Focusing on demographic differential vulnerability

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Introduction

Who is vulnerable and to *what* is a fundamental question in vulnerability reduction efforts. In line with the Sustainable Development Goal 10 on equality for all, it is important to incorporate the concept of *demographic differential vulnerability* into vulnerability analysis and policy measures aiming at reducing vulnerability. This approach has already been highlighted as a key to sustainable development by two groups of international experts: first in preparation for the United Nations (UN) World Summit on Sustainable Development in 2002 (Lutz and Shah, 2002) and a decade later for RIO+20 Earth Summit (Lutz et al., 2012). It was emphasized that vulnerability and adaptive capacity to environmental change not only varies between countries, regions, communities and households, but that even within families, the effects may differ by age and gender. Failing to recognize such demographic heterogeneity in vulnerability can lead to policies that are not appropriately directed at the truly vulnerable groups (Muttarak et al., 2016).

Why certain subgroups of population are more vulnerable to global environmental change can be analysed based on how risk factors are accumulated. Differential vulnerability result from differences in physiological susceptibility, hazard exposure and socioeconomic and psychosocial factors influencing risk perceptions and capacity to respond. While conventionally demographic characteristics such as age, gender, race/ethnicity and income are considered as a key source of heterogeneity, here religion and education are highlighted as additionally important determinants of vulnerability. Both exposure and vulnerability to the impact of common exposures differ substantially by population subgroups as elaborated below.

Physiologic susceptibility

Biological differences make different demographic groups more or less susceptible to extreme events and climatic shocks. For example, with limited ability to thermoregulate body temperatures comparing to younger persons, the majority of recorded 70,000 deaths in 12 European countries during the heat wave in summer 2003 comprised the elderly aged >65 years (Robine et al., 2008). Similarly, differences in physiology and baseline metabolism result in greater sensitivity to certain exposures among young children. Expansion of the geographical range of conditions conducive to malaria transmission due to increases in temperature, for instance, can exacerbate morbidity and mortality from malaria for children under five given their lower immunity to malaria species (Loevinsohn, 1994; WHO, 2011). Moreover, in certain hazard events such as tsunami where physiology plays a key role in survivorship, women, children aged <5 and the elderly aged >70 years had a clear mortality disadvantage (Doocy et al., 2007). Differential vulnerability thus is a function of biological differences between demographic groups, to a certain extent.

Differential exposure

Apart from biological distinction, differential social and behavioural patterns associated with demographic characteristics also influence hazard exposure. For example, adjusting for age, women exhibited higher susceptibility to heat waves not only due to physiological differences such as a reduced sweating capacity but also living arrangement (D'Ippoliti et al., 2010). With social isolation or living alone being the most significant risk factor for mortality during heat waves, that higher proportion of elderly women living alone than elderly men is also responsible for gender differences in heat wave mortality risks. Indeed, the mortality ratios for women aged ≥55 years were 15% higher than those of men (Fouillet et al., 2006). Likewise, the higher mortality rates of women during the Indian Ocean tsunami in 2004 are also partially explained by ability to swim or restrictive clothing (Neumayer and Plümper, 2007). The findings that men have higher mortality risks from floods and storms than women are due to the fact that men are engaged in outdoor activities more frequently and hence have higher exposure to hydrological disasters (Zagheni et al., 2016). In this case, differential vulnerability is determined by socially constructed demographic characteristics and norms associated with these characteristics.

Beside socially constructed behavioural patterns, differential exposures to natural hazards are related to socioeconomic status. It is well-documented that socially and economically disadvantaged groups often live in poor housing and hazard-prone areas making them more exposed to natural hazards. A review of European literature has shown that less affluent population groups are more likely to live in low-quality housing (e.g. exposure to dampness, chemical contamination, temperature problems and poor sanitation) as well as poor residential location (e.g. close to hazardous waste sites, industrial facilities, proximity to pollution sites) (Braubach and Fairburn, 2010). Furthermore, low-income households disproportionately live in coastal or low-lying areas prone to storm surge and flooding such as the slum areas in Ho Chi Minh City, Vietnam (Bangalore et al., 2017), the two most deprived deciles in the UK (Walker et al., 2006) and areas with higher social vulnerability in Mumbai, India (de Sherbinin and Bardy, 2016). Apart from underlying economic factors, members of racial or ethnic minority groups are also more likely to live in environmentally undesirable areas (Ard, 2015; Mohai et al., 2009; Mohai and Saha, 2007). Ueland and Warf (2006) explained that discrimination at work and in housing markets coupled with prejudicial access to mortgage lending and exclusionary zoning contribute to unequal exposure of hazards among low-income and minority groups. Differential probability of exposure partly explains unequal distribution of climate risks across population subgroups.

Differential vulnerability

Other than influencing exposure, demographic and socioeconomic characteristics are principal drivers of population's ability to prepare for, respond to, cope with and recover from natural disasters and impacts of climate change. The literature commonly identifies the elderly, children, women, the disabled, members of minority ethnic groups and individuals with low income as being more vulnerable to shocks (Cutter, 1995; Fothergill et al., 1999; Masozera et al., 2007). These subgroups of population are generally less able to cope and respond to hazards or shocks due to their disadvantaged position: *socially* because of minority status (e.g. members of certain religious/ethnic groups); *economically* because they are poor; and *politically* because of lack of independence, decision making power and underrepresentation (e.g. women and children) (Gaillard, 2010).

The demographic and socioeconomic characteristics associated with vulnerability also intersect and are stratified based on social identities and positions of people and groups. Certain population subgroups uniformly lack of access to economic, social and human resources or knowledge to cope with and respond to risks. Female-headed households in South Africa, for instance, are economically more vulnerable to climate variability than households headed by two adults, not only because of their lower level of education and greater economic disadvantages to start with but also due to gender differences in limited access to social networks (Flatø et al., 2017). In this case, female-headed households are more vulnerable as a result of their gender as well as socioeconomic disadvantages associated with single-headed household. Likewise, it is explained that in the United States, women and ethnic minorities consistently have higher risk perception than white males (the so-called "white male effect") because their reduced social and formal decision-making power make them more vulnerable to climate risks (Satterfield et al., 2004). However, in Sweden where women have broadly the same opportunities and life chances as men, there is virtually no gender disparities in risk perception (Olofsson and Rashid, 2011). It is thus important to consider the intersectionality between different demographic and social categories in order to better understand differential vulnerability.

It is also important to note that population characteristics underlying vulnerability are not static and depends on the type of risk considered. Women, for instance, are not always more vulnerable to climate risks than men. There is evidence that lower risk perception and risk-taking behaviour (e.g. driving a car in flooded roads, crossing flooded bridges) make young and middle aged men more likely to die in floods (Ashley and Ashley, 2008; Doocy et al., 2013; Pereira et al., 2017). Furthermore, in certain situations, the shared sense of ethnicity serves as a basis for cooperative social relations and enables a minority ethnic group such as Vietnamese in New Orleans to return and recover from Hurricane Katrina at faster rate than the average population (Vu et al., 2009). Therefore, it is not possible to label one characteristic as always vulnerable since vulnerability is dynamic and multidimensional.

Religion and differential vulnerability

Generally, studies that look at differential vulnerability to natural disasters and climatic shocks do not include religion as a demographic characteristic underlying vulnerability. Religion is another source of heterogeneity because religious affiliation shape beliefs and social identities (belonging). Religious beliefs shape risk perceptions and behaviours. There is evidence that some religions view disasters as acts of God which can lead to fatalistic attitudes on disaster risk and mitigation. The Islamic religious leaders in Satun, Thailand and some Islamic leaders in Aceh, Indonesia considered the 2004 tsunami as collective punishment (Adiyoso and Kanegae, 2012; Merli, 2010). Hindu also believes that disaster is part of god creation (Chester et al., 2012). Seeing disasters as the will of God may discourage engagement in disaster risk reduction accordingly. Nevertheless, Adiyoso and Kanegae (2017) showed that since religious leaders play an influential role in interpretation of Islamic teachings, they can reverse the fatalistic attitudes and include disaster risk reduction in their teachings. Faith thus can impact how disaster events are interpreted and prepared for.

Furthermore, religious networks and religious engagement is a source for social capital. There is evidence that the elderly who engaged in social activity including religious activities were 84% less likely to die in August 2003 heat wave in France as compared to those who did not participate in any activities

(Vandentorren et al., 2006). Similarly, belonging to a church provides support networks in times of hardship (Fletcher et al., 2013). Christian churches in Fiji, for example, could render assistance including food and provisions, reconstruction of housing, relocation and financial aid after hurricanes while Islamic Mosques and Hindu Temples had far more limited resources to support and assist their members (Gillard and Paton, 1997). Religion therefore influences vulnerability both through beliefs and belonging to a religious denomination.

Education as a key to reducing vulnerability

Apart from age, sex, race/ethnicity and income differentials, recent empirical studies have demonstrated consistent evidence showing that countries, communities, households and individuals with higher average levels of education experience lower vulnerability to natural disasters (Muttarak and Lutz, 2014). For instance, it has been found that in the absence of disaster experience, the highly educated exhibit higher level of disaster preparedness thanks to their better abstraction skills in anticipating the consequences of disasters (Hoffmann and Muttarak, 2017; Muttarak and Pothisiri, 2013). Not only were educated individuals more likely to survive and had a lower risk of injuries e.g. from the 2004 Indian ocean tsunami (Frankenberg et al., 2013; Guha-Sapir et al., 2006), communities and countries with higher average levels of education also experienced much lower losses in human lives from climate-related disasters (KC, 2013; Lutz et al., 2014; Padli and Habibullah, 2009; Striessnig et al., 2013). This suggests that public investment in education can have positive externality in reducing vulnerability to climate risks.

Education equips individuals with cognitive and problem-solving skills as well as enhances access to knowledge and information. Education therefore can contribute to vulnerability reduction in a similar way as found in other circumstances such as reducing infant mortality and promoting healthy behaviors (Montez and Friedman, 2015; Pamuk et al., 2011). Hence, better educated societies are more resilient and hold greater adaptive capacity to climate change.

Conclusion

This essay has shown that the impacts of natural disasters and climatic shocks are not distributed evenly across population subgroups. Given that vulnerability is multidimensional and dynamic, identifying *who* is vulnerable to *what* hazard in *which* way is fundamental in intervention efforts to reduce vulnerability. Beyond age, gender, race/ethnicity and economic factor, demographic characteristics underlying differential vulnerability also include education and religion, which influence values, beliefs, knowledge and capacity to respond and adapt. The concept of demographic differential vulnerability should be incorporated into vulnerability assessment, when applicable.

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