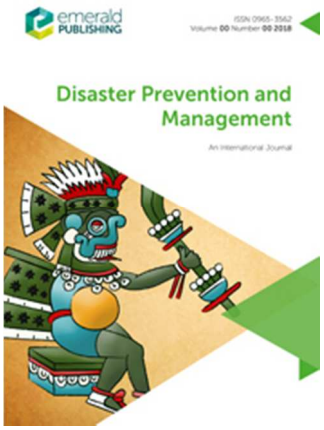

Warning systems as social processes for Bangladesh cyclones

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Abstract

Purpose: This article connects the theoretical idea of warning systems as social processes with empirical data of people's perceptions of and actions for warning for cyclones in Bangladesh.

Design/methodology/approach: A case study approach is used of two villages near Khulna in southwest Bangladesh: Kalabogi and Kamarkhola. Sixty households in each village were surveyed with structured questionnaires regarding how they receive their cyclone warning information as well as their experiences of warnings for Cyclone Sidr in 2007 and Cyclone Aila in 2009.

Findings: People in the two villages had a high rate of receiving cyclone warnings and accepted them as being credible. They also experienced high impacts from the cyclones. Yet evacuation rates to cyclone shelters were low. They did not believe that significant cyclone damage would affect them and they also highlighted the difficulty of getting to cyclone shelters due to poor roads, leading them to prefer other evacuation options which were implemented if needed.

Originality/value: Theoretical constructs of warning systems, such as the First Mile and late warning, are rarely examined empirically according to people's perceptions of warnings. The case study villages have not before been researched with respect to warning systems. The findings provide empirical evidence for long-established principles of warning systems as social processes, usually involving but not relying on technical components.

Keywords

Bangladesh, cyclone, cyclone vulnerability, storms, warning, warning process, warning systems

Article classification

Case study

Introduction

Bangladesh is frequently termed one of the most disaster-prone countries (e.g. Khan, 2008; Shahid and Behrawan, 2008) but it is also touted as a good practice example for cyclone warning and evacuation (e.g. Akhand, 2003; Haque *et al.*, 2012; Mallick *et al.*, 2011). The explanation is framed through declining disaster mortality despite increasing population numbers: a 1970 cyclone killed at least 224,000 people (Sommer and Moseley, 1970), Cyclone Gorky in 1991 killed approximately 140,000 people (Paul, 2009), and then Cyclone Sidr in 2007 killed 3,406 people (Paul, 2009) followed by Cyclone Aila in 2009 killing about 190 people (Saha, 2015). The cyclone death toll reduction is attributed to a system in which villages are warned of impending cyclones through community-based efforts followed by evacuating to shelters which are integrated into the community.

Although communities are never homogenous and some households and communities always have fewer options than others (Cannon, 2007), Bangladesh's community-based efforts differ from assumptions in much literature about the nature of warning systems. The traditional scientific structure of warning systems is top-down. External institutions provide information about an impending hazard followed by command-and-control instructions directing response. Any previous training and drills are selected, designed, and organised externally.

Research, policy, and practice has challenged this construct, from evidence regarding the importance of unofficial warnings (Parker and Handmer, 1998) to the United Nations' people-centred warning systems (Basher, 2006). As illustrated by these studies respectively, most publications countering the top-down view of warning systems are either empirical or theoretical. Few interpret people's perceptions of and actions for warning in the context of theories of warning systems as social processes—despite some foundational work (e.g. Mileti *et al.*, 1975) pushing for this agenda.

This article contributes to warning systems literature through case studies near Khulna in southwest Bangladesh where people have been affected by cyclones and provide their experiences of warning systems. It provides further originality in that the locations selected have not before been studied with respect to warning systems, although some wide-scale studies on cyclone warning and evacuation (e.g. Saha, 2017; Saha and James, 2017) encompass southwest Bangladesh within their data.

Fieldwork

Khulna, Bangladesh sits at approximately 22.9ºN and 89.5ºE and experiences numerous cyclones. Due to local topographic and societal differences, communities in the coastal area can undergo highly differentiated impacts from the same storm. Research was conducted in two villages in Dacope Upazila, Khulna: Kalabogi in Sutarkhali Union and Kamarkhola in Kamarkhola Union.

All of Kalabogi (Jhulantapara) is directly exposed to wind and water from cyclones. Most of the 480 households sit along the River Shibsha, so they experience loss of land and they frequently move as the river shifts its course. Their livelihoods are mostly fishing, as their settlement is surrounded on three sides by rivers and the Sunderban mangroves. Kamarkhola village is less exposed to the water from cyclones, as it is sited away from waterways and is divided by a road serving as an embankment. Kamarkhola has around 375 households which depend mainly on traditional crop agriculture for livelihoods. Kamarkhola's villagers enjoy better access to health, education, markets and administrative services than Kalabogi's.

Both villages were affected by Sidr and Aila. Sidr damaged mainly trees and houses, while Aila also impacted livelihoods because areas in and around the villages were inundated with saltwater which hampered rice cultivation and interfered with freshwater fishing. In Kamarkhola, the area behind the road/embankment was not subject to saltwater contamination, whereas all other areas were submerged, severely damaging infrastructure. No fatalities occurred in either village from either cyclone.

In each village, 60 households were surveyed with structured questionnaires regarding how they receive their cyclone warning information as well as their experiences of warnings for Sidr and Aila. Because the surveys were conducted at the household level, respondents' demographic features are not reported. The surveys were conducted in the local language by

teams of men and women from Khulna. Because these villages had not before been studied, pre-Sidr comparative data are not available.

Tables 1-4 indicate warning, evacuation, and post-cyclone impacts in the villages for Sidr and Aila. The high rate of timely warnings received contrasts with the low rate of evacuation and the long period of post-cyclone impacts. Those who received warnings but did not go to shelters indicated that it is a deliberate choice. Despite previous cyclone experiences, they did not believe that significant cyclone damage would affect them and they also highlighted the difficulty of getting to cyclone shelters due to poor roads. Even the worst case of complete inundation of the village would permit them to reach high land by swimming to an embankment, which they did, with little concern about potential dangers, such as flowing water, dirty water, debris, snakes, inability to swim, fatigue, darkness, and hypothermia. The extensive post-cyclone impacts experienced after Sidr and Aila did not appear to influence this attitude of not needing to evacuate, although Table 2 does show increases in evacuation rates for Aila just 18 months after Sidr. The reason stated was mainly the higher impacts, as noted above, especially in terms of Kamarkhola flooding which led may more people to shelter on the embankment.

Tables 1, 2, 3, 4 here.

Tables 5-6 provide the population's cyclone warning sources. In both villages, receiving multiple information sources is common and media are by far the most popular source, with internet not listed because access is limited and it is uncommon for households to be online. For Kalabogi, the next most popular sources are word-of-mouth, coming from friends and relatives as well as the mosque. The formal cyclone warning systems are least informative, mainly due to the village's remoteness, poor transport accessibility, and the lack of personnel to cover all villages. These reasons indicate why the most effort should have been put into such isolated villages, because they need support the most. Kamarkhola displayed some differences from Kalabogi, where formal programmes matched more closely with word-of-mouth.

Tables 5, 6 here.

Warning systems require pre-warning awareness and preparedness programmes. Otherwise, people might not recognise a warning signal and might not know how to act in response to warning information. Cyclone awareness and preparedness programmes for the two villages are listed in Tables 7 and 8. Formal training and workshops reached the most people followed by popular entertainment, with a minority in each village going through more than one programme. Other means, including door-to-door efforts and using communal outdoor spaces, had the least reach. These results indicate the importance of using more than one means to reach people to cover as many households as possible, but formalised methods through education and arts appear to reach more people than informal or targeted approaches.

Tables 7, 8 here.

The highly lauded cyclone warning and shelter system across Bangladesh (Akhand, 2003; Haque *et al.*, 2012; Mallick *et al.*, 2011), notwithstanding other factors lowering cyclone mortality such as coastal ecosystem management (Haque *et al.*, 2012; Paul, 2009), is further indicated by the fieldwork here in small, isolated villages. Nevertheless, a significant proportion of the population still does not receive cyclone warnings through formal channels,

even though the formal awareness and preparedness programmes had significant reach. Meanwhile, a large part of the population would not necessarily evacuate to shelters because they are not concerned about cyclone-related threats to life.

Discussion

The fieldwork highlights the importance of several aspects underlying warning systems as social processes. In contrast to previous findings (Haque and Blair, 1992; Haque *et al.*, 2012; Paul, 2012; Paul and Dutt, 2010; Paul *et al.*, 2010; Saha and James, 2017), the lack of evacuation to shelters in these two villages did not seem to be due to poor or untrustworthy warning communication, concerns about the shelters, worry about possessions, or specific demographic groups in the population. Instead, the people in this study's villages—hampered by poor road access to reach the shelters—perceived that they would manage on their own, which would include moving to a neighbour's safer building or to an embankment.

This strategy did not lead to recorded fatalities for Sidr or Aila and this success might extend to future cyclones—or might lead to large numbers of deaths. The key is examining whether or not the warning system serves local needs in multiple scenarios.

For serving local needs, 'The First Mile' for warning systems should be implemented. This approach re-defines 'The Last Mile' principle of warning systems being about conveying the right information to the right people in the right way at the right time, thereby making warnings timely and effective. Providing such information does not begin when a hazard manifests, but would be integrated into ongoing, day-to-day community development. 'The right time' for warning information in a First Mile warning system is now and every day, with 'the right information' being a continual process of exchanging and understanding environmental and societal characteristics. A warning system is not a one-off spurt of material, based on a single hazard, which then stops until the next hazard appears. Instead, preparation and awareness need to be integrated into daily lives, not as an extra item or separate task, so that no specific hazard warning information (as part of the overall warning system) is a surprise. Consequently, as part of the warning system, people will know how to generate their own warning information and how to respond to any given warning.

This approach can be achieved only 'in the right way' by starting with the people and their needs, which was a pertinent lesson following appropriate warnings and inadequate evacuation for the 1991 cyclone affecting Bangladesh (Haque, 1995). As the fieldwork here demonstrated, certain mechanisms for preparedness and awareness dominate as do certain sources for specific warning information. These mechanisms and sources need to be emphasised with consideration also given to who is not reached by them and why. 2% of households in Kalabogi were reached by the Union Disaster Management Committee. This figure does not mean that the committee should be abolished, if those 2% have no other source of warning or if those 2% are the most marginalised households—given that 'the right people' means everyone. People have different needs and many would prefer to be reached by more than one source as contingency, so 'in the right' way means continuing to understand how warning information is generated and received, enhancing successful pathways, filling in gaps, and paying attention to changes in the community and the people.

A similar ethos applies to evacuation. While the people in the villages could be criticised as being blasé or naïve for not evacuating to cyclone shelters, the lack of reported mortality during Sidr and Aila indicates that the system has benefits. This situation does not mean

assuming that nothing could go wrong in the future. Additionally, care is needed to factor in more than just immediate mortality; for instance, morbidity, malnutrition, sexual assault, and long-term deaths. Working with the villagers would help to determine how dangerous the situation could be for people who do not evacuate to shelters and then potentially tailoring messages to indicate when evacuation to shelters would be essential and when survival is likely without evacuating. If people are resolute about not leaving, then strengthening sheltering-in-place might bring benefits. This way would entail a co-design model to best meet the needs and interests of all the villagers.

The First Mile for warning systems encompasses all these aspects, contrasting with The Last Mile which tends to view warning systems as being top-down and technology-based. In the Last Mile, a technical system is created for monitoring hazards and preparing messages, so the Last Mile is the final step of disseminating the top-down messages to communities who are expected to obey what the messages advise. The First Mile makes no assumptions about what the people want or need from a warning system. It develops a long-term, continuous warning system based on the people's articulated interests balanced with needed support and supplements from external knowledge and expertise.

For instance, the two villages here could potentially be affected by tsunamis, some of which would originate too far away to notice the trigger, such as an earthquake, volcanic eruption, landslide, or meteorite strike. In these cases, rapid dissemination of external, technical knowledge of a coming wave would be essential as part of the warning system. Without prior community involvement, it is unclear how these messages would have credibility or if appropriate action would be taken by everyone. The warning system's core is that the villagers would be involved in regularly teaching themselves about tsunamis, indicating what message(s) they would wish to receive and how, and practising response actions. The process of developing, implementing, and maintaining the warning system is as important as the specific products of monitoring hazards and sending messages.

These specific products, typically technological, should remain part of warning systems. Tsunami warning systems for the villages here would need real-time regional geological monitoring, ocean buoys, and telemetered data, as per the Indian Ocean Tsunami Warning System. As well, given Bangladesh's propensity for damaging earthquakes (Steckler *et al.*, 2016), emulating components of automatic earthquake warning systems such as in Mexico, Taiwan, and Turkey (Allen *et al.*, 2009) for the villages here could be useful. Warning systems as social processes do not eliminate technology. They use technology within the social contexts to which it applies without relying on it entirely, meaning that any tsunami or earthquake warning systems implemented would need to start by working with the people in the villages—that is, the First Mile approach—rather than starting with the technical system, which would be the Last Mile approach.

Warning systems as social processes promotes diversity in implementation, which is needed as demonstrated by the variety of sources through which the villagers here receive cyclone warnings. Deeper understanding of the gamut of information sources which people seek and desire for warnings, alongside the frequently expressed need to confirm information before acting, have been on the warning system research agenda (Phillips and Morrow, 2007). This need is further corroborated by this study.

Another dimension of warning systems as social processes relates to the time scale for warning information. Much work presumes the need for warning systems which are 'early'

(e.g. Basher, 2006). Kelman and Glantz (2014) challenge the standard notion of early warning systems (EWS). They query the meaning of 'early' (which must be contextual), point to research which indicates that providing too much advance notice can lead to complacency, and raise examples where early warning is not feasible; for instance, flash floods and near-shore tsunamis with mere minutes of lead time. Earthquakes provide perhaps seconds of warning time, which is long enough to get underneath a sturdy piece of furniture (if houses have one and if it is certain that the structure will not collapse), to move away from cooking stoves, and to shield a child.

For this study, cyclones typically provide several days of warning with prospects for describing the wind, storm surge, and rainfall parameters expected in each village in advance of a cyclone's landfall. Given the population's acceptance of the warnings coupled with a reluctance to evacuate, it is conceivable that several days might be too much warning time. For people living at subsistence level, much of their day is focused on food and water, so extended or frequent activities for warning response could conflict with life and livelihood maintenance. Perhaps they would prefer 2, 12, or 24 hours' notice—or a specific warning only when it is clear which areas will be flooded, irrespective of the lead-time. By then, their local knowledge might have already alerted them to a cyclone in the vicinity, so it could be that more technical information for late warning would be more useful than evacuation suggestions as part of early warning.

A social warning system as a continuing process covers all time scales, using a variety of information sources and messaging mechanisms to reach all the people in a manner amenable to their needs. This approach could possibly start with seasonal entertainment and drills for education at the beginning of each cyclone season; continue via local environmental knowledge and word-of-mouth once a cyclone forms with a track heading towards their village; and end with specific statements of areas imminently flooding to encourage evacuation to shelters (or elsewhere). Whether or not this sequence would be the most expected and effective requires further consultation with the communities; The proposition here is one example of how to develop an integrated, respected, first mile warning system, instead of aiming for only a technocratic construction invoked externally once a specific cyclone's probable track has been calculated. In any case, nothing precludes both in tandem; for example, a probabilistic warning several days' in advance of landfall and a warning of certain, imminent flooding.

Conclusion

Examining warning systems as social processes through cyclone experiences in isolated Bangladeshi villages has reaffirmed the importance of contextuality. A single route for warning information cannot meet everyone's needs, yet the point of a warning system is to ensure that everyone is included. Therefore, multiple channels, mechanisms, and approaches are required to be fully inclusive. As the evidence here illustrates, even with apparently accepted, accurate, and desired warning information from trusted sources, people will not necessarily continue the warning process (as it was designed) by evacuating and using cyclone shelters. This situation is not necessarily detrimental, but the consequences need to be made explicit.

Additionally, not all experiences and lessons are necessarily transferable, even to similar villages around southwest Bangladesh. As noted earlier, the literature provides multiple reasons why people have not always gone to cyclone shelters along Bangladesh's coast,

despite warnings. Those reasons did not appear in the fieldwork here. Determining local contexts, interests, and needs supports a locally effective warning system across locations.

These findings reinforce what has long been described with regards to warning systems (Anderson, 1969; Gruntfest *et al.*, 1978; Mileti, 1975), indicating that the long-established warning system characteristics remain apposite: transparent, integrated, trusted, continual, flexible, having clear signs and signposts, and timely, along with variations of these terms. Enacting these characteristics produces warning systems which are part of the villages, developed with and by the people, rather than being constructed and imposed by external agencies or governments. Warning systems should not compete with day-to-day life and livelihoods, but be enfolded within them. The evidence from two previously unstudied locations in Bangladesh with respect to cyclones supports these traits, providing a strong indication that the principles of warning systems are robustly understood, yet the challenge remains to apply these principles.

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Table 1: Percent of respondents receiving timely warning for Sidr and Aila

	Kalabogi	Kamarkhola
Sidr	78%	60%
Aila	87%	68%

Table 2: Percent of respondents evacuating to a safe place for Sidr and Aila

	Kalabogi			Kamarkhola		
	Cyclone shelter	Neighbour's safe house	Embankment	Cyclone shelter	Neighbour's safe house	Embankment
Sidr	22%	5%	10%	7%	5%	17%
Aila	27%	7%	15%	12%	8%	48%

Table 3: Post-cyclone impacts for Sidr and Aila in Kalabogi

Post-Sidr	Average time period	Post-Aila	Average time period
Stayed on embankment	11 days	Stayed on embankment	61 days
Stayed outside of own residence	11 days	Stayed outside of own residence	64 days
Dependent on external assistance/relief	1.5 months	Dependent on external assistance/relief	4.7 months
To fully recover economically	10 months	To fully recover economically	31 months

Table 4: Post-cyclone impacts for Sidr and Aila in Kamarkhola

Post-Sidr	Average time period	Post-Aila	Average time period
Stayed on embankment	11 days	Stayed on embankment	73 days
Stayed outside of own residence	11 days	Stayed outside of own residence	138 days
Dependent on external assistance/relief	1.2 months	Dependent on external assistance/relief	17 months
To fully recover economically	9.2 months	To fully recover economically	28 months

Table 5: Sources of cyclone warnings
(Respondents could select more than one answer.)

	Kalabogi	Kamarkhola
Cyclone Preparedness Program Volunteers	9%	20%
NGO personnel	14%	40%
Union Disaster Management Committee	2%	13%
Radio/TV/newspaper	62%	77%
Friends/relatives	29%	20%
Mosque's loudspeaker	26%	47%

Table 6: Number of sources from which cyclone warnings are received

Number of sources for received warnings	Kalabogi	Kamarkhola
0	32%	2%
1	20%	12%
2	28%	53%
3	20%	33%

Table 7: Participation in cyclone awareness and preparedness programmes
(Respondents could select more than one answer.)

	Kalabogi	Kamarkhola
Training/workshop	44%	88%
Mock drill	2%	2%
Outdoors session	4%	3%
Door-to-door campaign	0%	12%
Entertainment: video, theatre, music	21%	40%
Warning signal/flag display	5%	17%

Table 8: Number of cyclone awareness and preparedness programmes attended
(Columns do not add up to 100% due to rounding.)

Number of programmes	Kalabogi	Kamarkhola
0	37%	3%
1	50%	50%
2	12%	28%
3+	2%	18%