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Adaptive capacity in light of Hurricane Sandy: The need for policy engagement

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ABSTRACT

The aftermath of Hurricane Sandy brings to light the tenuous U.S. model of natural disaster management. Climatic extremes, like Sandy, are projected to increase in magnitude and frequency, calling upon societies to adapt appropriately to imminent threats. In this paper, we describe the knowledge and policy disconnect exposed by Sandy between what we submit are four key elements of adaptive capacity: resources, institutions, knowledge and innovation of technology. Our synthesis of multi-disciplinary expert knowledge and admonition from civil engineers, climatologists, and urban planners demonstrates the significance of mobilizing knowledge to design robust socio-ecological systems. We contrast the U.S. model to the Dutch system of climate adaptation to emphasize the feasibility, value, and effectiveness of adopting robust adaptive capacities, rather than policies steeped in reactionary responses. Such strategies that integrate coordination and imagination from members across society are imperative in translating scientific foresight into institutional action. The solution we offer is not only material for a more action-based discussion, but also provides an illustration of crafting policy that enhances adaptive capacities of socio-ecological systems.

Introduction

Climate change is expected to bring an increase in the frequency, intensity, spatial extent, and duration of weather and climate extremes (Lavell et al., 2012: 30). Recent report of the Intergovernmental Panel on Climate Change (IPCC) shows that over the last 50 years, extreme events have been on the rise in most regions of the world (Field et al. 2012). In fact, recurring 'rare' events have been occurring in relatively quick succession over the last 50 years (Field et al. 2012) with events (e.g. heat waves (DSE, 2008; Fouillet et al., 2008), droughts (Peterson, Stott, & Herring, 2012; Rupp et al., 2012), forest fires (Parliament of Victoria, 2010; National Climatic Data Center (NCDC), 2013a,b,c), and severe storms (National Climatic Data Center (NCDC), 2013a,b,c)) pointing to the need for robust adaptation.

As the frequency and intensity of these events increase with climate change (IPCC, 2012), socio-ecological systems not only become more exposed, but also their interdependence heightens its sensitivity to change (Turner et al., 2003). Resiliency is becoming a central tenet for assessing society's ability to respond to climate change. Nested within this broader context of vulnerability, resiliency refers to the magnitude of a disturbance that can be absorbed before a system radically changes to a different state as well as the capacity to self-organize to emerging circumstances (Folke, 2006; Keessen, Hamer, Van Rijswick, & Wiering, 2013). Adaptive capacity assesses the potential for a socio-ecological system to cope with challenges posed by climate change (Adger, 2006). Therefore, enhancing the adaptive capacity of socio-ecological systems is central to building resiliency to extreme events (Adger, 2006; O'Brien et al., 2012).

Following Nelson, Kokic, Crimp, Meinke, and Howden (2010), we argue that robust adaptation necessitates flexible governance, institutional organization and investment in innovation of technologies on demand. Adaptation strategies may range from short-term fixes to incremental change or transformation of whole systems. For example, the unprecedented flood of 1953 in the Netherlands triggered a paradigm shift prompting the government to redesign their water management system nationwide (Haasnoot & Middelkoop, 2012: 111). Following this transformative approach of the First Delta Committee policy and engineering feats of the Deltaworks project (Delta Committee, 1960), the Dutch continued to expand on their ideology of national flood safety recognizing stressors of climate change and spatial planning in 'Room for the

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River' (Haasnoot & Middelkoop, 2012; Vink, Boezeman, Dewulf, & Termeer, 2013). This subsequent policy laid the foundation for flexible and innovative adaptation approaches by using 'soft' measures (e.g. ecological engineering) or natural systems such as wetland restoration in addition to the traditional 'hard' measures (e.g. dams) (Haasnoot & Middelkoop, 2012; Inman, 2010).

Recent literature has highlighted the linkages and multi-scalar processes between environment and society, demonstrating the value of place-based approaches to innovations (Chhetri, Chaudhary, Tiwari, & Yadaw, 2012; Rodima-Taylor et al., 2012). Adding to the growing body of literature on human and social dimensions of climate change, we explore the sensitivity of socio-ecological systems in the wake of Hurricane Sandy as a case study. More specifically, this paper: a) identify the importance of institutions and governance in minimizing the vulnerability of socio-ecological system; b) provide additional examples of the disconnect between knowledge about disaster impacts and policy; c) highlight the value of resource flow; and d) discuss the importance of integrating knowledge and policy to increase the resiliency of socio-ecological systems. We review the Dutch model as an example of a robust socio-ecological system to shed light on how integrating policy and knowledge can lead to successful adaptation.

In the following section, we provide a conceptual foundation of this paper that explores the significance of resources, knowledge, governance and innovation of technology in light of the potential ramifications of climate change adaptation. Section 3 presents a case study of Hurricane Sandy using specific examples from New York (NY) and New Jersey (NJ) to demonstrate disconnect between knowledge and policy and the negative implications for socio-ecological systems. We further discuss the admonition of climatologists, urban planners, and engineers that preceded Sandy yet failed to enact effective resiliency measures. In Section 4, we offer examples of robust systems that effectively integrate knowledge and draw contrasts between U.S. governance and the evolving Dutch flood policy. This article concludes by offering recommendations for decision-makers to improve socio-ecological systems through knowledge co-production and multi-level collaboration.

Conceptual framework

While society may not alter the risk of threats stemming from impending climate change (see Fig. 1), its impacts may be reduced through increasing the resiliency of socio-ecological systems. Different forms of adaptation have been illustrated and defined in Table 1 as a means to improve societal resilience (Levine, Ludi, & Jones, 2011; Rickards & Howden, 2012). Following Pelling (2011: 204) we argue that pathways for enhancing adaptive capacity demands four elements: a) resources; b) knowledge; c) institutions;

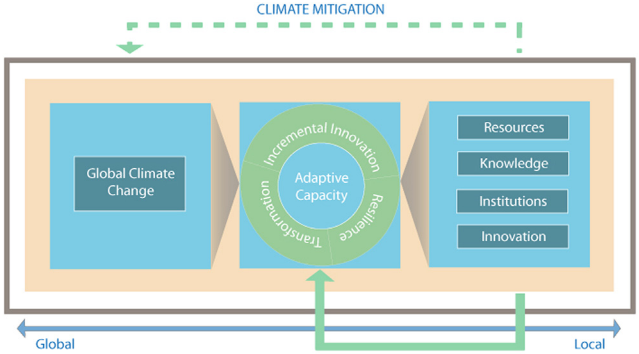

Fig. 1. Adaptive pathways to social ecological resiliency.

and d) innovation of technologies (see Fig. 1). We recognize that vulnerability may emanate from other external drivers (e.g. demographic change, land cover change, technological change), however, we argue that even these threats can be successfully managed when these four elements are synchronized harmoniously. On the other hand, dysfunctional or disconnected systems can lead to maladaptive situations, amplifying the vulnerability of socio-ecological systems. Therefore, attention must focus on multi-level collaboration, knowledge co-production and governance to design robust socio-ecological systems. While climate change threats can serve as opportunities, barriers to adaptation have been raised from several fronts, including inadequate climate information (Deressa, Hassan, Ringler, Alemu, & Yesuf, 2009), partial understanding of climate impacts, and uncertainty about the benefits of adaptation (Hammill & Tanner, 2010), institutional inertia and lock-in (path dependency) (Chhetri, Easterling, Terando, & Mearns, 2010), lack of use-inspired research (Moser, 2010), lack of credit (Bryan, Kench, & Hart, 2008), weak market systems (Kabubo-Mariara, 2009), and lack of foresight in technology innovation.

Resources are universally noted as determinant factors in enhancing adaptive capacities (Chapin et al., 2006). Although resource rich countries or groups may also be vulnerable to climatic events, often it is deemed that vulnerability is greater in poorer countries or areas where resource poor reside (Pelling, 2011). Extensive evidence of disparate impacts on marginalized subgroups raises concerns of disproportionate effects of climate change on these already vulnerable subgroups (Bohle, Downing, & Watts, 1994). Resources are consequently a function of institutional arrangements and knowledge.

Knowledge is instrumental in devising robust adaptation strategies. While increased knowledge and understanding of past events has improved the processes for anticipating and dealing with extreme events (Pelling, 2011), knowledge must be mobilized to reach a consensus and implement corrective actions (Vink et al., 2013). For example, the Dutch model frames recurring flood risk as a matter of national policy, but negotiates consensual decision-making at the local level (Vink et al., 2013). It is this local pattern of reciprocity and knowledge exchange that elucidates multiple stakeholders from public to private of the vulnerability and rallies their willingness to invest by understanding the adaptation costs (Rodima-Taylor, Olwig, & Chhetri, 2012). In the case of Hurricane Katrina, recurring flood risk has been known for almost three centuries with scientists and media repeatedly warning New Orleans of the "Big One" four years prior to Katrina (Kates, Colten, Laska, & Leatherman, 2006). Thus, information alone may not guarantee a desirable outcome due to the social and cultural constructs of risk, perception of the hazard incidents and their expectations (Adger, Hughes, Folke, Carpenter, & Rockström, 2005; McIvor & Paton, 2007). As Vink et al. (2013: 92) point out, different publics assign different meanings to the problem and this plurality of publics and associated problem definitions make it difficult to define what is at stake and what should be done. This concept along with market-driven behaviors may help explain past use of ineffective incremental approaches (extending levee heights post-flood) and shift toward transformational strategies (Kates, Travis, & Wilbanks, 2012; Kates et al., 2006).

Limitations to adaptation also include our inability to recognize climate change signals due to problems of detection and appreciation (Chhetri et al., 2010). Our preoccupation with other pressing concerns can divert attention away from climate change (van Aalst, Cannon, & Burton, 2008). Additionally, knowledge gap in understanding, planning, and management can precludes us from designing appropriate disaster responses (Moser & Ekstrom, 2010). The lack of administrative and social support for making adaptive decisions adds another layer of complexity. Although investments