



Where does climate fit? Vulnerability to climate change in the context of multiple stressors in Funafuti, Tuvalu



Sandra McCubbin^{a,*}, Barry Smit^a, Tristan Pearce^b

^a Department of Geography, University of Guelph, Guelph, Ontario N1G 2W1, Canada

^b Sustainability Research Centre, University of the Sunshine Coast, Queensland, Australia

ARTICLE INFO

Article history:

Received 2 May 2014

Received in revised form 9 October 2014

Accepted 13 October 2014

Available online 24 November 2014

Keywords:

Climate change

Vulnerability

Adaptation

Multiple stressors

Pacific

Small islands

ABSTRACT

This paper examines vulnerability to climate change in the context of multiple stressors through a case study of Funafuti, Tuvalu. Climate change research in Pacific Islands has largely focused on biophysical changes such as sea-level rise. Less is known about how livelihoods are affected and what adaptation options are realistic. The research employs a vulnerability framework to identify where climate fits in the suite of forces (socioeconomic, cultural, environmental) already affecting livelihoods. The participatory approach includes semi-structured interviews with community members, initially without reference to climate. Key areas of concern to people in Funafuti are economic, food, water and overcrowding, rather than climate change. Vulnerability to changing climatic conditions is evident in water, land, and food through the interaction of non-climatic forces (e.g. overcrowding, urbanization, few economic opportunities, changing land use, and shifting cultural norms), and climatic forces (e.g. dry spells, extreme sea-levels, strong winds and changing marine conditions). Adaptations, beyond bearing the effects and sharing the burden, are mainly reactive and short-term. Future changes in climate will be experienced in the context of these multiple, interacting forces, and adaptation initiatives will need to be designed in light of these.

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1. Introduction

The Pacific Islands boast a long history of human occupancy and resilience to changing socioeconomic and environmental conditions (Bridges and McClatchey, 2009; Lefale, 2010; Nunn, 2013). In many instances, resilience was rooted in cultural practices such as food storage and preservation, elevated settlement sites, community cooperation, and population control (Bedford et al., 1980; Campbell, 2009). In recent decades, however, communities in the Pacific Islands have undergone sweeping social, economic, cultural, political, and environmental changes, which have dramatically altered food systems, settlement patterns, and traditional lifestyles and compromised some traditional sources of resilience (Connell, 2013; Lauer et al., 2013; Rudiak-Gould, 2013; Veitayaki, 2009). As a result, some cultural adaptations and sources of resilience are no longer available or relevant.

More recently, Pacific Islanders have been exposed to risks associated with climate change. Instrumental measurements and

local observations have recorded changes in temperature and precipitation patterns, sea-level, coastal erosion, wind dynamics, and the marine environment (Hoegh-Guldberg and Bruno, 2010; IPCC, 2013; Webb and Kench, 2010). These changes are already affecting ecosystems and people who depend on them, and these changes are expected to continue in the future (Barnett, 2011; Cinner et al., 2012; Ebi et al., 2006; Gravelle and Mimura, 2008; Rasmussen et al., 2011).

Research on climate change in the Pacific Islands has provided considerable insights about the implications of climate change for biophysical systems (e.g. Collins et al., 2010; Walsh et al., 2012). There has been less work examining how Pacific Island communities experience climate change, including how livelihoods are susceptible to harm, and their capacity to deal with and adapt to changing conditions. It is increasingly recognized that to better understand what climate change means for communities, especially for the purposes of facilitating adaptation, there is a need for knowledge of how people experience and respond to changing climatic conditions that are particularly relevant to them (Barnett and Campbell, 2010; Kelman and West, 2009; Mortreux and Barnett, 2009; Nunn et al., 2014). Furthermore, it is recognized that for adaptation interventions to be practical and effective, there is a need to consider ways in which conditions associated with climate

* Corresponding author. Tel.: +1 519 835 7209.

E-mail addresses: sandra.mccubbin@gmail.com (S. McCubbin), bsmit@uoguelph.ca (B. Smit), tristanpearce@gmail.com (T. Pearce).

change interact with socioeconomic and cultural forces to influence vulnerability (Bardsley and Wiseman, 2013; Gaillard, 2012; Hjerpe and Glaas, 2012; O'Brien et al., 2009).

This study addresses these issues by examining community vulnerability to climate change in the context of multiple stressors through a case study of Funafuti, Tuvalu. Tuvalu is often presented as a prime example of the particular vulnerability of small island states to climate change, usually with a focus on sea-level rise. This study draws on the experience of people in Funafuti to identify where climate change fits among the multiple climatic and non-climatic forces affecting livelihoods and to consider opportunities for adaptation relative to other human development initiatives.

The paper begins by reviewing current knowledge regarding the human implications of climate change in Pacific Islands, followed by a summary of how multiple stressors have been considered in climate change vulnerability assessments. Next, the community of Funafuti is described, and the analytical approach and methods employed in the study are outlined. Results are presented first for existing vulnerabilities and then for possible future conditions, followed by a conclusion in which opportunities for adaptation are discussed.

2. Human implications of climate change in Pacific Islands

This paper builds on a growing body of scholarship on the human dimensions of climate change globally and in Pacific Islands. Much of the information on human implications of climate change in Pacific Islands is in the form of broad regional studies (e.g. Barnett, 2011; Ebi et al., 2006; Julca and Paddison, 2010; Nurse and Moore, 2005). National scale information is available in documents submitted under the UNFCCC-endorsed National Adaptation Programme of Action (NAPA), which most Pacific Island countries have completed. Much of the research follows “top-down” approaches, which specify scenarios of climate change, model effects on biophysical systems, and infer implications for people and adaptation (e.g. Gravelle and Mimura, 2008; Terry and Chui, 2012). Many studies focus on the potential effects of sea-level rise on community viability and implications for climate-induced migration (Barnett and Adger, 2003; Farbotko and Lazrus, 2012; Locke, 2009).

Some recent research has provided insights into the sensitivities and adaptive capacity of Pacific Island communities and resource systems (e.g. Birk, 2014; Fazey et al., 2011; Kuruppu and Liverman, 2011; McNamara and Prasad, 2014; Nakalevu, 2006; Nunn, 2009; Reenberg et al., 2008). Food security will be adversely affected by sea-level rise and changing precipitation patterns, and settlement patterns will be impacted by shoreline erosion (e.g. Barnett, 2011; Nunn, 2013). Institutions like the church and local governments play significant roles in adaptation processes in communities by shaping value systems and decision-making structures (Kuruppu, 2009; Lata and Nunn, 2012; Sutherland et al., 2005). Adaptation research has also found that aid can have different effects on adaptive capacity by both enhancing capacity, and reducing self-efficacy of communities (Barnett, 2008; Veitayaki, 2009). Notwithstanding these insights, our knowledge about the nature of community vulnerabilities to changing conditions and the processes of community adaptation remains limited (Gaillard, 2012). Barnett and Campbell (2010, p. 80) have noted “despite longstanding recognition that the Pacific islands are very vulnerable to climate change, there have been few locally oriented empirical studies of vulnerability in the region.”

Research on the effects of climate change in the Pacific Islands has largely focused on the impacts of climate change in isolation from other non-climatic stressors (Barnett and Campbell, 2010; Kelman and West, 2009). In the scholarship on the human dimensions of climate change it is recognized that climate change

is experienced (and responded to) in the context of multiple climate and non-climate stressors (Adger and Barnett, 2009; O'Brien et al., 2009). Assessing the vulnerability of Pacific Island communities to climate change requires documentation of how climate conditions are experienced and coped with in the context of other conditions already affecting livelihoods.

3. Vulnerability and multiple stressors

In climate change scholarship, vulnerability is broadly interpreted as the manner and degree to which a system is susceptible to adverse effects of climate change (Adger, 2006; Smit et al., 2000). The concept of vulnerability has evolved in a variety of research fields, including natural hazards (Burton et al., 1993; Cutter et al., 2003; Hewitt, 1983), entitlement theory (Sen, 1981), political ecology (Blaikie et al., 1994; Wisner et al., 2004), environmental change (Kasperson et al., 1995; Liverman, 1990), and sustainable livelihoods (Chambers and Conway, 1992; Turner et al., 2003).

The vulnerability of a system (in this case a community) to climate change is often conceptualized as related to a community's exposure and/or sensitivity to changing conditions and its adaptive capacity to deal with those conditions (IPCC, 2007; Smit and Wandel, 2006; Turner et al., 2003). While the major components of vulnerability are not independent, exposure-sensitivity generally refers to the ways in which a community experiences conditions (also called forces, stresses or stressors); and adaptive capacity refers to a community's ability to adapt, adjust to, moderate, take advantage of and/or cope with the effects or consequences of the changing conditions (Adger, 2006; Smit and Wandel, 2006).

Multiple stressors have been considered in a variety of ways in climate vulnerability studies. O'Brien and Leichenko (2000) and others (e.g. Eakin, 2005; Silva et al., 2010; Lung et al., 2013) assess the “double exposure” or the “multi-hazard impact” of climate and non-climate changes by overlaying impact scenarios of multiple processes. Some studies have sought to rank the relative significance of stressors, often via community surveys and sometimes using pre-determined categories of stress conditions (e.g. Bunce et al., 2010; Schwarz et al., 2011; Tschakert, 2007). Other studies aim to understand the processes through which multiple forces interact to influence vulnerability, and have employed a variety of approaches including the sustainable livelihoods framework and the vulnerability approach (e.g. Belliveau et al., 2006; Birk, 2014; Few and Tran, 2010; Reid and Vogel, 2006; McDowell and Hess, 2013; Nielsen and Reenberg, 2010; Reenberg et al., 2008; Pearce et al., 2010; Prno et al., 2011; Westerhoff and Smit, 2009).

The research presented in this paper employs a vulnerability approach consistent with this later variety of studies. It aims to identify the ways in which people and their livelihoods are vulnerable to the interaction of multiple stressors, and was conducted using the case study of Tuvalu's main atoll, Funafuti.

4. Funafuti, Tuvalu case study

Tuvalu is a Polynesian country composed of nine coral atolls located in the Pacific (Fig. 1). Tuvalu is the fourth smallest nation in the world with a total land area of 26 km², and a maximum elevation of 5 m above sea-level. The United Nations classifies Tuvalu as a Least Developed Country indicating that it is low-income with structural impediments to sustainable development. Tuvalu's population of nearly 11 000 is unevenly distributed among the atolls, with Funafuti, the capital, home to over 6000 people (Tuvalu Census, 2012). This empirical study was undertaken in Funafuti, largely because a local contact facilitated acceptance in the community, and because logistical considerations precluded field work in the outer atolls.

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