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Differential Vulnerability to Hurricanes in Cuba, Haiti, and the Dominican Republic: The Contribution of Education

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ABSTRACT. The possible impacts of the level of formal education on different aspects of disaster management, prevention, alarm, emergency, or postdisaster activities, were studied in a comparative perspective for three countries with a comparable exposure to hurricane hazards but different capacities for preventing harm. The study focused on the role of formal education in reducing vulnerability operating through a long-term learning process and put particular emphasis on the education of women. The comparative statistical analysis of the three countries was complemented through qualitative studies in Cuba and the Dominican Republic collected in 2010-2011. We also analyzed to what degree targeted efforts to reduce vulnerability were interconnected with other policy domains, including education and science, health, national defense, regional development, and cultural factors. We found that better education in the population had clear short-term effects on reducing vulnerability through awareness about crucial information, faster and more efficient responses to alerts, and better postdisaster recuperation. However, there were also important longer term effects of educational efforts to reduce social vulnerability through the empowerment of women, its effect on the quality of institutions and social networks for mutual assistance creating a general culture of safety and preparedness. Not surprisingly, on all three accounts Cuba clearly did the best; whereas Haiti was worst, and the Dominican Republic took an intermediate position.

Key Words: *adaptive capacities; Caribbean; education; vulnerability*

INTRODUCTION

Owing to their geographic location, Cuba, the Dominican Republic, and Haiti are all equally exposed to the threat of extreme natural events associated with the sea. The numerous hurricanes and floods that have struck these Caribbean islands throughout their history demonstrate the particular vulnerability of small island development states to climate change. According to United Nations Environment Programme (UNEP) Regional, none of the Caribbean islands is ranked as resilient as measured by the Environmental Vulnerability Index, and all of them are highly vulnerable to natural catastrophes (UNEP 2007: Chapter 7). Sea-level rise and the increasing frequency and severity of extreme events threaten livelihoods and limit adaptation options.

However, populations in these countries are not affected in the same way. The desperate situation of the Dominican Republic and Haiti, where repeated hurricanes and related floods have caused, over the years, a steadily high number of casualties, stands in stark contrast to the apparent sustainability success story of Cuba. Although damage to property, industry, agriculture, and infrastructure tends to be large in Cuba as well, lives are seldom lost, and, even in comparison to most other Latin American countries, Cuba stands out with its remarkably robustness to extreme natural events.

Unlike predominant strategies for dealing with disaster risk that focus on emergency response and reconstruction, we looked at the impact of education and preparedness and found

that reducing the occurrence and impact of disasters requires not only investment in response and reconstruction efforts but also changes in the paths of development.

When looking at the deeper reasons for differential disaster vulnerability in the Caribbean, several factors were shown to be at work in Cuba to make it a relative success story. Education and training-enhancing social networks of support and reciprocity were one way of improving local resilience. Cuban policy managed to establish legal frameworks for disaster management from the very beginning of the Socialist Revolution in 1959. However, the real turning point in creating Cuba's "culture of safety" was Hurricane Flora in 1963. The tragedy of 1157 fatalities was taken seriously and was used to invoke the right of communities to protection and access to resources both during and in the wake of disasters. Since that time, the country has been able to protect its populace from catastrophes of a similar magnitude (Ramos Guadalupe 2009:126).

This has been possible because of a clear commitment of the Cuban government to undertake disaster mitigation measures. Challenges to building local resilience remain in contemporary Cuba, especially since it entered its "Special Period" when it could no longer count on help from the Soviet Union. Household economies are weak, and resources for the pursuit of livelihoods after disasters are limited. Nevertheless, the strategies developed by Cubans to cope with environmental stresses stand in complete contrast to the powerlessness of the population in the Dominican Republic,

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as reflected in the respective significant idioms used to describe the prevention cultures in both countries, in Cuba, *sembrando el futuro*, or “sowing the future,” an allusion to the agrarian reform that was the first magnum opus of the Revolution; in the Dominican Republic, *la mala unión*, literally a “poor consolidation,” such as a fracture badly reset or wires badly soldered, an expression of hope in Cuba and an expression of disjuncture, mistrust, and despair in the Dominican Republic (Whiteford and Manderson 2000).

These differentiated ways of defining a relationship between a responsible government and its population are a qualitative expression of human vulnerability in the Dominican Republic and Haiti. Even small hazards can turn into large social disasters where high vulnerability means that many people are at risk because state institutions and cooperation communities are insufficiently prepared, emergency response is inadequate, and the critical infrastructure is fragile. In countries like the Dominican Republic or Haiti, the collapse of civil order resulting from natural catastrophes is a particular threat to girls and women who are exposed to multiple forms of violence in a space of lawlessness (Duramy 2011).

Compared to their Caribbean neighbors, Cubans are far better prepared for emergencies. Not only do they benefit from better infrastructure and housing, as well as a highly effective risk-communication system, but more importantly, Cuba is populated by the most educated population in the developing world that is trained for dealing with catastrophes. According to the 2005 *World Disasters Report*, education predisposes popular understanding and action, making it a “vital link” in the early warning chain that makes the difference between life and death in the face of some of the planet’s most ferocious storms (CRED and IFRC 2005).

The aim of this comparative study was to focus on adaptive capacities to climate change by shedding some light on the factors influencing adaptive human behavior, particularly formal education, institutional resources, community involvement, and well-implemented health services accessible to the population.

METHODOLOGY

Our study built upon work by (Striessnig et al. 2013) who studied the link between education and disaster vulnerability across a range of 125 countries. In a first stage, therefore, we used macrodata to sketch the quantitative evidence on the number of casualties from climate-related extreme natural events by plotting the data against the educational attainment levels of the three island states of interest. This comparison of the available empirical data highlighted the profound impact of education on differential social vulnerability, gender equality, and sustainability.

To support those macrolevel findings with microlevel evidence, in a second step, we attempted to evaluate the impact

of formal education on adaptive capacities within specific social contexts. For this, extensive fieldwork was conducted both within Cuba and the Dominican Republic (Pichler 2011). Because we did not conduct similar field work in Haiti, in our qualitative analysis we did not judge Haiti based on the same evidence as Cuba and the Dominican Republic but relied more strongly on secondary sources. Our qualitative analysis of a total of 51 interviews, 32 in Cuba and 19 in the Dominican Republic, was based on a questionnaire centered on formal education. The preliminary study was conducted in December 2010 and January 2011 in Cuba and was subsequently extended to the Dominican Republic in March 2011. Feedback from both Cuban and Dominican interview partners informed the structure of the survey. Local experts reviewed the modified survey and approved its research design.

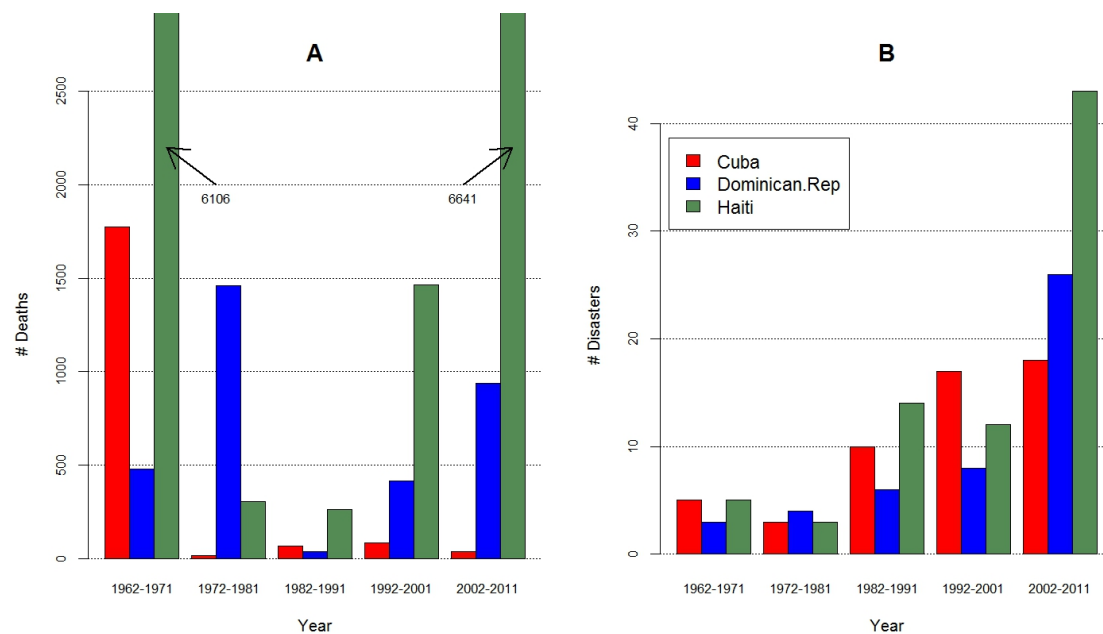
In the Dominican Republic, the research was conducted in two widely separated regions, the towns of Miches and Barahona, both located in geographically vulnerable zones, near the coastline and at the mouths of rivers, both rated as high-risk localities in the national vulnerability maps. Parts of both Barahona and Miches have been hit by hurricanes in recent years and, in the case of Barahona, by flooding. Some of the interviews took place in settlements that had been rebuilt only 2 years earlier.

In Cuba, the research was conducted in greater Havana and Pinar del Río, which had been affected by Hurricanes Gustav and Ida in 2008. Interviews were held at the interviewees’ houses. Especially in the Dominican Republic, it was impossible to conduct a public interview without a group forming and everyone expressing common views about their increased vulnerability following the flooding of the village. The people interviewed invariably confirmed that they were in the habit of talking about these events, a constant subject of conversation among themselves. Further interviews were carried out with several experts within Cuban and Dominican civil defense organizations.

The questionnaire was grouped according to what are commonly defined as the four different stages of response to disaster: (1) the initial emergency; (2) the alert, 72 hours before the event; (3) the alarm, 48 hours before the event; and (4) the recovery phase (Thompson 2007, IFRC 2010b, Puig González et al. 2010). In addition to that, based on the primary research question, concerning the quality of formal education as a tacit aspect of the social and human capital employed in coping strategies, the questionnaire was divided into questions on (1) institutional resources, (2) information, (3) community involvement, and (4) knowledge. For a more detailed description, refer to the Appendix.

A main goal of these detailed interviews was to look deeper into what drives the behavioral patterns of people who have experienced recent hurricanes and floods. The questionnaire

Fig. 1. Total number of deaths from climatic natural disaster (A) and the number of natural disasters (B) for Cuba, the Dominican Republic, and Haiti between 1962 and 2011, from CRED (2004).



asked about the resources that those affected have at their disposal, their behavior in emergency situations, and their strategies to overcome the difficulties these occasioned and to reorganize their lives during and after such events. The central objective in the development of this questionnaire was to arrive at a methodology to conceptualize the impact of education on the process of disaster adaptation.

Although the small sample size of only 51 interviews does not provide a sufficiently comprehensive empirical basis to trace how education impacts disaster preparedness and mitigation and to define the full role of education in the improvement of adaptive capacities with regard to climate change, it nevertheless suffices to further stress the need for expanded studies of the important role of education as a key indicator for adaptive capacity building and disaster management (Striessnig et al. 2013).

DIFFERENTIAL SOCIAL VULNERABILITY IN THE CARIBBEAN

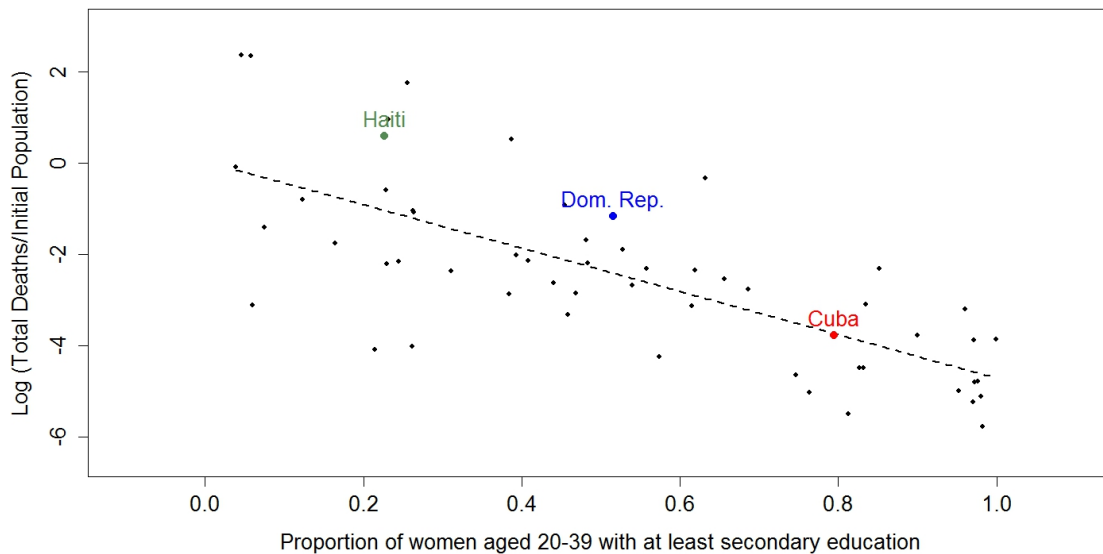
The dissolution of the Council for Mutual Economic Assistance, which ended the Soviet Union's economic support to Cuba, marked the beginning of Cuba's "Special Period," or *período especial*, bringing chronic poverty and economic hardship (Coyula and Hamberg 2003, Espina Prieto 2008). However, despite the pervasive limitations imposed by the economic crisis, the disaster prevention system, first implemented half a century ago by the civil defense, continues to function as successfully as it ever did.

As shown in Figure 1, the continuing vulnerability of the island, its infrastructure and production facilities, is undeniable. Recently, Hurricanes Gustav and Ike, for example, which struck the Pinar del Río area on 28 August and 1 September 2008, caused substantial damage to the built environment, electrical and communications systems, and important export crops such as sugar and citrus. However, compared to its Latin American neighbors, Cuba has shown itself to be remarkably robust in response to hurricanes, and its coping strategies are incomparably more effective than those of any of its Caribbean neighbors.

In 2001, in total, nearly 6 million people were affected by natural disasters in the Caribbean. Hurricane Michelle, which hit the Cuban Matanzas area on 4 November 2001, caused tremendous material damage (Ritter 2002) but cost only 5 lives, 4 of which were lost in a building collapse. The same can be said about the consequences of Hurricane Jeanne, which in 2004 claimed more than 2700 victims in Haiti; whereas in the Dominican Republic fewer than 20 persons lost their lives, and there were no deaths in Cuba (Cuba Hurricanes, <http://www.cubahurricanes.org>).

Even though Cuba suffers from a similar, and sometimes even larger, number of hurricanes than other states in the region, and damage to property, industry, agriculture, and infrastructure tends to be great, hurricanes do not claim many lives in Cuba. This has not always been the case. As Figure 1 also shows, Cuba was anything but well prepared in 1963 for

Fig. 2. Relationship between the log of deaths from climatic natural disasters including floods, droughts, and storms per 1000 of the 1980 population (CRED 2004) and female education, proportional to secondary and higher education among women aged 20-39 (Lutz et al. 2007), for 56 countries with one or more disasters on average per year.



Hurricane Flora, which killed 1157 people on that island alone. In those days, the educational system still suffered from a colonial heritage characterized by entirely class-based access to education. Higher education was reserved for the offspring of high-earning parents, a privileged minority. In 1953, only 56% of Cuba's children completed grade school, and 28% completed high school (from ninth grade up); roughly 23% of the overall population was completely illiterate, and among the rural population the percentage reached 41.7%, both groups including significantly more women than men (Hickling-Hudson et al. 2006).

Compared with today, those figures are dramatic, as are those of Cuba's Caribbean neighbors. What has happened in the meantime? First and foremost, Cuba underwent an unprecedented country-wide educational campaign with full community participation even in the remotest areas of the country. Within a very short period of time, the country was able to advance its status from "basic literacy" to "postliteracy" to "literacy equivalent to primary and secondary schooling" (Carnoy and Samoff 1990:176-178). Up through the 1980s, the Cuban education system, together with its health system, was celebrated both at home and abroad. In total, literacy rates increased from 76% to 96% (UNESCO 2005). Today, literacy among 15- to 24-year-olds in Cuba is 100%, and Cuba is one of only a few Latin American countries expected to fulfill the

Millennium Development Goals with regard to education by 2015. Evaluations of Cuba's educational system differ, depending on ideological approaches, but none of its critics would deny its intrinsic quality or its impact on Cuban society as a whole.

Figure 2 indicates the education revolution that has set Cuba apart from its Caribbean neighbors in developmental terms and puts it into the context of reduced disaster vulnerability. As can be seen in this cross-country comparison, for the 1970-2011 period there is a high correlation between the educational attainment levels of women and the death count from natural disasters. Compared internationally, Haiti and the Dominican Republic suffer from an even higher number of casualties than could be expected at their respective levels of educational attainment.

The role of girls and women in building resilience and reducing disaster vulnerability is apparent and has recently been accredited by the International Federation of Red Cross and Red Crescent Societies (IFRC 2010a), as well as in the theme of the 2012 International Day for Disaster Reduction: "Women and Girls – the [in]Visible Force of Resilience." Nevertheless, women also belong to the most vulnerable groups in disaster situations, particularly so in countries where the lack of female education leads to lower social status and their disempowerment. Neumayer and Plümper (2007) found that

the higher women's status, the smaller is the differential negative effect of natural disasters on female relative to male life expectancy. Where men and women do have equal access to education and women participate fully in the various groups and organizations that respond to catastrophes, their death rates do not differ significantly.

A CONSOLIDATION OF QUALITATIVE INTERVIEWS AND FINDINGS FROM THE QUESTIONNAIRE

Education as key for prevention: preparedness

Measured by the approach established in disaster studies to categorize and understand the various stages of intervention, including preparedness, response, reconstruction, recovery, and mitigation (Tierney et al. 2001), the Cuban state has a relatively good record when it comes to preparedness and response, but a very poor one when it comes to reconstruction and recovery. In Cuba, the subject of response to natural disasters has clearly been assimilated by the entire population, including schoolchildren, as was confirmed from several informal interactions and encounters on the street. Children, or cleaning personnel in Cuban hotels, will readily converse about any of this. In a conversation in Santa Rosa, located to the east of Havana, a 12-year-old boy (Carlito) recalled Hurricane Wilma in 2005 as follows:

Carlito: I hope that I never have to go through anything like it again. But now I feel prepared, and if it happens again, I'll know exactly what to do. Hopefully not, but nature is nature. I lost many things, I don't want to talk about that. My Atari, and really a lot.

Interviewer: What do you have to do when a hurricane strikes?

Carlito: As soon as the first information appears on the news, we discuss what has to be done. Who should go to live in whose house? Which things are really necessary to pack together? Then we seal the doors and windows with tape. That's the first thing to do.

Carlito: I know in advance in which house my grandmother will be relocated, and in which one I myself will go. (Interview, 28 December 2011)

This boy, just like all of his Cuban peers who were interviewed, was very well informed and clearly knew what to do in case of an emergency.

All Cuban children when asked whether these topics were taught at school replied with a clear "yes." A 45-year-old female teacher from Havana explained that children were provided with detailed information on the subject at school: "They create groups of child 'guards' of the fifth grade (9 years

old) to impart instruction along with adults. In the training of 'guards' by the CDRs [Committees for the Defense of the Revolution, or *Comités para la Defensa de la Revolución*], which is realized in every neighborhood so children can learn what they are doing, monthly 'interest circles' are organized." At school, children also get information leaflets that provide them with information relevant to emergencies.

The same level of preparedness was not observed in the Dominican Republic, where in general the level of information on any related topic and especially on disaster response seemed to be poor. The interviews strongly confirmed earlier findings from the *World Disasters Report* (CRED and IFRC 2005) that throughout the rest of the Caribbean, lack of education and literacy prevents people from even understanding warnings. In a conversation with children on the streets of Barahona, they sometimes even had difficulty understanding the interviewer's questions. Asked about when one learns how to behave when a cyclone hits, more than half reported that they were not being taught anything like this at school. It is much more customary, they said, that family members teach children what protective measures to take. Eric, a 42-year-old teacher in Miches confirmed: "Up to now this subject has not been integrated into school curricula. We are lacking both informational material and personnel trained to communicate knowledge on the subject. It's high time for the government to take the problem seriously."

Institutional resources and community involvement

Although formal education in Cuba lays the foundation and the school system provides basic knowledge about what to do before, during, and in response to disaster situations, "preparedness" is also a medium-term planning activity that involves developing and testing disaster management plans, implementing early warning systems, coordinating agencies, and ensuring that evacuation plans work. In doing so, state and nongovernmental institutions have to pay particular attention to groups especially at risk, such as women, pregnant women, or the elderly.

Cuba has an effective risk-management and risk-communication system, with neighborhood-based organizations capable of developing preparedness, mobilizing labor, and guaranteeing cooperation, both among citizens and between the population and the authorities. Chapter 2 of the *World Disasters Report* (CRED and IFRC 2005), which covers hurricane warning systems in the Caribbean, comes to the conclusion that local organization and awareness working from "below" are just as important as timely, accurate hi-tech warnings from "above." In accordance with these findings, the capacities of the Cuban system include self-help and social protection at the neighborhood level, as well as the training of neighborhood activists ("below"), as much as scientific capabilities, such as Havana's Weather Institute and public health services ("above"). In addition to that, Cuban public

media provide an institutionalized historical memory of past disasters (Wisner 2001, Thompson and Gaviria 2004, Thompson 2007).

The CDRs are one of the two major national “mass organizations” with a community presence and responsibility for vulnerability mapping in the neighborhoods. They work together with the Federation of Cuban Women, or *Federación de Mujeres Cubanas*. The CDRs are all-purpose block associations that maintain block watches, run blood drives, and engage in cleanup, infrastructure, and neighborhood embellishment activities, when resources are available.

The most important thing is the mutual help among those who live in the neighborhood. The primary goal is to save human lives, only then they take measures to protect material [belongings]. They are setting up a system of vigilantes, a social control in the quarter; they are the CDRistas. (Conversation with Ariel, Matanzas, Varadero, 12 November 2010)

Because mass evacuation is Cuba’s first line of defense, in the event of an emergency all available means of transport are mobilized by the local Civil Defense as needed and placed at the disposition of the evacuation. Cooperation is obligatory. The abandoned houses are sealed tight, and material possessions are transported to a safe place, where they remain under lock and key. The military patrols the flooded zones, and there have been no known incidents of looting. Cuban community shelters are set up in schools or community buildings at the beginning of the alarm stage. They receive stocks of water, medicines, and supplies and are generally reported by affected victims to be “safe places.”

In the Dominican Republic, the results of the study indicate a complete lack of such institutionalized long-term prevention plans and both ignorance and indifference at the state level. The data gathered from informants confirmed an inadequate administrative and legislative framework for risk management and response to disasters, i.e., no regulations concerning overflowing rivers. Although 25 out of the 32 people interviewed in Cuba confirmed that they were willing to cooperate with state organizations in an evacuation procedure, the majority of Dominicans when asked stated that they would refuse collaboration with the authorities if evacuation was ordered and be exposed to even greater risk.

As a result of the absence of institutionally provided safety procedures, the major lesson learned from earlier flooding for Dominicans is to not leave their homes because organized gangs will loot them. A woman who, in the most recent flood, entrenched herself in the roof truss of her house described the situation as follows: “I always stay there. It doesn’t matter how high the water rises. Anyone has to stand watch, otherwise everything will be gone. Gangs will arrive, and take from wherever they can.”

The collapse of civil order is a particular threat for the safety and health of women. Daria, a woman interviewed in the Dominican Republic, said that she does not allow herself to be evacuated because she would not feel safe in shelters used for the evacuation, where dormitories and toilet facilities are not separated by gender. The reports from Haiti on sexual violence and rape following the earthquake of 2010 are dramatic (Duramy 2011, Kang 2011), and more specifically, the number of rapes in shelters under exclusively Haitian authority was significantly higher than in those run by international nongovernmental organizations (NGOs). Amnesty International and other NGOs reported that many women were forced to exchange sex for water, food, and safety, i.e. they had to prostitute themselves in order to survive (Amnesty International 2011).

In addition to that, women suffer from the deteriorated sanitary conditions. The World Health Organization (WHO 2002) names many factors that disproportionately affect women when catastrophes strike. Oversalty and polluted water has a particularly negative effect on female hygiene and puts pregnant women at risk. Although all women interviewed in the Dominican Republic said that after floods they suffered from diarrhea, fever, and other diseases caused by lack of hygiene and that some children became ill with dengue and cholera, such diseases are either exceedingly rare or simply do not exist in Cuba. Preventive medicine, including obligatory fumigation in every household, and vaccination campaigns control or eliminate them on a permanent basis (Thompson 2007).

Although efforts to respond to disasters also take place in the Dominican Republic, this does not happen as a centralized effort by government authorities, but instead in individual regions. In large part, international NGOs take the lead in designing, disseminating, and directing programs for disaster mitigation. Respondents claimed that the central government had little to offer for the survivors of catastrophes and that, in many cases, the first response mobilization was led by locally built civil society groups supported by NGOs. One of the groups was organized by Augusto, the head of the civil defense in Barahona, whom we interviewed.

Some interviewees stated that over the past 10 years, state-provided measures had improved; however, in many cases, they still do not address the risk itself or the underlying processes that generate it. Some university sectors are now beginning to factor risk considerations into their curricula. However, there remains a lack of social perspective in risk management that explicitly focuses on the links between gender, poverty, and vulnerability and the risks faced by highly vulnerable social groups.

The local civil defense groups, which consist entirely of volunteers, have too few means placed at their disposal by the authorities, who, in general, assume little responsibility for the

dramatic shortfalls during disaster relief operations. The first active efforts toward the formation of regional groups for protection from catastrophes were taken only in 2002. On both national and regional levels, the agenda for handling emergencies and disasters “are still in a preparatory stage, and the authorities are not attending in any thorough or precise way to these functions” (interview with Augusto Moreta Peña, director of the civil defense group in Barahona, 26 March 2011).

The important cultural factor of trust: education, training, and past successes guarantee preparation, participation, and cooperation

As a consequence, the important factor of trust, which is crucial in providing effective help during disaster situations (Whiteford and Manderson 2000), is very weak in the Dominican Republic, and so is the willingness of people to cooperate with aid institutions. Trust influences the adoption (or failure) of educative prevention programs on the community level (Ostrom 1990) and is mainly a consequence of past positive learning experiences with these institutions during episodes of environmental stress. Answers to the questionnaire revealed that these institutions were generally valued for enabling coordinated behavior and what individuals viewed as effective practice based on a transparent repository of knowledge. Education comes into play as relationships of trust are established in long-term learning settings, in schools, training camps, and neighborhood participation over generations.

The Cuban disaster policy took highly visible and transparent measures at all stages of its intervention, beginning with prevention (the warnings of its Weather Institute), and the advance preparation of care in the public health sector. The government that marshals whatever material and discursive power it has at its disposal is rewarded with even higher levels of popular response to emergencies and postdisaster legitimacy. Therefore, the social constructions of trust between government and local communities, established over long periods of experience in both countries and repeatedly evaluated in terms of human behavior and decision making, vary widely.

Asked about whether they believe that state agencies were adequately prepared for natural catastrophes, 75% of the people interviewed in the Dominican Republic replied in the negative. An equally high proportion asserted that they did not believe that the state lived up to its responsibilities. In Cuba, the picture was inverted: 27 out of 32 informants stated that the government was well prepared for natural catastrophes. Asked about trust in actions taken by the civil defense, in Cuba 30 of 32 informants replied positively, whereas in the Dominican Republic all 19 persons asked asserted that neither preventive measures nor the early warning system functioned.

Although Cubans described themselves as individually well prepared and believed that their government was too, Dominicans considered themselves completely unprepared (14 out of 19), and only 5 believed that the government was prepared. This high correlation between answers to the two questions led to the hypothesis that individually perceived safety is closely linked to perceived government preparedness. If the government is not prepared, neither is the individual. If government responsibility fails, or simply is not present, then there is no trust in one’s own competence either, with corresponding apathy, ignorance, and a sense of impotence on the part of individuals in the face of their plight.

In Cuba, where the government assumes responsibility for prevention programs that have proved to be effective, citizens have the corresponding confidence that they too will act in a secure and competent way as participants. If, however, educational campaigns and information programs fail to reach the persons in need, citizens do not have the capability to confront the stresses of extreme weather events.

DISCUSSION AND CONCLUDING REMARKS

Disasters serve as a lens for revealing failings in underlying development processes. Clearly, the two case studies presented very different and contrasting contexts within which hazards are managed. However, there are shared lessons from both studies that offer insights on the role of formal education for adaptive capacity building and disaster risk reduction.

In the Dominican case study, we found only weak state-supported measures. Civil defense activities were carried out by local groups of volunteers, which remained for the most part dependent on international NGOs and other private funds, while the state seemed in denial.

Cuba, on the other hand, has made significant efforts to improve its educational system, producing a high number of qualified teachers and professionals and building schools and universities, resulting in nearly universal literacy. At the same time, the health sector was expanded, and public health professionals recognized that changing health outcomes from “very bad” to “better” could be accomplished through the provision of potable water, sanitation, access to basic medical care, and effective immunization campaigns.

All of these efforts to strengthen the human resource base have also impacted the population’s capacity to cope with natural disasters. Both disaster mortality and morbidity have been significantly reduced in Cuba compared to its Caribbean neighbors. The case study showed that radical and significant changes in health and education outcomes are important preventative measures that can have major impacts on the extent to which natural disasters affect human populations.

Thus, we can conclude that the political and social reform processes started in Cuba in the 1960s can be identified with

effective civil defense measures up to the present day. These include popular mobilization and information campaigns legitimized by discursive/ideological, organizational/social capital, and material/financial support. The Cuban experience demonstrates that risk management systems should give maximal support to training and education programs that create a relationship of trust between the state and its citizens. Sufficient governance for risk reduction begins with political will and results in a bottom-up “culture of responsibility,” empowering even its most vulnerable social groups to cope with natural disasters.

Without being a prosperous country, Cuba has found purposeful interventions to cope with natural disasters. Looking into the future, its society seems astoundingly resilient with respect to the expected climate change and should be considered a blueprint for the entire region.

Responses to this article can be read online at:

<http://www.ecologyandsociety.org/issues/responses.php/5774>

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Appendix 1.

Categories chosen for the questionnaire:

Based on the primary research question, concerning the quality of formal education as a tacit aspect of the social and human capital employed in coping strategies, the following categories were chosen for the questionnaire to highlight the impact of education on the process of response (emergency, alert, alarm, and recovery):

- Information on the aid systems available in the neighborhood, whether originating outside, or in self-help, or in the help of neighbors
- Trust in official aid systems (i.e., trust between the authorities and the population)
- Preparation, and the timely distribution of provisions and reserves
- Training, on a neighborhood basis
- The transparency with which aid groups close to the Government work and act
- The advancement and conveyance of scientific knowledge on the subject (i.e. mapping of geographic vulnerability or the research of the meteorological institute)
- The possibilities for prediction and warning
- Public health services

Accordingly, the questionnaire was divided into the following types of questions:

- 1 Questions on INFORMATION: including advance information, early warning- systems, mass media, communications systems, etc.
- 2 Questions on INSTITUTIONAL RESOURCES and support to cope with disaster situations, including lifeline structures, evacuation, shelters
- 3 Questions on COMMUNITY INVOLVEMENT on the neighborhood level: cooperation with aid systems, with neighbors, with families
- 4 Questions on KNOWLEDGE: this category is divided into
 - 4.1 questions of personal preparedness, personal participation in aid systems
 - 4.2 questions on implicit or tacit resources, cognitive social capital such as trust, responsibility, and solidarity on individual and collective levels