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Research paper

Relationship between socioeconomic vulnerability and ecological sustainability: The case of Aran-V-Bidgol's rangelands, Iran

Valiollah Raufirad[a,b,*], Qodratollah Heidari[a], Richard Hunter[c], Jamshid Ghorbani[a]

[a] Department of Natural Resources, Sari University of Agricultural Sciences and Natural Resources, Sari, Iran
[b] Department of Biology and Biochemistry, University of Houston, USA
[c] Geography Department, State University of New York College at Cortland, USA

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ABSTRACT

This study combines the Me-Bar and Valdez's vulnerability assessment techniques with geographic information systems (GIS) to assess socioeconomic vulnerability and its relation to ecological sustainability in winter rangelands of Aran-V-Bidgol County, Isfahan province, Iran. Socioeconomic data were collected using a researcher-made questionnaire and ecological sustainability parameters (including plant, litter, soil, sand and gravel cover and forage yield) data were collected through field measurements. Results showed that "local problems", "number of rangeland users", "rangeland user's access to rangeland experts", "utilization pattern", "livestock type", "economic status of rangeland users", "livestock number" and "increasing prices" were the most important socioeconomic indicators influencing socioeconomic vulnerability in the rangelands. In addition, a significant relationship was found between the socioeconomic vulnerability index and ecological sustainability parameters, including forage yield of annual forbs and total forage yield. Findings further indicated that a combination of the social and economic indicators with a focus on the local scale dimensions of vulnerability could create a useful tool for decision-makers, practitioners and rangeland users whose main recent concern is vulnerable rangeland ecosystems.

1. Introduction

Rangelands account for around 50% of the world's land surface (Sugita et al., 2007). Many rangelands are presently overgrazed and experiencing severe degradation (Merriam et al., 2016; Tahmasebi, 2012). This problem is especially acute among rangelands located in arid and semi-arid zones where the effects of climate change and growing human populations are putting rangelands under increasing pressure (Tahmasebi, 2012). Practical advancements in our understanding of rangeland vulnerability are required to achieve sustainable rangeland management. Vulnerability assessment is one of the most important conceptual tools to determine the vulnerability level of ecosystems to internal and external stresses (Adger, 2006; Wisner, 2009). The concept of vulnerability has been extensively used in a variety of research contexts to refer to the degree in which a system is likely to be harmed by various stressors (Sangpenchan, 2011; Zarafshani et al., 2012).

Vulnerability assessments can incorporate either a socioeconomic or a biophysical approach, or an approach that integrates variables from both of those areas. Although the latter approach may be more informative because many rangelands are threatened by both socioeconomic and biophysical variables, it has some important limitations. For example, the lack of standard methods for combining biophysical and socioeconomic indicators can create major problems in dealing with vulnerability assessments (Deressa et al., 2008). This approach uses different data sets, ranging from socioeconomic data sets (e.g., age, gender of ecosystem users) to biophysical data sets (e.g., soil and vegetation based variables of ecosystems); these data sets certainly have different and yet unknown weights in shaping vulnerability (Deressa et al., 2008). Cutter et al. (2000) explained that because this analysis provides no common metric for determining the relative importance of social and biophysical vulnerability, nor for determining the relative importance of each individual, much care is required. Until now many studies have been published on the ecological vulnerability of ecosystems (Nandy et al., 2015; Ippolito et al., 2010; Li et al., 2006) but relatively few studies (e.g., Brown et al., 2016) have addressed the roles of socioeconomic variables on rangeland vulnerability.

* Corresponding author at: Department of Biology and Biochemistry, University of Houston, Houston, TX 77004, USA.
E-mail addresses: al.raufi@gmail.com, vraufirad@uh.edu (V. Raufirad).

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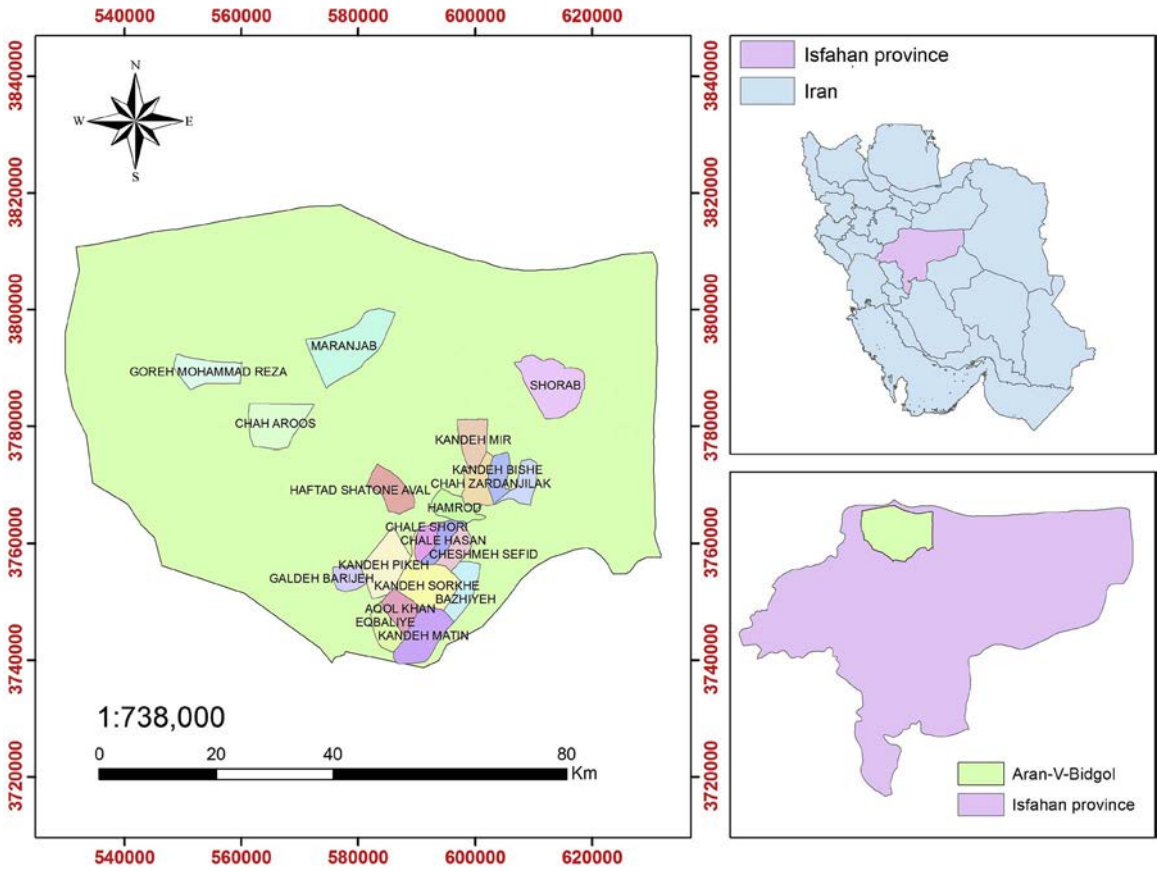

Fig. 1. The location of the study area.

1.1. Socioeconomic vulnerability in rangelands

Socioeconomic vulnerability of rangelands is related to a social construction of vulnerability with a special focus on social and economic root causes. Rangeland vulnerability to socio-economic issues is complex and closely related to a set of indicators. Because determining indicators influencing socioeconomic vulnerability is time-consuming, selecting methods that are expedient, understandable, and inexpensive for all stakeholders of rangelands should take the highest priority. For example, the artificial neural network method, which is used to determine the weight of indicators for a vulnerability assessment, requires historical data that are not always available, or requires considerable time to implement from different data sets. Besides, such methods are not understandable for non-technical users (e.g., rangeland users).

Vulnerability assessment methods can be divided into two groups: econometric and indicator methods. The econometric methods use a massive range of socio-economic field data to evaluate the vulnerability of various groups. In contrast, the indicator methods employ a particular range of indicators to quantify vulnerability through estimating indicators, averages or weighted averages for those selected determinants using some formula and techniques (Nazari et al., 2015). Therefore, because indicator approaches are relatively straightforward to understand and implement by different stockholders, we aim to assess rangeland vulnerability using indicator methods.

Socioeconomic indicators have always affected the vulnerability of rangeland ecosystems. For example, appropriate access to education and information improves the integration of the rangeland user's production system into the market economy, and a high educational level helps rangeland users better understand and effectively participate in sustainable rangeland management. Regarding age, more educated and younger rangeland users are more likely to use more sustainable livelihood strategies. Rangelands with such exploiters are less sensitive to external pressures and stressors. Another example is access to labor. Because labor is intensive, particularly in the realms of herding and dairying, labor is a leading cost in this economic sector. The rangeland users without adequate household labor exhibit a lower capacity to resist outside pressures and stresses (Tahmasebi, 2012). As a result, ecological sustainability in rangelands is being affected by socio-economic changes, which have led to a loss in resilience and further degradation of the rangelands.

1.2. Ecological sustainability in rangelands

Ecological sustainability in rangelands depends largely on ecosystem functioning and the impact of livestock on ecological processes. Hobbs and Norton (1996) and Heitschmidt et al. (2004) identified three major threats to ecological processes in rangelands: (a) invasion of noxious species that decrease substantially the attractiveness of a given rangeland due to a reduction in the functioning of biomass as forage material; (b) the conversion of rangelands into other land uses such as residential areas, agricultural fields, and industrial areas; and (c) a significant decrease in productivity due to soil degradation as a result of intensified erosion processes and over-grazing. Therefore, monitoring changes in plant cover, land cover categories such as litter, soil, sand and gravel, and forage yield are appropriate ecological sustainability indicators in rangelands. An imbalance between socioeconomic indicators (e.g., income and expenditure, increases in population density) may threaten the ecological sustainability in rangelands by increasing the social and economic vulnerability in rangelands (Svoray et al., 2013; Weltz et al., 2003)

1.3. Objectives

This study assesses rangeland socioeconomic vulnerability to