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Abstract

This paper explores the relationship between disaster risk reduction and long-term adaptive capacity building in two climate vulnerable areas—the Cayman Islands in the Caribbean and Ceará, in NE Brazil. Drawing on past applications of the disaster risk reduction framework, we identify four critical factors that have led to reductions in risk: flexible, learning-based, responsive governance; committed, reform-minded and politically active actors; disaster risk reduction integrated into other social and economic policy processes; and a long term commitment to managing risk. We find that while the presence of these factors has reduced overall risk in both regions, in Ceará, disaster response as it is currently practiced, has fallen short of addressing the fundamental causes of vulnerability that leave those prone to hazards able to cope in the short term, yet enmeshed in poverty and at risk from the longer term changes associated with climate change. Although calls for integration of disaster risk management with poverty eradication are not new, there has been insufficient attention paid in the literature on how to foster such integration. Based on the two case studies, we argue that the adoption of good governance mechanisms (such as stakeholder participation, access to knowledge, accountability and transparency) in disaster risk reduction policy may create the policy environment that is conducive to the kind of structural reform needed to build long-term adaptive capacity to climate-driven impacts. We conclude that without a synergistic two-tiered approach that includes both disaster risk reduction and structural reform, disaster risk reduction, in the face of climate changes, will prove to be an expensive and ineffective palliative treatment of changing risks.

Keywords: hazards, disasters, disaster risk reduction, climate, tropical cyclone, drought, Cayman Islands, Brazil, governance, institutions

1. Introduction

"Floods are 'acts of god,' but flood losses are largely acts of man".

(Gilbert F. White, 1945)

Disaster risk managers have long known that environmental perils (such as rain, storms, high winds, heatwaves) that create environmental hazards (e.g. floods, landslides, drought) do not always have to result in disasters (see for example, White, 1945, Burton et al 1968). It is now almost received wisdom that natural disasters are rarely "natural"; their causes are complex, often attributable to a combination of socioeconomic factors that modulate, for better or worse, the impact of environmental hazards on human systems. More recent work (Hewitt, 1983; Alexander, 2000; Pelling, 2003; Wisner et al., 2004; Lemos, 2007a) advances this thinking, highlighting that disasters are the combination of environmental hazard, poverty, and other causes of vulnerability – including an array of deficits and characteristics (such as income, age, political power, health, education, gender) – that define and shape livelihoods of those at risk. Often the poor, uneducated, very old or very young, the sick, the oppressed, experience the worst impacts of natural hazards (Comfort et al., 1999).

In line with this understanding, disaster policy has evolved. First, the focus on hazard response (wherein interventions focussed on preparing for impacts) evolved into the active promotion of disaster risk reduction to reduce hazard impacts (O'Brien et al., 2006; Kwatra, 2005; La Trobe and Davis, 2005; IFRC, 2007; Inter-agency Working Group on Emergency Capacity, 2007). Second, disaster risk reduction has in some cases been effectively linked to general risk and vulnerability reduction (Thompson and Gaviria, 2004; see for example Christoplos et al., 2001; Helmer and Hilhorst, 2006; Lemos, 2007a). This shift on focus can partly explain the progressive decrease in the number of fatalities associated with natural hazards since the 1900s, especially in developed countries, see Figure 1.

Figure 1 here

Despite significant improvements in our understanding of hazards and disasters, the familiar paradox is that while managers and systems have become so much better at responding to hazards, the poorest in society still often experience the worst effects of hazards. Development gains can be rapidly lost and emergency responses can fail even in the most resource-endowed societies (see for example Mitchell, 1996) if continual attention and focus

is not directed towards enhancing access to knowledge about disaster risk reduction and redistributing resources towards the poorest in society to remove them from poverty. In the most vulnerable areas of the less developed south, for example, in drought ravaged areas of Africa and Latin America, high levels of hardship have persisted despite a decrease in casualties associated with natural hazards. The persistence of hardship and maladaptation – that is, when those affected cope with the hazard but never improve upon their condition before the disaster – suggests that however much better, disaster risk reduction still falls short of the goal of positive post-disaster adaptation (Glantz and Jamieson, 2000)

Drawing extensively on the scholarly literature focusing on the political ecology of disasters, we argue that a general approach to decreasing vulnerability to short term hazards and to build long-term adaptive capacity to climate change involves a two-tiered strategy. As proposed by Wisner et al. (2004), Lemos et al. (2007) and others, disaster risk reduction needs to be combined with deeper levels of structural reform—such as agrarian reform, education and health reform, income redistribution to name few, for effective vulnerability reduction; it also needs to take into account intergenerational equity (Glantz and Jamieson, 2000). Although these reforms are not usually part of disaster risk reduction in practice, their outcomes (e.g. higher levels of education, health care and income) are among the determinants of adaptive capacity often theorised in the literature as integral to disaster risk reduction (Brooks et al., 2005). Calls for the integration of risk reduction with structural reform are not new. Yet relatively little attention has been paid to designing and delivering this integration in practice.

In this paper, we suggest that if disaster risk reduction is implemented by adopting good governance practices such as stakeholder participation in decision making, democratic access to knowledge, transparency and accountability, an indirect benefit may be generated wherein the pre-conditions are set for the implementation of deeper reform that can decrease overall vulnerability. One example is when disaster managers adopt community based participatory disaster response plans that encourage stakeholder mobilization and the creation of social capital, which in turn, challenges power inequalities at the local level (Mitchell, 2003; Allen, 2006). Another example is when disaster risk management is integrated with long-term land use planning, health service provision or actions to improve access to knowledge and information.

Therefore, it is critical not only that we find out what has enabled some countries and regions to fare relatively well in terms of reducing risk and how to transfer this knowledge to other regions but also to understand how such successes can foster long-term reduction of vulnerability to climate change. Identifying generic lessons from best-practice case studies of disaster risk reduction in different geographic regions experiencing different types of hazards and utilising different forms of governance may provide some insight into how disaster risk reduction practice can be enhanced to bring about the wider development gains as proposed by Wisner et al (2004).

In this article, we use a multi site ethnographic approach to examine markers of success in disaster risk reduction in two distinctly different locations: the Cayman Islands in the Caribbean and the state of Ceará in Northeast Brazil. Both regions have been the subject of extensive previous research by the authors (Lemos, 2003; Lemos, 2007a; Tompkins, 2005; Tompkins and Hurlston, 2003; Lemos et al., 2002)¹. Both sites have also been historically vulnerable to climate variability and extremes (tropical cyclones in the Cayman Islands and drought in NE Brazil) and their response to these climate related hazards may offer the best analogue available to explain their vulnerability and adaptive capacity to climate change. Despite the considerable difference in GDP per capita, wealth distribution, physical characteristics, politics and culture, we find that there are some markers of success common to both areas. These markers are most obvious in the design and implementation of the institutions that respond to hazards and address vulnerability. The fact that we found these markers of good disaster governance to be effective in both cases indicates that such practices may hold the promise of efficacy in a wide variety of environments, especially in less developed regions.

Our empirical research suggested that four factors were critical to improving disaster management in both cases. First, the agencies and organizations responsible for disaster management were flexible, able to learn from past success and/or failure and to build on their relationship with stakeholders to push for the policy agendas and their implementation. Second, a group of committed, reform-minded and politically active actors in the public sector (in NE Brazil) and in the public and private sectors (in the Cayman Islands) championed a series of changes in the approach to disaster that lent it credibility and political feasibility. Third, these organizations and individuals sought to integrate disaster response into other social and economic policy processes, creating an approach to disaster response

that was much better fit to the changing nature of social disasters and their many stressors beyond the physical hazard causing them. Fourth, in both cases there was a long-term commitment to investing in disaster risk management and in collaborative learning-based approaches to managing risk.

Yet, despite the fact that all four factors played a role in NE Brazil, and that response to drought has improved markedly in the region (Lemos, 2003; Lemos, 2007b), their effect on decreasing general vulnerabilities has been much slower and less far reaching than in the Cayman Islands. And whereas there are many reasons for the different outcomes associated with the application of disaster risk reduction in the two regions, we argue that the most critical difference that has prevented Ceará from transforming through disaster risk reduction in practice is the level of overall inequality that exists in Brazil. As such, vulnerability is a birthright determined by income distribution, political capital, access to education and health services and to other assets that influence the capacity of individuals and systems to cope with and recover from disasters (Brant, 2007). In Ceará, since progress towards decreasing social vulnerability and addressing underlying inequalities has been slow and insufficient, risk reduction, albeit much improved, can only ever maintain the status quo.

Climate change is expected to increase the likelihood of disasters through three mechanisms: by changing the incidence and severity of weather and oceanic hazards (and potentially the magnitude); by increasing climate variability; and/or by increasing the vulnerability of human populations to multiple stressors. The former could occur through changing weather conditions, such as changing precipitation, temperatures or storminess (IPCC, 2001; van Aalst, 2006; Hoyos et al., 2006; Knutson and Tuleya, 2004). The latter could occur through increased environmental and social pressures arising from both the causes and consequences of climate change and future development pathways (McCarthy et al., 2001; O'Brien and Leichenko, 2000; Few, 2003). In light of these potential additional pressures on vulnerable communities, efforts are needed to understand the complete role and the limits of disaster risk reduction in preparing for climate change.

In the next sections, we explore each one of these factors in detail and in the context of the two case studies. Specifically, we consider how existing hazards are managed and identify best practice mechanisms in both cases. Finally, we qualify where these mechanisms may fall short to overcome existing constraints and suggest different ways to address this situation.

2. Hazards and the institutional conditions for effective disaster risk reduction

A comprehensive body of literature has been developed over the past 50 years that describes the theory and application of disaster risk reduction. Various guidelines on managing natural hazards and reducing the damaging impacts from them have been compiled (see for example Thompson and Gaviria, 2004; Smith, 2001; Alexander, 2000; Burton et al., 1993; Middleton and O'Keefe, 1998; Wisner et al., 2004; White, 1945). The disaster risk reduction approach is often depicted by the circular process beginning with disaster risk "prevention" followed by "preparedness", then "response" and finally "rehabilitation", for example see (Wisner and Adams, 2003; White et al., 2004). Both sets of authors emphasise the two clear dimensions of disaster risk reduction: the short term recovery and relief aspect that is predominantly humanitarian, and the other longer term planning aspect which addresses sustainable development, see Figure 2.

Figure 2 here

"Preparedness" is a medium term planning activity that involves developing and testing disaster management plans, implementing early warning systems, stockpiling resources, coordinating agencies and ensuring evacuation plans work. "Response" occurs when the hazard is about to happen, or is happening and involves real-time disaster response (assessment, coordination and relief). "Rehabilitation" focuses on recovery, taking into account long term planning objectives. A detailed description of the disaster risk reduction process can be found in (Bankoff et al., 2004; Pelling, 2003; Alexander, 2000; International Red Cross, 2002; Middleton and O'Keefe, 1998).

This framework has been applied in many different contexts, including: drought in Mexico (Liverman, 1999), landslides and tsunami on the east coast of Canada (Liverman et al., 2001), tropical cyclones in North America (Reddy, 2000; Sobel and Leeson, 2006) and Central America (Rocha and Christophlos, 2001), the Caribbean (Thompson and Gaviria, 2004; Challenger, 2002; Berke et al., 1993; Sims and Vogelmann, 2002) and India (Palakudiyil and Todd, 2003; Thomalla and Schmuck, 2004), and volcanic hazard in Equador (Tobin and Whiteford, 2002) to cite just a few.

Empirical evidence from this literature suggests that when disaster management organisations are flexible, that is, when they can learn and adapt to changing conditions, change as they develop, and responsively reshape their governance structure as necessary, they can deliver positive disaster management processes and outcomes, see for example (2007). We find examples of these features in different but related areas such as integrated coastal zone management (Cicin-Sain, 1993; Olsen et al., 1998), social and ecological resilience (Berkes and Folke, 1998; Tompkins and Adger, 2004) and climate change adaptation (Berkes and Jolly, 2002; Berkhout et al., 2006). In addition, this literature finds that organisations that forge strong relationships with stakeholders, who in turn, “buy in” to the whole approach, are more successful at achieving their goals than those that are not (Brown et al., 2001; Burroughs, 1999; Brosius et al., 1998).

While these elements are critical for effective disaster risk reduction, they are not always designed to concurrently bring about long term development. Indeed, an alternative ‘structural’ school of thought, led by Ben Wisner, David Alexander, Mark Pelling and others, has argued for the need to bring together agency and behavioural change for disaster risk reduction with concurrent change to economic and political structures. They argue that specific actions have to be taken to reduce general social vulnerability. The wider disaster literature has paid relatively less attention to understanding empirically how to foster such integration. Significant attention has been paid to the challenges of structural reform for pro-poor growth, less has been said about how different approaches to disaster risk reduction can create policy environments that are more or less conducive to the design and implementation of structural reform. We argue that good disaster risk reduction may foster structural reform and vice-versa, however, structural reform in areas where there are high levels of inequality and poverty appears to be the most important element in producing sustainable outcomes. In fact, it is precisely in the synergy between disaster risk reduction and structural reform that we believe the great opportunity for long-term effective disaster risk reduction may lie. Understanding both best practice and the limits of disaster risk reduction in practice should ensure that climate change hazards can be evaluated both in terms of their impact on risk and on deep rooted vulnerability.

3. Best practice of disaster risk reduction: hurricane preparedness in the Cayman Islands

The Cayman Islands are one of the wealthiest Caribbean islands, with a per capita GDP of US\$33,700 in 1997. The three islands cover 102 sq. miles, have a population of approximately 43,000, and are a UK Overseas Territory, see Figure 3.

Figure 3 here

Financial services and tourism provide the backbone to the country's economy. As a result of various government initiatives in the 1960s (specifically innovative taxation and banking laws that led to a rapid expansion of the islands' banking industry) coupled with an investment in tourism infrastructure, the Cayman Islands have experienced a booming economy since the 1970s (Johnson, 2001). The small size of the Cayman Islands is reflected in the government which comprises 18 Members, 15 of whom are the elected representatives for the Islands' six districts. The Cayman Islands lie within the North Atlantic hurricane belt and are seasonally affected by tropical depressions, tropical storms and tropical cyclones (hurricanes). The recent storms affecting the Cayman Islands (specifically Grand Cayman – WMO weather station identifier: MWCR) are shown in Table 1.

Table 1 here

In relation to their island neighbours the Cayman Islands tend to fare reasonably well during and after tropical cyclones, although economic losses can still be significant, see McLaughlin (1994) and ECLAC (2005). In part this can be attributed to the actions of the National Hurricane Committee (NHC) – the public-private partnership that manages hurricane disaster risk reduction. The NHC has evolved from a committee of volunteer civil servants loosely organised by government to a formalised efficient quasi-government management organisation, chaired by the Chief Secretary, a politically appointed civil service position. As directed in the Emergency Powers Law (2006b), the committee takes over all aspects of hurricane preparedness, response and recovery in the event of a disaster, yet the role and structure of the committee emerged as much from luck as by design. While the NHC produced its first comprehensive national hurricane plan in 1989 (Tompkins, 2005), there were a series of domestic and international events – including government departmental reorganisation, changes in development and planning regulations, including a strengthening of the Building Code (2006a) in 1995/6, and changes to the Development and Planning

Regulations (2005) in 2002 to increase waterfront set back for beach construction (see also Tompkins and Hurlston, 2003) and a rising global prioritisation of risk (Tompkins, 2005) – that allowed the nascent NHC to garner support and become a trusted cornerstone in hurricane risk management in the Cayman Islands.

The success of the NHC can be viewed in comparison with other country responses to hurricanes. For example, in 2004 when Hurricane Ivan battered the islands (Ivan was approximately the same magnitude as Hurricane Katrina that hit New Orleans the following year), only two fatalities occurred despite extensive wind damage and flooding of the islands (McCarthy, 2005)². To have such a low level of fatalities from such a major storm is testament to the work of the NHC. If the effectiveness of government response to storms is measured by the length of time it takes the government to prepare (full shuttering of government buildings in less than 6 hours), the number of fatalities directly resulting from storm impacts (reported to be less than 5 in the past 30 years), and the length of time to return the economy to full function after a major storm, the Islands fare considerably well in comparison with their island neighbours (details of this case study can be found in Tompkins, 2005; and Tompkins and Hurlston, 2003).

Four factors appear to have enabled the transformation of the NHC: the committee is supported by the population; it is a learning-based institution that actively requires managers to draw on mistakes made in previous years; it is operating within a government context where the policy focus is on mainstreaming disaster risk reduction; and there is buy-in from critical stakeholders. We now consider each in turn.

Despite some frustrations, there is general popular support for the NHC (reported in Tompkins and Hurlston, 2003). Part of the support for the NHC came from its humble beginnings. Although members of the initial committee were volunteers, they were highly motivated, enthusiastic and trusted civil servants who were seen to be investing time and energy beyond 'what was required' to improve hurricane planning in the islands. The strong, influential and well-respected chair of the NHC (the Chief of the Fire Department) worked diligently to raise the profile of hurricane risk within the government. In short, the committee benefited from the participation of committed, hard working and trusted volunteers, from the high level of inclusiveness across government departments and from a willingness to consider

any approaches that might work. A detailed discussion of the development of the NHC can be found in Tompkins and Hurlston (2003).

Learning from past years successes and failures has been an integral feature of the response strategy (National Hurricane Committee, 2006), in this way the Cayman Islands' Government has avoided the 'blame culture'. At the end of every hurricane season the committee reviews what it has done effectively the year before and what has not worked. Consequently, the national hurricane plan is revised annually and mistakes are not repeated nor bad-practices institutionalised. Hurricane preparedness exercises are a diary entry and budget item in all government officials year plans from April to December. This deliberate and explicit acknowledgement of the time, staff and financial resources required to be prepared for hurricanes is critical to the learning process. Learning can only occur where there is space for innovation and institutional adjustment (Clark et al., 2001). Evidence of responsive adjustment can be seen in the changing composition of the NHC after the islands suffered from the major impacts of Hurricane Ivan in 2004 and Hurricane Gilbert in 1988. In each case the NHC reviewed its composition (to ensure it maintained the appropriate membership), its structure and network arrangements, its funding allocation, and its responsibilities. While the National Hurricane Committee is now a formal committee within the Cayman Islands Government, it has retained its flexibility, which, in turn, enables it to adapt to changing conditions. This flexibility also extends to policymakers since discretion to design and implement new initiatives to reduce risk is built-in to disaster risk reduction policy. This allows decision makers to make adjustments and take politically motivated actions. Whereas this can be harmful in places where corruption is prevalent, decision makers in the Cayman Islands assume that the advantages of flexibility outweigh its disadvantages. This is particularly true in terms of being able to use political capital for setting development priorities or pushing forward long term planning goals.

The Cayman Islands' Government has mainstreamed disaster risk reduction by embedding risk management into all areas of policymaking. In 1994, the government carried out an insurance and risk management study to assess the potential losses that the Cayman Islands might face under different risk scenarios. One outcome of the assessment was the creation of a risk management advisory committee to advise the Cayman Islands' Government Cabinet (the Executive Council). Initiatives emerging from this include decentralising risk. This was achieved through increasing departmental accountability for some risks. For example rather

than providing central insurance for government vehicle drivers, the cost of insurance was transferred to the departments. Departments then had a greater incentive to encourage safer driving practice as the costs of rising insurance premiums came from the departmental budget. Long-term risk management is incorporated through integrated land use planning. The Development and Planning Committee within the government requires participation from all government departments to ensure that plans rolled out achieve the broader objectives of the Cayman Islands' Government. While all parties do not necessarily agree with all elements within these plans, the process of decision making is essentially an integrated, cross-departmental one that strives to tie in with the overall national structure.

The final element that enables the Cayman Islands to manage hurricane risk effectively is the buy-in of all the critical stakeholders in disaster risk reduction. In the long-term planning phase, members of the National Hurricane Committee sit on the various committees that advise on long-term planning within the islands, such as the Central Planning Authority that allocates planning approval (National Hurricane Committee, 2006). Members of the NHC are also involved in long-term planning exercises such as Vision 2008 that set out broad planning and development objectives for a 10 year period (Government of the Cayman Islands, 1999). Annually, leading actors in the different economic sectors and government departments get involved in planning for the next hurricane season. Among the islanders there is a strong perception of their dependence on each other to succeed and a staunch belief in collective action as the way to get there (Tompkins 2005). In all phases of hurricane response all members of the National Hurricane Committee have a role and detailed plans of what they should do at what times. Even when there are inevitable complaints that not enough is happening fast enough at the recovery phase, there is a general acceptance that the National Hurricane Committee is looking after the general well-being of the people of the Cayman Islands. Inclusion also means that there is a strong support network throughout the islands. This is reinforced year after year as different communities, sectors, businesses and government agencies find that they are either affected by a hurricane or involved in the response and clear up.

The lesson from the Cayman Islands study is that integrated, learning-based management systems, with widespread buy-in and support can deliver long term disaster risk reduction benefits. Disaster risk reduction, as practiced in the Cayman Islands can ensure that those who are exposed to hazards and those who are sensitive to their impacts are assisted to

prepare and cope better. We now turn to NE Brazil to consider the pre-conditions necessary to provide disaster risk reduction benefits with simultaneous development gains in a different political, social, geographic and hazard context.

4. Drought-Relief and Policymaking in Northeast Brazil and Ceará: institutions for managing climate change

The Northeast region of Brazil is the country’s poorest. It comprises nine states, including Ceará – located at the heart of the region’s infamous “polygon of drought” (see Figure 4). In 2000, Ceará’s GDP per capita was approximately half of the national average (IPLANCE, 2000). Despite high levels of poverty, for the past ten years, Ceará has been undergoing a remarkable political and socio-economic change that has critically affected its social indicators and policymaking process. Table 2 displays some of these improved numbers.

Figure 4 here

The history of drought in NE Brazil is long and well-documented. In the sixteenth century Jesuit missionaries recorded the first stories of devastation and in the 1800s a particularly severe El Niño event killed 800,000 (4 percent of the Brazilian population at the time) in NE Brazil alone (Villa, 2000: 83; Davis, 2001). More recently, the 1979-83 drought affected 18 million people and cost approximately US\$1.8 billion in emergency programmes (Ribot et al., 1996: 293).³

Table 2 here

The first hundred years of drought policy in NE Brazil, primarily sought to expand the network of water storage infrastructure. Locally known as the “hydraulic solution”, these efforts resulted in the massive construction of reservoirs, dams and canals that alleviated immediate water shortage but did little to decrease long term vulnerability (Lemos, 2003). Especially vulnerable were small non-irrigated farmers whose livelihoods were made possible only because of the state’s drought emergency programs, which included the distribution of food baskets and drinking water, and the organisation of work fronts — (*frentes de trabalho*) where farmers displaced by drought get less than the minimum wage to work for the government on fixing roads, building small dams etc.

This approach to drought response was rooted in the high level of politicisation of water management and conservation in the region. First, because policymakers equated drought to water scarcity – investing in water storage infrastructure seemed to be the right thing to do. It was also an approach that allowed local managers to stick to their technical background in search of a solution that insulated their work from the messiness of politics. This search for a ‘technical fix’ to the drought problem also led to substantial investment in climate-related data collection and science including cloud-seeding (Lemos, 2003)⁴. Second, drought emergency policy was at the heart of the “drought industry” – that is, the misappropriation of public funds earmarked for drought response. The large influx of money into drought-affected regions engendered widespread corruption and political manipulation of the affected populations, who exchanged electoral votes for placement in work fronts and food basket programs⁵ (Lemos and Oliveira, 2004). The potential to accumulate both political and financial capital, means that local politicians and those illicitly benefiting from the drought industry have little incentive to address drought effectively and proactively.⁶ As these funds filtered into the local power hierarchy, they created a vicious cycle of drought, clientelism, and poverty that seemed impossible to break, see Figure 5.

Figure 5 here

By the early 1980s, however, political reform in the region and particularly in Ceará, started to take hold (Pessoa, 1987; Tandler, 1997) and affect different policy areas, including drought response. A succession of relatively politically progressive governors charged state officials with the mission of reforming the state’s drought response apparatus. The new approach moved from trying to buffer the effects of drought to emphasising the need to adapt to water scarcity. By 1987, state response to drought, at least on paper, had undergone a dramatic reform⁷. Rather than emergency actions, the state government decided to focus on long-term projects associated with communities. New programmes emphasised rural development and alleviation of poverty through agrarian reform, creation of irrigated zones, development of hydrographic microbasins, rational water management, development of micro and small businesses in the interior, education, basic rural health and sanitation, agro-industry, rural extension, creation of food security programmes, community development, etc. (Ribot et al., 1996). Although these programmes intended to strengthen the resistance of the rural population to drought by stabilising production for the small farmer, their design mostly

concentrated on reducing sensitivity to drought instead of longer-term re-distributive policies. In addition, many of these initiatives never left the planning stage while others were only partially achieved or failed all together. Consequently, large segments of Ceará's poor remain significantly vulnerable to climate variability (Lemos et al., 2002).

Similarly to the Cayman Islands case, in Ceará, the presence of flexible organisations capable of adaptive learning, stakeholder engagement, and reform-oriented policymakers were critical in the improvement of risk reduction mechanisms. In this case study we look at two agencies—Civil Defence (CEDEC) and Cogerh (the water management agency)—as examples of achievements and limitations associated with these factors.

Civil Defense (CEDEC) had been a fixture in drought relief policy for over three decades. Through its several phases, it has gone from a mostly ineffectual actor in the drought industry to one of the most active players in drought relief. Behind CEDEC's progress are both political support by a reform-oriented governor and the presence of a cadre of dedicated managers who have been able to push for much needed drought-relief reform (Tendler, 1997; Lemos, 2003). In addition, CEDEC has been able to learn considerably from past experience and apply these lessons to respond to disaster more efficiently and equitably. Although the agency acts mostly reactively, the delivery of emergency response has improved markedly most notably by neutralising the most corrupt aspects of the drought industry. Its approach to drought relief, started in the late 1980s, has improved upon the old clientelistic model in several ways. It democratised local decision making by installing district-based committees formed by community representatives (both from the public and private sectors) called COMDECs (Comite de Defesa Civil—Civil Defense Committee). These committees are responsible for identifying the neediest families in each drought-affected community. Food baskets, water trucks and jobs are then distributed within the district to these families. Civil Defense officials supervise their workings and try to closely monitor emergency fronts' implementation. However the transition to the more democratic COMDECs was met by fierce resistance especially from local politicians threatened by the new system. Despite this resistance and persistence of a certain degree of clientelism in the choice of members the COMDECs, the system proved an improvement over previous practices and, in 1997, managers from the state Civil Defense agency expanded this approach by establishing a series of criteria to rank districts according to their vulnerability to drought as well as their need for emergency relief (Lemos, 2007a). These criteria included rainfall quantity and

distribution, run-off, yield losses by district, a vegetation index, and levels of social unrest. New plans exist to re-structure the emergency programme through the implementation of a system of permanent response whose main goal is to decrease vulnerability to climate variability.

The second agency, Cogerh, was created in the early 1990s as part of a water reform to enhance societal participation and decentralise water resources management in the state. In contrast with conventional water agencies, Cogerh included a competent cadre of reform-oriented managers including engineers, economists, and social scientists responsible for the organisation of river basin councils to support water management. The agency was responsible for the creation of a number of stakeholder-driven councils, including reservoir commissions and river basin committees that have significantly democratised water resources management, especially when compared to the old insulated system (Lemos and Oliveira 2004). Yet, the system remains considerably elite-driven in that poor farmers continue to be underrepresented (Taddei, 2005). The combination of social scientists and engineers at Cogerh was critical to the agency's ability to innovate and learn in the process of water reform. Although Cogerh was created to be more flexible than other insulated water agencies typical of water management in Brazil, its actions seem also make it more vulnerable to political influence. For example, the election of a more politically conservative governor in the early 2000s has threatened the most progressive aspects of its stakeholder-driven efforts (Lemos and Oliveira, 2004).

The evolution of both Cogerh and CEDEC was shaped by the presence of reform-oriented managers pushing for their interests at the state level. These policy entrepreneurs were committed to pursue reformist goals including the democratisation of decision-making, decentralisation, and environmental sustainability. They were also firm believers in societal participation and the implementation of stakeholder-driven organisations to support their agencies' missions. These managers are also part of broader reformist networks that provided resources (financial and human) and political support. They are formed by an array of actors across the public-private divide including domestic and international environmental and anti-poverty NGOs, leftist politicians, labour unions and even the World Bank (Lemos and Oliveira, 2004). The support of these networks for the creation of more responsive and equitable disaster risk reduction is critical for the accumulation of the kind of political capital

required to push for policy that may threaten entrenched elites such as the ones historically benefiting from the drought industry.

If we define long-term engagement by the number of years state structures have been involved in drought relief, then the state of Ceará fares well. However, if defined by the quality of outcome of this response, then Ceará’s risk management is less successful. The same can be said for integration where, despite concerted efforts from progressive governments to integrate policy planning and response with other broader initiatives to reduce poverty and vulnerability, substantial gains have remained elusive. The reason may be entrenchment of poverty through social institutions combined with the magnitude of need after decades of policy failure and inequality. Hence although the state has been attempting to implement an integrated and proactive drought policy, structural reform to decrease poverty and vulnerability keep eluding Ceará’s policymakers. Notwithstanding, the state risk management system has come a long way.

As in the Cayman Islands four elements—flexible organisations, stakeholder engagement, reform-oriented policymakers and long term integration of drought response with other policies—seem to be increasingly present in some form in drought relief policies in Ceará. However, the extent they are able to bring about the depth and breadth of reform required to reduce vulnerability has fallen short of the magnitude needed.

6. Discussion and Conclusions

Clearly the two case studies present very different and contrasting contexts within which hazards are managed, yet there are shared lessons from both studies that offer the reader guidance on designing and implementing disaster risk reduction. As stated before, our empirical research suggests that four factors were critical to improving disaster management in both cases. First, the agencies and organisations responsible for disaster management in both regions were flexible, able to learn from past success and/or failure and to build on their relationship with stakeholders to push for the policy agendas and their implementation. Second, a group of committed, reform-minded and politically active actors in the public (in NE Brazil) and public and private sectors (in the Cayman Islands) championed a series of changes in the approach to disaster that lent it credibility and political feasibility. Third, these organisations and individuals sought to integrate disaster response into other social and

economic policy processes, creating an approach to disaster response that was a much better fit to the changing nature of social disasters and their many stressors beyond the physical hazard causing them. Fourth, in both cases there was a long term commitment to investing in disaster risk reduction and in collaborative learning-based approaches to managing risk.

A key challenge is finding ways to manage entrenched poverty and exclusion in hazard-prone areas. Perhaps as in the case of Ceará, an inability to integrate disaster risk reduction into broader poverty-reduction initiatives is at the heart of this issue. Deeply embedded poverty is likely to impose limits on the effectiveness of disaster risk reduction. To shift the vulnerable and poor out of the conditions that define their long-term vulnerability, disaster risk reduction needs to be effectively coupled with other policy interventions. While this message has been at the heart of the work of structuralists such as Blaikie et al (1994), Alexander (2000) and Pelling (2003), the practice of disaster risk management around the world has mostly sidestepped these concerns and focused on addressing the hazard element of the disaster rather than the social and economic context in which disasters unfold.

While progress in disaster risk reduction has been well documented and broadly positive (e.g. Allen, 2006; Benson et al., 2007), the history of addressing the structural inequalities at the root of socio-environmental vulnerabilities has been much less positive (Comfort et al., 1999; Glantz and Jamieson, 2000). Not surprisingly deeper structural transformation is not easy to implement either economically or politically, as decades of failed development and anti-poverty interventions demonstrate (Lucas Jnr, 1998). In both regions studied in this article, we find that the presence of the four factors for effective risk reduction (flexible, learning-based, responsive governance; committed, reform-minded and politically active actors; disaster risk reduction integrated into other social and economic policy processes; and a long term commitment to managing risk) have improved response to disaster even if the outcome in the NE Brazil case has fallen short of the magnitude needed. By choosing to focus on these four factors, we intentionally pursue a higher level of generalisation that hopefully can be relevant to other regions and case studies beyond the two we target, especially systems that are increasingly vulnerable to global climate change. We believe that looking at how systems and groups respond to climate variability driven stress can inform future policy focusing on prevention and response to a changing climate.

We also found that by incorporating well-tested good governance practices in their disaster risk reduction, especially stakeholder involvement and more open and democratic decision mechanisms, both regions may have paved the way for deeper reform. Especially in the case of NE Brazil, the empowerment of local collective action structures may have both diluted elite dominance and constrained the most negative aspects of corrupt drought response. While these actions are not sufficient to spearhead structural reform, they may wear away the inequalities (social, economic, and political) that shape vulnerability in less developed regions. To go even further, bridging institutions linking disaster risk managers with the development planners are required to ensure that the palliative care offered by disaster risk reduction is not used as an alternative to deeper structural surgical reforms that may be needed to address the issues of inequality in society.

Climate change is expected to bring greater levels of climate variability and to worsen the social and economic stresses that the world's poor live with. Most of the literature on managing current climatic changes such as drying trends in southern Africa and warming trends in the Arctic recommends that two types of response are needed: short-term coping mechanisms and longer-term cultural and social shifts (Thomas et al., 2007; Berkes and Jolly, 2002), see also (Osbaahr et al., In review, 2008). For disaster risk reduction to be effective in the context of human induced climate change, it needs to be coupled with more fundamental structural reforms to have a significant impact. This means more appropriate sharing of the risks and the costs associated with getting people away from hazard-prone areas, and out of poverty. It also means the design and implementation of policy that integrates across different policies and promotes positive synergies between existing disaster response strategies and policies to reduce overall vulnerabilities.

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¹ Removed for review purposes.

² While there is no instrumental evidence of the impact of Hurricane Ivan due to a lack of functioning tidal gauges and other oceanographic instruments during the storm (Young, S. R. (2004) Impact of Hurricane Ivan in Grand Cayman. Understanding and quantifying the hazards, HM Government, Department for International Development, , pp. 49.), based water marks on buildings and associated personal recollections, the Department of Lands and Survey in the Cayman Islands Government estimates that at the height of the storm 85% of Grand Cayman was inundated with seawater.

³ The 1997 to 1999 drought resulted in approximately 80 percent loss of crop yields in some parts of the Brazilian Northeast causing considerable social unrest.

⁴ As early as 1910, Northeast Brazil had 124 rain gauges and four hydrometer stations installed. By the early 2000s the state of Ceará alone had over 7,000 reservoirs built, many on private properties (see Lemos, M. C. (2007b) Whose water is it anyway? Water management, knowledge, and equity in NE Brazil. *Water and Equity: Fair Practice in Apportioning Water among Places and Values*, (Eds, Perry, R., Ingram, H. and Whiteley, J.) MIT Press, Cambridge, MA.). Of those, only eight have public policy significance.

⁵ For example, charges of work fronts clearing land or building dams on private *fazendas* (large landholdings) of phantom workers registered on the fronts, of non-existent tanker trucks contracted to deliver drinking water, of families not included in the program because of their local political affiliations are common among critics of drought policy in the Nordeste.

⁶ For an in-depth discussion of these issues see Lemos, M. C. (2003) A Tale of Two Policies: the Politics of Seasonal Climate Forecast Use in Ceara, Brazil, *Policy Sciences*, **32**, 101-123..

⁷ For the past fifteen years, the state government in Ceará has gone from an entrenched oligarchy of a few traditional political families to the most progressive state government in the Northeast. The shift started in 1987 with the election of Tasso Jereissati as governor, his succession by Ciro Gomes in 1991, Jereissati return to power in 1994, and reelection in 1998.