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INVITED ARTICLE

Disaster vulnerability by demographics?

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Abstract

This article provides a brief overview of the relationship between disaster vulnerability and demographic variables. Population numbers and densities are examined along with using a gender focus as illustrative of individual characteristics. For the most part, people's and society's choices create vulnerabilities based on demographics rather than specific demographic characteristics inevitably conferring vulnerability.

Keywords: disaster risk reduction; gender; population; vulnerability

Defining disaster

The question "What is a disaster?" is not straightforward to answer, having been the subject of books as well as debates over synonyms and the use of terminology (Britton, 1986; Quarantelli, 1998; Perry and Quarantelli, 2005; Leroy, 2006). Concatenating the academic literature, dictionaries, and professional glossaries (e.g. UNISDR, 2017), a straightforward suggestion encompassing these ideas is that a disaster is defined as "A situation requiring outside support for coping".

The key is the element of coping. Many environmental phenomena and processes occur, from volcanic eruptions to droughts to space weather, but not everyone

1 ilan_kelman@hotmail.com. Ilan Kelman's latest book is *Disaster by choice: how our actions turn natural hazards into catastrophes.*

is affected by them or is affected in the same way. If a house is flood-resistant, including being resistant to contaminants in the water such as salt and petrol, then a family might be able to move back in a few days after the water subsides, compared to several months for many dwellings without flood resistance (Lamond et al., 2011). Similarly, dwellings built and maintained to resist earthquakes might not require evacuation unlike those which collapse and kill the occupants (Coburn & Spence, 2002).

The ability of a society to cope with the environment indicates aspects of its vulnerability. However, a society's vulnerability is itself the result of societal processes which set up people, groups within society, and communities so that they are harmed by environmental activity and nature becomes hazardous. It is these vulnerabilities which are the fundamental cause of disasters rather than natural hazards. The phrase "natural disaster" is therefore preferably avoided as a misnomer, since disasters themselves are not natural and instead should simply be referred to as "disasters". Choices are available to better deal with the environment, but often we live or are forced to live in places and in ways which subject us to harm (Hewitt, 1983, 1997; Lewis, 1999; Wisner et al., 2004), such as not having flood-resistant or earthquake-resistant infrastructure.

Examples of created vulnerabilities are:

- Where we live or are forced to live, in places such as floodplains, over earthquake faults, on unstable slopes, or near volcanoes. Any location has advantages and potential environmental hazards, so understanding them will indicate how to act to avoid a disaster, provided that resources and opportunities are available.

- How we live or are forced to live, such as with few livelihood options, without education, and with little opportunity to accumulate assets or savings which could assist with safer and healthier living.

- Who we are and the population groups to which we belong, such as population numbers and densities as well as individual characteristics.

This article summarises some aspects of this last point, exploring how vulnerabilities are not inherent to individuals and groups, but people are made to be vulnerable by their choices or, more commonly, by the choices of others.

Population numbers and densities

By definition, a disaster cannot occur without people and society being affected, with a disaster's scale defined according to these impacts. How do population numbers and densities influence the potential effects? Are higher numbers more worrying? As always, the straightforward answer is "it depends". It depends on which numbers are considered and the specific context, with no single figure providing a complete answer.

Consider population numbers. The more people who are affected, the worse a disaster is generally assumed to be. But absolute numbers of people paint only part of the picture, because proportional numbers also need to be considered (Lewis, 1999).

In 1995, the Caribbean island of Montserrat had a population of approximately 12,000 people when the volcano comprising the island starting erupting, settling down only in the past few years. During the two decades of eruptions, most of the island's infrastructure was destroyed and the entire population fled their homes, some to rebuild in the island's north and up to 2/3 of the population to other countries, with many but not all of them eventually returning (Pattullo, 2000). On June 25, 1997, at least nineteen people were killed in pyroclastic flows.

All Montserratians directly experienced this disaster, with 100% of lives being upended and possible long-term impacts from continual inhalation of volcanic ash still to be determined (Baxter et al., 2014). Yet the number of immediate deaths was small and even the total number of people affected in Montserrat was less than half the death toll of the 26 December 2003 earthquake in Bam, southern Iran (Ghafory-Ashtiany, 2004). Comparatively, though, 0.16% of Montserrat's population was killed by the volcano in 1997 compared to 0.038% of Iran's population killed by the earthquake in 2003 – a far higher percentage in Montserrat.

Examining absolute numbers makes Montserrat's disaster appear irrelevant compared to Bam's. Examining proportions makes Montserrat's disaster appear

to be far worse than Bam's. Both were disasters in their own right, but each had different characteristics in terms of population numbers affected, meaning that it is not straightforward to compare them. Neither should necessarily be made out to be a worse disaster than the other; both were devastating, could have had their impacts reduced through prevention, and required major responses and reconstruction. Proportional vulnerability and absolute vulnerability each provide different but important disaster-related perspectives (Lewis, 1999).

Similar aspects of "it depends" emerge for population density. One often-heard mantra is that urbanization worsens disasters due to higher population densities. Cities expanding means larger population numbers concentrated within the same agglomeration, augmenting disaster risk and making disasters worse.

The flipside is that more people are available to assist. High-density urban areas sometimes have the most experienced, best equipped, and highest concentration of emergency services (e.g. Reames et al., 2009 for emergency physicians in Oklahoma), including healthcare facilities, as well as shorter transportation times to the nearest one (e.g. Fleischman et al., 2011 for paediatrics in Oregon). Logistics and planning personnel are likely to be dealing with larger and more closely confined populations in cities, and this is certainly a major factor in the high infection and death rates in London and New York during the 2020 Covid-19 pandemic. They are also dealing with smaller areas and typically more options for supply chains, transportation, distribution networks, and nearby skilled people – although this does not necessarily translate into improved or easier disaster responses (Kovács and Spens, 2012). Urban areas without formal or well-maintained roads, as often exist in informal settlements, are a logistical nightmare for emergency services and supply chains.

Another disadvantage of cities is that, if multiple hospitals or fire stations are put out of action by the disaster, then the emergency services will be overloaded and the non-urban areas in the vicinity are not likely to be able to take up the slack. In addition, many examples exist of rural areas with better disaster prevention and response than larger centres; for instance, Johnston (2015) found that more isolated communities in Fiji had received less disaster aid in previous cyclones and so were more prepared than their larger counterparts who had previously received, and therefore expected to receive, external aid. Moreover, much is

contextual: rural rescuers are likely to be more familiar with isolated mountain rescue than their urban counterparts, while the latter probably know large building collapse rescue better.

Similarly, the siting of a city or other settlement can be selected to reduce (or increase) the possibility of environmental hazards, irrespective of population numbers and densities. If a large city develops in a country's least hazardous location while a village is placed in a canyon subject to flash floods, rockfalls, avalanches, and more, then the overall disaster risk might be more for the village, despite the large difference in population-based vulnerability and depending how hazard and vulnerability are quantified for calculating disaster risk.

Conversely, cities tend to be paved over much more than less urban locales, meaning that rain runs off and pools in low-lying areas, flooding them, rather than being absorbed by the ground. Green spaces and permeable paved surfaces, though, can prevent flooding (e.g. Webber et al., 2020 for Melbourne, Australia). Siting, designing, planning, and landscaping – irrespective of population numbers and densities – affect many aspects of possible disasters.

Even for disaster evacuation and sheltering, locations with high population density can enact swift and effective measures through planning, training, suitable routes, and sufficient vehicles and organisation (Renne, 2018). People in non-urban areas have frequently been trapped when a wildfire is burning across their only escape road or a flood or earthquake severs it – or if information flow for warnings is inhibited, so residents decide not to evacuate, as documented for the Philippines and Dominica (Yore and Faure Walker, 2020). The safety and success of disaster evacuation is determined more by preparation and readiness than by population numbers and densities.

Some cities offer a form of evacuation rarely available in non-urban areas: vertical evacuation up tall buildings. Provided that the building will remain standing and not be overwhelmed by a hazard, the quickest, safest, and easiest evacuation in floods, tsunamis, avalanches, and many types of slides, might be heading to upper floors (Mostafizi et al., 2019). Even for pyroclastic flows – which are hot, fast ash and gas clouds from some volcanoes – inner rooms in large buildings might provide survival spaces against the heat and ash which would be unavailable in

smaller structures (Spence et al., 2007). The key is that the structures need to withstand the environmental forces and energies to keep people safe, which is not a function of population numbers or densities (and which is not always easy to know in advance).

Disasters are certainly influenced by population numbers and densities, yet much emerges from societal choices on how to deal with the people in a location. We can and should make choices to prevent disasters, no matter what the population numbers.

Individual characteristics: A gender focus

Disasters are also about individual demographic characteristics – such as age, gender, sex, sexuality, disabilities, medical conditions, ethnicity, race, caste, religion, belief systems, education, communication abilities including languages spoken, livelihoods, and wealth among others – playing roles in how vulnerability is determined by and for individuals. These variables have a range of dependencies and the interplay among them produces complex analyses, correlations, causations, and chains of influence. Detailed work has covered many of these variables, such as religion (Gaillard and Texier, 2010) and disability (Bennett, 2020), while others, such as prisoners (Gaillard and Navizet, 2012) and homeless people (Wisner, 1998), have only received sporadic study. Combinations are now being more fully explored through intersectionality, based on Crenshaw (1989), where multiple individual characteristics intersect to create, augment, or diminish vulnerability.

To exemplify individual demographic characteristics, this section addresses vulnerability differences in males and females, meaning sex-differentiated vulnerability which, in the literature, tends to be termed gender. 'Sex' and 'gender' are not interchangeable, since they depict characteristics which are different and the male-female binary division is not how many people regard or live their gender. Disaster fatality data has tended to be reported through a division of women/girls and men/boys (Neumayer and Plümper, 2007) with more thorough approaches starting to be explored (Gaillard et al., 2017). For now, gender-differentiated vulnerability generally means comparing girls/women and boys/men, so the phrase is used here, even though 'sex-based vulnerability' would be more correct.

For instance, following the 26 December 2004 Indian Ocean tsunami, fatality data from villages in Sri Lanka, India, and Indonesia found that female deaths were consistently higher than male deaths (Oxfam, 2005). When examining why this difference emerged, the pattern became clear that the reason was gender-differentiated roles in society, not that women were inherently more vulnerable to tsunamis than men. As two examples documented in the report showed, when the tsunami appeared:

- In an area of Sri Lanka, it was the time at which women bathed in the sea; a few hours difference would have meant that the women were not in the water.

- In some Acehnese villages, the women were waiting on the shore for their fisher husbands to come in from the sea with the catch; again a few hours difference would have changed the situation.

These gender-based roles and the societal separation of the genders creates gender-based vulnerability leading to gender-differentiated death tolls (Enarson and Morrow, 1998).

In many of the tsunami-hit locations and other places around the region, further similarly artificial factors disadvantage women and girls in dealing with water hazards, including river and coastal floods. Females are typically not taught how to swim, are not always allowed to leave their home (such as for evacuating) without a male relative, are expected to be carers which makes evacuation harder and slower, wear clothes which inhibit running or swimming (and they would never remove their clothes to survive), and tend to be more malnourished and hence physically weaker than men. Such points explain why far more females than males died in the 1991 cyclone in Chittagong, Bangladesh across all age groups (Begum, 1993; Chowdhury et al., 1993).

Many more factors that lead to women and girl's vulnerabilities become manifest through examining gender-based data and experiences (e.g. Bates, 2014; Criado Perez, 2020), but are under-researched. They represent the typical, day-to-day gender-based marginalisation and the normalisation of gender-based discrimination and violence which reduces options for education, health,

and initiative, thereby augmenting vulnerability on the basis of gender alone. Examples are ostracising menstruating women, a legitimate fear of violence and assault when evacuating or in shelters, the objectification of women's bodies, not considering women's bodies when designing clothes and equipment, and devaluing the importance of girls for rescue and evacuation. In all these instances, the vulnerabilities are socially constructed.

The same occurs for men and boys, with their vulnerability being socially constructed through expected cultural roles for them (Enarson and Pease, 2018). More men than women are recorded as dying in floods in the USA (Doocy et al., 2013) and Australia (Coates, 1999). The reasons are generally attributed to risk-taking behaviour, such as driving through floodwater and being in rescue-related professions. More fundamentally, expectations regarding risk-taking behaviour are typically foisted on men, especially within contexts of toxic masculinities, hypermasculinity, assumptions of machoism/machismo, and culturally engrained mantras such as 'women and children first' for rescue when ships sink (Mosher, 1991). Sexual and physical violence against boys and men occurs and is not often admitted (Zalewski et al., 2018), suggesting that males could also decide to avoid safe evacuation and sheltering out of fear of being assaulted.

The evidence shows that the demographic categorisation of being male or female is not the causation of gender-differentiated mortality. Women/girls or men/boys are not intrinsically or genetically less intelligent, less capable of surviving floods, or more attuned to water than the other. Instead, gender-based cultural roles are created, leading to gender-based disaster vulnerabilities and abilities to overcome these vulnerabilities which, in turn, produce the observed differences in male-female flood and tsunami mortality – and the same with other hazards and disasters (Neumayer and Plümper, 2007; Kinnvall and Rydstrom, 2019). Irrespective of females and males having differences in physiology, they are made by society to have different vulnerabilities due to cultural, not physiological, constructions.

Disaster by choice

Ultimately, vulnerability is typically not inherent to certain people, populations, or subgroups. Instead, vulnerability is created by society, usually by some population groups for others; that is, individuals and groups are made to be vulnerable by the

choices of others. Even where demographic features do influence vulnerability directly, we could make choices to reduce this influence and to reduce vulnerabilities in other ways, showing that "natural disasters" rarely exist.

Yet no situation is ever as simple as it appears in a short paragraph: "we could make choices" is the crux in terms of why people often cannot make choices, even if they theoretically could (and would). Considering the influence of population size on disasters, one approach among many is to seek population stabilisation by reducing the world's population growth rate to a negative value in the short-term followed by a growth rate of zero over the long-term, once a suitable population size is agreed and achieved.

Who must agree and how will they agree? Who is permitted to make these policy choices and to enact the subsequent actions, how they are made, and how they are implemented leads to labyrinthine political entanglements intersecting with ethics, belief systems, and ideologies (Coole, 2018). The political philosophy of this decision is particularly troublesome for reaching consensus and consistency, in terms of balancing how much individuals should have choices regarding reproduction compared to national governments or international organisations. Science fiction writers have even speculated about why people have the right to breed at will, with contraception often government controlled, rather than contraception being the norm with governmental permission required to have a child – leading to tortuous ethical consequences of either approach.

The difficulties of managing population stabilisation without neglecting all the other contributors to disaster vulnerability (and to wider social and environmental challenges) pushes 'disaster by choice' into the realm of 'yes, but whose choice'? The majority of the world's population has little prospect for fully tackling the deep-rooted, systemic structures which make choices for them while denying their own abilities to choose. The focus on choice, therefore, deserves critique through examining:

(i) Similarities and differences among choice, free will, agency, and other notions (Holton, 2006).

(ii) The contrasting adages that everyone always has some level or modicum of choice and that everyone is always highly constrained

> by the norms, rules, and regulations governing our opportunities and behaviour (Giddens, 1979, 1984; Mouzelis, 1995; Stones, 2005).

If disasters fundamentally come down to choices – namely, someone's choices – then much more work is needed to drill down into what choices really are and the processes by which choices are and should be made, such as when irreconcilable societal and individual philosophies and values conflict (Baron, 1993; Findlay, 1961).

Nonetheless, there is so much more which those with power and resources could choose to do more immediately to avert disasters. Even a comet or asteroid, heading towards the Earth to generate a cataclysmic explosion threatening all demographic groups within humanity, would not induce a "natural disaster". We already have some space monitoring networks and some readiness to deflect or destroy dangerous objects, but we have a long way to go to safeguard ourselves fully (Schmidt, 2019). It is our choice to provide only some surveillance and response capability, rather than ensuring that we could avert a major impact under all circumstances. Irrespective, some natural hazards might be unstoppable and could indeed represent true natural disasters, such as gamma-ray bursts (Palmer et al., 2005) or supernovae from nearby stars (Wallner et al., 2016), ice ages due to orbital cycles (Hodell 2019), and basaltic flood volcanic eruptions (Courtillot and Fluteau, 2014).

Apart from these extremes, disasters are not natural because we make choices to create or tackle vulnerabilities, as illustrated by this brief exploration of demographics. We need to learn more from the successes to change 'disaster by choice' into 'no disaster by choice'.

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