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Review

Vulnerability of wheat farmers: Toward a conceptual framework

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ABSTRACT

Vulnerability is expected to differ based on climatic conditions as well as socio-economic attributes of farming households. In this regard, attention toward vulnerability assessments is increasing within policy-making processes, to assist in selecting suitable coping strategies and policies to reduce farmers' vulnerability. Through identifying the main vulnerability indicators from a sustainability perspective (including social, economic, and environmental dimensions) among wheat farmers, this study is seeking an inclusive conceptual framework to assess their vulnerability to both socio-economic and environmental changes. Taking the main elements (i.e., sensitivity, exposure and adaptive capacity) of vulnerability into account, this paper tried to develop an inclusive systemic framework to understand the most important indicators of vulnerability for wheat farmers at various spatial and temporal scales. It is supposed that the framework is a useful guide for policymakers in identifying the vulnerable groups of wheat farmers and zones so that they can decide about proper coping strategies to effectively deal with adverse effects of climate and undesired socioeconomic changes in the wheat farming system.

Contents

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1. Introduction

1.1. Importance of vulnerability assessment

Vulnerability assessment is an effective tool to determine the systems that are sensitive to harm; mainly food security, water, public health, natural resources. Understanding the vulnerability level of a system is useful to recognize and create mitigation actions such as enhancing coping capacity and reducing the susceptibility and understanding the interactions between the various structures and processes that cause the vulnerability (Botero and Salinas, 2013). The evaluation of the vulnerability of farm families to global climate change is presently the main focus of agricultural policies, especially when food sector relies on irrigated farming and when agriculture sector is yet the main source for economy of a country (Aulong and Kast, 2011). The global agriculture in the twenty-first century will face significant challenges that call for an integration of the environmental, social, and economic dimensions of development to meet the needs of present generations without compromising the needs of future generations. The world population is expected to grow by almost 3 billion within the next 50 years, mainly in developing countries. Countries cannot launch any poverty alleviation and food security projects without first tackling concerns about sustainable agricultural and rural development. Moreover, climate change poses the risk of further depressing the economic performance of the agricultural sector (Aulong and Kast, 2011). Consequences of climate change on farming systems sustainability are straight forward: crop yields are decreasing with some years in which there was a significant loss of production as a consequence of droughts. Crop diversity is suggested as an adaptation strategy but with no stable empirical evidence (Reidsma and Ewert, 2008). Agriculture is significantly related to the relationship between the natural environment and human society and the degree to which climatic events can affect agricultural systems depends on a wide variety of factors including environmental and socio-economic. Considering the rapid population growth, identifying the social, economic, and environmental vulnerability of agricultural systems seems unavoidable as far as sustainable development is concerned (Fischer et al., 2002).

1.2. Current trends in vulnerability assessment

In recent years, the central focus of the global change and sustainability researches has been on the concept of vulnerability (Metzger and Schroter, 2006). This concept has been known and become familiar in association with climatic factors and natural disasters. IPCC (2007) defines vulnerability as a functional effect of climate variability exposed to a system which has susceptible defensive capacity to adverse effects. From the social science point of view, scientists should focus on those socio-economic, environmental and political structures and processes which can make people vulnerable, apart from the physical dimension of environmental threat (Luers et al., 2003; Schroter et al., 2005; Metzger et al., 2005; Adger, 2006; Metzger and Schroter, 2006; Birkmann and Wisner, 2006; Eakin et al., 2006; Berry et al., 2006; Villagran De Leon, 2006; Polsky et al., 2007; Fussel, 2007; Acosta Michlik and Espaldon, 2008; Chazal et al., 2008; Pearson and Langridge, 2008; Wisner, 2009; Pearson et al., 2011; Sangpenchan, 2011; Shrestha, 2011; Nicholas and Durham, 2012; Anderson and Mclachlan, 2012; Zarafshani et al., 2012). All these researchers have identified the critical components of vulnerability such as the exposure to stressors, the capacity to adaptation, cope with, resist and recover from natural hazards, and the consequences of stresses. Most studies have however focused on vulnerability to the direct or indirect physical or environmental impacts of global environmental problems, while socio-economic and political aspects have received much less attention (Anderson and Mclachlan, 2012). This has been also confirmed by Lindoso et al. (2012) who considered socio-economic, institutional and climate indicators for assessing the vulnerability of smallholder farming to climate change in a case study in Brazil. They emphasized that the vulnerability of smallholder farming is affected not only by climate drivers but also by socio economic and political-institutional factors. Therefore, the vulnerability of a region relies not only on its exposure to severe climatic variations, but also on its social characteristics that will influence the consequences of the unusual climate. Importantly, land use changes resulted from the institutional issues and their influences on rising vulnerability at different scales need to be taken into account (Máñez et al., 2011).

Majority of literature has considered environmental and social exposures as independent functions. This mono-disciplinary factor-driven vulnerability research has been criticized for oversimplifying the real-world context by neglecting the interaction of exposures (Kelly and Adger, 2000; Turner et al., 2003a; O'Brien et al., 2004; Reidsma, 2007; Deressa, 2010; Sangpenchan, 2011; Anderson and Mclachlan, 2012; Azadi et al., 2007, 2009). Given that, how to incorporate multiple and often conflicting values into the analysis of environmental systems and their vulnerability has remained as a continuous challenge for future works in global environmental change. Methods and frameworks that can account for multiple perspectives on vulnerability for particular people in specific locations are very few (Mclaughlin and Dietz, 2007; Chazal et al., 2008). To address these challenges, much effort has been put into better understanding the vulnerability and adaptive capacity of individuals, communities, industries and institutions in the face of global environmental change (Eriksen and Kelly, 2007; Fussel and Klein, 2006; Sangpenchan, 2011).

Agricultural systems are realized as one of the most vulnerable systems in the planet due to a high dependency on climatic conditions particularly on temperature and rainfall. In developing countries, the increase in temperature and reduce in precipitation have become more intense (Sivakumar et al., 2005), and climatic hazards (drought, flood, heat, and coldness) have been accruing more often with higher severity (IPCC, 2007). Surely, global agricultural production systems are being influenced by any variation in climatic condition (Valizadeh et al., 2014). Variations and long-term changes in climate variables pose challenges to farmers and their communities which rely much on the output of agricultural systems (Sangpenchan, 2011).

Farmers will have to adjust to both climate variations and socio-economic changes at the same time, and thus vulnerability must be taken into account from a multiple rather than limited perspective. It is hard for farmers, particularly those in developing countries to find a way to overcome climatic changes since they do not have required investments for implementing (new) adaptive practices so that they can preserve their properties and households (Thompson et al., 2007). In particular, families whose life depends on rain-fed agriculture are most vulnerable to these changes (Thorlakson and Neufeldt, 2012). Moreover, individual farmers are inevitably vulnerable to the negative impacts of climate change, and particular adaptation strategies (such as adopting new seed varieties, relocating the farm, or installing irrigation systems) are usually required. Even though agricultural effects are mostly discussed at larger scales, individual farmers are likely to confront and respond to the impacts resulting from this double exposure, and they are likely to be the most sensitive group in the agricultural production system. Therefore, the gains/losses from double exposure at the national level should not be extrapolated as the gain/loss at a lower level (e.g., an individual farmer). Hence, in addition to addressing