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Understanding livelihood vulnerability to climate change: Applying the livelihood vulnerability index in Trinidad and Tobago

Kalim U. Shah [a], Hari Bansha Dulal [b,*], Craig Johnson [c], April Baptiste [d]

[a] York University, Toronto, Canada
[b] World Bank, 1818 H Street, NW, Washington, DC 20433, USA
[c] University of Guelph, Ontario, Canada
[d] Colgate University, New York, USA

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ABSTRACT

This paper develops and tests the application of a Livelihood Vulnerability Index (LVI) for agricultural and natural resource-dependent communities in developing countries. The index is applied in a comparative study of two wetland communities in Trinidad and Tobago, a country that is expected to bear some of the most severe impacts of climate change. Our application of the LVI entailed a series of critical focus group discussions involving local community representatives, government officials and researchers. Researchers collected household data for eight types of assets, which were aggregated into composite LVIs and differential vulnerabilities of the two communities being compared. The results of the analysis suggest that one of the communities, "Nariva", was more vulnerable than the other, "Caroni", particularly in relation to socio-demographics, health and water security, natural disaster and climate variability. Caroni on the other hand was more vulnerable in relation to other LVI indicators with the exception of food security. On questions of gender, the study found that female-headed households were marginally more vulnerable than male-headed households. Overall, the study suggests that the livelihood vulnerability index can be broadly applied in comparable settings in small-island developing states and other developing countries. In so doing, it provides a reliable methodology that can be used to assess community vulnerability and design management plans in areas with limited resources and access to reliable data.

1. Introduction

Vulnerability indicators provide a potentially useful means of monitoring vulnerability over time and space, identifying the processes that contribute to vulnerability, prioritizing strategies for reducing vulnerability, and evaluating the effectiveness of these strategies in different social and ecological settings (Adger et al., 2009; Dow, 1992). To date however, definitions and assessments of climate change vulnerability are often applied inconsistently. The Intergovernmental Panel on Climate Change provides a useful typology, suggesting that vulnerability may be characterized as a function of three components: adaptive capacity, sensitivity, and exposure (Schneider et al., 2007). Adaptive capacity describes the ability of a system to adjust to actual or expected climate stresses, or to cope with the consequences. It is considered "a function of wealth, technology, education, information, skills, infrastructure, access to resources, and stability and management capabilities" (McCarthy et al., 2001). Recent research also indicates that perceptions of social identity by communities play a strong role in climate risk perception and adaptive ability (Frank et al., 2011). Sensitivity refers to the degree to which a system will respond to a change in climate, either positively or negatively. Exposure relates to the degree of climate stress upon a particular unit of analysis; it may be represented as either long-term changes in climate conditions, or by changes in climate variability, including the magnitude and frequency of extreme events.

Landmark studies of disasters, risk and climate change highlight three broad characterizations about the dynamic and integrated nature of social and environmental vulnerability (Watts and Bohle, 1993; Blaikie et al., 1994; Kelly and Adger, 2000). One concerns the impact of exposure to hazardous events on human populations and social structures. A second explores the social and historical conditions under which people are put at risk to a diverse range of climate-related, political, or economic stresses. A third integrates physical event and the underlying causal characteristics of populations that lead to risk exposure and limited capacity of communities to respond (Adger, 1999; Cutter et al., 2000).

Correspondingly, livelihood vulnerability to climate change can be usefully understood as an outcome of biophysical and social factors (Cutter et al., 2000). Biophysical climate change vulnerability refers to the level of exposure communities face from the physical

* Corresponding author.
E-mail addresses: hbdulal@gmail.com, hdulal@worldbank.org (H.B. Dulal).

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impacts of sea level rise, increase in sea surface and/or atmospheric temperatures. Climate-induced variability increases the vulnerability of rural livelihoods and reduces the ability of households to deal with risks, shocks and stresses (Prowse and Scott, 2008). Since these households typically have limited assets, they are at increased risk (exposure) and their ability to cope is restricted (Dulal et al., 2010b). Social vulnerability is partially the product of those factors that shape the susceptibility of communities to harm and those that govern their ability to respond. It also includes "place inequalities" - those characteristics of communities and the built environment, such as the level of urbanization, growth rates, and economic vitality - that contribute to the social vulnerability of particular places (Cutter et al., 2000).

Kelly and Adger (2000) differentiate between 'end-point' and 'start-point' features of climate change vulnerability. End-point studies define vulnerability in terms of net impacts and inevitably frame adaptive options in terms of "fixes", often technological in nature, which will minimize particular impacts that have been projected. The 'starting-point' approach, which is employed in this study, defines vulnerability as a pre-existing state generated by multiple factors and processes, such as political or economic marginalization, that conditions the ability to respond to stress.

Methods of vulnerability assessment take diverse approaches to systematically examining and integrating interactions between humans and their physical and social surroundings. Many approaches use indicators to characterize and quantify multidimensional issues, often combining diverse indicators into a single composite index of vulnerability. Vulnerability indices are constructed for three primary purposes. First, they offer a reference point for evaluating frameworks for development policy (Kelly and Adger, 2000; Eriksen and Kelly, 2007). Second, they can provide information for developing adaptation and mitigation plans (Gbetibouo et al., 2010). Third, they can provide a means of standardizing vulnerability measurement, thereby allowing comparison of different contexts. This in turn provides a means of setting priorities in resource allocations for adaptation and mitigation (Preston et al., 2011; Heltberg and Siegel, 2009).

While indexes provide a useful means of comparing and evaluating different units of analysis (e.g. households, geographic regions), they must also be able to incorporate local, context-specific variables (Eakin and Bojorquez-Tapia, 2008). Without such flexibility, assessments can suffer from a lack of specific, local indicators that may be used to differentiate between vulnerability assessments based on the best quality information obtainable and the limited resources and expertise available (Shah and Rivera, 2007).

At the household level, an index assessing livelihood vulnerability should provide an explicit indication of the capabilities, assets, and activities required for a sustainable means of living for the respective household (Chambers and Conway, 1992). A livelihood is considered sustainable when it can cope with and recover from shocks, and maintain or enhance its capabilities and assets, while not undermining the natural resource base. Livelihood vulnerability assessments can provide decision-making information at two adaptation and planning levels. First, among multilateral institutions they are increasingly being adopted and developed as an effective policy framework to address poverty and vulnerability, consistent with maximizing growth and development objectives. Second, among national social development and environmental protection agencies, they assist in developing community-specific plans that balance environmental, socio-economic and socio-cultural needs and rights of rural communities whose livelihoods are dependent upon natural resources (Arvai et al., 2006).

The Sustainable Livelihoods Approach (SLA) is a conceptual tool used to improve understanding of the livelihoods of the poor. It looks at five types of household assets – natural, social, financial, physical and human capital, using multiple indicators to assess exposure to natural disasters and climate variability, social and economic characteristics of households that affect their adaptive capacity, and current health, food and water resource characteristics that determine their sensitivity to climate change impacts (Chambers and Conway, 1992). Drawing upon the SLA, Hahn et al. (2009) developed a Livelihood Vulnerability Index (LVI) aimed at using household-level data to inform strategic community level planning. Having incorporated climate exposures and household adaptive practices into their approach, they tested the LVI in two communities in Mozambique, where it proved insightful in capturing differentials in community-level climate vulnerability. The ability of the LVI to draw out subtle yet critical differences in specific vulnerabilities (e.g. related to water, food etc.) is valuable in tailoring policies that can meet the needs of resource-dependent communities in the developing world. Although used in the southern African context of Mozambique, its structured approach provides a realistic framework for the developing country context in general.

Drawing upon Hahn et al. (2009), this study explores the analytical utility of using the LVI to understand livelihood and climatic vulnerability in small-island developing-states (SIDS). It does so by applying the model in selected coastal wetland communities in Trinidad and Tobago.

The communities were selected because they are directly and indirectly dependent upon the ecological services of wetlands, which provide important livelihood options in farming, hunting and fishing (Dugan, 1990; Dolan and Walker, 2004). They were also selected because rural communities in coastal, wetland areas of small island developing states are likely to be among the first to feel the impacts of climate change and therefore merit immediate attention.

This study builds upon the approach developed by Hahn et al. (2009) in three significant ways. First, it incorporates local and indigenous knowledge into the selection of indicators. At the community level, local perceptions and experiences of climate extremes can help in identifying the factors that enable or constrain the ability of communities to respond, recover and adapt to climate change. As such, the approach incorporates local and traditional knowledge in ways that can inform more effective decision-making, planning and management in remote areas susceptible to climate change hazards.

Second, the study starts from the premise that resilience and vulnerability are gendered by important norms in society. The empirical literature has shown that adaptation strategies are gendered by sector-specific employment, lower wages, and family care responsibilities (Enarson and Scanlon, 1999; Morrow, 1999). Compared to men, women and children are fourteen times more likely to die during disasters (Brody et al., 2008). Jankowska et al. (2012) found that climate change had varying levels of human health effects (e.g. malnutrition) in men, women, infants and young children in Mali. However, all women are not equally vulnerable because of capital asset differentials (Neumayer and Plumper, 2007). In order to reduce gender disparity in climate vulnerability, marginality needs be viewed through the power relations that produce the vulnerability in the first place (Arora-Jonsson, 2011). How men and women are impacted by, and respond to climate change is directly related to gender roles, relative socio-economic status and political power differentials (Kumar-Range, 2001). The social experience of climate change vulnerability and adaptation affirms, reflects, disrupts and otherwise engages gendered social relationships, practices and institutions (Enarson and Morrow, 1998).

Finally, the study presents original empirical data that can be used to inform its assessment of the LVI. According to a recent evaluation by Preston et al. (2011), only 9% of the 45 climate change vulnerability mapping studies they addressed in their