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COMMENT

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Asia's looming Black Elephant events

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Devastating disasters that are predicted but ignored are known as Black Elephants—a cross between a Black Swan event and the proverbial elephant in the room. It's time we acknowledged the looming natural hazard risks that no one wants to talk about.

Asia is the most disaster-prone region in the world: from 1970 to 2016, a person in the Asia-Pacific region was five times more likely to be affected by a natural hazard compared to someone outside of the region[1]. As such, acknowledgment of Black Elephants is fundamental to the future resilience of this rapidly developing region. Disastrous events are often proclaimed as a Black Swan—an unlikely and unexpected occurrence. However, at a closer look, for many of these disasters, the hazard was known and understood but not addressed, and they are therefore better described as a Black Elephant (Fig. 1)[2]. Individuals, and in particular scientists, can make a difference by defining and drawing attention to these hazards before they occur: we should not allow known risks to be ignored.

Known risks

Black Elephant events have the potential to affect individuals and systems both locally and globally. One example is the COVID-19 pandemic, first identified in December 2019 in Wuhan, China that has had devastating health and economic impacts around the globe[3]. In 2019, the Global Health Security Index[4] had already noted that international preparedness for epidemics and pandemics was very weak. Yet little was done to mitigate the risk. The threat is not limited to individual hazards: there is growing evidence that the number of countries affected by multi-hazard events is rising[5]. In these contexts, interactions between multiple hazards and multiple events strain resources and defy typical single-hazard protocols. For example, in 2020 during the COVID-19 pandemic, individuals affected by tropical cyclones had to choose between staying socially distanced at home, at risk of the cyclone, or evacuating to a shelter, where they would be unable to socially distance[6,7].

The rising exposure from rapid urbanization and high levels of social and physical vulnerability are important drivers of natural hazard risk in Asia. Mitigation of these risks is crucial to the region's resilience, but climate change, and other known but under-characterized hazards make addressing these risks complex. We highlight several—but by no means all—of the Black Elephants that threaten Asia (Box 1) and offer five practical recommendations (and associated challenges) for addressing the risks.

Five recommendations

Black Elephants are inherently complex and challenging: this is exactly why they became Black Elephants in the first place. The key first step towards mitigating a Black Elephant event is to define it, draw attention to it, and begin the conversation. There are contributors to future risks

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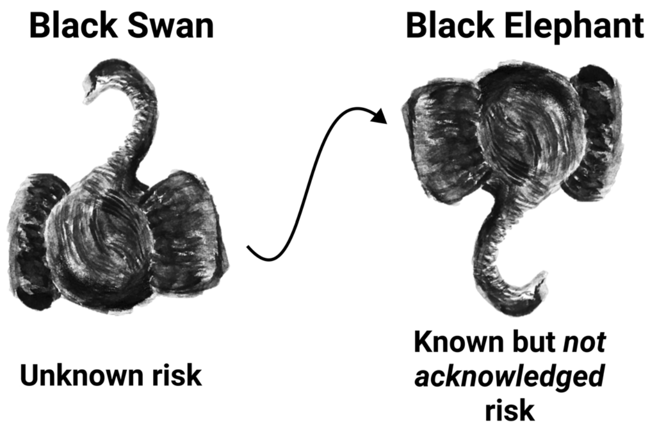

Fig. 1 One risk, two perspectives. Black Swans and Black Elephants both describe hazard events with high impact, high exposure, and high vulnerability but are viewed from two different vantage points. With knowledge but without acknowledgment, a Black Swan becomes a Black Elephant. Both have the potential for catastrophic impacts.

that are out of our control, such as the time and magnitude of an earthquake, and then there are contributors to risks that are within our control and influence. These latter contributors, such as exposure, vulnerability, and anthropogenic-driven hazards such as climate change, are where we can focus our efforts moving forward.

We offer five recommendations to move forward, starting with actions for individuals and then moving to recommendations that require coordination across organizations, agencies, and groups.

1. **Call Black Elephants by their name:** Not every catastrophic event is a Black Swan. Calling known events a Black Swan obfuscates the responsibility for its impacts. We call for scientists, journalists, and governments to refrain from using the term Black Swan for known but rare events. Unlike Black Swans, Black Elephants can be identified and plans can be put in place to address them.
   The challenge: A key challenge lies with governments. Overt acknowledgment of a Black Elephant can leave politicians open to criticism for being aware of a problem, but not having acted on it. As such, individuals in the media, science, civil society, and other non-government sectors have a vital role in changing perceptions.
2. **Acknowledge the risks, but also averted disasters:** Post-disaster discourse commonly focuses on negative outcomes, but it is critical to also highlight the policies, programs, and designs that worked. Acknowledging Black Elephant events is so difficult, not least because it is unpleasant and uncomfortable to discuss something that seems hopeless. Celebrating effective policy decisions against former Black Elephant events that overcame complex and challenging risks should be encouraged. An example is the 1999 Super Cyclone Odisha that claimed 10,000 lives in India. This event served as a wake-up call. Subsequently, disaster mitigation authorities at state and national levels were established to focus on preparedness, prevention, and mitigation. Though cyclone danger remains high in India, mortality has dropped significantly and we can count Cyclone Phailin (2013) and Cyclone Fani (2019), among others, as successful mitigation stories when considering lives lost[8,9]. Rather than accept risk as static and unchangeable, highlighting these successes reinforces the idea that we can collectively shape future risk[10].
   ***The challenge*:** Even with mitigation measures that decrease impacts from a hazard, there is almost always still some impact. Celebrating the relative success of mitigations efforts must be balanced with considerations for those who were still affected by the event.
3. **Just because we do not measure it does not mean it is not there:** Under current metrics, a measured improvement in resilience or reduced risk may only reflect the fact that the hazard did not occur within the considered timeframe. For example, in the Sendai Framework for Disaster Risk Reduction, United Nations member countries set global targets for reduced disaster mortality, affected persons, economic impact, and disaster damage over a 15-year period[11]. However, this measure depends directly on the occurrence of hazard events, and a decrease in global hazard occurrences (such as major earthquakes in highly populated regions) could be misconstrued as progress towards these global targets. What we measure must reflect how human efforts are changing the risk, rather than how random fluctuations in hazard occurrence change risk. With this change in metric, acknowledgment of Black Elephants can become institutionalized.
   ***The challenge*:** Adjusting metrics of risk is a significant departure from the status quo, and calculations based on risk can be more difficult to communicate than metrics based on realized impact. This is an aspect in which scientists, who are more familiar with uncertainty than people in other sectors, can have an important role to play.
4. **Break disciplinary silos to acknowledge Black Elephants:** Findings from scientific research must break out of disciplinary and academic silos to ensure that results find their way to the public sphere as real changes in policies, building codes, or public messaging. For example, the devastating 9.0 M Tohoku, Japan earthquake on 11 May 2011 and subsequent tsunami, resulted in 19,000 persons dead or missing, damaged or destroyed an estimated 800,000 buildings, and triggered a severe nuclear accident[12]. This event appeared to many as an unforeseen Black Swan. However, tsunami records, studied since 1990, showed deposits from the AD 869 Jogan earthquake and tsunami were identified kilometers farther inland than any other tsunamis known at the time[13]. In 2010, when the Japanese national seismic hazard map was updated, the affected area still showed hazard representative only of the past 400 years of tsunami records[13]; and did not include the hazard indicated by the 869 Jogan event. The Fukushima Daiichi Nuclear Power Plant was built based upon the seismic and tsunami hazard identified by the national seismic hazard map, and the consequences of this disaster are now tragically etched in modern history. This Black Elephant shows the consequences of remaining in disciplinary silos.
   The challenge: Within academic institutions, transdisciplinary work is often misaligned with traditional metrics for academic scholarship such as publishing, a key factor for tenure and promotion[14]. Transdisciplinary work will only be possible with the support of major scientific funding agencies and the recognition of collaborative research by academic institutions.
5. **Pre-disaster resilience**: Disasters exacerbate existing inequalities and vulnerabilities. One way to mitigate disaster impacts is to reduce pre-disaster vulnerability. This action can be driven by political systems that wish to protect residents and their economy, international organizations (e.g., The World Bank[15,16]), financial instruments (e.g., reinsurance) that are vested in preventing the financial collapse of an entire region or industry, or collective

Box 1 | Documented Black Elephants in Asia

The combination of historical underestimation or evolving nature of hazards, rising exposure, and high levels of social and physical vulnerability contribute to the potentially catastrophic consequences. Here we have gathered an illustrative, but non-exhaustive, list of documented Black Elephants in Asia of various hazard types.

Ground shaking: 140 million people live within 100 km of the subduction zone beneath Bangladesh, Myanmar, and East India capable of an estimated M8.2 to 9.0 earthquake[19]. The risk in this region is further driven by earthquake-prone building construction, limited building regulation, political unrest, and poverty.

Tsunami: The Manila Trench, west of Luzon in the Philippines, is the major contributor of tsunami risk in the South China Sea. Guangdong, Hong Kong, and Macau have a 20–50% probability of experiencing tsunami waves at least 1 m in height in the next century[20].

Landslide or debris flow: Chittagong, Bangladesh is at risk of landslides due to unstable soil structures on slopes, and increasing precipitation rates as a consequence of climate change. The high population density of lower-income in landslide-prone regions and lack of landslide awareness puts the region at higher risk[21].

Volcanic: Tokyo is at risk from volcanic ashfall (tephra) hazards from Mt. Fuji. An eruption similar to its last 1707 Hoei eruption could result in 10 or more cm of ashfall over the Tokyo metropolitan area. This could disrupt power, air, and rail travel, and result in other significant societal impacts[22].

Storm: Cyclones have seldom hit southern Vietnam, but a cyclone and 1 m storm surge is possible; the lack of preparation in this region could lead to disastrous damage and loss of lives[23].

Drought: The Lower Mekong River Basin (Thailand, Cambodia, Laos, and Vietnam) is vulnerable to increasing drought according to future projections (2016–2099). Droughts in this region affect the socio-economic conditions of over 60 million people and result in economic losses in the hundreds of millions of USD[24].

Vegetation fire: Satellite analyses suggest that Myanmar has the second-highest number of vegetation fires per year in Southeast Asia, after Indonesia. It is one of the least-studied countries in the region for fire risk, which can impact human health through transboundary air pollutants and result in loss of biodiversity and forest cover[25,26].

Flood: Pearl River Delta region in Guangdong Province of China has transformed from rural villages into the biggest urban area and one of the most densely urbanized megacities in the world, and is subject to land subsidence, river floods, and storm surge. Up to 15% of the population was subject to flooding annually from 2010 to 2015[27,28].

Physiological heat stress: Projections for cities in Asia show New Delhi with the highest expected temperatures at the end of this century, and estimates that 450 billion USD will be lost per year due to heat-related work losses[29].

Infectious disease: Human encroachment on the natural world increases the likelihood of viral epidemics like SARS-CoV and SARS-CoV-2[30–32].

Compound risks: Asia is at risk for compound events, where the multi-hazard risk is heightened relative to single-hazard events[33]. Compound risk can arise from concurrent hazards (events overlapping in time and space), cascading hazards (secondary hazards that are a direct or indirect result of the initial hazard event), and consecutive hazards (multiple hazard events closely spaced in time)[5,34]. The EM-DAT international disaster database shows that 42 of 49 countries in Asia have three or more natural hazard event types recorded in the last decade (2010–2019)[35].

grassroot desires to improve resilience for affected communities. Actions could include boosting scientific literacy, increasing risk awareness and education, and reducing physical vulnerability[17,18].

The challenge: These changes require political will and capital, which may be limited or in competition with other short-term issues. In addition, balancing short-term risks with long-term risks tends to be misaligned with political incentives.

Our recommendations are written with the Asia context in mind, but these strategies are applicable elsewhere. Raising the profile of Black Elephants builds more resilient and robust systems; tools put in place in preparation for these complex risks may actually help address a true unknown Black Swan in Asia or elsewhere. Ultimately, we cannot act on what we are unable to discuss. The Black Elephants of Asia will be uncovered in the coming decades; whether we decide to acknowledge them will shape their impact.

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