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Drought vulnerability assessment: The case of wheat farmers in Western Iran

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ABSTRACT

Drought, as a natural and slow-onset phenomenon, creates numerous damages to agricultural communities. As a drought prone area in the Middle East, Iran has currently launched a crisis management approach to mitigate the harmful impacts of drought. However, thus far studies indicate that effective drought management strategies should be designed based upon vulnerability management which can increase farmers' ability to challenge the impacts. The purpose of this study was to assess drought vulnerability across three drought intensities (very high, extremely high, and critical) areas in Western Iran. Accordingly, a survey study was applied and 370 wheat farmers who all experienced drought during 2007–2009 were selected through a multi-stage stratified random sampling method. Face to face interviews were used to collect data on vulnerability indices from the farmers. Me-Bar and Valdez's vulnerability formula was applied to assess the vulnerability of wheat farmers during drought. Results revealed that the farmers' vulnerability is influenced mainly by economic, socio-cultural, psychological, technical, and infrastructural factors. The results also indicated that the farmers in Sarpole-Zahab township were most vulnerable compared to those in the Kermanshah township as the least vulnerable. Accordingly, some conclusions and recommendations are drawn for both policy-makers and practitioners who often must prioritize limited resources in the design vulnerability-reducing interventions.

1. Introduction

Drought is one of the nation's most costly natural disasters in Iran. During the past 40 years, Iran has experienced 27 drought occurrences (Amirkhani and Chizari, 2010). This shows that drought is a slow-onset, creeping natural hazard that is a normal part of climate for virtually most part of the country. Current studies (Karami, 2009; Keshavarz et al., 2013) show that national drought planning efforts are mainly based on 'crisis management'. However, making the transition from crisis to risk management is difficult because little has been done to understand and address the risks associated with drought. Drought risk management involves mitigation programs which modifies operations before a drought strikes in order to reduce the impending harmful impacts. For instance, the National Drought Mitigation Center in the United States has promoted drought mitigation and preparedness in order to reduce vulnerability (Knutson et al., 2001).

In the context of drought, assessing vulnerability is a starting point to determine the effective means of remedial actions and to mitigate the impacts by supporting coping strategies and facilitating adaptation (Kelly and Adger, 2000). Since farmers are the most vulnerable groups in rural areas (Zahedi Mazandarani and Zahedi Abghari, 1996), the identification of vulnerable groups can act as an entry point for both understanding and addressing the processes that cause and exacerbate vulnerability (Brooks et al., 2005). Moreover, farmers' vulnerability assessment aims to not only identify which groups of farmers are most at risk but also to understand why. On the one hand, this information is critical for drought management policy-makers in Iran who often must prioritize limited resources when designing the vulnerability-reducing interventions. On the other hand, the assessment of "who" is vulnerable and "why", recognizes the interactions between drought hazard and vulnerability that define the risk of serious impacts, and is one of the main aspects of drought mitigation and planning (Wilhelmi and Wilhite, 2002). Hence, the purpose of this study was to assess farmers' vulnerability toward drought in Western Iran.

2. Vulnerability assessment

The scientific use of 'vulnerability' has its roots in geography and natural hazards research but this term is now a central concept in a variety of other research contexts such as ecology, public health, poverty and development, secure livelihoods and famine, sustainability science, land change, climate impacts and adaptation (Füssel, 2007). Vulnerability is defined as the characteristics of a

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person or group in terms of their capacity to anticipate, resist, cope with, and recover from the impact of natural or man-made hazards (Blaikie et al., 1994; IFRC, 1999; Ethlet and Yates, 2005; Paavola, 2008). According to IPCC (2001), vulnerability is defined as the extent to which a natural or social system is susceptible to sustaining damage from climate change. Vulnerability is a function of the sensitivity of a system to changes in:

i) climate (the degree which a system will respond to a given change in climate, including beneficial and harmful effects);
ii) adaptive capacity (the degree to which adjustments in practices, processes, or structures can moderate or offset the potential for damage or take advantage of opportunities created by a given change in climate); and
iii) the degree of exposure of the system to climate hazards.

Perkins (2001) categorized vulnerable individuals on the basis of their exposure and stress; most sensitive to perturbations or stress, and generally weak coping strategies. Therefore, vulnerability is a condition in which individuals face food insecurity (hunger), job insecurity (unemployment), social insecurity (power isolation), and insecurity of health (illness and physical weakness) (Zahedi Mazandarani and Zahedi Abghari, 1996).

United Nations International Strategy for Disaster Reduction (UN/ISDR, 2004) distinguishes four groups of vulnerablility factors that are relevant to the context of disaster reduction:

1) physical factors, which describe the exposure of vulnerable elements within a region;
2) economic factors, which describe the economic resources of individuals, populations groups, and communities;
3) social factors, which describe non-economic factors that determine the well-being of individuals, population groups, and communities, such as the level of education, security, access to basic human rights, and good governance; and
4) environmental factors, which describe the state of the environment within a region.

All of these factors describe properties of the vulnerable system or community rather than of the external stressors (Füssel, 2007); Chambers (2006) believes that vulnerability has two folds: an external aspect of risk, shocks, and stress to which an individual or household is the subject; and an internal aspect which is defencelessness, meaning a lack of means to cope without damaging loss. Loss can take many forms–becoming or being physically weaker, economically impoverished, socially dependent, humiliated or psychologically harmed. Furthermore, Aysans (cited in Wisner, 2004) identifies eight types of vulnerability: economic, social, ecological, educational, attitudinal and motivational, political, cultural, and physical.

According to the literature, many scholars from different fields of specialization have been conceptualizing vulnerability differently based on the objectives to be achieved and the methodologies employed. These differences limit the possibility of having a universally accepted definition and methodological approach to assessing vulnerability against which the appropriateness of a given concept or method can be judged. However, the knowledge of the existing conceptual and methodological approaches can guide the choice of one of the methods, or the combinations of existing methods, in analyzing vulnerability for a specific area of interest (Deressa et al., 2008). Some of these techniques have been used in assessing the vulnerability such as: fuzzy modeling (Alcamo et al., 2005; Azadi et al., 2007, 2009), statistical analysis (Shewmake, 2008), GIS and mapping techniques (Wilhelmi and Wilhite, 2002), cluster analysis (Haan et al., 2001; Sharma and Patwardhan, 2008) and using index (Adger, 1999; Patnaik and Narayanan, 2005; Zakieldeen, 2009). Recently, there have been growing attempts to develop mathematical models to measure vulnerability (Riely, 2000; Luers et al., 2003; Davis, 2004; Metzger et al., 2004; Wisner, 2004; Brooks et al., 2005; Me-Bar and Valdez, 2005; Deressa et al., 2008; Fontaine and Steinemann, 2009; Slejko et al., 2009).

Vulnerability assessment requires that researchers measure factors influencing such a phenomenon. This in turn, would enhance social and environmental resistances toward drought. According to the literature, many studies have focused on factors influencing external vulnerability. Researchers believe that some individuals and groups will suffer more in times of natural disasters. This difference in vulnerability is due to different individual (e.g. gender, age, education, attitude), socio-economic (e.g. social class, religion, ethnicity, social networks, access to resources and power, political structures, income diversification, infrastructural constraints, poor technology, lack of market access and capital, land size), and biophysical attributes (e.g. irrigation, type of product, type of irrigation) (Benight et al., 1999; Coeelho, 2000; Downing and Bakker, 2000; Elfaigh, 2000; Knutson et al., 2001; Norris, 2002; Wilhelmi and Wilhite, 2002; Vásquez-León et al., 2003; Alcamo et al., 2005; Ethlet and Yates, 2005; Brant, 2007; Paavola, 2008; Shewmake, 2008; Simelton et al., 2009).

3. Drought vulnerability

Factors influencing drought vulnerability are numerous, and their inclusion may depend on data availability. Despite limitations, available information on regional drought vulnerability could aid decision makers to be proactive to take appropriate mitigation actions before the drought occurence (Wilhelmi and Wilhite, 2002). Bohle et al. (1996), Azadi et al. (2011a,b), and Rudi et al. (2012) believe that vulnerability, in the most general sense, refers to the relations between nature and society. They believe in this way, vulnerability is a concept originated from “human ecology” that mainly shows how the risk and threats of environmental hazards like drought are experienced by individuals and society. They consider farmers and pastoralists as most vulnerable groups to drought. They believe that among rural households, vulnerability might be doubled in times of drought, particularly if national institutions fail to provide timely support to the food system (Wilhelmi and Wilhite, 2002). According to Sonmez et al. (2005), high economic cost and social vulnerability of drought problem have led to increasing attention to the drought vulnerability in recent years. Losses from drought events across the world have significantly increased in line with the increased number or severity of droughts. The impacts of drought depend largely on societal vulnerability at the time when drought occurs. In recent years, increased losses from droughts are increasingly being focused on societal vulnerability. For example, Blaikie et al. (1994) showed how the risk of drought is a combination of a hazard and societal vulnerability.

Furthermore, drought vulnerability can be different for different individuals and nations. According to Brooks et al. (2005), it is important to note that factors that make a rural community in a developing country vulnerable to drought could be different from those of a wealthy industrialized nation. Even for a given system, vulnerability is unlikely to be the same for low and high frequent droughts (Smit and Wandel, 2006). Downing and Bakker (2000) stated that hazardous weather differs from normal weather by its potential to do damage, and not by its physical or statistical properties. Blaikie et al. (1994) showed that the risk of possible disaster is a combination of hazard and vulnerability. Therefore, the level of risk that the hazard poses to people is directly related to societal vulnerability.

Downing and Bakker (2000) also stated that vulnerability largely defines drought risk rather than the frequency and severity of weather anomalies on their own. In order to lessen the impacts of drought, societal vulnerability must be reduced. However, more effort has been spent on predicting and monitoring climatic, hydrological and biological conditions, than on identifying societal