Applied Geography 89 (2017) 1–11

Contents lists available at ScienceDirect

Applied Geography

journal homepage: www.elsevier.com/locate/apgeog

The impacts of environmental and socio-economic stressors on small scale fisheries and livelihoods of fishers in Ghana

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ABSTRACT

Small-scale coastal fisheries are exposed to many stressors, such as poor governance, lack of alternative employment, overfishing and diseases. Stressors, in this context, constitute environmental and socio-economic changes or events at local, national or global levels making the fisheries sector or fishers vulnerable. Climate change is expected to compound the consequences of these stressors on fisheries and livelihoods. Identifying and understanding the effects of important stressors are imperative for building and organising appropriate capacity to adapt and, ultimately, for successful adaptation. However, how climate-related and non-climate stressors jointly affect small-scale fisheries is still to be fully explored. In this paper, we use case studies of three coastal communities in the Western Region of Ghana to gain insights into how multiple stressors combine to affect small-scale fisheries. The findings show that multiple stressors combine in complex ways, affecting fisheries-based livelihoods and the coastal landscape, vegetation and infrastructure. This suggests that any single stressor is just a part of a set of stressors that jointly affect small-scale coastal fisheries. This study proposes that the effects of climate-related stressors are better comprehended when analysed in light of the synergetic effect of multiple stressors. It has the potential to guide policy-makers and managers in designing and implementing improved strategies to enhance adaptive capacity in response to climate change. Moreover, this knowledge can present an opportunity and justification for solving other inherent developmental problems through climate change adaptation policies and actions.

1. Introduction

A deeper understanding of how societies respond to multiple stressors (climate and non-climate) is critical to successful adaptation efforts in vulnerable sectors, such as fisheries. These stressors refer to environmental and socio-economic changes or events at local, national or global levels that make a system or group of people vulnerable (O'Brien, Quinlan, & Ziervogel, 2009; Smit et al., 1999). Their effects are caused by dynamic processes influenced by biophysical, socio-economic, cultural and institutional conditions across geographical scales (Amaru & Chhetri, 2013). Importantly, they are critical factors influencing vulnerability (Chen & Lopez-Carr, 2015; Fussel & Klein, 2006; Wagner, Chhetri, & Sturm, 2014). Yet, the dynamic nature of these stressors, particularly how these stressors interact with each other to affect vulnerability is poorly understood. Current studies largely tend to assess single stressors by considering linear processes and outcomes (Brander, 2007; Bunce, Rosendo, & Brown, 2010; MacNeil et al., 2010). Underlying multiple reasons why people are affected, and able or unable to cope or adapt to stressors are often ignored in these studies (Andrew et al., 2007; Bennett et al., 2014; Sumaila et al., 2011). As a result, they may provide some useful insights based on partial knowledge of stressors, but will not be enough to inform strategies (e.g., policies and plans) to increase adaptive capacity to multiple stressors.

Small-scale coastal fisheries (SSCF), particularly in the developing countries, have basic dispositions, such as low income, poverty, poor governance, lack of alternative employment and diseases (Béné, Hersoug, & Allison, 2010; Ellis & Freeman, 2005; Prado, Seixas, & Berkes, 2015; Sumaila et al., 2008). These make SSCF vulnerable to multiple climate and non-climate stressors. (Bennett, Dearden, & Peredo, 2015; Bunce et al., 2010). Climate stressors include severe storms, winds and waves, ocean acidification, sea-level rise and increased sea surface temperature (Wong et al., 2014). Non-climate stressors include overfishing (Sumaila et al., 2008), competition with other resource users, apathy and neglect of governments (Dugan, 2005) and HIV/AIDS (Andrew et al., 2007). Importantly, stressors may interact synergistically, e.g., climate change is expected to compound

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http://dx.doi.org/10.1016/j.apgeog.2017.09.009
Received 12 November 2016; Received in revised form 21 September 2017; Accepted 21 September 2017

many non-climate stressors affecting SSCF (Sumaila et al., 2011). Developing countries, given their dependence on fisheries, high levels of poverty, limited levels of human and physical capitals, as well as poor infrastructure are more likely to be affected by climate change (Assan & Kumar, 2009). This situation is particularly severe in SSCF communities in the African continent due to the risky nature of fishing, compounded by other social, economic, ecological and political constraints (Dulvy et al., 2011, pp. 31–89; Neiland & Béné, 2004). In Ghana, for example, increase in sea surface temperature by 1 °C is estimated to influence the catch rate of round sardinella by over 70% (MoEST, 2011). In addition, Ghana's coastal strip is home to about 25% of the entire country's population (Collier, Conway, & Venables, 2008). With such a high concentration of population, a relatively small rise in sea level could have dire effects on coastal livelihoods and the economy.

The ability of SSCF to respond and adapt to stressors will invariably determine their vulnerability, with implications for livelihood and environmental sustainability. In this context, vulnerability is conceptualised as susceptibility to climate and non-climate stressors expressed by exposure, sensitivity and capacity to adapt to such stressors (Adger, 2006; Turner et al., 2003). Exposure is the extent to which a system, including people or socio-economic sectors, experience the magnitude or rate of the stressors (Adger, 2006; Kasperson, 2005). Sensitivity is the extent to which a system will react to, or suffer from, the impacts of the stressors subject to how such system depend on climate-related resources for sustenance or development (Adger, 2006; Luers, 2005). Adaptive capacity is “the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences” (IPCC, 2014, p. 118); it is a the key determinant of the type and scale of adaptation that a system can initiate and accomplish (Engle, 2011; Nelson, Adger, & Brown, 2007).

Empirical studies on how multiple stressors affect SSCF are emerging in the environmental change and geography literature (Barnett & Eakin, 2015; Bennett et al., 2015; Brklacich, Chazan, & Bohle, 2010; Perry et al., 2011; Shameem, Momtaz, & Rauscher, 2014) but do not necessarily provide a better understanding of how climate and non-climate stressors combine to affect vulnerability. Notwithstanding, these studies suggest that understanding how a diverse array of stressors jointly affect a system (e.g., community) is integral to the assessment of adaptive capacity. Further, how a community perceives causes and effects of stressors greatly influences how it prepares and strategizes to adapt (Bennett & Dearden, 2013; Chen & Lopez-Carr, 2015; Marshall et al., 2009; Watson, Claar, & Baum, 2016). In our effort to provide further insights into these issues, we ask, ‘how do climate and non-climate stressors combine to confront SSCF?’ This study draws on three case studies from the Western Region of Ghana to examine local perceptions of climate and non-climate stressors, and how these stressors interact to affect SSCF and coastal communities.

2. Case study description

The Western region includes a land area of about 21,391 sq km, which is approximately 10 per cent of the total land area of Ghana. Its coastal zone has over 70 km of sandy beaches stretching across six districts, i.e., Jomoro, Ellembelle, Nzema East Municipality, Ahanta West, Sekondi-Takoradi Metropolis and Shama (deGraft-Johnson et al., 2010), and includes an inshore exclusion zone reserved for SSCF (Fig. 1). Thirty two percent of Ghana's fish catches come from the Western region, comprising forty-eight species including finfish and sea breams, snappers, groupers, sea catfishes, rays and sharks. Small pelagic fish are the most important type of fish followed by large pelagic fish and demersal fish (Mensah & Koranteng, 1988; Mensah & Quaatey, 2002). Catching, processing (smoking and drying) and marketing of fish have been the mainstay of the local economy and important source of livelihood and employment for the majority of coastal community members (CRC-URI and SustainaMetrix, 2010).

Similar to other coastal jurisdictions, many stressors affect the Western Region. These include increasing population, overfishing, coastal erosion, oil exploitation, and climate change (CRC-URI and SustainaMetrix, 2010; Mills et al., 2012; deGraft-Johnson et al., 2010). Approximately 1.2 million people – half of the Western region's total population – live in coastal districts, which are also home to 60% of all industries in the region (GSS, 2012).

Given the high population growth rate in the region (GSS, 2012), demand for fish, farming land, wood energy and other natural resources are expected to increase accordingly. Such increased demand will likely compound existing stressors. For example, overfishing, known to be one of the causes of declining livelihoods, is attributed to destructive fishing practices, such as the use of small mesh nets (less than 1 cm stretched mesh) and light fishing, which indiscriminately capture undersized and spawning fish. Further, because of recent development of the oil and gas industry, the coastal environment is increasingly being encroached upon for different purposes, such as beach sand winning, housing, and socio-economic development and infrastructure projects (CRC-URI and SustainaMetrix, 2010). Some landing sites (e.g., Princess Town, Poasi, Nkontonpo and Essipon) have been abandoned because of severe coastal erosion (EPA/UNOPS, 2004). Last, climate change data suggest that between 1960 and 2001, maximum and minimum temperatures along the coast of Ghana increased by 2.5 °C and 2.2 °C, respectively (Dontwi, Di, & Bs, 2008). It is projected that Ghana's annual mean temperature will increase between 1.0 °C and 3.0 °C by 2060 and between 1.5 °C and 5.2 °C by 2090 (McSweeney, New, & Lizcano, 2010), with severe consequences for coastal communities.

This study was conducted in three coastal fishing communities in the Western Region (Fig. 1 and Table 1): Dixcove in the Ahanta West District Assembly, Abuesi in the Shama District Assembly, and New Takoradi in the Sekondi-Takoradi Metropolitan Assembly. These communities feature a concentration of fishing activities, high dependence on fisheries for livelihood, multiple climate and non-climate stressors (e.g., overfishing, and sanitation, coastal erosion, oil exploitation, and climate change).

Dixcove is an important coastal community with about 30,000 people (CRC and FoN, 2010). SSCF and farming are important sources of livelihood, with about 90% of men engaged in fisheries. Most women process and sell fish. The common species caught in Dixcove are tuna, sharks and sardines. Tilapia is caught in surrounding lagoons. Abuesi is an urban fishing community, home to over 9000 people (CRC and FoN, 2010). Most its population depend on SSCF for their livelihood. Sardinelles, anchovies and herrings are the main fish caught in Abuesi. The rest are employed in petty trading, as there are no farmlands in the community. New Takoradi has a population of over 18,000 people (CRC and FoN, 2010), the majority of which depend on fishing for their livelihood. Common fish species caught include herrings, mackerel and cassava fish. Other members of the community engage in petty trading and labourer jobs in the Takoradi harbour and Takoradi Flour Mills.

3. Methods

3.1. Selection of case studies

Following scoping visits and interviews in 20 of the 89 existing coastal communities in the Western Region of Ghana, Dixcove, Abuesi and New Takoradi communities were selected based on the concentration of fishing activities, high dependence on fisheries for livelihood, various forms of capitals and multiple climate and non-climate stressors (Table 1). It is important to note that several communities, including Axim, met these criteria and were equally important to our study. However, we limited the number of communities studied to three because of time and resources constraints to undertake this research.