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Drought, Governance and Adaptive Capacity in North East Brazil: A Case Study of Ceará

Maria Carmen Lemos

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Maria Carmen Lemos

University of Michigan

Corresponding Author:

Maria Carmen Lemos

School of Natural Resources and Environment

University of Michigan

2006 Dana Building

460 Church St

Ann Arbor, MI 48109-1041

Phone: (734) 764 9315

email: lemos@umich.edu

Around the world, the devastation of climate-related impacts has threatened livelihoods, ecosystems and the stability of sociopolitical institutions. Droughts have often caused serious agricultural losses and human suffering and the images of famine in Africa and human displacement in Northeast Brazil illustrate just a few of the hardships that are part of a much larger problem. In recent years, the possibility of more frequent and extreme events as a result of longterm climate change has fueled new avenues of inquiry to understand the vulnerability of different human and social systems to these events. And the growing recognition that some degree of adaptation to climate change will be unavoidable has increasingly moved the burden of action from the scientific realm to nation states, multilateral and bilateral development organizations, citizen's groups and communities that will be expected to respond to negative impacts of climate variability and change (Eakin and Lemos 2006).

One critical element of this inquiry is the need to understand the process through which institutions at different scales are affected and respond to climate variability as a means to assess how prepared they might be to respond to and recover from future climate change. The IPCC defines adaptive capacity as "the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences'' (IPCC 2001). Adaptation, in turn, refers to the actual actions and responses of a system to exposure—defined as the amount of (potential) damage caused to a system by a particular climate-related event or hazard. Successful adaptation should result in an equal or improved situation (when compared with the initial condition); unsuccessful ones, or maladaptation occur when the outcome situation is worse than before.

Adaptation is essentially related to a system's level of resilience, defined as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (Folke, et al. 2005). In this view, resilience refers not only to the amount of change or variability a system can absorb before shifting states but also its capacity for self-organization and its ability to learn and innovate in face of uncertainty and change. Although it is possible to design specific *adaptations* to anticipated impacts, a greater challenge is to define what attributes are necessary to make these adaptations successful. Given the large uncertainty in scenarios of future change, it makes more sense to focus on *capacities* rather than specific adaptations. While there has been considerable effort in the literature to theorize what attributes may enhance the capacity of human and sociopolitical systems to respond and recover from negative impacts of climate related phenomena (Smit, et al. 2000; Folke and S. R. Carpenter 2002; Yohe and Tol 2002; Tompkins and Adger 2005; Eakin and Lemos 2006), there has been relatively few empirical studies that seek to understand how this capacity can or has been built (or not) in the real world. What factors make human, social and political systems less vulnerable to climate-related phenomena? In this article, I argue that building resilience is a two-tiered process that must include both risk management to climate impact and deeper level socioeconomic and political reform that addresses the root causes of vulnerability, especially among the vulnerable poor. In this process, tier one comprises the design and implementation of risk management institutions and organizations—such as disaster preparedness plans, warning systems and emergency disaster relief—that can potentially mitigate the most immediate and egregious effects of climate-related impact. Although the efficacy of risk management

systems varies widely—even among countries at similar levels of vulnerability and development—some form of risk management can currently be found in most countries of the world. Tier two encompasses socioeconomic and political reform that addresses the range of inequalities at the root of differential vulnerabilities. Reforms such as income redistribution, land reform, educational programs and political reform are just a few that might be necessary to decrease vulnerability among the poor in less developed countries, for example. Although these kinds of reform have been in the development agenda for a long time, they have proved elusive to most poor countries in the world. Yet, the threat of climate change as an emergent stressor that will exacerbate vulnerability, especially in less developed areas of the world, only make their implementation more urgent. Beyond the state—but certainly not without it—this two-tiered process must involve a broad number of institutions across the state-private-community divide as well as across different scales of decisionmaking (Lemos and Agrawal 2006). On the one hand, the kind of deep transformation needed to address inequalities at the root of vulnerability has historically been economically, socially and politically too costly for most governance systems to tackle and the daunting character of its implementation maybe intimidating at best and paralyzing at worst. On the other hand, aiming at deeper transformation does not have to be an all or nothing proposition and one way to spearhead change is to identify which among risk management actions currently in place can be more or less conducive to create the conditions for structural reform. For example, by subscribing to risk management approaches that create positive synergies across the state-society divide, drought response planning or water management institutions may create the conditions to build longer term resilience among vulnerable groups. Approaches that are inclusionary (participatory), accountable, transparent and democratic, maybe more conducive to the creation of an empowered citizenry more equipped to break free from clientelist systems and to mobilize for social reform. Similarly, approaches that integrate risk management with sustainable natural resources use and adaptive governance may be more conducive to social learning and to building resilience and social capital than topdown approaches that insulate decisionmaking from stakeholders.

This case study focuses on Northeast Brazil, a region historically plagued by drought (and occasionally by flooding in urban settings), which is presently the object of concerted efforts to assess the vulnerability of human and natural ecosystems to climate variability (Lemos, et al. 2002; Lemos and Oliveira 2004; Nelson 2005; Lemos forthcoming). In this region, water scarcity and vulnerability to drought have been given high priority on policy and decisionmaking agendas. This analysis particularly examines the state of CEará, one of the poorest in NE Brazil. For the past twenty years, Ceará has been the object of numerous studies focusing both on its vulnerability to drought as well as on the reform of its governance and political approach to respond to it (Pessoa 1987; Magalhães and Neto 1991; Magalhães, et al. 1991; Carvalho, et al. 1993; Tendler 1997; Lemos, et al. 2002; Lemos 2003; Nelson 2005). The next sections will briefly describe Ceará and its historical response to drought; explore some of the ways socio-political change shaped drought planning reform and speculate how such reform contributed (or not) to the building of adaptive capacity in three specific policy sectors: agriculture, water management and disasters response.

NE Brazil and Ceará: Brazil's Northeast encompasses eighteen percent of the national territory and one third of the country's population. It is divided into nine states that constitute the vast majority of the infamous "polygon of drought", a particularly vulnerable region, which has recorded five centuries of periodic crisis. In 2000, Ceará's GDP per capita corresponded to only 50% Brazil's GDP per capita (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 1 displays some of these improved numbers.

Table 1: Selected social indicators

Indicators	1987	1997	2005
Infant Mortality	137.0 (1)	40.0	33.2(Folke and T. Hahn)
Population with monthly income below minimum wage (%)	33.5 (2)	19.9	
Illiteracy (% of the population over 7 years-old)	43.3	31.7	22.6(Folke and T. Hahn)
Level of education (% of population between 7-14 years old(6)	56.7	95.0	96.8
Households with piped water (%)	31.5	53.3	74.0
Houses with electricity (%)	53.1 (Folke and T. Hahn)	75.6	95.6
Households with garbage collection (%)	28.0	49.0	72.2

Source: IBGE/PNAD, SEDUC, SESA, Government of the State of Ceará, 2000
Notes: (1) 1986
(2) the rate for 1997 is 42/1,000
(Folke and T. Hahn) 1985
(Folke and T. Hahn) 2004
(Folke and T. Hahn) % population over 15 years old
(6) Number of people enrolled in schools

While, this positive change can be partly explained by broader processes of democratization in Brazil and concerted efforts from progressive politicians in Ceará—especially at the higher echelons—to improve public policymaking implementation, the effects of macroeconomic growth on the poor have been less straightforward and high levels of inequality and income concentration persist. For example, the state's Gini coefficient has actually increased from 0.65 in 1991 to 0.68 in 2001 (Nelson 2005). Yet, recent research on policymaking in Brazil has identified Ceará as a case where policymakers have achieved a significant level of success while carrying out public policies (Tendler 1997; Lemos 2003; Lemos and Oliveira 2004; Lemos and Oliveira 2005).

Impacts of Global Climate Change: Societies in semi-arid regions in developing countries are typically highly vulnerable to variability of climate and water availability due to low consistency of water availability under average climate conditions. Northeast Brazil is typical of these regions in that it is already regularly affected by severe droughts that have led to major famines in the past. As a result of this natural climate variability, local populations' economic and social well-being has been negatively impacted (Gaiser, Ferreira and Stahr 2003). More frequent droughts will only make this situation worse. As

mean global temperatures rise, semi-arid regions are expected to experience more frequent prolonged droughts and decreased water availability.

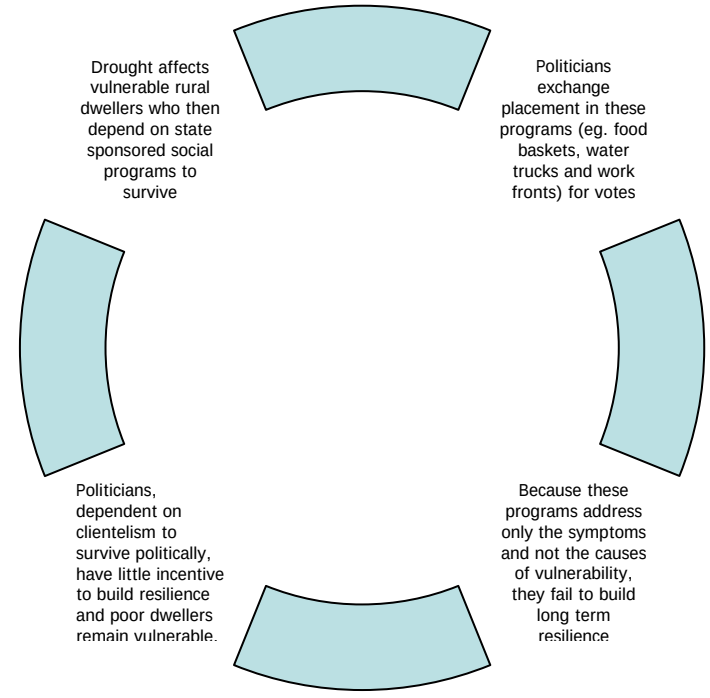
Recently released climate projections for Northeast Brazil are indicating a strong likelihood of increased temperatures and decreased precipitation, resulting in a growing aridizabtion of the region (Ambrizzi, et al. 2007). If predictions that under climate change there will be more El Niño-like mean conditions are right, Northeast Brazil will become drier since dry years are highly linked to the ENSO phenomenon. Extreme droughts occurred in Northeast Brazil during the strong ENSO years of 1911-1912, 1925-1926, 1982-1983, and 1997-1998 (IPCC TAR). In addition, a recent modeling study (Krol and Bronstert 2007) indicates strong links between changes in precipitation and availability of water resources. Under their dry scenario, river runoff decreases by twice the level of precipitation change. Coupled with increased demand, the model predicts increasing water shortages over the next 50 years.

Under climate change, drier conditions will have a major impact on agriculture. In Ceará, these impacts can potentially be devastating since an estimated 96% of the agriculture in the state (around 1, 700 000 ha) is rainfed (SDA 2007). And although the economic contribution of agriculture to the overall economy is low (6.6 percent of state GDP), around 40% of the economically active population still depends on it for their livelihoods (SEPLAN, 2000).[1] Moreover, soil moisture levels are expected to decrease, reducing the suitability to cereal production in the region (Fischer, Shah and Velthuizen 2002). In fact, Northeast Brazil is predicted to suffer among the worst yield impacts in the world (Rosenzweig, et al. 1993; Rosenzweig and Hillel 1998). Since the region is home to 45 million people and is already prone to droughts and famine, changes in the climate that exacerbate food shortages are expected to have major human consequences (IPCC 2001). In this context, understanding the underpinnings of adaptive capacity building in the region is paramount.

Historical Response to Drought. In Northeast Brazil, reports about devastating drought episodes trace back to the first Jesuit missionaries who arrived in the region in the late 1500s. From 1877-79, a well-documented period of global drought resulted in a widespread famine that forced 3 million people to migrate and killed an estimated 500,000 (four percent of the Brazilian population at the time) (Villa 2000 p. 83; Davis 2001). More recently, the El Niño-related 1979-83 drought affected eighteen million people and cost approximately US$1.8 billion in emergency programs (Magalhães, et al. 1988 p. 293).[2] And while the region's low levels of average rainfall is surely a factor in these disasters, vulnerability to drought among the poor is critically defined by an extreme unequal distribution of power and resources within the region.

For over a century, local and federal governments have attempted to alleviate the negative effects of drought in the region mostly by managing risk rather than addressing deeper causes of vulnerability to drought.[3] Because early on public officials equated drought to water scarcity, most of the emphasis to respond was concentrated around two actions. First, officials sought to increase the region's capacity to storage water. Consequently, both state and federal governments spent significant resources in the construction of waterworks, especially reservoirs and dams. Additionally, the state initiated investment in climate-related data collection and science (Lemos 2003).[4] Second, the state and federal governments invested substantially in post-disaster

emergence relief by funding food and water distribution programs as well as state-financed work fronts for drought victims. These two approaches to adaptation not only failed to decrease longterm vulnerability to drought significantly among the poorest segments of Ceará's population but also contributed to a vicious cycle of clientelistic politics that has plagued the history of drought response in the state. The "drought industry", that is, the corrupt misappropriation and misuse of public funds earmarked for drought-relief for private gain (Lemos and Oliveira 2004), both feed and is fed by the ability of conservative policy networks to keep the status quo of poverty and inequality. Because the drought industry involves the accumulation of both political and financial capital, local politicians and those illicitly benefiting from it may have little incentive to address drought effectively and proactively.[5] One of the main strategies of emergency drought relief since the beginning of the century has been the creation of public work fronts (*frentes de trabalho*), which continue to be a national symbol of suffering (Lemos, et al. 2001). In the past, local officials informed the state government of critical levels of deprivation, which then was relayed through political channels to the federal government. Once an emergency status was officially "declared", resources were then released at the federal level to move back down the structure to the state, to the município, to those affected by drought. Placement in such programs was often obtained through a clientelist relationship with local political bosses. Figure 1 illustrates the vicious cycle of drought, vulnerability, and clientelism in Ceará and NE Brazil.



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However, as the definition of drought expanded from water scarcity (the climate-related hazard) to include its interaction with poverty and other determinants of vulnerability such as reliance on rain-fed agriculture, lack of credit, illiteracy, lack of knowledge and technology, etc, drought policy also changed. By 1987, state response to drought, at least on paper, had undergone a dramatic reform.[6] Rather than emergency

actions, the state government decided to focus on long-term projects associated with communities. New programs emphasized 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 programs, community development, etc. (Magalhães, et al. 1991). These programs also encouraged more community involvement in the decision-making process. However, many of these initiatives never left the planning stage while others either only partially achieved their goals or failed altogether. The modernization push improved many aspects of policy making in Ceará (Tendler 1997) but still was not enough to reduce the consequences of drought significantly, primarily because a substantial portion of the rural population were not benefited by these programs (Frota 1985). Although they intended to strengthen the resistance of the rural population to drought by stabilizing production for the small farmer, here again implementation mostly concentrated on the increase of water supply instead of longer-term re-distributive policies. Consequently, large segments of Ceará's poor remain significantly vulnerable to climate variability (Lemos, et al. 2002).

While integrated and proactive drought policy and structural reform to decrease poverty and vulnerability keep eluding Ceará's policymakers, the state risk management system has come a long way. On the one hand, the state's drought relief mechanisms have undergone an extensive reform, which eliminated many of the negative aspects of earlier predecessors. In the late 1980s, the state created a new integrated drought relief management (which since then has had several incarnations) that attempts to address corruption, clientelism, and inefficiency through the inclusion of stakeholders in decisionmaking, the implementation of institutional arrangements that hold both organizations and public actors more accountable, and the systematic use of knowledge to support response to drought. While the reform system is far from perfect (see next sections), it is a great improvement over past initiatives and has had the ironic effect that, as a result of the influx of emergency resources, many farmers actually have more resources in a drought year than in other years (Nelson and Finan 2007). In addition, the state is still experimenting with different approaches to respond to drought, including a few new initiatives that learn from past successes and attempt deepen both participatory processes and new methodologies to assess vulnerability. One of these initiates—Projeto Maplan (Participatory Mapping for Planning)—is presently being undertaken by the State Secretary of Regional and Local Planning, in conjunction with FUNCEME. It addresses issues of drought within a larger framework of vulnerability reduction through building adaptive capacity and bridging the civil society-political divide. However, it is too early to assess its outcomes.[7] Other projects trying to address longterm vulnerability to drought include small farming crop insurance for those who lose 50% or over of their crops because of drought[8] and projects to enhance access of small farmers to rural extension services and more lucrative cultures targeting export markets.[9] Next, we examine three specific policy areas—water management, disaster-relief and agriculture—and compare their outcome both in terms of risk reduction and general adaptive capacity building.

Agriculture[10]. The *Hora de Plantar* Program, a program started in 1988, aimed at distributing high-quality, selected seed to poor subsistence farmers in Ceará and at

maintaining a strict planting calendar to decrease rainfed farmers sensitivity to climate variability. In exchange for the selected seeds, farmers "paid" back the government with grain harvested during the previous season (the same amount of the seeds they receive) or received credit to be paid the following year. The rationale for the program was to provide farmers with high quality seeds (corn, beans, rice, and cotton), but to distribute them only when planting conditions were appropriate. Because farmers tend to plant with the first rains (sometimes called the "pre-season") and often have to replant, the goal of this program was to use scientific information to orient farmers with regard to the true onset of the rainy season (Lemos, et al. 2001).

To inform the program, the agriculture state agency used a computer-based soil humidity model developed by the state meteorology agency (FUNCEME) (Andrade 1995).[11] This model, used to calculate soil humidity, incorporates seven main physical parameters: soil humidity, daily precipitation, evaporation, maximum water retention capacity of the soil, water infiltration capacity, run-off, and water percolation. During the rainy season FUNCEME *técnicos* entered daily rainfall data into the model and calculated the level of soil humidity and its ability to retain enough moisture for plant growth (Andrade 1995). From the model, FUNCEME established the number of days that would take for the soil to lose the moisture gained from the last rainfall. FUNCEME then mapped out the *municipios* whose soils could withstand at least eleven days without rain and sent this information to the state agency in charge of distributing the seed to these *municipios* (Andrade 1995).[12]

There are many drawbacks to this plan. First, the quality of the data (both rainfall and soil data) is low for the level of precision designed into the model. Second, the program was plagued by a series of logistical and enforcement problems (transportation and storage of seed, lack of enough distribution centers, poor access to information and seeds by those most in need, fraud, outdate client lists, etc). Third, the program systematically ignored local and lay knowledge accumulated for year to inform its design. In stead it relied on a model of knowledge use that privileged the use of technical information imposed on the farmers in a exclusionary and insulated form that alienated stakeholders and hampered buying in from clients (Lemos 2003). Finally, farmers strongly resented *Hora de Plantar*'s planting calendar and its imposition over their own best judgment. According to one farmer "even if I plant and loose, at least I have a chance. When I don't plant, I know for sure I won't have what to eat." Thus, at great sacrifice, most farmers store their own seed from one season to the next so as not to depend on *Hora de Plantar*.[13] Despite the shortcomings of the *Hora de Plantar* seed distribution program, a few small farmers did recognize the advantage of genetically improved seeds and praised the program as a help to those who have no seed or cannot afford to buy it on the market. The program is still active, although by 2002, the strict coupling of seed distribution and the planting calendar had been phased out (Lemos 2003). Table 2 shows the level of participation in Hora de Plantar.

Table 2: Participation in the *Hora de Plantar* program

Município	Previous Participation % HH	Participation in 1997 % HH

Limoeiro do Norte	56	37
Barbalha	67	47
Parambu	43	21
Boa Viagem	64	54
Itarema	53	43
Guaraciaba do Norte	44	42
Total	54	41

Source: (Lemos, et al. 2001)

Drought relief. After many years of clientelistic policymaking, in the mid-1980s, the structure of drought relief in Ceará underwent a profound reform. For the first time, Ceará's government created a centralized structure for drought response that coordinated the efforts from all areas of the state government under the state department for Social Action (*Secretaria de Ação Social*) (Carvalho 1993).

From the early 1990s on, adhering to a new philosophy of drought policy, the Productive Work Fronts Program (*Programa Frentes Produtivas de Trabalho*— PFPT) embodied two major changes over past efforts. First, it sought to identify and pursue permanent public works directed to community use. Second, the PFPT encouraged the creation of local municipal councils responsible for selecting emergency program beneficiaries and the specific local public works projects to be executed (Carvalho et al. 1993: 114). Another critical change in the approach to disaster relief was the design of new criteria for the kind of works and workers that would qualify for funding (Tendler 1997). The new Community Action Groups became the focal point for decisionmaking regarding emergency relief. In contrast to previous programs where local politicians used relief funds and jobs as political currency, the GACs (under the supervision of local extension agents) included representatives of several sectors of society such as the Church, rural labor unions, city council representatives, landowners associations, state officials, and professional associations (Tendler 1997).

In the new system, at the onset of a drought, the state Civil Defense employs a local level monitoring system based on the quantity and temporal distribution of rainfall, vegetation indexes, yield losses, and social tension episodes to establish a triage ranking for government response (Governo do Estado do Ceará 1997). As suggested earlier, the new system, which started in the late 1980s but was constantly changed throughout the 1990s, improved the old clientelistic model in several ways. It democratized local instances of decision by installing município-based committees that are responsible for identifying the neediest families in each drought-affected community. By the early 1990s, the committees' coordination was transferred from the state extension agency to Civil Defense *técnicos* who supervised their workings and closely monitored emergency fronts' implementation. Community representatives in the committees–now called COMDECs (Comite de Defesa Civil)–generate a list ranking the families of each community according to need. These lists are then prioritized within the *município* and used as a basis for the distribution of jobs, food baskets, and water trucks. CEDEC also introduced a statewide ranking of *municipios* affected by drought based on "techno-scientific criteria." The ranking was then used both to select different *municipios* to

receive emergency relief and to challenge local politicians' claims and attempts to "pressure" state officials to include their strongholds in the program (Lemos, et al. 2001).

*Water and Reservoir Management***.** In 1992, as part of Ceará's modernizing government administration, and in response to a long period of drought, the state enacted Law 11.996 that defined its policy for water resources management. This new law created several levels of water management, including watershed Users' Commissions, Watershed Committees and a state level Water Resources Council. The law also defined the watershed as the planning unit of action; spelled out the instruments of allocation of water permits and fees for the use of water resources; and regulated further construction in the context of the watershed (Lemos and Oliveira 2004).

One of the most innovative aspects of water reform in Ceará was the creation of an interdisciplinary group within the state water agency (COGERH) to think about how best implement all aspects of the reform. The inclusion of social and physical scientists within the agency allowed for the combination of ideas and technologies that critically affected the way the network of técnicos and their supporters went about implementing water reform in the state. Right from the start COGERH sought to engage stakeholders, taking advantage of previous political and social organization within the different basins to create new water organizations (Lemos and Oliveira 2005). In the Lower Jaguaribe-Banabuiú river basin, for example, the implementation of participatory councils went further than the suggested framework of River Basin Committees to include the Users Commission[14] to negotiate water allocation among different users directly. Técnicos specifically created the Commission independently of the "official" state structure to emphasize their autonomy vis-à-vis the state (Lemos and Oliveira 2005). This agenda openly challenged a pattern of exclusionary and clientelist water policymaking prevalent in Ceará and was a substantial departure from the topdown, insulated fashion water allocation was negotiated in the past. The ability of these técnicos to implement the most innovative aspects of the Ceará reform can be explained partly by their insertion into policy networks that were instrumental in overcoming the opposition of more conservative sectors of the state apparatus and their supporters in the water user community (Lemos and Oliveira 2004).

The role of knowledge in building adaptive capacity in the system was also important. As I have argued elsewhere:

> On the one hand, knowledge can contribute to more effective management by informing stakeholders about system capacity and fluctuations, potential disruptions to resource availability (e.g. drought or flooding), implications of intra- and inter-basin water transfers, long term availability, and intergeneration implications of different levels of resource use (i.e. climate change impact scenarios). It can also inform stakeholders about the implications of water quality for current use and future sustainability of water resources and support decisions regarding water zoning plans and pricing schemes. Moreover, the ability to transfer knowledge and adopt innovation is an essential factor in building adaptive capacity to climate variability and change (Smit, Burton et al. 2000). In this sense, knowledge can potentially improve effectiveness and

> democratize decision-making since better-informed stakeholders can make better-informed decisions. On the other hand, if controlled by a few actors seeking to bolster their position vis-à-vis other stakeholders, knowledge can insulate decisions and exacerbate power imbalances between those with access to knowledge and those without that access (Lemos 2003). In such cases, knowledge can have critical implications for the "elite capture" of the decision-making processes, which in turn can affect issues of equity and justice in water management. Here, the difference between democratization and insulation rests on the rules of engagement of stakeholders and the practices regarding the availability (Lemos forthcoming).

In the case of water management reform in Ceará, the organization of stakeholder councils and the effort to use technical knowledge to support their decisions may have enhanced the systems adaptive capacity to climate variability as well as improved water resources sustainability (Formiga-Johnsson and Kemper 2005; Engle 2007; Lemos forthcoming). For example, in a recent evaluation of the role of governance institutions in influencing adaptive capacity building in two basins in NE Brazil (Lower Jaguaribe in Ceará and Pirapama in Pernambuco), Engle (2007) found that water reform played a critical role in increasing adaptive capacity across the two basins. Indeed, participation can empower and legitimize the new water reform institutions, expand the array of stakeholders deliberating about water use and sustainability, improve accountability and strengthen the capacity of reform-oriented policy networks to push for further reform (Lemos and Oliveira 2004).

In the context of Ceará's Users Commissions, the advantages in this case are many. First, users are more likely to abide by the decisions at the river basin level (at this point there is not an established enforcement system, so basically, social pressure is the only weapon the técnicos and other users have to enforce how much water is being used) since they have been directly involved in the decision-making process. Second, by making simplified reservoir models available to users, COGERH is not only enhancing knowledge about the river basin but also is crystallizing the idea of collective risk. While individual users may be willing to "free-ride", collective decision-making processes may be much more effective in curbing overuse. Third, information can play a critical role in the democratization of decision-making at the river basin level by training users to make decisions, and by dispelling the widespread distrust that has developed as a result of the traditional patterns of bureaucratic insulation. However, effective participation does not necessarily mean equitable participation. In fact, especially a the local level, there is growing evidence that despite progress in terms of increased participation, many stakeholders still perceive water management as an exclusionary process (Taddei 2005).

These findings are consistent with data collected by a broad survey of Lower Jaguaribe River Basin Committee members carried out in 2004. Although they believe technical information is useful and helpful to their decision-making, they find it is neither widely available nor easily accessible and understandable. They also perceive power within the River Basin Committee as strongly skewed in favor of técnicos over other actors. For example, although 93.1 percent of the members report that technical information makes decision-making easier, only 32.1 percent perceive it as accessible and available to all members. Moreover, members surveyed pointed out that the main

constraint to the democratization of decision-making within the Committee is the disparate level of knowledge between técnicos and general members. This constraint is more important than economic and political power disparities. Indeed, such findings suggest that the persistence of technocratic insulation maybe one of the biggest hurdles to overcome in order to increase effective participation in river basin councils. They also show that despite the best intentions of reform-oriented técnicos, the dominance of technical expertise in water management in Brazil is a difficult pattern to break.

A tale of three policies. This case study examines three policy areas in Ceará, NE Brazil and discusses their role in terms of adaptive capacity building for climate variability and change. In the introduction, I argued that any attempt to build adaptive capacity among poor segments of society vulnerable to climate-related phenomena must include both risk management and deeper structural reform to address the root causes of vulnerability to climate. While risk management attempts to prevent and plan specific adaptations to different climate impacts such as drought and flooding, structural reform encompasses addressing the many deficits (income, education, political power, safety, etc) that define vulnerability. And while risk management has been somewhat easier to come by, structural reform has remained unattainable to most poor countries in the world. However, because these are not discrete processes, action in one tier can affect and be affected by action in another in way that creates a positive synergy between them. Hence, it is important to identify which and how risk management institutions can contribute to not only to build resilience to specific climate-related hazard but also to decrease overall vulnerabilities among groups at risk.. From these three briefly examined case studies, it is possible to identify three factors through which risk management strategies can contribute to build overall system resilience beyond specific climate impacts. First by subscribing to principles of good governance in the design and implementation of risk management mechanisms, policy makers can contribute to build the resilience of decisionmaking systems overall. Thus while, Hora de Plantar topdown insulated policymaking process alienated clients and ultimately sealed the fate of the program as a failure, the creation of local level independent COMDECs to support disaster-relief meant a significant departure from previous clientelistic politics that perpetuated the vicious cycle of the drought industry. Second, policy networks and the reform oriented cadre that constitute them play a critical role in pushing for good governance and more participatory and accountable means of making and implementing policy. Third, knowledge can play a pivotal role in either insulating or democratizing decisionmaking. Whereas in Hora de Plantar, knowledge insulated decisionmaking from clients, in water management it may have contributed to better informed decisions. Yet, even in the context of participatory institutional reform, unequal availability and access to knowledge may skew decisionmaking and benefit some participants over others.

Despite some promising trends, these three examples are but a tiny portion of what is needed to decrease vulnerability to drought in Ceará. They are also limited to assessing adaptive capacity building to governance systems and do not assess general household vulnerability to drought in the state. Overall, Ceará remains one of the most poor and unequal states in Brazil and the hardship of drought still defines poverty, destitution and hopelessness among the poor rural population. Reforming governance is a

necessary but far from sufficient step to build resilience to drought for the most vulnerable.

[1] And while irrigation could be an option to decrease this vulnerability, it might not be the best option since it currently consumes an estimated 60% of the state's already overtaxed water resources (Lemos and Oliveira 2004).
[2] The 97 to 99, resulted in approximately 80 percent loss of crop yields in some parts of the Brazilian Northeast causing considerable social unrest.
[3] These policies ranged from the sublime–such as the distribution of food baskets among poor families affected by drought– to the bizarre as exemplified by the importation of fourteen camels from Northern Africa to work as farm animals in Ceará in the late XVIII century (Villa 2000).
[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 property (Lemos forthcoming).

[5] For an in-depth discussion of these issues see Lemos (2003) and Nelson (2005).
[6] 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.
[7] The project uses an innovative participatory mapping methodology developed by Nelson (2005). For more details, see www.projetomaplan.com.
[8] This program currently serves around 180,000 small farmers and 113 municipios (SDR 2007).
[9] For an official description of these programs, see http://www.seagri.ce.gov.br
[10] This section relies heavily on results from a NOAA funded project focusing on the use of climate information in NE Brazil. For more details see, Lemos et al. 2001..
[11] Evaluation of soil humidity is vitally important to agriculture, particularly in the semi-arid farming regions. In the state of Ceará, about 90 percent of the area is classified as semi-arid. Water deficits occur frequently and constantly threatening subsistence agriculture production. The small farmer depends on rainfed agriculture for his subsistence, and therefore experiences a high vulnerability to dry spells and climate change.
[12] *Hora de Plantar* distributes four kinds of seeds: corn, rice, and two kinds of beans–a fast growing type more suitable to short growing seasons– and a slower growing type with higher productivity and market value. Beans, corn, and rice are the principal crops of small farmers in the Northeast.
[13] Personal communication, 2000.
[14] The Users Commission meets once a year (with smaller meetings happening in between) to negotiate bulk water allocation. A larger pool of stakeholders elects representatives from users, the state, and organized civil society to participate in the negotiated allocation process. Membership is broken down as follows: a) twenty-seven representatives from the municipal government (25%); b) eighteen representatives from the state and federal governments (17%); c) thirty-two representatives from civil society, and d) thirty representatives from the sectors of water users (28%). For a detailed study of these commissions see Taddei 2005.

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