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Identifying trade-offs between adaptation, mitigation and development in community responses to climate and socio-economic stresses: Evidence from Zanzibar, Tanzania

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A B S T R A C T

In this paper, we examine how communities in Zanzibar cope with and adapt to multiple-stressors including climate change, and how these responses affect long-term adaptation, mitigation and development (AMD) goals. In particular, we identify the multiple-stressors that affect natural-resource dependent communities in Zanzibar. We then explore how community responses affect long-term development and mitigation goals before we examine the barriers to maximising AMD synergies in community responses. We use the DPSIR (Drivers – Pressures – States – Impacts – Response) as a tool to organise the complex information relating to both the marine and terrestrial SES in Zanzibar. Using data from household surveys and community-level focus groups, we find that responses to stressors resemble coping strategies as they provide short-term relief but in the long-term may negatively affect development goals. Furthermore, responses generate a trade-off between adaptation, mitigation and development. For example, when farmers respond to low productivity by spending longer on the farm, there is a development trade-off as time burdens are increased, and a mitigation trade-off as secondary forest cannot be established. We identify that AMD compatible responses are constrained by resource, regulatory, learning and governance barriers. We conclude that without local climate policy intervention, 'mal-adaptations', which threaten both mitigation and development goals, could occur across a range of temporal and spatial scales.

Introduction

Climate change threatens the ability of natural-resource dependent communities to maintain sustainable livelihoods and achieve development goals (Yohe et al., 2007). Climate impacts are compounded by multiple social and environmental stressors, including chronic poverty, population growth and resource depletion (Barnett & Adger, 2007; O'Brien & Leichenko, 2000). Nevertheless, societies have inherent capacities to adapt, even in the absence of deliberate policy decisions to guide actions (Adger, 2003; Smit & Pilifosova, 2001).

Multiple definitions of adaptation exist but there is general acceptance that adaptation involves long-term adjustments within a system (e.g. a subsistence community) to better manage external stress (e.g. Adger, Arnell, & Tompkins, 2005; Smit & Wandel, 2006). Examples include changing planting times, or diversifying livelihoods (Stringer et al., 2009). Coping strategies are short-term responses to stress, which may create greater pressures in the long-term (Brown, 2011). For example, selling assets, eating fewer meals, or removing children from school may make a household more vulnerable to future events. Even when responses to change appear to alleviate external stress, further negative externalities may occur. Some adaptations/coping strategies may compromise long-term socio-economic development goals, exacerbate climate change by increasing greenhouse gas emissions, or increase the vulnerability of other systems, sectors or social groups (Barnett & O'Neill, 2010). Such responses can be considered 'mal-adaptations' (Barnett & O'Neill, 2010). Conversely, when adaptation meets both

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long-term development and mitigation goals, Climate Compatible Development (CCD) is achieved (Mitchell & Maxwell, 2010).

CCD fuses together strategies from adaptation, mitigation and development (AMD) and aims to create low emission, climate resilient futures (Mitchell & Maxwell, 2010). For example, Ayers and Huq (2009) describe a waste-to-compost project in Bangladesh in which reduced methane emissions (mitigation), along with soil improvement in drought-prone areas (adaptation) and poverty reduction (development) occur. Although synergies between AMD exist, trade-offs may also occur. However, evidence-based case studies of trade-offs are rare (Tompkins et al., 2013). As such, newly emerging debates around AMD examine whether it is indeed possible to capitalise on natural synergies between the three strategies, or whether the trade-offs are too great (*ibid.*).

In this paper, we examine how communities in Zanzibar cope with and adapt to multiple-stressors including climate change, and how these responses affect long-term mitigation and development. We also identify considerations for developing future CCD policy. We address three research questions; (1) what are the multiple-stressors that affect natural-resource dependent communities in Zanzibar? (2) How do community responses (adaptation/coping) affect long-term development and mitigation goals? (3) What are the barriers to maximising AMD synergies in community responses? By exploring day-to-day community and household adaptations to change, opportunities emerge to create CCD policies that are rooted in local realities (Gupta & Hisschemöller, 1997; Rojas Blanco, 2006; Amaru & Chhetri, 2013). The Tanzanian island of Zanzibar is used as a case study country because: (1) the majority of the island's coastal households depend on natural resources for their livelihoods (Tobey & Torell, 2006) and (2) there is a recognised absence of supportive policy for climate adaptation, which means most responses begin at the community and household level (Mustelin et al., 2010).

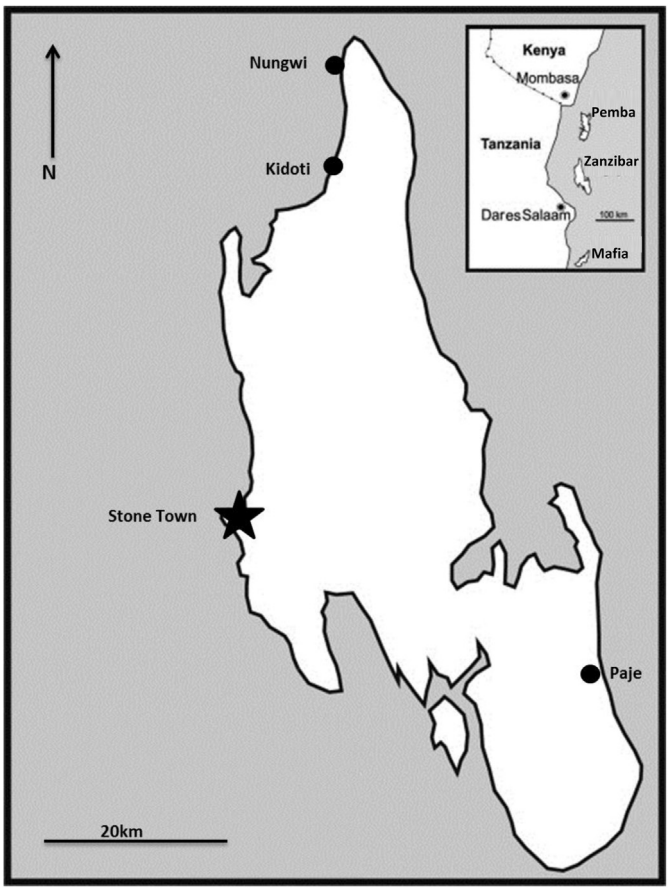

Fig. 1. Map of the three study sites on Zanzibar.

Coastal livelihoods in Zanzibar

Zanzibar lies in the Indian Ocean, off the coast of Tanzania (Fig. 1). At independence from colonial rule in 1963, the island formed a political union with Tanzania. The union, originally based on African socialism, has been blamed for keeping the island politically and economically stagnant (Cameron & Larsen, 2009). Some two decades after the first competitive party elections, a sense of nationalism based on the pursuit of a distinct Islamic Zanzibari identity has emerged (Brown, 2010). However, Zanzibar remains chronically poor and the island's 1.5 million residents are heavily dependent on a vulnerable marine and terrestrial resource base.

The marine ecosystem underpins economic activity accounting for 30% of GDP (Lange & Jiddawi, 2009). Key livelihood activities within the marine socio-ecological system (SES) include artisanal fishing, and aquaculture especially seaweed farming, which was introduced in the late-1980s. Within the terrestrial SES, agriculture directly employs about 42% of the population, contributing more than a quarter of the island's GDP (RGoZ, 2009). Forests present economic opportunities through fuelwood collection, growing conifer trees for use as building poles (for tourist infrastructure) and wood for charcoal production (Fagerholm, Kaeyhko, Ndumbaro, & Khamis, 2012). Finally, beach tourism to the island presents some opportunities for local employment (Gössling, 2003). Livelihood activities are traditionally gendered. Fishing and farming are undertaken by both males and females, with women carrying out activities nearer to the village. In forestry, men grow commercial species whilst women collect fuelwood. Seaweed farming is predominantly female, and tourism predominantly male.

Livelihoods in Zanzibar face a number of drivers of change, including population growth, land pressures, globalisation, tourism and climate change (Watkiss et al., 2012). The population has more than doubled in 30 years, from 476,111 in 1978 to 1,211,000 in 2010 (NBS, 2013). This creates obvious pressure on resources. For example, the rate of deforestation is approximately 1000 ha per annum (Watkiss et al., 2012). Resource pressures are exacerbated by tourism infrastructure (Käyhkö, Fagerholm, Asseid, & Mzee, 2011). Prior to 1985, tourism was almost non-existent but has rapidly expanded from 42,141 visitors in 1990 to 132,836 in 2010 (Zanzibar Commission for Tourism). Large hotels now line the beaches of traditional fishing villages (Gössling, 2001). Tourism is a central dimension of globalisation with visitors arriving from around the world, while migrants from mainland Africa move to the island for work in tourist areas (Gössling & Schulz, 2005). More recently, increasingly global networks have enabled young Zanzibari men to study Islam abroad and return to challenge the island's politics (Turner, 2009).

Against this backdrop, the island's climate is changing. Livelihood activities are likely to be affected by coastal erosion exacerbated by sea-level rise; flooding in low-lying areas; reduced agricultural productivity due to decreased rainfall and higher inland temperatures; and, extreme weather events such as storms (Watkiss et al., 2012). For example, erratic rains in 2006/2007 significantly reduced agricultural production and also led to widespread malnutrition (*ibid.*). Despite this, locally-specific climate policy is lacking (Mustelin et al., 2010) and there are few explicit provisions for Zanzibar in the Tanzanian National Adaptation Programme of Action (NAPA).