 (Ishiwatari et al. 2020).

- Local communities are required to engage in the evacuation procedures while sharing the risk in a timely fashion. During the ongoing pandemic, relevant knowledge regarding COVID-19 mitigation measures has been limited; thus, appropriate plans for disseminating evacuation measures are crucial to avoid the spread of rumors and misinformation (Ishiwatari et al. 2020; Ahasan et al. 2020).

- Local communities or community-based organizations might play an effective role in managing disasters amid the pandemic. In New Orleans, Evacuteer (i.e., a nonprofit organization) normally prioritized providing assistance to residents as they evacuated during a disaster. However, the organization shifted operational priorities in managing the hurricane Ida amid the COVID-19 pandemic to stockpiling foods and supplies. It recognized the risks of exhausted local food and medical supplies during the pandemic. Also, the Mississippi River Cities and Towns Initiative (i.e., a coalition of mayors and leaders) had procured personal protective equipment before flooding took place so that they could immediately distribute those items to the citizens in the case of a flood event during the pandemic (Abkowitz 2020).

- A few studies considered that vacant hotel rooms and college dormitories might be used as evacuation shelters (e.g., Southeast of the USA during the tornado in April 2020). Also, the American Red Cross revised its playbook for sheltering people after considering social distancing in its management plans. Instead of opening new shelters during the pandemic, the Red Cross collaborated with hotels to accommodate hundreds of storm victims. Through this decision, volunteers’ safety was ensured as the emergency response had been coordinated from home (Abkowitz 2020).

Bangladesh is uniquely vulnerable to cyclone disasters because of its geographical setting, funnel-shaped exposure to the Bay of Bengal, high population density, and limited infrastructural supports to protect the coastal regions (Alam and Chakraborty 2021). According to Parvin et al. (2019) and Haque et al. (2012), approximately 6–10% of the global tropical cyclones and 40% of Great Danger Signal No. IX at the Bay of Bengal, which is responsible for 42% of tropical-cyclone-associated deaths in Bangladesh. Though Bangladesh has successfully reduced the number of deaths caused by cyclones and storm surges recently, the COVID-19 pandemic situation urges an increase in deaths. Therefore,
it is essential to analyze the evacuation scenarios available for disaster management during the pandemic. On March 8, 2020, Bangladesh reported its first three cases of COVID-19 and imposed an indefinite nationwide lockdown from March 26 (Kariul et al. 2020). With the dispersion of COVID-19 at an exponential rate and a sudden stagnation of all economic activities due to the subsequent lockdown, Bangladesh was already struggling, and its disaster resilience was fragile. During the pandemic, Amphan (i.e., a category-5 hurricane) made landfall on the evening hours of May 20, 2020, through the Sundarbans between Bangladesh and West Bengal with a wind speed of about 190 km/h, along with storm surges of up to 5 m (i.e., 17 ft) (Ellis-Petersen and Ratcliffe 2020; Mishra and Vanganuru 2020). The Meteorological Department of Bangladesh (BMD) issued the highest possible warning (i.e., Great Danger Signal No. IX, X) in the low-lying coastal districts to evacuate approximately two million people in two days (Reliefweb 2020). During the pandemic, the evacuation advisories provided by the government have had an immense impact on the personal decision of community members to evacuate immediately. Under normal circumstances, volunteers are in place to assist residents in evacuating quickly. However, the pandemic has made it difficult for people to decide whether to evacuate or stay at home. Therefore, it is critical to study the evacuation behavior of people when there are 21,145 active COVID cases and the super cyclone of the century is raging at the door.

Studies such as Paul (2009), Ahsan et al. (2016), Roy et al. (2015), Saha and James (2017), and Parvin et al. (2019) endeavored to understand the dynamics of evacuation systems during tropical cyclone events in coastal areas of Bangladesh. These studies evaluated evacuation scenarios in coastal Bangladesh from cyclone Bhola (1970) to cyclone Roanu (2016) and identified an improved evacuation framework over time. Cyclone Bhola was the deadliest tropical cyclone in the world, which caused nearly half a million casualties and first indicated the huge evacuation problems of coastal communities. Frank and Hossain (1971) reported less than 1 percent of coastal people took refuge in the safe shelter, and the scholars identified a failure in warning and citizens’ tendency to underestimate the potential danger as the major causes of non-evacuation during cyclone Bhola. Later, Paul et al. (2010) studied the evacuation behavior during cyclone Gorky (1991) and reported a higher rate of evacuation when comparing it with previous events. He found that around 26.7% of people were evacuated during cyclone Gorky. These studies identified flaws in early warnings and cyclone shelter-related issues, such as inadequate and crowded shelters, and the long-distance of the shelters from citizens’ homes, as major reasons behind non-evacuation. Studies on cyclone Sidr (2007) demonstrated an improved warning system in place that successfully evacuated almost 60% of people before the cyclone’s landfall, as indicated by Paul (2010, 2012) and Uddin (2010). Along with cyclone shelter and early warning issues, these studies identified non-evacuees’ choices to not evacuate during cyclone Sidr as related to fear of burglary, religious orthodoxy, false sense of safety at home, etc. After cyclone Aila hit coastal Bangladesh in 2009, Ahsan et al. (2016) and Parvin et al. (2019) also examined the factors that discouraged people from complying with the evacuation orders by conducting focus group discussions and administering questionnaire surveys. The majority of these studies effectively illustrated the evacuation scenarios of previous cyclone events in Bangladesh; however, super-cyclone Amphan was considered unique because it took place during the COVID-19 pandemic (Vinoj and Swain 2020; Mishra and Vanganuru 2020). Thus, a study of the evacuation scenarios during the super-cyclone Amphan would reveal the impact of the pandemic on evacuation decisions and destinations for vulnerable populations. Therefore, this paper aims to investigate the factors influencing evacuation decisions before cyclone Amphan, which took place amidst the pandemic, in the study area. Consequently, this study identified a few emergency planning implications.
based on empirical analysis and findings that might assist stakeholders and policymakers in devising judicious emergency preparedness and mitigation measures in future.

2 Concept and context

2.1 Human risk perception dimension and cyclone hazard

Human risk perception is a crucial predictor of disaster preparedness, evacuation, and mitigation strategies and which is shaped by social, cultural, religious beliefs, and familiarity with hazards (Peacock et al. 2005). Risk perception varies widely depending on geographical and cross-cultural settings (Lee et al. 2015). Considering the disaster vulnerabilities of Bangladesh, several studies have highlighted the dimensions of human risk perception of cyclone hazards. Sattar and Cheung (2019) consider a cyclone risk perception index using 10 indicators from the familiarity/experience of hazards. Ayeb-Karlsson (2020) focuses on the gender dimension of risk perception in coastal Bangladesh. Ayeb-Karlsson et al. (2019) identify variation of social and cultural perception of disasters in Bangladesh. Paul et al. (2010), Paul (2012), Ahsan et al. (2016), Parvin et al. (2019), and Uddin (2010) explain how human perception influences the evacuation decision of individuals. During the COVID-19 pandemic, Alam and Chakraborty (2021) investigated COVID-19 risk perception and its relationship with evacuation decisions in coastal Bangladesh. Considering the importance of risk perception on cyclone hazard, we have reviewed the relevant literature and identified the risk perception factors active in previous cyclone events. We then included the factors in our questionnaire to extract information related to non-evacuation decisions taken by the families and individuals in our study area.

2.2 COVID-19 scenario and preparedness measures during cyclone Amphan

Though COVID-19 was first detected in December 2019 in China, Bangladesh identified its first three cases on March 8, 2020. Since then, the country has faced an unprecedented crisis of exponential infection and death rates. To hinder the transmission of COVID-19 in the country, the government first declared a country-wide lockdown and imposed travel restrictions from March 26, 2020. Also, the government imposed measures such as the National Preparedness and Response Plan (NPRP) to limit the transmission of COVID-19 and to lessen its impact on the country’s health, wellbeing, and economy. Consequently, the government set up the COVID-19 emergency operation center to coordinate nationwide preparedness and response activities jointly with the Diseases Control Unit of the Directorate General of Health Services (DGHS) and the Institute of Epidemiology Disease Control and Research (IEDCR). The initiative started testing the samples and provided daily updates of COVID-19 infections in the country. Up to the end of April 2020, 17 laboratories and 18 hospitals were equipped to test samples and offer treatment to the infected patients, which was insufficient for 160 million people (Rahaman et al. 2020). Moreover, the healthcare services available in these hospitals were inadequate in light of the insufficient number of doctors and nurses. As a result, on May 16, 2020, when super-cyclone Amphan originated in the Bay of Bengal, the country was already in the community transmission phase, with around 21,145 active total cases (Fig. 1) (WHO, 25 May 2020b). The daily infection and death tolls of COVID-19 before and after cyclone Amphan are summarized in
The government had to make the challenging decision of evacuating 5 million coastal people to accommodate them in approximately 12,000 cyclone shelters in light of the social distancing rules of COVID-19 (Kelman and Ahmed 2020). The Cyclone Preparedness Programme (CPP) volunteers and evacuees were requested to follow appropriate protective measures while in the cyclone shelters.

### 3 Study area

We considered one of the coastal districts of Bangladesh (i.e., Satkhira) as our study area. On the evening hour of May 20, 2020, the ‘super cyclone’ Amphan made landfall in West Bengal, India. The cyclone then entered Bangladesh during the night through the Satkhira district, with 60–90 km/h wind speeds and high tidal inundation (NAWG 2020). The cyclone destroyed approximately 50 embankments and inundated more than 100 villages in Satkhira (ibid.). According to BMD, the Satkhira district anticipated the route of cyclone Amphan (Jahan and Sal 2020). As a result, before the landfall, the highest early warning and massive evacuation plans were made in Satkhira. Even prior to this cyclone event, the district had suffered from many socio-economic issues, including severe poverty, high population density, illiteracy, and inaccessibility to basic amenities because of its remoteness (Alam et al. 2019).

The total administrative area of the Satkhira district is reported as 3817.29 sq. km. (e.g., a 1632.00 sq. km. area is forested.) with 7 Upazila, 2 Paurashava, 79 unions, and 1436 villages (BBS 2014). The district is composed of a flat landscape that is surrounded by the world’s largest mangrove forest—the Sundarbans (a UNESCO heritage site). Furthermore, the West Bengal state of India is located on the west side, and the Bay of Bengal is on the southern side (Fig. 2 for details). The latest population census has summarized that the total population of Satkhira district is around 754,097, with a male–female ratio of 1.01, a population density of 198 per sq. km., and a 52.07% literacy rate (BBS 2014). As the devastation of the cyclone has been tangible, it is important to investigate the evacuation...
scenarios undertaken during the pandemic. For this, we have opted to randomly choose two villages in each Upazila (the region hosts a total of 14 villages in 7 Upazila) to conduct the study (Fig. 2).
4 Methods

In this study, we employed a method comprised of a (1) literature review, (2) structured interview survey to residents, and (3) geospatial analysis. The details of these procedures are as follows.

4.1 Literature review

We conducted an in-depth literature search to establish the relationships among cyclone evacuation procedures, early warning systems, people’s perception in understanding the threats of super cyclones, the governance system, volunteer’s involvement, and the impacts of the ongoing COVID-19 pandemic. Additionally, we collected local and regional newspapers (both in English and Bengali), census information from the Bangladesh Bureau of Statistics (BBS), published and unpublished research reports, scientific articles, and government documents highlighting the evacuation need and methods that were adopted during the pandemic.

4.2 Structured interview survey

Structured interviews and unstructured consultations with the Amphan-hit communities were the key primary sources of information in this study. The interviews included a few specific questions regarding the socio-economic information of the respondents, COVID-19 risk perception, understanding the early warning systems, familiarity of evacuation procedures, choices of evacuation routes and shelters in the nearest proximities, and reasons of either evacuating or not. In collecting the primary information, we adopted a systematic sampling method. The sampling procedures were performed in two stages: (1) selection of the number of villages and (2) determining the appropriate number of interviewees. We then finalized the questionnaire through a sequential process such as a literature review, discussion with community members, and reconnaissance survey for checking the consistency and uniformity of the questionnaire. Table 1 demonstrates the details.

We conducted the survey in fourteen villages during June 2020, where an individual respondent was considered the primary sampling unit. We interviewed twenty-seven households from each village using KoBoToolbox to ensure the data quality. The nationwide lockdown and restriction on mobility were a few challenges we encountered for collecting data, and therefore, a ‘random walk’ practice, as suggested by the World Health Organization (WHO 2011), was used to select households for the interviews. Note that to assess the validity of the questionnaire, a scale-level content validity index method (S-CVI/Ave) was employed in this study. In developing the S-CVI/Ave, a panel of 10 professionals were asked to evaluate the relevance of each question on a 4-point Likert scale, where 1 referred to “irrelevant” and 4 indicated “very relevant.” Using the Microsoft Excel platform, the opinions of ten experts were evaluated to measure the validity of the selected 26 questionnaire items. The result of the content validity index (S-CVI/Ave) was 0.83, which a good fit (Fig. 3 for details).

1 A panel of ten disaster risk management (DRM) professionals from Asian Disaster Preparedness Center (ADPC), Bangladesh was selected to validate the results. They were asked to evaluate the relevance of each question on a 4-point Likert scale where 1 referred to irrelevant, and 4 indicated very relevant.
4.3 Characteristics of the interviewees

The distribution of the interviewees’ social characteristics is summarized in Table 2. It appears from this table that a small proportion (5.82%) of the interviewees are sixty-one years old or above (i.e., senior citizens). The respondents are mostly distributed among the age groups of those between 31–45 years (51.32%), 46–60 years (27.77%) and 18–31 years (15.07%). While conducting the household survey, we prioritize household heads for the interview. As most households in the region are headed by males, the proportion of male respondents (i.e., 70.1%) is comparatively higher than that of female interviewees (i.e., 29.9%). Also, a majority of the respondents are Muslim (94.7%), and the rest are distributed among other religions, including Hinduism (4.8%) and Christianity (0.5%). Furthermore, Table 2 shows that a negligible percentage of the respondents are unmarried (0.52%), whereas 97.35% of the households are married. The remaining 2.11% of the respondents are widowed, separated, or divorced. Most of the interviewees are self-employed and involved in the fish processing industry, the wood business, shopkeeping, etc. Another 24.1% of the respondents are involved in agriculture; this includes fish cultivation, crab farming, poultry farming, agricultural product cultivation, etc. Furthermore, a few interviewees are involved in services (15.3%) or other industries (25.4%) (e.g., cobbler, social services, non-governmental organizations, etc.). Interestingly, 24.1% of respondents have attended primary schools, and many had dropped out at some point in primary school (i.e., grades 1 to 5). Many of the respondents (33.3%) are illiterate and have never attended formal schools, whereas 24% of respondents have completed primary education. Around 10.8% have attended secondary school (grades 6–10) but dropped out without completing their degree. A small portion (8.7%) have passed secondary school certificate examination or achieved a higher level of qualification. A very few interviewees (3.1%) have completed their undergraduation.

Table 1 Distribution of the number of households interviewed in different villages. 
Source: BBS (2014)

| Upazila      | Village  | Total households | Sample households |
|--------------|----------|------------------|-------------------|
| Kalaroa      | Boddipur | 487              | 27                |
|              | Sonabaria| 1515             | 27                |
| Satkhira Sadar| Narayonjol| 397              | 27                |
|              | Fingri   | 1381             | 27                |
| Tala         | Nagarghata| 2997             | 27                |
|              | Jiala Nalta| 732             | 27                |
| Kaliganj     | Hogla    | 216              | 27                |
|              | Mautala  | 2096             | 27                |
| Dehhata      | Kulia    | 2182             | 27                |
|              | Parulia  | 800              | 27                |
| Assasuni     | Budhata  | 1462             | 27                |
|              | Pratap Nagar| 1736           | 27                |
| Shaymnagar   | Gabura   | 1460             | 27                |
|              | Burigoalini| 1444            | 27                |
| Total        |          | 18,905           | 378               |
4.4 Index to calculate trustworthiness Index

To measure the perceived trustworthiness of different sources of the evacuation order, respondents were asked to provide a score for each component using a Likert Scale, where 5 referred to “high trust” and 1 meant “no trust” of that source. Therefore, using the Garrett (1924) ranking method, we summarized the trustworthiness score. The equation adopted for evaluating the relative importance of trustworthiness assigned to the evacuation order by the respondents is provided in Eq. 1. The results demonstrated that
the level of trust in the sources of the evacuation order might have a relationship with the respondents’ evacuation behavior (see Table 3).

Relative Importance Index (R) = \[
\sum \left[ (r_1 \times f_1) + \ldots + (r_n \times f_n) \right] / \left( A \times N \right)
\]  

\[ (1) \]

Here \( r \) = individual rank given by the respondent, \( f \) = frequency, \( n \) = number of components identified, \( N \) = number of total respondents, and \( A \) = highest weight (i.e., 5).

### 4.5 Geospatial analysis

We collected geographic information system (GIS) datasets to investigate the distance of the nearest cyclone centers, alternative access roads, nearest waterbodies (e.g., canals,
Table 3 The contrast between respondent evacuation status and socio-demographic profile

| Indicator                  | Evacuee         | Non-evacuee | Chi-square | Effect size (Cramer’s V/Phi) |
|---------------------------|----------------|-------------|------------|-----------------------------|
| Age                       |                |             |            |                             |
| Less than 30 years        | 21(36.8%)      | 36(63.2%)   | $\chi^2 = 16.991$, $df = 3$, sig = 0.001** | $V = 0.212$ |
| 30–45 years               | 66(34%)        | 128(66%)    |             |                             |
| 45–60 years               | 60(57.1%)      | 45(42.9%)   |             |                             |
| Greater than 60 years     | 12(54.5%)      | 10(45.5%)   |             |                             |
| Gender                    |                |             |            |                             |
| Male                      | 107(40.4%)     | 52(46.0%)   | $\chi^2 = 1.034$, $df = 1$, sig = 0.309 | $\phi = -0.052$ |
| Female                    | 158(59.6%)     | 61(54.0%)   |             |                             |
| Religion                  |                |             |            |                             |
| Muslim                    | 148(41.3%)     | 210(58.7%)  | $\chi^2 = 4.209$, $df = 2$, sig = 0.122 | $V = 0.106$ |
| Hindu                     | 11(61.1%)      | 7(38.9%)    |             |                             |
| Christian                 | 0(0%)          | 2(100%)     |             |                             |
| Education                 |                |             |            |                             |
| Illiterate                | 67(53.2%)      | 59(46.8%)   | $\chi^2 = 24.683$, $df = 6$, sig = 0.001** | $V = 0.256$ |
| Class I–V                 | 41(45.1%)      | 50(54.9%)   |             |                             |
| Class VI–X                | 30(40%)        | 45(60%)     |             |                             |
| SSC or equivalent         | 10(24.4%)      | 31(75.6%)   |             |                             |
| HSC or equivalent         | 5(15.2%)       | 28(84.8%)   |             |                             |
| Honors or equivalent      | 6(60%)         | 4(40%)      |             |                             |
| Master’s or equivalent    | 0(0%)          | 2(100%)     |             |                             |
| Number of family member   |                |             |            |                             |
| 3 Members                 | 16(50%)        | 16(50%)     | $\chi^2 = 1.087$, $df = 3$, sig = 0.780 | $V = 0.054$ |
| 4 Members                 | 61(42.7%)      | 82(57.3%)   |             |                             |
| 5 Members                 | 54(40.6%)      | 79(59.4%)   |             |                             |
| > 5 Members               | 28(40%)        | 42(60%)     |             |                             |
| Marital status            |                |             |            |                             |
| Married                   | 153(41.6%)     | 215(58.4%)  | $\chi^2 = 5.054$, $df = 2$, sig = 0.08 | $V = 0.116$ |
| Unmarried                 | 0(0%)          | 2(100%)     |             |                             |
| Widow/divorced            | 6(75%)         | 2(25%)      |             |                             |
| Occupation                |                |             |            |                             |
| Agriculture/farming       | 49(53.8%)      | 42(46.2%)   | $\chi^2 = 13.960$, $df = 3$, sig = 0.003** | $V = 0.192$ |
| Business                  | 61(45.9%)      | 72(54.1%)   |             |                             |
| Service                   | 34(35.4%)      | 62(64.6%)   |             |                             |
| Others                    | 15(25.9%)      | 43(74.1%)   |             |                             |
| Household ownership       |                |             |            |                             |
| Yes                       | 158(43.10%)    | 209(56.90%) | $\chi^2 = 5.054$, $df = 1$, sig = 0.025** | $\phi = 0.116$ |
| No                        | 1(9.10%)       | 10(90.90%)  |             |                             |
| Household type            |                |             |            |                             |
| Pucca                     | 3(6.3%)        | 45(93.8%)   | $\chi^2 = 100.651$, $df = 3$, sig = 0.001** | $V = 0.516$ |
| Semi-pucca                | 30(21.4%)      | 110(78.6%)  |             |                             |
| Katcha                    | 102(63%)       | 60(37%)     |             |                             |
| Wooden house              | 24(85.7%)      | 4(14.3%)    |             |                             |
| Vehicle ownership         |                |             |            |                             |
| Yes                       | 39(34.8%)      | 73(65.2%)   | $\chi^2 = 3.425$, $df = 1$, sig = 0.064 | $\phi = -0.095$ |
| No                        | 120(45.1)      | 146(54.9%)  |             |                             |
| COVID awareness           |                |             |            |                             |
| Yes                       | 123(45.2%)     | 149(54.8%)  | $\chi^2 = 3.967$, $df = 1$, sig = 0.04** | $\phi = 0.102$ |
| No                        | 36(34%)        | 70(66%)     |             |                             |
rivers, ponds), and possible inundation areas. This information was collected from reliable government sources, Khulna University’s research cell at Urban and Rural Planning Discipline, and local municipalities. Note that, we obtained the GIS shape files by using a Universal Traverse Mercator (UTM) projection system.

Table 3 (continued)

| Indicator                      | Evacuee | Non-evacuee | Chi-square | Effect size (Cramer’s V/Phi) |
|--------------------------------|---------|-------------|------------|-------------------------------|
| Cattle ownership               |         |             |            |                               |
| Yes                            | 124(48.1%) | 134(51.9%)  | $\chi^2 = 11.999$, df = 1, $\text{sig} = 0.001^{**}$ | $\phi = 0.178$ |
| No                             | 35(29.2%)  | 85(70.8%)   |            |                               |
| Land ownership                 |         |             |            |                               |
| Yes                            | 152(45.8%) | 180(54.2%)  | $\chi^2 = 15.489$, df = 1, $\text{sig} = 0.001^{**}$ | $\phi = 0.202$ |
| No                             | 7(15.2%)   | 39(84.8%)   |            |                               |
| Child below 6 years            |         |             |            |                               |
| Yes                            | 51(40.5%)  | 75(59.5%)   | $\chi^2 = 0.195$, df = 1, $\text{sig} = 0.658$ | $\phi = -0.23$ |
| No                             | 108(42.9%) | 144(57.1%)  |            |                               |
| Old (60+)                      |         |             |            |                               |
| Yes                            | 65(31.7%)  | 140(68.3%)  | $\chi^2 = 19.712$, df = 1, $\text{sig} = 0.001^{**}$ | $\phi = -0.228$ |
| No                             | 94(54.3%)  | 79(45.7%)   |            |                               |
| Previous cyclone experience    |         |             |            |                               |
| Yes                            | 158(43.2%) | 208(56.8%)  | $\chi^2 = 5.786$, df = 1, $\text{sig} = 0.016^{**}$ | $\phi = 0.0124$ |
| No                             | 1(8.3%)    | 11(91.7%)   |            |                               |
| Previous storm surge experience|         |             |            |                               |
| Yes                            | 150(80.6%) | 36(19.4%)   | $\chi^2 = 223.670$, df = 1, $\text{sig} = 0.001^{**}$ | $\phi = 0.769$ |
| No                             | 9(4.7%)    | 183(95.4%)  |            |                               |
| Year of living                 |         |             |            |                               |
| Less than 5 years              | 0(0%)     | 4(100%)     | $\chi^2 = 22.860$, df = 4, $\text{sig} = 0.001^{**}$ | $V = 0.246$ |
| 5 to 10 years                  | 1(33.3%)  | 2(66.7%)    |            |                               |
| 10 to 15 years                 | 0(0%)     | 7(100%)     |            |                               |
| 15 to 20 years                 | 1(4.5%)   | 21(95.5%)   |            |                               |
| More than 20 years             | 157(45.9%)| 185(54.1%)  |            |                               |
| Income                         |         |             |            |                               |
| <5000 BDT                      | 0(0%)     | 3(100%)     | $\chi^2 = 7.467$, df = 3, $\text{sig} = 0.058$ | $V = 0.141$ |
| 5000–10,000 BDT                | 54(42.9%) | 72(57.1%)   |            |                               |
| 10,000–20,000 BDT              | 105(43.4%)| 137(56.6%)  |            |                               |
| 20,000–30,000 BDT              | 0(0%)     | 7(100%)     |            |                               |

$N=378$, Significant variables are marked with (**)

Results of some indicators such as age, gender, education, religion, and income are also presented in Alam and Chakraborty (2021)
5 Results

5.1 Socio-economic characteristics and evacuation behavior

During natural disasters, an individual’s choice to evacuate or not is associated with his/her socio-economic characteristics (Ersing et al. 2020; Burnside et al. 2007). Therefore, nineteen socio-economic variables are listed in Table 4 regarding the evacuation status of the respondents. A chi-square test (i.e., in determining a variable’s independence with $\alpha = 0.05$) is used here to analyze whether the evacuation behavior of the respondent is related to the socio-economic variable or not. The chi-square test is statistically significant for 12 out of 19 variables (shown in Table 4). According to the chi-square test results, gender, religion, number of family members, marital status, vehicle ownership, children below six years of age, and income are statistically insignificant. The significant variables are age, education, occupation, household type and ownership, COVID-19 awareness, land and cattle ownership, elderly population, previous cyclone and storm surge experience, and number of years lived.

Furthermore, to assume the influence of each variable on the respondent’s evacuation decision, the Phi coefficient and Cramer’s V analysis have been applied. Phi coefficient is a measure for the strength of an association between two categorical variables in a $2 \times 2$ contingency table (Prematunga 2012). In contrast, Cramer’s V is an alternative to Phi for tables bigger than $2 \times 2$ (Grimm 1993). Akoglu (2018) classifies the Phi coefficient and Cramer’s V value; the values he obtained indicate very strong, strong, moderate, and weak associations, respectively. According to the Phi/Cramer’s V value shown in Table 4, previous storm surges, household type, and education variables are strongly associated with the evacuation decision of the respondent during cyclone Amphan. Moreover, number of years lived, respondent’s age, land ownership, cattle ownership, and occupation have a strong relationship with the decision of the respondent to either evacuate or stay. It is also evident from the Phi coefficient value that a respondent’s awareness about COVID-19 spread played a moderate role in evacuation behavior during cyclone Amphan.

Table 4 Ranking the trustworthiness of evacuation orders and associated sources

| Sources             | High trust (5) | Moderate trust (4) | Neutral (3) | Low trust (2) | No trust (1) | Total | A*N Score | Rank |
|---------------------|----------------|--------------------|-------------|--------------|-------------|-------|-----------|------|
| Radio               | 465            | 540                | 435         | 10           | 0           | 1450  | 1890      | 0.77 | 6    |
| TV                  | 835            | 532                | 234         | 0            | 0           | 1601  | 1890      | 0.85 | 2    |
| Newspaper           | 790            | 532                | 261         | 0            | 0           | 1583  | 1890      | 0.84 | 3    |
| Mosque              | 850            | 684                | 111         | 0            | 0           | 1645  | 1890      | 0.87 | 1    |
| Social media        | 450            | 524                | 447         | 16           | 0           | 1437  | 1890      | 0.76 | 7    |
| Siren and Miking    | 330            | 404                | 513         | 58           | 11          | 1316  | 1890      | 0.70 | 9    |
| Friends/relatives   | 310            | 920                | 258         | 0            | 0           | 1488  | 1890      | 0.79 | 5    |
| NGO/CBO             | 280            | 552                | 477         | 28           | 11          | 1348  | 1890      | 0.71 | 8    |
| CPP volunteers      | 165            | 1316               | 48          | 0            | 0           | 1529  | 1890      | 0.81 | 4    |
5.2 Real and expected evacuation order scenario

The evacuation order is the final stage of the early warning systems issued by BMD; it is issued at least 10 h prior to when the cyclone landfalls (Parvin et al. 2019). In this study, respondents have been asked to explain the evacuation procedures in detail. The analysis (see Fig. 4 for details) suggests that 96.6% of the respondents in Satkhira district had received an evacuation order, which supports the previous findings of Ahsan et al. (2016). Also, 56.6% of respondents received the evacuation order 3–6 h before landfall, and 27.5% of respondents received the order 3 h before landfall.

Furthermore, more than half of the respondents (63.8%) prefer to receive an evacuation order within 6–12 h before the cyclone landfalls (Fig. 4). Consequently, 31.5% of respondents prefer receiving the evacuation order within 3–6 h before the landfall.
5.3 Sources of evacuation order

Cyclone warning and evacuation orders from the government usually reached the people through multiple sources, including government officials, media, and community volunteers (Walch 2018). We found that friends, relatives, and neighbors (61.9%) were the leading sources of receiving evacuation orders during cyclone Amphan, followed by mosques (55.37%), social media (46.05%), and television (37.85%) (Fig. 5 for details). Interestingly, some respondents reported that electricity outages and mobile network issues hindered the distribution of information through television, mobile phone, and internet. Thus, they relied on mosques and social connections to receive the evacuation order.

5.4 Trustworthiness of the evacuation order source

Based on the Henry Garrett method (Eq. 1), this study ranks the trustworthiness of the evacuation order sources (Table 5) as received from mosques, television, newspaper, CPP volunteers, friends, relatives, and neighbors. Consequently, we have included the reasons for respondents’ mistrust of the source of the evacuation order, as determined by our use of open-ended questions, and we have categorized the responses based on their content (Fig. 6 for details). From the responses, it is evident that failure of appropriate warning in the previous cyclone is the leading cause of mistrust. Inaccurate, exaggerated, risk unspecific, and misleading warnings in the previous cyclones are the
major factors behind the ‘Crying Wolf Syndrome’ impacting the coastal communities. Due to the inefficiency of experts and authorities (41.3%) and enormous corruption (39.4%), people have lost their confidence in evacuation orders. Some respondents (32.3%) complained about the political polarization of community organizations, institutions and the media, which reduced the social acceptance of those organizations. Moreover, yellow journalism in electronic/print media (29.1%) and rumors spread through unmonitored social media (27.8%) have significantly reduced public trust in evacuation orders.

### 5.5 Preparation time for evacuation

Though the evacuation order was issued 10 h before the landfall, we observed that people received it about 3–6 h before cyclone Amphan struck. Therefore, the public had little time to evacuate. People started to leave their houses at the last moment when the weather conditions turned to the worst. Interestingly, we found that the respondents who complied with the evacuation order had left home around 0–2 h before the landfall. A few of them had left home when the storm struck and heavy rainfall triggered
flash floods. Moreover, the average preparation time of men was 108 min (SD = 32), whereas women required 143 min (SD = 43) to evacuate. Interestingly, we found that women required more evacuation time, as they were responsible for ensuring the safety of children and the elderly, household chores, assets, and the household's belongings, including livestock and poultry. Additionally, women prepared food and ensured access to valuable assets (e.g., jewelry, cash, clothing, etc.) to bring along to the evacuation centers. It was evident that 77.4% of evacuees were aware of the COVID-19 risks, and therefore, they brought COVID-19 safety kits (e.g., face mask, hand sanitizer, and hand soap) to the cyclone shelters. Note that assembling the COVID-19 safety kits required a few extra minutes and thus delayed evacuation procedures.

### 5.6 Evacuation destinations

Based on our investigation, we found that 42.06% of the respondents were evacuated to a safe place during cyclone Amphan. According to Tables 6 and 7, 50.9% of evacuees chose cyclone shelters as their evacuation destination. Approximately 40% of evacuee women took shelter in their neighbor’s or relative’s house during cyclone Amphan. Also, we found that Shaymnagar (91.74%), Assasuni (90.74%) and Upazila (i.e., closest to the Bay of Bengal) had the highest evacuation rates, whereas no one in Kalaroa Upazila evacuated.

### 5.7 Modal choice during evacuation

Figure 7 shows that most of the evacuees reached the shelters on foot (40.3%) or in vans (37%). In contrast, most of the evacuees returned home by walking (62.9%) or by boat (16.4%) after the cyclone. In fact, the flash flood inundated several areas and evacuees used boats to return home.

### 5.8 Availability of COVID-19 preventive facilities for evacuees

This study investigated the availability of COVID-19 protection facilities in the shelters. About 92.6% of the respondents mentioned that there were no COVID-19 kits available
### Table 8  Cyclone shelters’ capacity and service area in Satkhira district

| Upazila name | Total area | Total population | Number of cyclone shelter | Capacity of cyclone shelters | Served area (1.5 km buffer) | Area served (%) | % of Population served |
|--------------|------------|------------------|---------------------------|-------------------------------|-----------------------------|-----------------|------------------------|
| Assasuni     | 378.05     | 268,754          | 8                         | 4750                          | 52.39                       | 13.86           | 1.77                   |
| Debhata      | 175.34     | 125,358          | 6                         | 6125                          | 41.62                       | 23.74           | 4.89                   |
| Kalaroa      | 232.82     | 237,992          | 0                         | 0                             | 0.00                        | 0.00            | 0.00                   |
| Kaliganj     | 326.10     | 274,889          | 11                        | 9390                          | 77.64                       | 23.81           | 3.42                   |
| Satkhira     | 397.75     | 460,892          | 14                        | 14,271                        | 98.53                       | 24.77           | 3.10                   |
| Shaymnagar   | 1543.43    | 318,254          | 39                        | 31,875                        | 265.77                      | 17.22           | 10.02                  |
| Tala         | 334.87     | 299,820          | 2                         | 1300                          | 14.12                       | 4.22            | 0.43                   |

Data obtained from multiple sources, including the district gazette book and census.
in the cyclone shelters and only 7.14% reported partial readiness (i.e., availability of hand washing soaps and sinks in the cyclone shelters). We found that men and women took shelter in different rooms; however, social distancing, facial masks, and hand sanitizers were absent in the rooms of the shelters. Furthermore, evacuees who took shelter in their neighbor’s, friend’s or relative’s house were better able to take COVID-19 precautions (Tables 8, 9).

### 5.9 Reasons for not evacuating during cyclone Amphan

Approximately 96.6% of respondents received evacuation orders, but many of them failed to evacuate. Haque (1995) reported only 22.8% evacuation in cyclone Gorky, Paul (2014)
identified 41.4% evacuation in cyclone Sidr, and Parvin et al. (2019) found an 84% evacuation rate during cyclone Aila in the coastal areas of Bangladesh. These results signify an improvement in evacuation rate over time. However, during cyclone Amphan, this study found that 42.06% of respondents were evacuated to a safe place.
5.9.1 Cyclone shelter problems

Overcrowding in cyclone shelters was one of the prominent causes of respondents choosing not to evacuate. Nearly 27% of respondents identified that overcrowding in cyclone shelters was the reason for their non-evacuation. In the time of social distancing as a response to COVID-19, some respondents viewed the crowded shelters as risky and decided to stay at home instead. A few evacuees (1.05%) returned home from the shelters after spotting the crowds there. Inadequate cyclone shelters in the locality and the need to travel long distances to the shelter were also responsible for non-compliance with the evacuation order, which took place at the rates of 21.92% and 23.74%, respectively. According to the Cyclone Shelter Construction, Maintenance and Management Policy-2011 of Bangladesh, cyclone shelters should be located within a 1.5 km distance from the housing areas to allow quick evacuation during a hazard (Hossain and Rahman 2018; Hossain et al. 2014). A cyclone shelter buffer analysis based on a distance of 1.5 km found that most of the areas in Kalaroa (0%) and Tala Upazila (4.22%) were unserved by shelters. Additionally, more than three-fourths of the area of other Upazilas, including Assasuni, Debhata, Kaliganj, Satkhira Sadar, and Shyamnagar had limited access to cyclone shelters (see Fig. 8 for details). Moreover, the capacities of the existing cyclone shelters were inadequate to serve the population. Our analysis revealed that only Shyamnagar Upazila could accommodate more than 5% of the total population in the shelters. Other Upazilas could only accommodate up to 5% at best to serve the local communities during a cyclone event.

5.9.2 Cyclone warning issues

Previous experiences with the failure of warnings (35.16%) and disbelief in the warning system (27.85%) were the leading reasons for respondents’ non-evacuation decisions. Some respondents mentioned that their past experience of failing to receive a warning during cyclones Sidr (2007) and Aila (2009) encouraged them not to evacuate. Other warning-related reasons for not evacuating were reported as lack of understanding of cyclone warnings (27.4%), sudden change of warning signals (16.89%), and delayed warnings (14.61%). Interestingly, 9.13% of the non-evacuee respondents reported that they were not aware of the evacuation warning at all.

5.9.3 Transportation and communication reasons

Around 38% of the non-evacuee respondents reported that poor and muddy road conditions were to blame for non-evacuation during cyclone Amphan. Additionally, the nationwide lockdown had an impact on respondents not having access to public transportation or vehicles that would allow them to evacuate. Moreover, this study reported that heavy rainfall just before the cyclone’s landfall shattered the electricity network. Thus, people struggled to receive updated information of the evacuation orders through radio, television, cell phones, or the Internet. Therefore, unlike previous cyclones, during Amphan, some respondents could not evacuate due to electricity blackouts (18.72%) and mobile network problems (10.96%). About 48% of all non-evacuees did not comply with the evacuation order, as they could not abandon their cattle. In approximately 24.2% of cases, respondents could not evacuate due to the difficulties of carrying the elderly or children to and from the cyclone shelters.
5.9.4 Social and cultural reasons

From the analysis, we identified that the respondents with no prior storm surge experience were less likely to evacuate during a cyclone. Respondents who lived in structured or semi-structured houses in low storm-surge risk areas mostly chose to stay at home during Amphan. Therefore, 68% of all non-evacuees did not comply with the order, as they felt safer at their own house (see Table 11 for details). Also, a few women did not evacuate because the household head (i.e., usually men) was not at home during the event. Note that many household heads in Kaliganj Upazila moved to cities in search of better livelihoods. In Boddipur village in Kalaroa Upazila, many people emigrated to foreign countries, mostly Malaysia, India, or Middle Eastern countries. Due to the absence of the household heads at home, women did not want to evacuate to cyclone shelters during Amphan for social and cultural reasons.

Approximately 34.25% of all non-evacuees reported that they were aware of the warning; however, they could not envisage the danger of the impending event. Thus, they assumed that it would not affect their own area. About 41.55% of all non-evacuee respondents indicated that they did not leave their homes because they feared that their homes/business or place or fish cultivation pond might be looted. Nearly, 14.61% of non-evacuees made their decision on this basis of unforeseen challenges while returning home after the cyclone, such as road blockade, waterlogging, and transport unavailability. About 11.67% of respondents believed that the cyclone was ‘God’s Will’ and therefore did not evacuate during Amphan. These people believed their fate was prefigured by God, and thus, it was irrelevant whether one stayed at home or evacuated to a shelter since survival depended on God’s will.

5.9.5 Other reasons

After considering the risk of COVID-19 infection at the crowded cyclone shelters, 26% of all non-evacuees decided to stay home during Amphan. As soon as the storm became stronger and the flood protection embankments became fragile, some community volunteers attempted to protect the embankments during the cyclone. This study found that about 5.5% of all non-evacuees could not go to cyclone shelters due to their voluntary involvement with protecting the embankments. Note that the Satkhira area is located in a low-lying coastal district, which makes it susceptible to flooding caused by cyclone and storm surges. To protect the sub-districts from flooding, the government had already built embankments. Several embankments throughout the districts required regular maintenance and were considered as fragile and vulnerable to cyclonic events. Gabura Union of Shyamnagar sub-district would have been considered as one of them; it is surrounded by rivers and isolated from nearby settled areas. It had been observed that embankments in this area were outdated and susceptible to damage during cyclones and storm surges. Previously, a large portion of these embankments were damaged in similar events. Thus, Gabura Union was mostly flooded, and the area was waterlogged for a long period (i.e., more than a year) (Mallick et al. 2011). With the goal of protecting their land and belongings from storm surges, local people decided to get involved with repairing the embankments before the cyclone struck. When they heard the warning, they started repairing embankments and did not evacuate. National and local newspapers published this information to encourage volunteers to stay at home and protect their land from inundation (Pobittro and Islam 2020). During this survey, we also found similar evidence, as 5.5% of the respondents in Gabura
Discussion

The rising curve of COVID-19 expansion and raging super-cyclone Amphan appeared to have created a double-disaster scenario in the coastal areas of Bangladesh. Consequently, it was difficult for people to decide immediately either to evacuate or stay. The requirement of this research might be easily determined using pre- and post-Amphan Google trend data of the Khulna division, which are shown in Fig. 9. We extracted the Google trend data of Khulna division for two search terms, ‘Amphan’ and ‘Coronavirus,’ for five days before and after Amphan to identify people’s concerns. The results illustrated that the coastal population of Bangladesh was equally concerned about COVID-19 (locally known as “coronavirus”) and the super-cyclone Amphan on the days before and after the landfall. The results indicated that coastal communities had to confront the cyclone by staying at home or risking COVID-19 contagion in cyclone shelters. Additionally, we compared our findings with previous studies regarding the evacuation behavior of people amidst the pandemic.

- We learned 12 out of 19 socio-economic variables were statistically significant regarding the evacuation decisions of respondents. The study found that the variable “age” was statistically significant in its relationship with evacuation behavior during a cyclone and demonstrated consistencies alongside similar studies. The results illustrated that people ages 45+ were more likely to evacuate during cyclones than were younger. Also, the threat of damage to coastal embankments in many villages encouraged young people not to evacuate and to instead engage in community-based efforts to prevent flooding during Amphan. This interesting fact was not documented in previously conducted research, and thus, this finding might encourage disaster management organizations to enhance their community-based evacuation planning framework to foster the involvement of the younger population.

- Though Uddin (2010) found gender and marital status to be significant, our findings differed in this study. This analysis identified that female-headed households had a higher percentage of evacuation (46%) than male-headed households. Generally, NGOs raised awareness and built capacity among the beneficiaries. During the cyclone, NGOs monitored the evacuation behavior for people’s safety, especially that of women. Fur-
thermore, Bateman and Edwards (2002) interpreted that widowed and divorced women were more likely to evacuate than married women because of having fewer responsibilities. Gender-specific evacuation programs such as those for married, widowed, divorced, adolescent and elderly women should be designed to be culturally competent. Also, home-based shelter development might be another option for improving the evacuation behavior of the women. In coastal areas, wealthy people often build houses where the upper part of their house is used as an emergency shelter for themselves and their neighbors during cyclones (Paul 2014). Therefore, disaster managers should consider constructing such homes as a way to integrate considerations related to women’s experience into disaster preparedness and evacuation planning measures. Consequently, the innovative planning of house construction and credit facilities might encourage people to build house-based shelters.

- On the contrary, Ahsan et al. (2016) mentioned that cattle and land ownership had a significant association with evacuation behavior, which was discordant with the results in Paul (2014). Throughout the overall evacuation scenario analysis, two factors were remarkably significant: (1) People who had experienced storm surges were more likely to evacuate; (2) the COVID-19 infection risk affected the evacuation, including preparation time, mode choice, evacuation decision, and destination. COVID-19 awareness was the second strongest predictor of one’s evacuation decision. Most respondents (54.8%) who were aware of the COVID-19 risk did not evacuate to cyclone shelters. Therefore, during the pandemic, the warning system was not enough to motivate people to evacuate from vulnerable places. Hence, the local government should compare the risks of the cyclone with the infection potentials of COVID-19 and prepare evacuation plans accordingly.

- This study identified that 96.6% of participants received cyclone evacuation orders before the landfall, which signified improvements in early warning and evacuation orders. Interestingly, Chowdhury et al. (1993) reported only 26% of respondents received an evacuation order during cyclone Gorky (1991), Paul (2014) stated that 75% of respondents had received the evacuation order before cyclone Sidr (2007), and Ahsan et al. (2016) found that the evacuation order had reached 97% of respondents during cyclone Aila (2009). However, these studies did not consider the ongoing pandemic and thus left gaps open for future studies.

- The role of the evacuation order and successful evacuation processes during a disaster was well established in evacuation research during hurricanes Katrina (2005) and Ivan (2004) (Kim and Oh 2014; Mesa-Arango et al. 2013), as well as cyclone evacuation research in Bangladesh (Mallick et al. 2011). In this study, we considered incorporating the coastal community’s preference for how to receive an evacuation order and then ranked the trustworthiness of order sources. This might be helpful for policymakers when devising a comprehensive warning system. Results from this study demonstrated that social connections (e.g., friends, relatives, or neighbors) and mosques were the major sources of receiving evacuation orders during Amphan, which supported the findings of Parvin et al. (2019). However, the rise of social media, such as Facebook, Twitter, WhatsApp, etc., was evident in the findings of this study. None of the respondents received an evacuation order through social media during cyclone Aila (Parvin et al. 2019), as social media was not available at that time, whereas 46% of respondents were informed through social media during Amphan. In terms of reliability, subjects identified social media as unreliable because it was seen as unmonitored and known for spreading rumors. Unlike the previous cyclones, the role of CPP volunteers in dissemi-
nating evacuation orders was found to be insignificant during Amphan because of the COVID-19 dispersion risk and lockdown issues.

- This study identified mistrust of many channels of information due to factors such as the perceived inefficiency of authorities, corruption, yellow journalism, and false news. For instance, just two months before cyclone Sidr (September 12, 2007), the authorities issued a tsunami alert in response to a massive earthquake event in Sumatra. People believed these risks and evacuated to a safer place after receiving this alert from officials and other media, but no earthquake happened in the region. Later, when cyclone Sidr approached, many communities ignored early warnings, which harmed the lives of many people (Samarajiva and Gunawardene 2016). Additionally, during cyclone Sidr, the Storm Warning Centre (SWC) of BMD published seven weather bulletins (13–19) for the coastal communities. From Bulletin 13–17, both Chattogram and Mongla port were alerted with cyclone warning signal 4. However, when the 18th bulletin was published, the danger level suddenly changed from 4 to 10 for Mongla and 4 to 9 for Chattogram. Such abrupt changes in two consecutive warnings created huge confusion and put millions of lives in danger (Paul and Routary 2013; Roy et al. 2015). During cyclone Fani (2019), BMD predicted that the storm would make landfall on the southwestern coast of Bangladesh and alerted those areas by assigning the region a ranking of danger level 7. Eventually, the cyclone moved its path and did not hit the southwestern part of the country (Ahsan et al. 2020). These events raised questions about the efficiency of the authorities and eroded people’s confidence in the warning system. Moreover, just a few months before Amphan, several online news and social media portals spread false news about COVID-19, and thousands of people were confused by the news (Al-Zaman 2021). Thus, many people came to mistrust the news provided by those platforms, including the news about cyclone Amphan. Since knowledge of COVID-19 among the rural communities was limited, sharing appropriate information with communities would be crucial to avoid rumors. Information shared with communities must be supported by scientific evidence and disseminated through legitimate sources. Once the trust of the communities was lost, it became difficult to engage them in the evacuation system (Ishiwatari et al. 2020).

### Table 10
Comparative analysis of evaluation behavior during different cyclones

| Cyclones | Sources | Study location | Percentage (%) that received evacuation order | Percentage (%) that evacuated |
|----------|---------|----------------|-----------------------------------------------|-------------------------------|
| Gorky (1970) | Chowdhury et al. (1993) | Kutubdia, Sandip | 60 | 30.5 |
| Haque (1995) | | Chittagong | 93 | 22.8 |
| Paul et al. (2010) | | Chittagong and Feni | N/A | 26.7 |
| Sidr (2007) | Paul et al. (2010) | Bagerhat, Barguna, Patuakhali Pirojpur | 78.2 | 33.2 |
| | Paul (2012) | | | |
| | Paul (2014) | Barguna, Patuakhali | 90 | 41.4 |
| | Uddin (2010) | Bagerhat | N/A | 44.8 |
| Aila (2009) | Ahsan et al. (2016) | Koyra, Khulna | 97 | 26 |
| | Parvin et al. (2019) | Gabura, Satkhira | 45 | 84 |
| Amphan (2020) | Authors | Satkhira | 96.6 | 42 |
• This study identified unavailability, long distances to shelters, and overcrowded capacity of the cyclone shelters as respondents’ reasons for not evacuating during cyclone Amphan. These findings are aligned with Paul’s (2012) study on cyclone Sidr and Ahsan et al.’s (2016) study on cyclone Aila; they found the mean distances to the cyclone shelters as 3 km and 3.14 km, respectively. This study identified early warning-related issues such as disbelief, previous experiences of failure, and sudden changes as reasons for non-compliance with the evacuation order. Due to the ongoing, country-wide lockdown, transport movements were reduced significantly, and therefore, evacuation was difficult. Also, transferring the elderly, children, and livestock to a safer place became problematic, and eventually, many people decided to stay at home. The local government should think about emergency vehicles’ provision to evacuate vulnerable populations during cyclones amid the COVID-19 pandemic.

Through this study, we have found that evacuation behavior amid the COVID-19 pandemic has been different from that of other cyclones. Table 10 summarizes a comparative analysis of evacuation behavior of people in different cyclone events in recent history. It is evident that more than 95% of households received evacuation orders in the last two cyclone events, such as Aila and Amphan. However, one of the major cyclones, Gorky in 1970, led to only 60% of households receiving an evacuation message. Interestingly, during Aila, 84% of households had been successfully evacuated from their houses to a safer place after receiving the evacuation order. When comparing Gorky (1970) and Sidr (2007), we can see that the percentage of evacuated households was almost double in Aila (2009). However, the percentage of evacuated households has drastically reduced during Amphan. The percentage of the evacuated households during Amphan was half that of cyclone Aila (2009). From this study, it is apparent that COVID-19 contributes to the change in evacuation behavior, although almost all of the households have received the evacuation order from multiple sources. The difference in the percentage that evacuated during the four cyclones is statistically significant \((p < 0.05)\). The difference in the percentage of people who have been evacuated between Aila and Amphan is also statistically significant \((p < 0.05)\). Additionally, the difference between the percentage of people who had received the evacuation order and the percentage who had evacuated during the four cyclones is statistically significant \((p < 0.05)\). Thus, we have included a summary table (see Table 11 for details) to reveal the extent of the influences that COVID-19 contributes to evacuation behavior.

7 Concluding remarks

The coexistence of the COVID-19 pandemic and cyclone Amphan has exposed the weaknesses of community resilience in the society. Though cyclones are not a new phenomenon in Bangladesh, the pandemic brings chaos to the traditional disaster management methods (e.g., social cohesion, food security, livelihood, mobility, etc.) and institutional resilience (e.g., healthcare system, emergency response, etc.). This study provides a comprehensive analysis of the evacuation scenarios of the coastal communities of Bangladesh during the super-cyclone Amphan, which occurred in the middle of the pandemic. The study attempted to collect primary data immediately after the cyclone. However, challenges were encountered while collecting the information in the time of lockdown, such as
Table 11: Impact of COVID-19 on evacuation behavior

| Evacuation dimensions          | Impact of COVID-19 in making a difference in evacuation                                                                                                                                                                                                 |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Evacuation order dissemination source | In previous cyclones, CPP volunteers played a vital role in providing evacuation orders to the coastal population. About 73% of the coastal people received a warning from CPP volunteers during cyclone Sidr, followed by government officials and NGO workers (Paul and Dutt 2010). Similarly, during cyclone Aila, CPP volunteers were the third major source providing the evacuation order in the Satkhira district. But during cyclone Amphan, the roles of CPP volunteers and NGO workers in disseminating evacuation orders were found insignificant. The heightened fear of COVID-19 infection, social distancing policy, country-wide travel restrictions, and lockdown issues were hindrances to the dissemination of information to the network. |
| Trust in evacuation order      | Around 46% of respondents received an evacuation order from social media during cyclone Amphan. However, people found social media unreliable as it had spread rumors and misinformation about COVID-19 since the first case of the virus had been reported. Another study on cyclone Amphan by Poddar et al. (2022) reported that 42% of respondents had received undesirable or harmful information from social media, including false news, rumors, superstitions, or political manifestos. |
| Evacuation decision            | A majority of the people (54.8%), who were aware of the COVID-19 risk, did not evacuate to cyclone shelters. These people decided to stay at home because fear of contracting COVID-19 from crowded shelters contributed to lowering the number of evacuees. Alam and Chakraborty (2021) also reported that the COVID-19 risk perception was a critical influence on the evacuation decision during cyclone Amphan. |
| Preparation time               | The preparation time of the evacuees was increased during cyclone Amphan due to the ongoing COVID-19 pandemic. One reason for this was the need to assemble the required safety kits (i.e., mask, soap, hand sanitizer, etc.), which it was thought might not be available in the shelters. During cyclone Aila, the average preparation time of men was 99 min, and for women, it was 125 min (Parvin et al. 2019). This was increased to 108 min and 143 min, respectively, for men and women during Amphan. |
| Transport availability or modal choice | The nation-wide lockdown had the impact of many evacuees not having access to vehicles for evacuation during the cyclone. This prevented 23% of people from evacuating during cyclone Amphan. About 40% of people had to evacuate on foot due to the unavailability of transportation as a consequence of the travel restriction policy. |

limited access to public transportation, less accessibility to remote villages due to water-logging and inconvenient road networks, and poor access to safe food and drinking water in the rural areas. Despite these challenges, the study has considered the issues related to evacuation systems during the cyclone Amphan amidst the pandemic. We have reported that the percentages of evacuees have decreased when compared with similar events that happened at an earlier time. This has happened due to the existence of the pandemic, and the fear in people's mind about the unknown virus. Consequently, the priorities of the local emergency management authorities have somewhat shifted to prioritize responding to the pandemic first. However, we have found that local authorities may trigger a better
Evacuation system by cultivating trust and an efficient communication network. Although some physical challenges were identified as a cause of non-evacuation, public perception-related issues were indicated as the leading cause for non-evacuation.

Researchers working in emergency management and planning during disasters have common interests in understanding the factors influencing people’s evacuation decisions. This article explains how people have decided to evacuate in the face of double whammy risks like the cyclone and the COVID-19 pandemic. Also, people have had unknown fears of COVID-19 infection under the ongoing lockdown situation, and thus, they decided to stay at home during the cyclone. Moreover, people have emotional reasons for not evacuating (e.g., if they had to die, they would rather die in their home instead of getting infected with the virus). In this double whammy situation, all the stakeholders require working together for an efficient strategy to protect people’s lives and assets. Furthermore, considering the intensity and spatial extent of cyclones or tsunamis, the government may relax social distancing and lockdowns to encourage people to evacuate. Consequently, the development of appropriate information dissemination strategies of evacuating people during the pandemic is critical for encouraging more people to evacuate to the shelters. Additionally, the dissemination of accurate information regarding COVID-19 is important to avoid rumors that have negative impacts on the evacuation behavior of the local people. Furthermore, we have conducted this study in remote rural villages, and thus, similar methods of data collection and results may not provide an identical experience for other researchers in different socio-economic conditions or diverse geographical settings.

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**Declarations**

**Conflict of interest** The authors declare no conflict of interests in publishing this article.

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