



Sustainable livelihood framework-based indicators for assessing climate change vulnerability and adaptation for Himalayan communities



Rajiv Pandey^{a,*}, Shashidhar Kumar Jha^b, Juha M. Alatalo^c, Kelli M. Archie^d,
Ajay K. Gupta^a

^a ICFRE, Dehradun, India

^b HNB Garhwal University, Srinagar, India

^c Department of Biological and Environmental Sciences, College of Arts and Sciences, Qatar University, P.O. Box 2713, Doha, Qatar

^d Climate Change Research Institute, Victoria University of Wellington, New Zealand

ARTICLE INFO

Article history:

Received 11 November 2016

Received in revised form 1 February 2017

Accepted 26 March 2017

Keywords:

Bottom-up approach
Exposure
Household capital
Resilience

ABSTRACT

This study evaluated the climate change vulnerability of Himalayan communities, and their potential to adapt to these changes, through assessing their perceived reactions and counter-actions to climate change. The evaluation was conducted through proposing and testing indices for vulnerability (Climate Vulnerability Index – CVI) and adaptation (Current Adaptive Capacity Index – CACI) based on the assumption that a community is an active dynamic entity and has tremendous capability to address the impacts of climate change through an ability to make adjustments based on perceived experiences. Both CVI and CACI include the five forms of capital leading to sustainable livelihood, i.e. human, natural, financial, social and physical capital, and were assessed for each of these forms of capital based on the IPCC framework of vulnerability assessment and its three dimensions (exposure, sensitivity, adaptive capacity). Data for the analysis were collected from randomly selected households located away from district headquarters (ADH) and near district headquarters (NDH). Each dimension was measured based on associated socio-environment-specific indicators for assessing vulnerability and sustainability at community level. The results showed that ADH households had higher human capital and natural capital vulnerability than NDH households. In contrast, NDH households had higher social capital and financial capital vulnerability than ADH households. Overall, ADH households had greater vulnerability than NDH households.

These results improve understanding of the environmental and socio-economic changes affecting rural livelihoods and the measures needed to address their specific vulnerabilities by addressing bottlenecks in education and training facilities for skill up-grading, increasing interaction opportunities through local functions and creating opportunities for income generation and effective market and farm linkages. An attempt was made to reduce the gap between bottom-up understanding and top-down policies by suggesting precautionary and ongoing adaptation practices for the communities studied, leading to effective and efficient addressal of vulnerabilities. Vulnerability in the study context was taken to mean externally driven change leading to disturbance in the human environment that could alter internal and external livelihood settings.

© 2017 Elsevier Ltd. All rights reserved.

1. Introduction

The Himalayas is a highly vulnerable region in terms of natural disasters and the effects of such disasters are further compounded by other influencing co-factors such as geographical location,

topography and unique economic, political, cultural characteristics of the region (Dolan and Walker, 2006). The increasing frequency of extreme climate events, widespread poverty, migration and marginalisation of Himalayan people make mountain communities more vulnerable to climate variability (Gerlitz et al., 2016). Climate change impacts in Himalaya have already led to a loss in agri-diversity and changes in the farm cropping pattern (Negi and Palni, 2010) and an overall reduction in food production (Sinha, 2007), increasing the vulnerability of smallholder farmers (Harvey et al., 2014). However, the Himalayas region is also endowed with

* Corresponding author.

E-mail addresses: pandeyr@icfre.org (R. Pandey), shashidharkj@gmail.com (S.K. Jha), jalatalo@qu.edu.qa (J.M. Alatalo), kelli.archie@vuw.ac.nz (K.M. Archie).

abundant natural resources that provide valuable ecosystem goods and services for livelihoods (Sandhu and Sandhu, 2014).

Nature's life support systems and community are the main components of sustainable development. These components are interdependent and, in the event of socio-environmental change, are likely to affect the well-being of individuals (Moser, 1998; Obrist, 2006). Vulnerability may result from natural disasters, over-exploitation or unsustainable use of resources, poverty, marginalisation and exclusion (Barnett, 2001). Social vulnerability explicitly involves those demographic and socio-economic factors that exacerbate or attenuate the impacts of hazardous events on local populations (Tierney et al., 2001; John Heinz III Center, 2002). In climate parlance, this means those who are at risk and the degree to which they can be harmed by increased climate variability. Marginalised communities are fundamentally affected by diverse (external) factors determining their livelihood over which they have no control (DFID, 1999; Hobley, 2002). In addition, a number of studies suggest that poor and marginalised people are more vulnerable to climate change and that their vulnerability is further compounded by their degree of association with natural systems (Nelson, 2011; IPCC, 2014). It is more pronounced in the mountains, as mountain peoples are dependent on natural resources (Pandey, 2009). Moreover, prosperous communities can be affected by extreme events, but through their prosperity, or better coping strategies, they are less likely to be critically damaged by extreme events.

Mountain ecosystems are among the Earth's most fragile ecosystems and are a key source of water, energy, minerals and forest products. In addition, mountain ecosystems play a critical role in economic development, environmental protection and ecological sustainability (Macchi et al., 2011). Despite this, mountain communities are confronted with limited livelihood options due to their remoteness, the fragility of their mountainous settings and the low incentive to stay in balance with surrounding ecosystems (Gerlitz et al., 2016). Thus mountain ecosystems are more exposed to various drivers such as climate variability, globalisation, economic policies and increasing pressure on land and resources. This burgeoning pressure on mountain ecosystems causes resources to be used in an unsustainable manner. This increased pressure may also lead to ecological imbalances and threaten the relationship between human and environment over a longer time (Parmesan and Yohe, 2003). It can be argued that the unsustainable use, or over-exploitation, of resources can be expected to put more pressure on future generations of resource-resilient, marginalised mountain populations compared with the present generation.

The vulnerability of mountain ecosystems and their intrinsic environmental fragility pose challenges to their sustainability. Sustainability can be achieved by enhancing capability, improving equity and increasing social sustainability. A livelihood or community is said to be sustainable when it can cope with, and recover from, stress and shocks, maintain or enhance its capabilities and assets and provide sustainable livelihood opportunities for the next generation (Chambers, 1989; Chambers and Conway, 1992). Furthermore, the extent of vulnerability depends on the costs of coping strategies, mitigation options and adaptive capacity of a community, as these may differ between more prosperous and poor communities. Poverty is one of the key drivers of vulnerability, as it limits the livelihood assets required for coping or adapting to climate variability. On the other side, prosperity is one of the major indicators of sustainability, because it is directly or indirectly related to the coping strategies of a community and individual. Prosperous communities can also be affected by extreme events, but due to their prosperity, or better coping strategies, they are less likely to be critically damaged by extreme events. For instance, a community that is unable to fulfil its basic need for livelihood capital (natural, financial, physical, human and social capital) is

not sustainable. The lack of basic livelihood capital for a community or an individual worsens the situation during the exigencies of extreme events and therefore the community or the individual is vulnerable to any potential stressor. It can be argued that the processes or responses leading to non-sustainability may also be instrumental in adding to the vulnerability and vice versa.

The Climate Vulnerability Index (CVI) and the Current Adaptive Capacity Index (CACI) are proposed approaches for judging vulnerability and adaptation capability, respectively. These two indices are based on the Sustainable Livelihood Framework (DFID, 1999) and the Climate Vulnerability Index (Pandey and Jha, 2012). Both CVI and CACI include the five forms of capital leading to sustainable livelihood, i.e. human (H), natural (N), financial (F), social (S) and physical (P) capital. The contribution to adaptation, and hence vulnerability reduction, is assessed for each of these forms of capital based on the IPCC framework of vulnerability assessment through its three dimensions (exposure, sensitivity, adaptive capacity). Each dimension is measured based on associated socio-environment-specific indicators for assessing vulnerability and sustainability at community level. The indicators are site-specific and are identified for different livelihood sectors. Therefore, the approach is valuable for monitoring trends and capturing the multi-dimensionality of vulnerability and adaptation (Leichenko and O'Brien, 2002).

The purpose of the CVI and CACI approaches is to reduce vulnerability by identifying weaknesses and strengthening the coping strategies, adaptation mechanisms or resilience of the poor by building up their livelihood assets through sustainable development. Reducing poverty and encouraging economic growth that benefits poor individuals, regions or countries should rely on sound, flexible and pro-poor policies and regulations, by which the poor can claim their rights to economic growth and access markets and resources that fulfil their requirements for a sustainable livelihood (DFID, 1999). The CVI and CACI approaches recognise vulnerability by identifying economic, social and environmental factors affected by climate change that could be helpful in designing adaptation programmes.

The aim of the present study was to evaluate the aggregated response of mountain communities under climate change by assessing their vulnerability, and their potential to adapt to these changes based on their perceived reaction and counter-actions, through developing indices of their vulnerability and adaptation capability.

2. Methods

2.1. Study area

The focus of the study area was Srinagar and adjoining areas in the Garhwal Himalayas, the western part of the Indian Himalayas (Rajwar, 1993) (Fig. 1), and lies in Pauri Garhwal (Pauri block) and Tehri Garhwal (Devprayag block) districts of Uttarakhand state of India. Srinagar (29°20' N–30°15' N; 78°10' E–79°20' E) is at an elevation of 650 m above sea level, with a land area of 5329 km² (FSI, 2011) and a population of 686,527. The literacy rate in the region is 82.59% (males: 93.18%, females: 73.26%), compared with 74.04% nationally in India (males: 82.14%, females: 65.46%) (Census of India, 2011).

The region has a sub-temperate to temperate climate, with mean annual temperature of 25–30 °C (45 °C in June and 1.3 °C in January). Mean annual rainfall in the district is 2180 mm, with over 90% of precipitation falling in the monsoon period (July–September). The topography of the Garhwal is mountainous. The cross profiles of the fluvial valleys display a convex form, with steep valley sides, interlocking spurs descending towards the main channel, and terraced agricultural fields on the gentle slopes on the

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات