COMMUNITY-BASED ENVIRONMENTAL MANAGEMENT:

A TOOL FOR NATURAL DISASTER RISK REDUCTION IN HAITI?

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DECEMBER 2006

DATE:

APPROVED BY: _____

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Masters Project submitted in partial fulfillment of requirements for the:
Master of Public Policy (MPP) – Master of Environmental Management (MEM) Joint Degree
Nicholas School of the Environment and Earth Sciences
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ABSTRACT

This report provides an in-depth analysis of how Haiti can successfully apply community-based environmental management as a tool for reducing its risks to natural disasters. The approach to answer this policy challenge is three-pronged. First, this report analyzes Haiti's disaster risk profile and establishes the various linkages between environmental degradation and natural disasters. Second, the report utilizes community-based environmental management literature and worldwide 'Best Practice Examples' of local disaster risk reduction initiatives to create a framework for risk-reducing community-based environmental management. Third, the report evaluates the soundness of this new framework by applying it to one Haitian community – Fondwa. On a more global scale, this study contributes valuable information on how communities can adapt and implement community-based environmental management practices in order to reduce their vulnerabilities to disaster impacts while simultaneously tackling environmental degradation.

ACKNOWLEDGEMENTS

I would like to thank my advisor Dr. David Hinton for all his support, guidance, and fruitful feedback throughout this project. Many thanks also to Dr. Dean Urban for all his patience and commitment to see all of us go through the Master's Project process in a timely manner.

I would like to thank my family and friends – here and across the world – for their loving support and continuous encouragement during my wonderful time here at Duke University.

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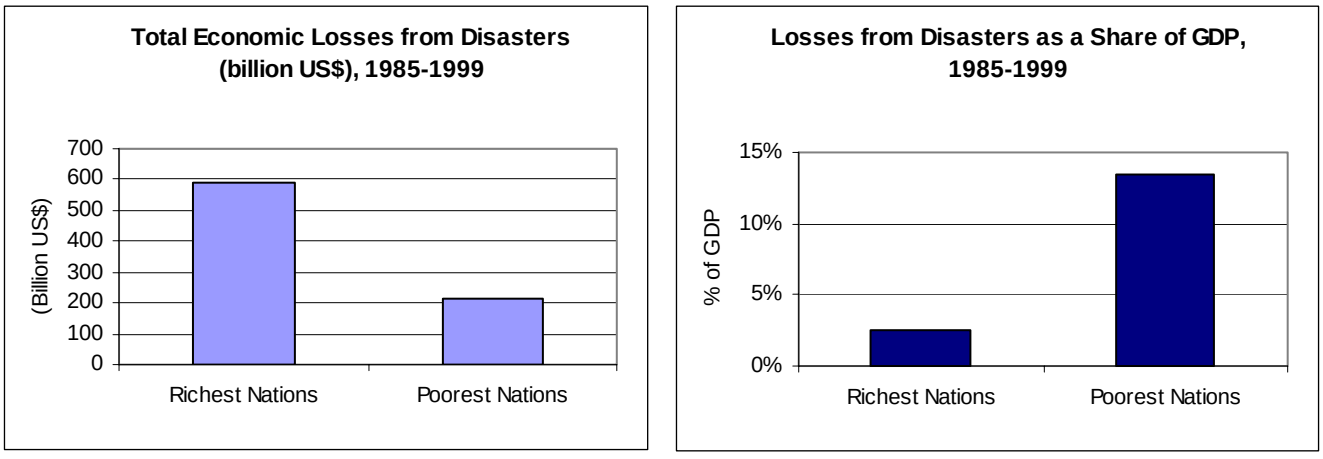
INTRODUCTION

Natural Disaster Risk Reduction - Emerging Global Challenge: In recent years, the importance of disaster risk reduction has increased on the international agenda. Not only have the cumulative impacts of disasters on development begun to capture the world's attention, but also an increasing awareness of the contribution of development approaches to rising risk levels from disaster occurrence. Hazards, including floods, drought, storms, volcanic eruptions, cyclones, landslides, earthquakes and tsunamis are having an increasing impact on humans. The international community's and national governments' approach to development can no longer be business as usual.

Annual economic loss associated with disasters is on the rise: US$ 75.5 billion in the 1960s, US$ 138.4 billion in the 1970s, US$ 213.9 billion in the 1980s and US$ 659.9 billion in the 1990s (UNDP-DRU 2004); (Herrmann, Ronneberg et al. 2004). In terms of percent of GDP, the losses of developing countries far exceed those in developed countries with disasters reducing the economic output of the poorest nations by around 3% and, depriving them of resources needed to escape poverty (see Figure 1) (Herrmann, Ronneberg et al. 2004). These resources not only refer to economic means, but they also comprise a functioning social network and a healthy environment that are able to recover from shocks. Given this scenario, it is important for countries to factor natural hazard and human vulnerability considerations into their development policies, strategies and plans (Blaikie and et.al. 1994); (Pelling and Uitto 2001); (Ruiz and Peduzzi 2005).

Figure 1: Disaster Losses Total and as a Share of GDP, in the Richest and Poorest Nations, 1985-1999



[Source: Created by Lisa Eichler with data from (Herrmann, Ronneberg et al. 2004)]

Most policymakers and academics now acknowledge that poor planning, poverty and environmental degradation create conditions of hazard exposure and vulnerability that convert otherwise

manageable natural hazards into recurrent disasters. The resulting losses compromise the achievement of the Millennium Development Goals (MDGs), including the overarching target of halving extreme poverty by 2015 (DFID 2005); (ISDR 2005). While humanitarian action to rapidly respond to the impact of disasters will always be vitally important, the global community is facing a critical challenge: *How to better anticipate — and then manage and reduce — disaster risk by integrating the potential threat into its planning and policies?* The key to achieving a sustainable reduction in disaster occurrence and consequent loss lies in factoring risk management considerations into all types of development interventions - including environmental, urbanization, health, and educational projects - on a permanent basis.

My Project: UNDP will explore several country case studies in order to gain a global overview from which to develop effective policies and guidelines for mainstreaming *disaster risk reduction* into development. Here is where my contribution comes in: My country case study on Haiti – comprised of my two master's projects[1] – contributes to UNDP's efforts to gain a global overview of how to mainstream disaster risk reduction into development under various exogenous conditions (Haiti provides an example for small island developing states, conflict-stricken countries, as well as those possessing multiple hazard areas).

This report provides an in-depth analysis of how Haiti can successfully apply community-based environmental management approaches to reduce its disaster risk. My approach to answer this policy challenge is three-pronged: First, I provide an analysis of Haiti's disaster risk profile and the various inter-linkages between environmental degradation and disasters; Next, I review best practice environmental management efforts that have successfully reduced people's vulnerability to disasters in other countries. These practices in combination with general community-based environmental management literature build the basis of a new framework I propose for risk-reducing community-based environmental management. Lastly, I demonstrate the application of this new framework for one Haitian case study community – Fondwa. This specific case study allows me to describe and recommend how communities in Haiti can adapt and implement this framework in order to reduce their disaster risks while simultaneously tackling their environmental degradation.

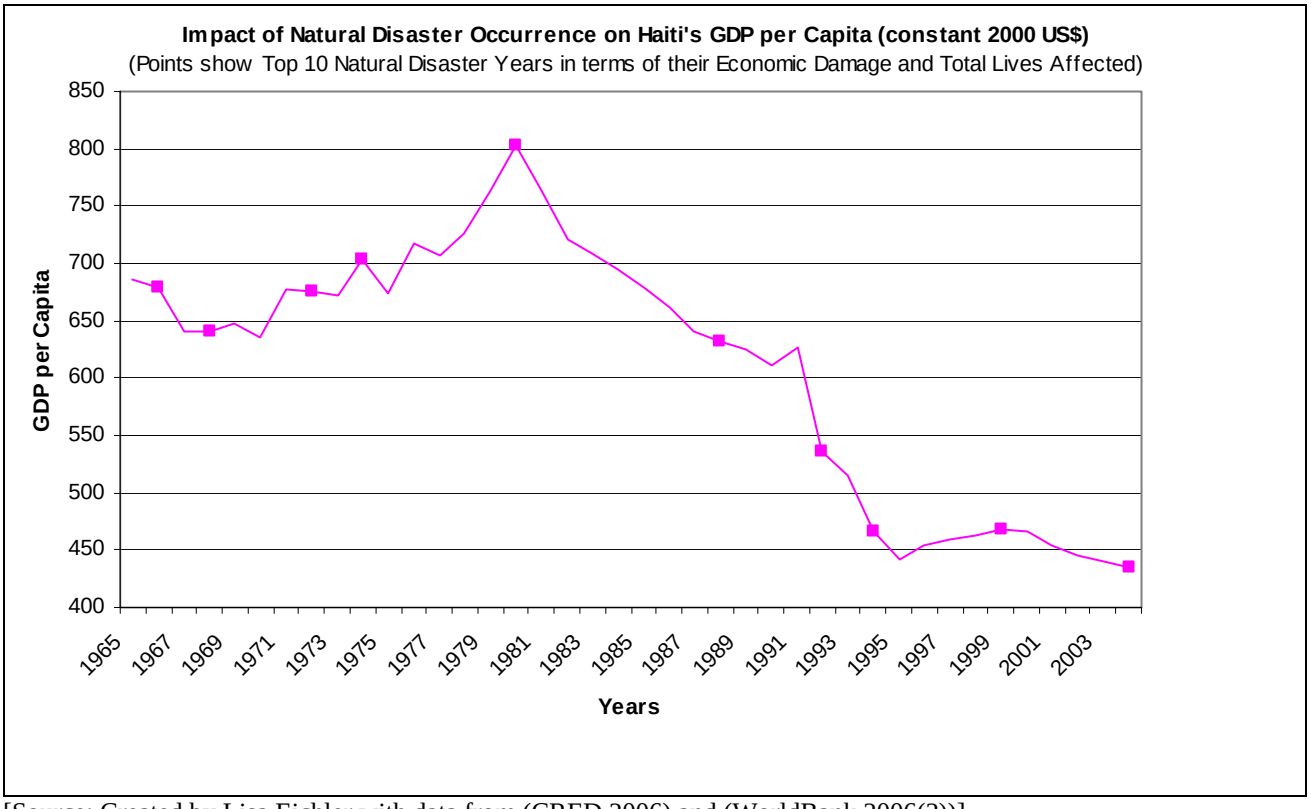
[1] See Appendix 1 for an overview on both master's project topics.

THE PROBLEM – HAITI'S DISASTER RISK PROFILE

Do disasters impede development in Haiti? The country's lack of disaster preparedness results in development set-backs – measured in GDP per Capita as a crude indicator of development - with each successive large-scale disaster (see Figure 2). On the contrary, in the Dominican Republic (DR), Haiti's neighbor, natural hazards do not cause significant set-backs in the country's development process (see Figure 3). Even though the DR faces pretty much the same natural hazard events as Haiti, its losses from disasters are considerably lower. This may largely be due to the fact that DR's natural environment is not degraded and thus can act as a buffer against the impacts of natural hazards. In contrast to Haiti, DR has sound environmental policies, a well-functioning disaster preparedness policy, and a population that is aware of the importance of ecosystem health. Thus, it becomes clear how sound environmental and disaster policies and management systems can provide the key to reducing the negative impacts of natural disasters.

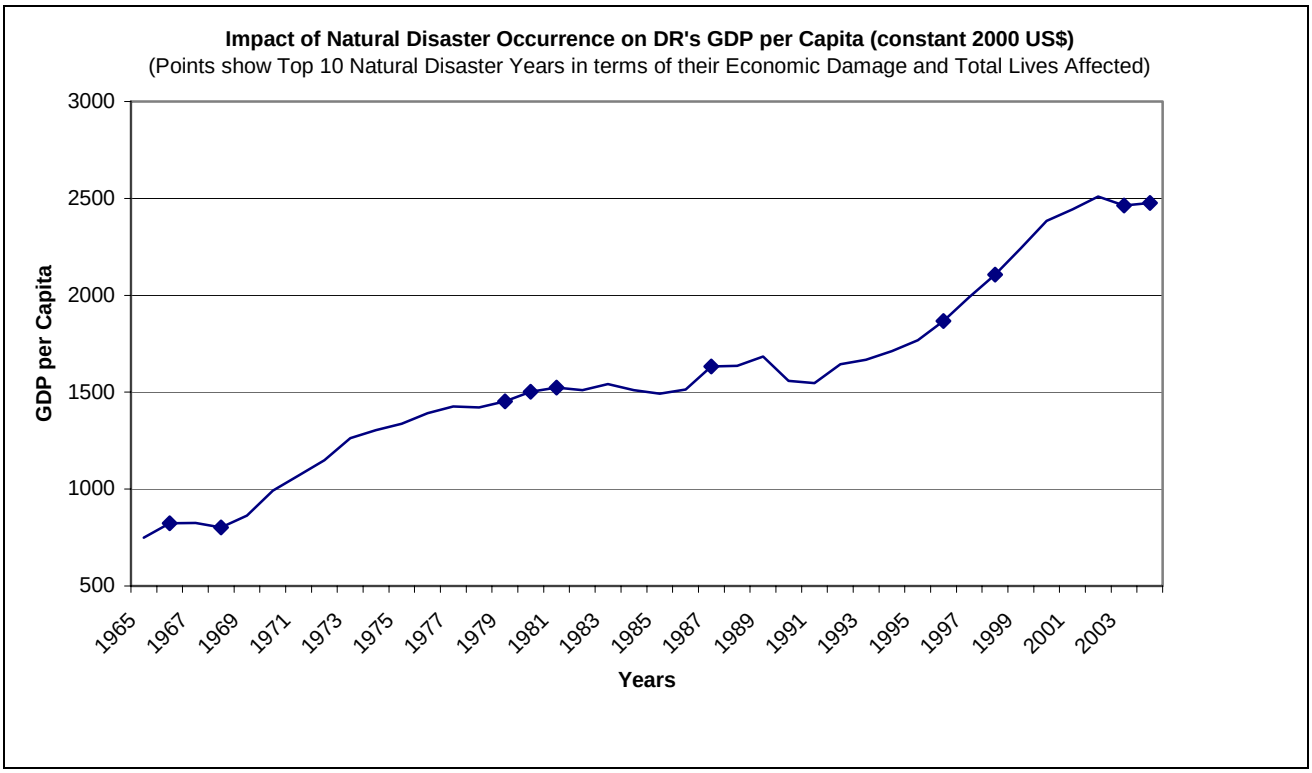
Most of the expert literature supports this development – disaster reduction linkage: research "indicates that over the past three decades more disaster-prone, low-income countries that are based on simple economies, have experienced a much slower pace of economic development than their less disaster-prone counterparts (UNDP 2001)."

Figure 2: Haiti – Natural Disaster and Development Linkages



[Source: Created by Lisa Eichler with data from (CRED 2006) and (WorldBank 2006(2))]

Figure 3: Dominican Republic – Natural Disasters and Development Linkages



[Source: Created by Lisa Eichler with data from (CRED 2006) and (WorldBank 2006(2))]

The correlation between natural hazard occurrence and GDP per Capita in Haiti is statistically significant at the 5% level (results based on two-tailed, paired TTEST)[2]. Due to the buffering capacity of its natural environment and sound disaster preparedness practices, the occurrence of natural hazards in the Dominican Republic is not significantly correlated with impacts on the country's GDP.[3] These figures should be seen as a crude measure of correlation between natural hazard occurrence and their impact on overall development progress: other factors clearly influence GDP growth as well and these calculations rely on data reported by the two countries, which could be inaccurate to some extent.

Why does Haiti face particularly high risk to disasters? Haiti faces the highest relative risk to disasters in the world (UNDP 2005). Two factors create this risk: human vulnerability and natural hazard occurrence.

[2] Data analyzed can be obtained from (CRED 2006).

[3] The statistical analysis for both countries included all natural hazards that occurred between 1965 and 2004 (n=39). During that time period, Haiti reported 26 large-scale natural hazards, the DR reported 23. T-Tests were conducted based on the occurrence of natural hazards in the given time period, but only the 10 biggest disasters are depicted in the graphs for illustration purposes. The independent variable is natural hazard occurrence (as a categorical variable, where 1= yes, 0 = no); the dependent variable is GDP per Capita (in constant 2000 US$). The dependent variable has been lagged by one year because impacts from a natural hazard will not be reflected in GDP until the next year.

Key natural hazards in the Caribbean are meteorological hazards, including tropical cyclones, floods, droughts and landslides. Natural hazard occurrence rates are high: 55 large-scale natural disasters affected Haiti between 1965 and 2004: an average frequency of 1.4 disasters per year (CRED 2006)!

Vulnerability is determined in part by the conditions people live in prior to a natural hazard event: vulnerability is a product of access to economic, political, social, environmental and geographic assets. Vulnerability levels also depend on "the human capacity to prepare for or mitigate and recover from (cope with) any negative impacts of disaster" (Pelling and Uitto 2001); Thus, risk is a function of human vulnerability and physical exposure to a natural hazard. There is no risk of disaster if vulnerability is zero but there is a natural hazard event (see Figure 4).

Figure 4: Risk Equation

Risk = Hazard Frequency * Vulnerability

[Source: Adapted from (IADB 2006)]

What factors contribute to Haiti's high natural hazard frequency? Geographic conditions make the island particularly prone to recurring natural hazards. As a small island[4] bordering the Caribbean Sea and the Atlantic Ocean it lies within the hurricane belt (UNDP 2001). Its horseshoe shape gives Haiti a disproportionately long coastline increasing the country's vulnerability to flooding. Haiti is situated on the mountainous half of the island of Hispaniola with slopes exceeding 20% grade covering nearly two-thirds of the country; thus the likelihood of landslide occurrence is extremely high if natural resources are degraded (Federal-Research-Division 2006(2)). Haiti's rivers often overflow during the rainy season, but are reduced to puddles during the dry season; this reinforces food insecurity, floods, and landslides.

What factors contribute to Haiti's high human vulnerability? A closer analysis of what transforms a natural event into a human and economic disaster reveals that the fundamental problems of development that Haiti faces are the very same problems that contribute to its vulnerability to the catastrophic effects of natural hazards (IADB 2006) (Pelling and Uitto 2001). The principal causes of human vulnerability can be divided into four essential aspects: (1) underlying development situation, (2) social infrastructure, (3) national development framework, and (4) the shock absorbing capacity of the natural environment (vanAalst and Burton 2002) (Arie 2004).

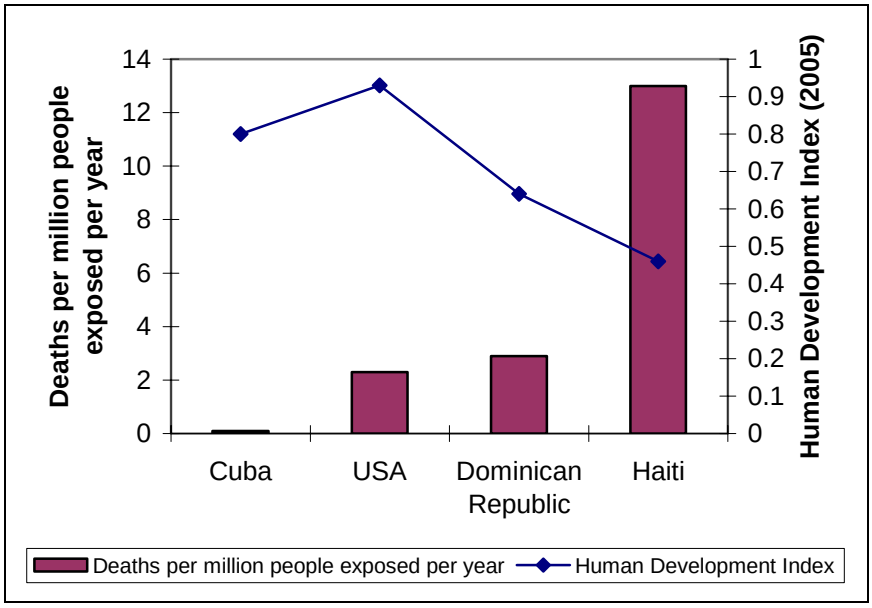
(1) Peoples' underlying development situation has previously been neglected as a key contributor to risk. However, the basic living situation and level of overall development cannot be overlooked as a key

[4] Haiti occupies 27,750 square kilometers, making it about the same size as the U.S. state of Maryland (Federal Research Division 2006(2)).

cause. Without a sense of security, economic opportunities and access to basic services, people's coping capacity is severely limited. Three key basic development conditions contribute to Haitian's vulnerability:

(1) *Persistence of widespread poverty* and low human development intensifies all other factors. 80 percent of Haitians live on less than US$2 a day (Federal-Research-Division 2006(2)). Haiti's average annual GDP growth rate is only 0.4%, with a GDP per Capita of only US$467 (Pertio and Hsu 2006). Widespread chronic poverty exists in urban and rural areas. Urban slum dwellers face economic exclusion and monetary poverty. Rural inhabitants - ¾ of Haiti's poor live in rural areas (Erikson 2004)- in mountainous regions live under the most destitute conditions; communities lack access to even the most basic infrastructure, including potable water, sanitation, health services and modern energy sources. Furthermore, regional differences in relative poverty exist with the northeast (Nord-Est) region being the poorest and the west (Ouest) region the richest (see Appendix 2 for map of Haiti). Over 70 percent of Haitians depend on subsistence farming to sustain their livelihoods. Due to endemic poverty, most peoples' efforts simply focus on daily survival; people's resilience to additional shocks on their system is extremely low (WorldBank 2006(1)). Figure 5 shows that typically countries with higher levels of human development suffer less severe impacts from natural hazards.

Figure 5: Linkages Between Disaster Impact and Level of Development (Human Development Index)



[Source: Created by Lisa Eichler with data from UNEP-GRID, EM-DAT, FAO]

- *Continued violent conflict* further degrades people's living conditions and hinders effective policy implementation. Throughout its history Haiti has faced many violent coups d'etats; the overthrow of governments results in continuously changing development frameworks. Even after the democratic elections in 2006 the security situation in the cities has not improved and kidnappings and gang activities are an everyday occurrence (Economic-Intelligence-Unit 2006).

- *Rapid population growth* and uncontrolled urbanization magnify poor people's vulnerability. Haiti with a population of 8.3 million is the second most densely populated country in the western hemisphere (Federal-Research-Division 2006(2)); Uncontrolled urbanization led to construction in areas vulnerable to natural hazards, poor quality of housing and other related land use issues (El-Masri and Tipple 2002).

(2) Sound social infrastructure is a key contributor to people's resilience. Social safety nets can buffer natural hazard impacts: safety nets are typically comprised of access to health infrastructure, education systems, and basic services, including water and sanitation, transportation networks. Unfortunately social safety nets are extremely underdeveloped in Haiti.

Investments in basic infrastructure are lagging. Only 38 percent of the population has access to potable water and the country ranks at the bottom of the World Bank's health indicators. (Federal-Research-Division 2006(2)). Thus, the MDG goal of improved health is also far from being reached. Over 50 percent of children are malnourished. Outside of Africa, Haiti has the highest incidence of HIV/AIDS. Severely limited government spending ($83 per capita annually) prevents effective health services. The weak social infrastructure results in inadequate preventative treatments. Road networks and health systems are inadequate to deal with large-scale evacuations and emergency response (Federal-Research-Division 2006(2)).

Inadequate education and information systems hinder the spread of awareness and knowledge about potential risk reduction techniques. Haiti has extremely low primary school enrolment rates and only slightly more than half of its young population is literate (FHM 2006). At the moment, 99 percent of schools are private (churches and 3 international schools) rather than state-funded, there is a shortage of teachers, and rural children often have to walk for over 4 hours each way to gain access to education (Federal-Research-Division 2006(2)). National data collection systems are unreliable and inaccessible to the public.

(3) Haiti's national development framework is extremely weak. While national disaster plans exist on paper, national disaster management capacity is inexistent. Currently, the government's role is limited to declaring a state of emergency once a disaster occurs and to soliciting international relief and reconstruction assistance. This may not be solely due to a lack of political will to invest in risk reduction, but also the mere fact that Haiti is faced with tackling so many fundamental issues of daily survival that disaster mitigation simply remains a luxury the country cannot afford.

Extremely weak institutions for governance result in inefficient public policies. The many changes in government led to high turnover that in turn lead to loss of institutional memory and capacity. The country has not been able to 'learn from experience' due to a lack of resources to do so. As a result the same disaster losses happen over and over again when some could easily be prevented.

Haiti's national disaster plan is non-functional. Due to the variety of problems the government has to address, disaster management remains severely under-funded. No early warning systems exist, no evacuation plans have been implemented on the municipal level. The current disaster plan includes large overlaps of responsibilities (UNDP 2005) and its complexity reinforces management challenges (see

Appendix 3 for current disaster management structure). So far the government has failed to involve all stakeholders in a coordinated effort towards vulnerability reduction – community/private sector involvement is nonexistent.

Haiti's environment is extremely degraded and thus lacks absorptive capacity to buffer impacts of natural hazards. By contrast, healthy environments prove more resistant and can recover from shocks. Severely degraded ecosystems, however, will not even be able to respond to and absorb small-scale natural hazards, such as landslides. Most media cited the poor condition of Haiti's environment as the main factor in the population's vulnerability. Haiti's environment has been severely degraded as a result of mismanagement of natural resources and the lack of sound environmental policies (Chapin-Metz 2001).

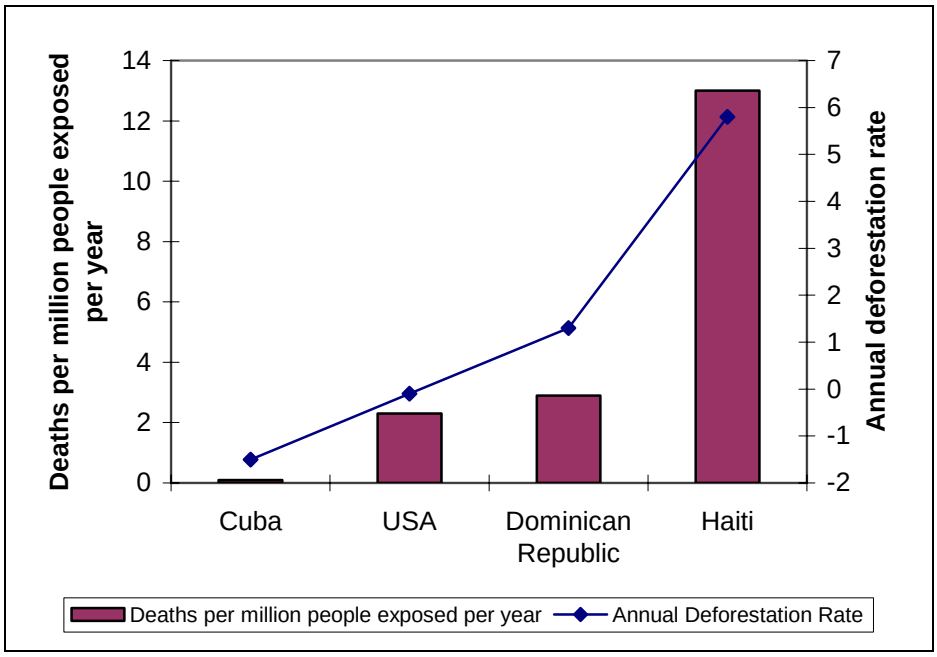
Deforestation is the most severe environmental issue the country is currently facing. Due to a lack of alternatives, the poor have no choice but to use firewood for energy (Europaworld 2004). This has resulted in severe deforestation: only 2 percent of the 1970 forest cover is present today (Picariello 1997). Deforestation in turn increases the impact of natural hazards. Research revealed an 89% correlation between the extent of deforestation and incidence of victims in case of landslides or cyclones (Peduzzi 2005).

Unsustainable agricultural practices are another contributing factor leading to further degradation and extremely low yields which in turn result in over 50 percent of the population being 'food insecure' (Federal-Research-Division 2006(2)). This food insecurity will only be amplified once a disaster hits.

These linkages between the level of environmental degradation and the severity of impacts from natural hazards also become very clear when comparing data between several countries. Figure 6 clearly demonstrates how a balanced natural environment can buffer impacts of natural hazards in Cuba, the United States of America, and the Dominican Republic. Haiti's high death toll from natural hazards corresponds to its extremely degraded environment. Thus, it will be very important to look at remedies for the environmental factors of Haitians' vulnerability when creating a disaster risk reduction strategy.

In addition to this compelling figure, other evidence confirms that natural hazards strike differently, depending on how the ground "was prepared for them: Hurricane Jeanne that hit Hispaniola in 2004, for example, yielded much harsher impacts in Haiti than in the Dominican Repoublic. In Haiti, extreme deforestation left large slopes barren, allowing rain to run off directly to the settlements at the bottom of the hills. In the neighboring Dominican Republic which is facing the same exogenous climate conditions, Hurricane Jeanne left only 11 victims to mourn compared to over 3,000 in Haiti (Europaworld 2004).

Figure 6: Linkages between Disaster Impact (Deaths) and Environmental Degradation (Deforestation)



[Source: Created by Lisa Eichler with data from UNEP-GRID, EM-DAT, FAO]

Part of the reason is that the Dominican hills remain covered by protecting forests and people there engage in more sustainable agricultural practices (Toepfer 2005). Statistics show that for the period of 1980-2003 the death toll per inhabitant exposed to cyclones was on average 4.6 times higher in Haiti than in the Dominican Republic (see Figure 9) (Peduzzi 2005). This example clearly shows that Haiti's environment is at a point of degradation where even natural hazards of relatively small extent, such as sustained rainfall, become disasters because nature has no way to absorb the shock.

Determining Haiti's disaster risk level. Even though the concept of vulnerability is relatively well understood, there remains the challenge of accessible data and a standardized method to estimate relative vulnerability. Nevertheless, most organizations agreed to use a simple indicator based on the UN Human Development Index (HDI) as the closest proxy to determining vulnerability (Pelling and Uitto 2001). Recognizing the importance of economic and social asset levels in the formation of vulnerability, this indicator – in addition to HDI – includes data on GDP, debt service ratio, public health expenditure and adult literacy. Using this method, Haiti shows the greatest vulnerability (1.25) worldwide.

Hazards are natural; human interaction turns them into disaster. Therefore, if we tackle human interaction with the environment, we still cannot prevent the natural event, but we can significantly reduce human vulnerability and the environmental, economic, and social impact of the natural event. It is this simple logic that makes the consideration and analysis of environmental management options so important

and such a powerful tool to tackle not only environmental degradation, but also risk and vulnerability to natural hazards. The following statement underlines the need for and significance of this issue:

> "Around the world, a growing share of the devastation triggered by 'natural' disasters stems from ecologically destructive practices and from putting ourselves in harm's way. Many ecosystems have been frayed to the point where they are no longer able to withstand natural disturbances […]. Although the inherent links between disaster reduction and environmental management are recognized, little research and policy work has been undertaken on the subject. The concept of using environmental tools for disaster reduction has not yet been widely applied by many practitioners." – ISDR cited in (UNEP 2005)

What should Haiti do to reduce its current vulnerabilities? Taken together, these factors explain why Haiti faces the highest disaster risk in the world. Given the negative impacts of recurring disasters on development progress, change needs to happen now. Enhancing peoples' resilience to better cope with natural hazards requires action on two levels – (1) reform national disaster policies and strategies and (2) initiate remedial action at community level. This report focuses on the latter and thus the question becomes: *How can we best promote community level environmental management actions that will decrease peoples' vulnerabilities to natural disasters?*

WHY A COMMUNITY-BASED APPROACH TO ENVIRONMENTAL MANAGEMENT?

"If you have come here to help me, you are wasting your time …
but if you have come because your liberation is bound up with mine, then let us work together."
- Lila Watson, Australian aboriginal woman (Partners in Progress)

Haiti's current political and economic situation in addition to its weak institutional set-up and implementation mechanisms for environmental and disaster policy clearly hamper the capacity for national level action. For many decades, Haitians – especially the rural poor – have paid taxes without receiving any services from the government in return. Although rural Haiti has provided most of the country's revenue, farmers have not seen returns in form of improved infrastructure or development. Most local infrastructure and livelihood improvements have been achieved when communities decided to take responsibility for improvement into their own hands, making use of their limited resources to improve their quality of life via community organization and action.

Furthermore, continued political and economic instability remains a key barrier to successful foreign investment in conservation projects and national efforts toward sustainable resource management. Thus, millions of dollars spent on large-scale donor projects, such as reforestation efforts, have not shown the intended results (Michel 2005). Instead, community-based initiatives involving local farmers, peasants' groups (gwoupman peyzian), and indigenous knowledge have been considerably more successful in the past and offer the greatest potential for effective environmental resource management and disaster risk reduction efforts in the future.

Yet another reason against foreign- or government-led environmental management projects is Haitians' suspicion towards development interventions due to their negative experiences in the past. For example, the US-led eradication of the indigenous Creole pig to preempt an outbreak of African swine fever in the early 1980s had disastrous economic and social consequences on rural livelihoods (Smith 2001).

Thus, community-based natural resource conservation and vulnerability reduction efforts promise to deliver the greatest impacts regardless of the political and economic actions that have thrown Haiti into a paralyzing poverty trap on the national level (McClintock 2003). Foreign donors should use a grassroots, participatory approach of empowering community-based environmental management efforts – it is about helping people to help themselves – otherwise the efforts will likely not prove sustainable and consequently prevent communities from enhancing resilience to disasters and improving their quality of life.

This community-based approach to disaster reduction and better environmental management will be absolutely essential in the short term. Once successes have been achieved and hopefully the political and

economic situations on the national level have been improved, actions can be scaled up with greater government support (vanAalst and Burton 2002). Community-based action will make a difference now, but eventually national level commitment via sound environmental protection policies, land use planning, disaster planning, etc. needs to be fostered to support the communities' long term vision of sustainable development in Haiti.[5]

[5] My MPP Master's Project analyzes national-level aspects of disaster risk reduction, such as capacity-building.

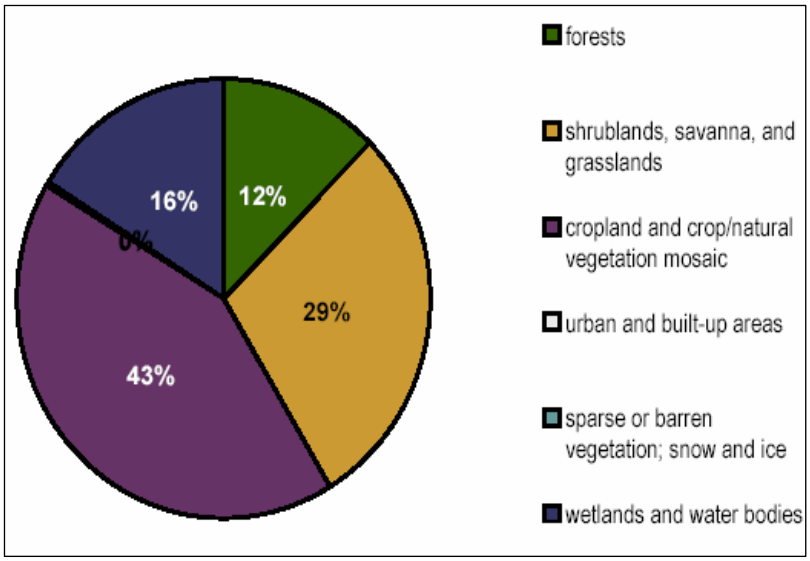
TOWARD A ROBUST FRAMEWORK FOR RISK-REDUCING COMMUNITY-BASED ENVIRONMENTAL MANAGEMENT

In order to effectively reduce Haitian communities' vulnerabilities to natural hazards via sound environmental management, one must look at the various vulnerability dimensions described above and how to best address them.

To restate the importance of a balanced ecological habitat for risk reduction one only needs to examine the impacts of a single natural resource use factor, i.e. charcoal use. More than 70 percent of Haitians currently depend on charcoal for energy. This has resulted in massive deforestation and led to environmental degradation including increased soil run-off, thereby decreasing agricultural productivity and contaminating watersheds (WorldBank 2006(1)). Thus, a degraded environment contributes to people's vulnerability in several ways: it heightens food insecurity; it raises landslide risk; and it worsens flood and hurricane impacts. Disasters degrade livelihoods and environment even further, reinforcing the vicious cycle.

Haiti's ecosystem is currently way out of balance (see Figure 7): over one third of all land is severely degraded (McClintock 2003). The rebalancing act seems almost impossible; yet the country has to start trying, otherwise the consequences will become even more severe. The next section of this report analyzes best practices from around the world that could be adapted to Haiti's specific needs.

Figure 7: Haiti's Ecosystem Areas by Type, 1992-1993



[Source: (EarthTrends 2003)

Environmental management techniques that have proven to be risk-reducing include alternative energy production, sustainable agricultural practices, integrated watershed management, and reforestation (vanAalst and Burton 2002). But even with the knowledge of those interventions that could work, questions often remain on how to approach the issues, where to start taking action, and what framework to follow.

This report first analyzes the previously missed approach of community-based environmental management approaches for disaster risk reduction. Then, the report lays out key steps for action with theoretical justifications for each, and provides a robust framework for evaluating community-based

environmental management initiatives in terms of their feasibility under a particular setting. Lastly, the report also provides a framework and criteria for evaluating progress and success of actions taken in order to allow for adjustment and greater flexibility.

The basic approach and framework established in this report (see next section) are robust and thus can be applied to any Haitian community as long as the community: the approach evaluates the options, decides which to implement, and finally monitors and evaluates progress and makes adjustments if necessary. The "application demonstration" section demonstrates the robustness by applying the framework to two Haitian pilot communities.

Key Steps: From Urgent Need to Community-based Risk-Reducing Environmental Management

(1) ***Initiating the process*** – build rapport between all actors; community or outsiders may initiate.

(2) ***Community profiling*** – initial understanding of community's development situation, its general fears, and key economic, social and environmental concerns. What basic social, economic, geographic conditions is the community facing?

(3) ***Community risk assessment*** – participatory assessment of hazards, vulnerabilities, local capacities, and people's perceptions of risks. What are the community's key strengths and weaknesses? What vulnerabilities should efforts focus on?

(4) ***Community environmental assessment*** – participatory assessment of key aspects of the community's ecological habitat (level of landscape degradation, water-related issues, energy, etc.). What is the type of environment that needs to be managed?

(5) ***Formulating initial risk reducing environmental management plan*** – use the robust framework for evaluating the introduction of risk-reducing community-based environmental management actions (see Table 1 in Appendix 5).

(6) ***Creating a Community Environment & Disaster Organization*** – it is important that the community organizes and mobilizes to create a sound structure to support its new management approach; build necessary capacity.

(7) ***Implementing short, medium, and long term measures*** – prioritize actions based on their importance for vulnerability reduction; implementation will likely require some adaptation to original approaches; continuously strengthen the community-based network.

(8) ***Monitor and evaluate on a continuous basis*** – determine those effects projects are having both in terms of improved ecological soundness as well as their impact on vulnerability reduction. Use the robust success evaluation framework provided in Table 2, Appendix 5; re-evaluate and adjust practices if necessary; document good practices for future dissemination and replication.

[Source: Adapted from (Victoria 2002)]

The evaluation framework establishes four broad categories of environmental management practices to foster greater ecosystem balance and thus reduce human vulnerability to natural hazards: (1) reforestation – both hillsides and mangroves; (2) integrated watershed management – includes flood protection, water storage systems, etc.; (3) sustainable agricultural practices; and (4) alternative energy development – mainly wind and solar energy.

Reforestation addresses a variety of risk factors including soil degradation, weather patterns, vulnerability of the built environment from winds and floods, and ecosystem health. Integrated watershed

management not only mitigates the flood destruction of shelter and crops, but it also ensures the availability of safe drinking water after a natural hazard occurs. This is crucial for reducing public health problems as well as preventing loss of agricultural productivity. Sustainable agricultural practices support soil fertility, reduce landslide risk and loss of crops due to floods and hurricane events. Greater agricultural productivity will also enhance food security and foster income generation. Lastly, alternative energies help reduce the need for continued deforestation and provide a healthier and renewable source of energy.

These four categories of environmental practices build the foundation of this new approach for addressing community vulnerabilities via sound environmental management. Depending on the particular geographic, social, economic and environmental situation of a given community, however, some practices may be more applicable than others. The relative importance of the various forces in the vicious cycle of environmental degradation poverty, and natural hazards differs from community to community. Thus, the framework includes a set of robust implementation evaluation criteria that will help communities determine which environmental practices to introduce for their risk reduction efforts.

ANALYSIS OF BEST PRACTICE EXAMPLES AROUND THE WORLD

The existing risk reduction literature has paid little attention to the linkages of environmental management techniques and vulnerability reduction outcomes. This excludes the power and role local communities most directly affected by the natural hazards may play. Their potential to aid in the management of natural resources had been largely ignored. Yet, community-based management approaches of these environment – disaster risk linkages seems to be one of the most promising tools for vulnerability reduction. Such an approach ensures that factors inherent in the creation of vulnerability, such as poverty driving people onto mountain slopes, become an integral part of the solution process, improving likelihood of sound solutions.

This section provides a review of Best Practices around the world; demonstrating the linkages between sound environmental management, vulnerability reduction and describing how to best incorporate practices into daily community action. Next, certain examples will then be adapted to Haiti's specific needs. Furthermore, to simplify this process examples were taken from other Caribbean islands since the region shares similar geographic conditions, is highly prone to multiple hazards and is strongly dependent on its natural resource base. Hence, these case studies build the basis for the robust framework for risk-reducing community-based environmental management efforts in Haiti. While most of these Best Practices did not explicitly set out to reduce disaster risk via community-based environmental management, they had the effect of reducing the community's vulnerability.

Hillside reforestation efforts in the Dominican Republic: This best practice example from the Dominican Republic is the 1984 Zambrana Agroforestry Project launched by the Enda Caribe NGO and the local community. It demonstrates how reforestation efforts can be successfully combined with income-generating wood production.

- *Why this project?* To combat the areas' continued severe deforestation and rural poverty issues.
- *What did the project do?* The community, with the help of technical experts, conducted field trials of 88 species of native and exotic trees to determine the species best suited in this specific environment. Once the *Acacia mangium* was identified, hundreds of enthusiastic farmers formed a local association of Agroforestry Producers planting several hundred thousand seedlings a year. They also built a sawmill to process the harvests (InternationalResourcesGroup 2001).
- *What did the project achieve?* The project proved so successful in demonstrating the economic feasibility of sustainable, locally managed wood harvesting that it was replicated in other regions of the country.

HASHI Reforestation Project in Tanzania: Success of this project that was started 18 years ago in response to the severely degraded environment in the Victorian Lakes region is attributed mainly to the community-based management approach and the decision to restore vegetation in protected enclosures. The project not only resulted in ecological benefits such as increased vegetation, a return of mammal and bird species and greater habitat resilience, but it also generated many community benefits, including higher household incomes, better diets, and greater livelihoods security (WorldResourcesInstitute, UNDP et al. 2005).

Mangrove reforestation efforts in Thailand: Community-based, this mangrove forest management safeguarded coastal livelihoods, protected communities against hazards, and generated alternative income sources. Rationale included the knowledge that mangroves provide a protective buffer zone to help minimize the damage of property and losses of life from natural hazards, including hurricanes, storms and tsunamis. When depleted, as for fire wood and income generation , affected coastal communities experience siltation, erosion, contamination of coastal waters and increased impacts of natural hazards (UNEP/GRID-Arendal 2005).

- *Why this project?* Mangrove forests are a dependable livelihood source for many poor coastal communities because of their production of food, medicines, fuel wood, construction materials, and as a natural water treatment system.

- *What did the project do?* The small Thai coastal community agreed to manage its mangroves as a 'community forest' setting strict user and management guidelines. Basically, the plan encouraged people to harvest the byproducts rather than to cut down trees. The key indirect produce of mangrove conservation has been the increase in the community's near-shore fish catch and increased species variety. Other byproducts include fuel wood from fallen or dead trees, fruits, medicinal herbs, sturdy poles for building. However, the extraction of these other byproducts is also limited to a sustainable extraction capacity and usage is based on family needs. The community also demarcated boundaries of community forest to clearly define protected area and to be able to defend it from outside intruders (Quarto 2006).

- *What did the project achieve?* Managing the mangrove forest in a sustainable, community-based manner has not only reduced losses to natural hazards, but it also substantially decreased the community's risk related to fishing. Fishermen spent less time on the water and reduced fishing expenses because they were no longer forced to venture out into the open sea. The 500 families in the community have increased their community income by 200 percent, US$600 to 800 per day (Quarto 2006)!

Integrated watershed management successes in northern Pakistan: The Mountain Areas Conservancy Project facilitated by IUCN fosters a community-based approach to watershed management in the mountains of northern Pakistan.

- *Why this project?* Its steep slopes, immense climatic variation, natural resource-dependent population, high poverty levels, lack of institutional capacity, and proneness to natural hazards render this mountainous area vulnerable to environmental degradation. However, community-based approaches are proving to be a valuable tool for sustainably managing Pakistan's mountain watersheds (IUCN 2006).

- *What did the project do?* Sustainable management efforts were scaled up from the village to the valley level to promote communal conservation efforts and resource stewardship that held both upstream and downstream habitats accountable for their actions (IUCN 2006).

- *What did the project achieve?* The project shows the rising awareness of the important upstream-downstream linkages (i.e. the watershed concept) as most of the resource demand stems from the lowlands, while the ecological health of the upland watershed determines the overall water quality and quantity of the watershed. Thus, promising types of upstream-downstream cooperation including environmental services and water user's associations should be adapted in more widely in other watersheds (Odermatt 2004).

Sustainable agriculture practiced in the Dominican Republic: USAID's Natural Resource Investment Fund Project (FIRENA) was one of the successful pilot projects promoting community-based agricultural solutions, soil conservation and reforestation in the Dominican Republic.

- *Why this project?* Landless subsistence farmers were laid off by landowners in the fertile valleys. In order to survive, they moved into the mountains slashing rainforests to create small agricultural sites on steep hillsides. This led to high rates of deforestation, reduced agricultural productivity, offset ecosystem balance, and increased hazard risks (vanAalst and Burton 2002).

- *What did the project do?* The project addressed the issue by increasing agricultural productivity via improved technologies, such as irrigation systems. The increased output allowed landowners to rehire some of the farmers. At the same time, these landowners had to sacrifice some of their land and give it, in small plots, to the landless farmers. The returning farmers, in turn, had to help reforest the mountain areas they left behind (vanAalst and Burton 2002).

- *What did the project achieve?* By addressing the underlying issues of agricultural productivity and land ownership, this project set up a sustainable solution. Its approach was successful in large part because it was community-driven and established a win-win situation for all stakeholders. Landowners improved their income, farmers became landowners receiving a steady employment, and the ecological balance was reestablished. As a result, this project also reduced people's vulnerability by moving them out of harms way and by improving nature's coping capacity (vanAalst and Burton 2002).

Alternative energy endeavors in rural India: The Tata Energy Research Institute with the help of locals in over 100 rural communities installed renewable and energy-efficient technologies. Demonstration projects were used to enhance local capacities to plan, install and manage these new technologies.

- *Why this project?* Biomass fuels provide more than 75 percent of all rural energy in developing countries. This results in unsustainable ecological consequences, severe health impacts and continued food insecurity. Most rural communities consume little electricity and therefore it would not be cost-effective to extend the national electricity grid. Instead, renewable energy sources already available in these communities – wind, solar, and biomass – prove to be more feasible once made available through

renewable energy technologies. These technologies include biogas plants, solar lanterns, solar home lighting systems, improved cook stoves, improved kerosene lanterns, solar water pumping systems, solar water heating systems, and water mills (Pachauri and Mehotra 2001).

- *What did the project do?* Despite the relatively high start-up costs of photovoltaic systems, they prove to be cost-effective when considering their reach to low-income consumers with low-load use and their life-cycle cost. Technological and commercial innovations over the last 20 years have made the photovoltaic energy accessible to poor users. Lastly, biogas was introduced as a more cost effective cooking fuel (Pachauri and Mehotra 2001).

- *What did the project achieve?* The newly-installed renewable technologies allowed the 100 villages to save enormous amounts of fuelwood (over 750 tons per year!). The key to success of this technology-transfer project was the close involvement of the communities and their contributions of cash and labor. Additionally, the community-based institutional arrangements established to take care of operation and maintenance have functioned well and seem successful for ensuring long term sustainability of the project (Pachauri and Mehotra 2001). Although not explicitly stated, this project reduced landslide and flood risk of Indian villages by reducing the need for slope deforestation while providing electricity to use two-way radios for early warning and emergency communication purposes.

INTRODUCING RISK-REDUCING COMMUNITY-BASED ENVIRONMENTAL MANAGEMENT IN HAITI: AN APPLICATION DEMONSTRATION IN FONDWA COMMUNITY

Environmental degradation increases natural hazard risk. Sound environmental resource management reverses environmental degradation, decrease natural hazard risk, and contribute to overall progress toward sustainable development. The two key geographic regions of degradation and risk in Haiti are: (1) at the coast, where degradation of natural protective structures - including mangroves, coral reefs, and natural beaches increases wave impacts; and (2) inland mountainous regions, where deforestation and unsustainable agricultural practices affect erosion, watershed balance, and flood-, hurricane- and landslide risk (see Appendix 4 for vulnerability and exposure maps). The example application of the new approach will take a closer look at one rural mountain community.

While the selection of this case study community may lead to questions of environmental justice and inquiry into the selection process, this community was selected out of a total of 565 rural Haitian communities (University-of-Fondwa 2006) and based mainly on available data and information about this community. It is believed, however, that this example will be useful for any Haitian community. Fondwa, a small mountain town in the Ouest Region with a population of about 40,000 including surrounding areas, has had previous exposure to community-based projects (see Appendix 2 for a map depicting the case study area). This community case study in Fondwa will provide valuable insights as to how to apply this evaluation and planning framework and develop a feasible plan for action.

Brief overview of Fondwa, Ouest Region: Fondwa, a watershed rural mountain community situated in the tenth communal section of Leogane, lies in rugged terrain about 60 kilometers South West of Port-au-Prince. Halfway between the cities of Leogane on the Northern coast of Haiti's Southern peninsula and Jacmel on the Southern coast, Fondwa itself has 6,000 inhabitants. However, the closely surrounding area, with six other villages, is home to about 35,000 rural people (FHM 2006). For many years the people of Fondwa, like most other rural Haitians, have paid taxes to the government without any services in return. The area lacked infrastructure to meet even the most basic human needs: drinking water, health care, roads, and education. Fed up with this situation, people started to organize themselves taking responsibility for their community. In 1988, they created the *Association of Peasants of Fondwa* (APF) with approximately 400 members and is the center of organized communal action for improving the quality of life in Fondwa (Gosser 2004).

Over the past 18 years APF - with the help of various partners such as Partners in Progress, Family Health Ministries, Fonkoze-Haiti, Peace Development Fund – has achieved tremendous success by prioritizing physical and social infrastructure development including creation of: access roads to nearby

markets; water and sanitation improvements (communal latrines); a medical clinic; St. Antoine School (kindergarten and primary education); and, a commercial center with a bakery, a carpentry and welding shop and an auto parts store. Most recently, APF set up the first rural university in Haiti. The University of Fondwa will educate students from across the country in the principles of sustainable agriculture, animal husbandry, and town/small enterprise management (Gosser 2004).

These achievements are absolutely encouraging in a country where everyone usually highlights the problems and dilemmas. However, Fondwa's progress could easily be wiped out with the next major natural hazard since the town so far has not directly addressed its disaster risk. Some of the above-mentioned projects are risk-reducing, however, APF has not actively engaged in resilience-enhancing resource management projects.

Analysis: Can risk-reducing community-based environmental management be applied in *Fondwa*?

STEPS 1 – 4: (1) *Initiating the process*;
(2) *Community profiling*;
(3) *Community risk assessment;*
(4) *Community environmental assessment*

This report only allows for an abbreviated coverage of steps 1 – 4 since the community really has to be actively involved in order to fully understand all the background details. However, the data gathered from the literature and the information provided by personal statements of community members should suffice to provide a general overview.

(1) Since the community of Fondwa is already actively involved in other community-based, NGO-supported development projects, the initiation and rapport-building stage has already successfully been achieved. This should allow for speedier transition from the planning to the action stage.

(2) What basic social, economic, geographic conditions is the community facing? As described above, the community has established a strong social network and a better quality of life for most people despite the chronic poverty levels rural Haitians are facing. The community enjoys improved roads, access to water and basic sanitation, and basic health care and education provisions. Having strengthened access to basic needs, APF is now focusing on building a sustainable local economy so as to diversify their income streams away from subsistence farming. The town's commercial center and the newly established tourism program are two examples of generating off-farm employment. Geographically, Fondwa is located in a very rural and mountainous area, cutting it off of national service provision, including disaster response. The community is forced to carry out agricultural activities on steep slopes, which creates severe environmental issues.

(3) Fondwa faces multiple types of hazards on a very frequent basis. Based on national risk maps (see Appendix 4), Fondwa is challenged with the following hazard frequencies and exposures:

- *Floods* – about 1,000 people are exposed to an average of 0.5 flood events per year; residents face a relatively low vulnerability in terms of people killed per event, but the number of livelihoods affected by the aftermath can once again be very large (CRED 2006).

- *Cyclones (damage from severe winds)* – as many as 10,000 people are exposed to an average of 0.3 storm events per year; residents face a relatively high vulnerability (vulnerability proxy of 100 killed per one million exposed per year), especially due to the indirect impacts of cyclones (CRED 2006).

- *Landslides* - many (but as of yet unquantified numbers) are exposed to an average of 0.01 landslides per year; the vulnerability proxy is estimated to be high, especially because landslides have a very local impact and destroy not only lives, but also endanger livelihood sources of entire communities (CRED 2006). Also, local landslide victims usually do not receive the amount of aid that typically pours into a country after a major national disaster occurs.

- *Droughts* - do not seem to be of priority concern for Fondwa, but they do occur during hot and dry summers and threaten harvest levels. As a consequence, food and water shortages may intensify.

Vulnerabilities and current weaknesses in Fondwa are a function of poverty and population density. Fondwa experiences one of the highest rural population densities in Haiti. As a result, the natural environment is being over-exploited. Resulting low agricultural productivity of mountain slopes causes continued food insecurity and high levels of severe malnutrition, especially among children. Additionally, levels of health are still a major challenge even with the local basic health clinic. Mothers and children are particularly vulnerable to health threats, with 10 percent of children under five dying each year (this is slightly below the 12 percent national average under 5 child mortality rate) (WorldBank 2006(2)).

The key local capacity that will foster the community-based environmental management effort is Fondwa's engaged and determined community - residents live a life of daily struggle, but keep up an eternal hope for a better future for their children. Previous community-based action has shown very positive results. Furthermore, Fondwa's relatively advanced and accessible educational system is a key advantage that most other rural communities do not enjoy. Fondwa offers K-12 education as well as tertiary education in its new University of Fondwa. These educational centers will be key human resources to carry out the community-based actions that are needed to reduce risks. Yet many rural children cannot receive education because their parents do not have $4 a month for tuition or because children do not have the time or energy to walk up to 4 hours each way to attend school. Lastly, another capacity raising tool already in place in Fondwa is the wide-spread use of radios to disseminate information – this is a useful tool not only for early warning and emergency communication purposes, but also for awareness raising campaigns (FHM 2006).

Thus, one of the primary reasons why disaster risk reduction has not yet been explicitly addressed by any of Fondwa's initiatives may be the ultimate perceptions of risk within the community. Most people seem to think along the lines of the majority of the world's population: disasters are a random 'act of God' and thus cannot be prevented (vanAalst and Burton 2002). While the common assumption is right in terms of not being able to prevent meteorological events – at least not on a local scale -, this common misunderstanding neglects the fact that most human vulnerabilities can be significantly reduced with a change in behavior and natural resource use.

(4) Fondwa's ecological habitat faces similar challenges as the entire country. Severe deforestation has left behind barren mountain slopes with extremely low agricultural productivity, soil run-off, decreased water supplies and other related issues. The Fondwa watershed is suffering from severe sedimentation. Daily water collection sometimes requires two hours of walking to find water containment areas. Few families boil their drinking water due to lack of sufficient energy supplies. This, in turn, creates one of the area's main health hazards (University-of-Fondwa 2006).

Continued search for energy leaves poor peasants with no alternative but to keep cutting down trees for fuelwood. Additionally, charcoal production for urban sale remains one of the key sources of income in Fondwa. As a result, the Fondwa watershed is highly deforested, with only a few scattered trees remaining. On a promising note, APF has actively tried to counteract this environmental dilemma by planting over a million tree seedlings; however, at this point the deforestation problem is so severe that most seedlings do not even get a chance to grow up. Yet, this local effort at the very least shows the local commitment and concern for its ecological surrounding (Gosser 2004).

Agricultural practices have also significantly altered the original landscape and contributed to deforestation. American, Canadian and Cuban agronomists have been helping Fondwa's peasants to improve the productivity of mountainous fields for almost two decades. Yet, severe challenges of soil degradation, soil runoff, and a lack of water supply remain key challenges for creating higher food security (University-of-Fondwa 2006).

STEP 5: *Formulating initial risk reducing environmental management plan*

This step is sub-divided into a detailed analysis of each type of community-based environmental management technique as presented in the framework.

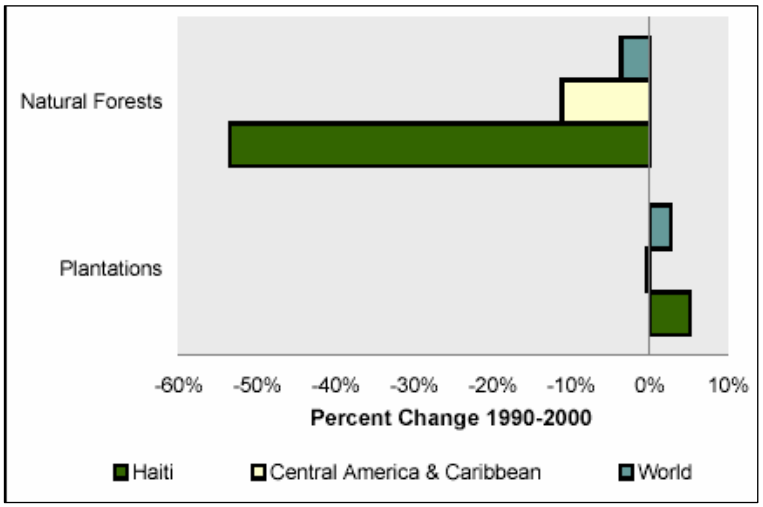
Increase Hillside Reforestation

Why? Deforestation seems to be one of the major challenges in Haiti today – not only in terms of attempting to reestablish the country's ecological balance, but also in terms of improving public health,

income-generating rural activities, hazard risk-reducing qualities, and the population's quality of life in general (see Appendix 7) for an overview of the extent of deforestation in the Ouest Region). Thus, given the vast extent of this ecological problem and the various impacts a healthy amount of trees could have for Fondwa, reforestation should probably be the highest priority environmental management activity.

What? Natural forests are clearly preferable to tree plantations under ecological habitat considerations. But given the great variety of development challenges Fondwa – and Haiti at large – are facing, it may only be feasible at this point to invest resources and efforts into promoting tree plantations. Especially, because tree plantations seem to have been growing in Haiti at a disproportionately high rate (5%) compared to the Latin American and Caribbean average (0%) (See Figure 8).

Figure 8: Percent Change in Forest Area by Type, 1990 - 2000



[Source: (EarthTrends 2003)]

The goal of any reforestation effort should be to not only plant seedlings, but to also maintain these trees in substantial numbers so that they can make a difference in terms of soil conservation and an improved ecological balance. This will be a major challenge because currently individual trees are very dispersed across the barren slopes.

How To? There are two main environmental management strategies that could be applied in Fondwa: (1) agroforestry; or (2) establishment and management of a communal forest. Agroforestry approaches can be categorized more as sustainable agricultural practices and will be discussed in the relevant section below. Thus, community-based reforestation efforts in Fondwa should focus on establishing communal forest lands. Similar to the forest revival initiative in Tanzania, there exist great opportunities and benefits for Fondwa residents to raise and manage a natural forest.

Currently, it takes up to 13 years to obtain land rights in Haiti and most rural areas simply do not have established property rights (WorldBank 2006(1)). Thus, all slopes are seen as common property. As a result, families cut down trees wherever it is most convenient / feasible for them. Consequently, the immediate surroundings of towns and villages are extremely barren, making the built environment much more vulnerable to landslides, floods and hurricanes. In order to set up more responsible natural resource

usage – even without clearly defined property rights – Fondwa could 'zone' areas immediately upslope of the town as a communal forest project.

With the assistance already provided by Partners in Progress, the majority of seedlings should be planted in this communal forest. Various indigenous species should be inter-planted to foster the growth of a 'natural' forest. One particularly robust multi-purpose tree is the indigenous oil palm *Attalea crassispatha* (*ti koko* in Creole). This tree can grow with relatively little water and nutrients; its tree trunk is relatively insect-resistant; and its wide, durable tree trunk can withstand heavy winds and rainfall. This palm tree will eventually supply fatty nut meat that can be eaten raw or used as cooking oil (McClintock 2003).

In order to empower and train villagers, Partners in Progress should cooperate with the University of Fondwa to provide the community with workshops and training regarding planting and maintaining the forest. It is absolutely essential that this training and "awareness raising" effort clearly states the expected environmental and community benefits of the project in order to gain widespread buy-in.

Similar to the Tanzanian Project, it will be essential to fence in the communal forest during the formative years to avoid seedling destruction by livestock or external loggers.

Potential Caveats? One important source of conflict that the community needs to address is the redistribution of land. If the determined communal forest area contains family farmland, the community needs to come up with a compensation plan that provides alternative farmland as well as enough of an incentive for the family to give up their traditional plot.

Lastly, in the future, the community needs to set up a sound system to fairly distribute benefits derived from the forest among community members. The community could analyze distribution structures that have been successful in other community-based forest management arrangements and have been incorporated in "awareness raising" efforts as part of the future goal. Examples include in the Tanznia model. Special attention should also be given to reinvesting a large part of the profits into other community-based projects so as to become self-sufficient at some point in the future.

Expected Benefits? Community-based reforestation efforts are expected to yield benefits in three areas: vulnerability reduction, community development, and ecological improvements. Vulnerability reduction will be achieved because trees decrease landslide occurrence, and they protect people from storms and floods. Community development progress and poverty reduction will be fostered via alternative income streams from environmental services, non-timber produce (fruits, etc.) and increased tourism. The overall ecological balance is expected to improve dramatically. Additionally, the reforestation project will provide an excellent study area for the university.

Evaluation of Overall Feasibility: The suggested community-based reforestation approach for Fondwa scores very well on the implementation criteria framework (see Appendix 6, Table 3). The project seems highly feasible in terms of carrying out the reforestation as a community-based effort. Furthermore, the community-based structure and process that already exist in Fondwa seem highly appropriate and effective for carrying out this new environmental management approach. Expected benefits (see success evaluation framework in Appendix 6, Table 4) clearly exceed the costs of not acting at all.

Improve Integrated Watershed Management

Why? Mountainous communities, such as Fondwa, are often vulnerable to degradation of their scarce resources. In Fondwa, water scarcity is a particular environmental threat during the dry season, while flooding often occurs during cyclone events and the rainy season. Thus, it becomes very important to better manage Fondwa's water resources in an integrated manner, buffering both flood and drought impacts.

What? Similar to the watershed management initiative in Pakistan, Fondwa could undertake several small-scale management actions that promise to have a significant impact in terms of water availability and protection from natural hazard impacts. Fondwa could build small ponds to capture water during rain events. This water may then be used for drinking water or irrigation purposes during drier periods. Additionally, Fondwa could increase flood protection by building flood channels around key infrastructures.

How To? APF and its partnering NGOs likely have the necessary know-how on how and where to build these retention ponds, and which infrastructures to protect from flood downwash. While Fondwa community can provide the physical labor to build these watershed management tools, the World Bank or other international organizations are very likely to sponsor watershed management initiatives.

Expected Benefits? Benefits are manifold, ranging from direct benefits of reduced impacts of flooding, to more sustainable availability of water, to decreased harvest impacts of droughts. Additionally, integrated watershed management promises to yield various indirect benefits. For example, ponds could potentially hold fish, which could serve as a source of protein for the community. In turn, this may decrease the demand for goats, which could have a positive impact on tree seedling growth and reforestation efforts.

Potential Caveats? Integrated watershed management is very complex. This report only mentioned two feasible techniques to manage this scarce resource more responsibly. Further techniques could be analyzed during implementation. Also, the siting of ponds could have potential negative impacts if they are placed in a way that they easily overflow and in turn create new downwash onto shelter or important infrastructure.

Overall Evaluation: Given the potential caveats and the complexity of integrated watershed management, it is important to carefully plan this type of environmental management intervention. Thus, overall this technique should probably be added in the medium term once time has been given to careful evaluation and planning. But once implemented, this initiative is likely to yield very positive benefits.

Continue Sustainable Agricultural Practices

Why? Soil erosion, like deforestation, is endemic in Haiti due to centuries of harmful agricultural practices. First, intensive monocropping of export commodities, such as tobacco, cotton, sugarcane and coffee, degraded the environment during the colonial period (McClintock 2003). Later, widespread harvest of timer for export markets and the expansion of peasant subsistence agriculture of maize, beans, cassava, and fruit on marginal sloping land made agricultural practices unsustainable (Picariello 1997). Increasing population numbers have exacerbated the problem due to increased demand for food[6] and fuelwood (EarthTrends 2003). According to USAID a third of all land in Haiti has been severely degraded by unsustainable agricultural practices (White and Jickling 1995); in many regions, unconsolidated marl and basalt bedrock is observable at the surface[7] (Smith 2001).

What? Currently, a lack of capital and land tenure limits sound agricultural practices. Most peasants own less than a quarter hectare of land (Smith 2001). Due to extreme land scarcity, many families sharecrop additional fields. However, farmers are usually unwilling to invest in improving land because they do not own it. Additionally, land scarcity does not allow for fallowing and thus soil fertility is compromised (McClintock 2003). Despite failure of government and NGO agroforestry initiatives on national, regional, and local levels, it should be noted here that many Haitian farmers traditionally practice agroforestry (Gosser 2004). Thus, the task of this community-based initiative is to get all farmers involved and to come up with a sustainable strategy that maximizes yields and increases resilience to external shocks.

How To? In Fondwa, the Association of Peasant Farmers, with the help of NGOs, has already engaged in soil conservation, irrigation, and sustainable agriculture projects (Partners-In-Progress 2006). Thus, these efforts simply need to be continued. Professors and students of Fondwa University could take on a leadership role in these initiatives: they have the necessary expertise to ensure ecological soundness and at the same time they know what actions are feasible in the Fondwa region (University-of-Fondwa 2006).

Typically, multi-storied food and tree crop species can yield sustainable agricultural outputs while at the same time limiting soil erosion and increasing crop resistance to external shocks (Bannister and Nair

[6] According to FAOSTAT, Haiti's food production has decreased significantly since 1982 while at the same time population has grown rapidly (McClintock 2003).
[7] In Haiti, people often state that "the mountains have grown old; you can see their bones poling through their skin" (Smith 2001).

1990). Such multi-storied crops include coffee, cassava, plantain, beans, mango, avocado, and citrus fruit trees (Bannister and Nair 1990). In addition, woody perennial species are well-suited to serve as live fences to protect fields from winds and at the same time they demarcate boundaries (McClintock 2003).

Hedgerow intercropping with nitrogen-fixing trees is thus a very effective way to increase resilience and conserve soils for greater agricultural productivity. This agricultural practice is low-cost, requires minimal training and education in addition to the already existing indigenous knowledge, and it serves the multiple purposes of providing food, increasing productivity, and decreasing vulnerability to natural hazards.

Potential Caveats? Agroforestry projects have been advocated in Haiti for decades. Yet, few have been successful. Thus, it is extremely important that Fondwa chooses the right type of trees and crops to plant, the right spacing between hedgerows and crops, the appropriate usage of trees, etc. Success is needed to build confidence among local inhabitants and to ensure that agricultural practices become sustainable.

Expected Benefits? In addition to the expected direct benefits, sustainable agriculture promises to yield many indirect social and economic benefits: tree rows can be used to formalize land rights within the village; incomes will increase due to increased agricultural outputs; and the town can serve as a good practice example for other similar towns in Haiti.

Evaluation of Overall Feasibility: Given the fact that Fondwa's peasant farmers were the ones who started community-based action in the town, they are highly motivated to generate new successful initiatives. The University is a great advantage for the town because it conducts research on the most suitable crop and tree species and other agricultural techniques.

Invest in Alternative Energy Sources

Why? Alternative energies could help reduce the need for continued deforestation and provide healthier and renewable sources of energy. Alternative energy options empower local communities to manage their own energy needs and thus provide rural development opportunities. While a wide variety of wind, solar, and hydro alternative energy options exist, most applications are currently not affordable, accessible, or appropriate for remote, disaster-prone communities in developing countries. Thus, Fondwa should focus on the few solar and hydro application options; small-scale wind turbines are still too vulnerable to sustained winds to be a feasible option.

	Solar Options	***Hydro Options***
What?	NGOs, including *Practical Action*, have developed low-cost solar lanterns and solar-powered water heaters to make alternative energy affordable, accessible and appropriate for the rural poor. The solar lamp can provide up to six hours of light, or a combination of light and power for the radio.	Small-scale micro hydro schemes promise cost-effective energy generation. Every kilowatt generated costs about US$ 1,500. Thus, at a cost of approximately US$ 9,000, a 60-kilowatt micro hydro facility can power a grinding mill and provide electricity to homes, schools, or health clinics for about 20 years. Such a scheme has an average capacity to supply 500 people with electricity!

How To?	Prototype solar lanterns and water heaters exist.[8] Fondwa NGOs should apply for international grants to purchase these solar applications and then distribute lanterns among households, while installing the heater systems in all communal facilities. Additionally, NGOs need to have the capacity to teach people how to use these technologies appropriately. Funds should be relatively easy to solicit given the current focus on climate change and alternative energy investment.	Micro hydro systems are usually 'run-of-the-river' systems. Thus, Fondwa would not have to build a dam or storage facility. The water simply needs to be diverted from the river stream, channeled into a valley, and dropped into a turbine via a pipeline. From there, the produced energy can be captured and diverted for mill operations, household usage, or for charging batteries.[9] Off stream storage of water during periods of high flow may be used to feed the turbines during droughts.
Potential Caveats?	Three potential obstacles could hinder project success: (1) relatively high dependence on technology transfer and external funding (one solar lantern costs approximately US$100) (2) inappropriate usage[10] of new technologies, and (3) how to allocate which households will benefit from solar energy tools.	Potential threats and benefits of hydro projects are closely related to one another. High upfront costs will likely threaten project feasibility. However, if external support for project installation could be secured, micro hydro schemes become self-sufficient very quickly: once communities receive training, they are able to carry out maintenance tasks. Increased productivity from the grinding mill and extended income generating hours provided by lighting will quickly generate income that can be used to pay for maintenance. In terms of reducing vulnerability, micro hydro schemes promise to significantly reduce firewood need. Also, having access to a local mill will allow farmers to grind their harvest; this way it can be packaged and stored in more hazard-resistant ways (i.e. grain silos).
Expected Benefits?	Solar tools would be particularly useful in Fondwa not only to improve health and reduce the need for deforestation, but also to directly strengthen the community's risk reduction efforts: lanterns would provide a reliable source of energy for powering radios, which in turn can be high effective early warning tools or they can serve to raise awareness within the community (see next option).	

[Source: Information based on (Karekezi and Mackenzie 1993; ITC 2006; Practical-Action 2006)]

Evaluation of Overall Feasibility: Fondwa community should consider the described alternative energy options as a tool for reducing environmental degradation and for increasing energy availability. The key benefit is clearly that efficient use of renewable energy enhances greater ecological balance by preventing further deforestation. Micro hydro systems are very cost-effective and they should withstand most natural hazards. Additional benefits of renewable energy include: it can generate better lighting, which increases the period of daily economic activity; it can benefit women due to hours saved in terms of finding fuelwood; improved cookstoves decrease health problems associated with using firewood. Once again – like the other community-based environmental management techniques - alternative energy initiatives will also generate local employment opportunities.

Awareness, Education, Early Warning Capabilities

Why? Given the current situation in Haiti, it is unlikely that the government will develop national early warning systems or provide environmental management education and awareness programs any time

[8] For more information on solar lanterns see (Practical Action 2006) and (ITC 2006); for water heaters see (Karekezi and Mackenzie 1993).
[9] For more information on how to build a functioning micro hydro system see (Practical Action 2006).
[10] Solar panels are highly sensitive and their efficiency can change drastically depending on appropriate usage: dirt on panel, current and future shading, orientation of the panel (south; 15 degree angle) need to be taken into account.

in the new future. Consequently, communities need to take action to improve their own awareness and early warning capacities.

	Awareness / Education Options	***Early Warning Capability***
What?	Environmental management education and awareness programs should convey the basic message of how vulnerability is created, what risks the community is facing, and how community-based environmental management efforts can reduce that vulnerability.	In Fondwa, current community structures already provide strong mechanisms and networks for communication. Additionally, a good portion of families own radios. Thus, it should be easy to start using community communication mechanisms for disaster preparedness purposes.
How To?	Fondwa is probably the one community in Haiti that has the capacity to provide education and awareness with minimum additional costs. St. Antoine School, Fondwa University, and churches can incorporate environmental management courses and disaster risk awareness programs into their already existing curricula. Additionally, the university could use radio broadcasting to spread messages to the wider community or even to other communities that do not have the advantage of housing a university. Greater buy-in can be achieved if these educational initiatives incorporate the various socio-economic incentives associated with risk-reducing environmental management techniques.	Community early warning mechanism consists of two components / key actors. First, Fondwa University could play a leading role and take on responsibility in forecasting natural hazards. Students and professors have the capacity to quickly learn how to use indigenous knowledge to predict extreme weather. Cloud movement and animal behavior are very reliable predictors of extreme events; other communities use them very effectively. Clouds are good indicators of heavy winds and rainfall; cows and goats tend to make unusual sounds before heavy rainfall; chicken try to find shelter before strong winds and heavy rains; and snakes and earthworms come out before heavy rainfall. The University already houses a variety of animals for their animal husbandry program. Thus, it would be simple to start monitoring these animals for signs of abnormal behavior. Monitoring will only be effective when coupled with strong communication mechanisms. This is where the community itself comes in as the second component of early warning: everyone should use radios, mobile phones, house-to-house and other communication tools to transmit and spread early warning messages throughout the community.
Potential Caveats?	Education and awareness raising is a very broad environmental management tool. Given the limited capacity of communities, they often focus on actions with more tangible outcomes. Yet, education and awareness are crucial in order to promote participation in all other environmental management projects as well as to increase the understanding of risks and vulnerabilities. Another major caveat is that people do not like to be 'preached' to. Thus, educators need to find an appropriate balance between conveying key information and at the same time not ignoring community concerns and indigenous knowledge.	The key problem associated with community-based early warning systems is that it will only function properly if linked with sound disaster preparedness mechanisms, including evacuation routes, emergency shelter, etc. Otherwise, people have nowhere to go to even if they know harm is on its way. Additionally, early warning does not directly contribute to addressing underlying vulnerability factors; it simply warns people about approaching hazards and gives them time to prepare/flee to save as many livelihood assets as possible.
Expected Benefits?	Education and awareness programs – if set up and carried out appropriately – can be very powerful tools to ensure continued community participation, to increase awareness on the issue, and to effectively implement action. Developing a community-based education and outreach project from the beginning will allow for quick and efficient information sharing and start-up of new community-based components in the future.	Functioning early warning systems have proven very effective in terms of significantly reducing natural hazard impacts. The number of deaths, livestock losses, and the number of people affected can be greatly reduced if people know when to move out of harms way. Reliance on indigenous early warning predictors coupled with modern technology is the best mechanism in the short term. Once national early warning systems are created, they should be incorporated into the community-based early warning.

[Source: Table based on information from (ITDG 2002)

Evaluation of Overall Feasibility: Education / awareness programs and early warning have been found among the most effective tools for disaster risk reduction. Early warning allows people to prepare for what is about to happen and gives them some time to move out of harms way. Education and awareness ensures that people know about the risks of natural hazards, possible ways to minimize impacts from shocks, and ways to actively reduce their risks to experience disaster. Education and awareness components can usually be achieved at relatively low cost. They are highly feasible and should build a crucial part of community-based action.

STEP 6: *Creating a Community Environment & Disaster Organization*

Fondwa does not have to carry out this step of creating a community environment and disaster organization from scratch. Fondwa has a considerable advantage over other villages because it already has an ongoing and well-functioning community organization – the Association of Peasants of Fondwa (APF). This will be very helpful for the success of risk-reducing community-based environmental management. Also, it will greatly speed up the process of actually translating the plans into action.

Basically, APF could simply add another branch to its organizations that focuses on environment and disaster risk reduction. This would merely require some additional expertise and some additional funding, but the basic sound structure to support the new approaches and initiatives with the necessary capacity, trust, and resilience is already in place. Experts to take on a leading role in this new branch of APF can be found at Fondwa's University; students and professors could use this as a way to get involved and give back to the community as well as a practical learning tool for students.

STEPS 7-8: (7) *Implementing short and medium term measures, and long term goals*
(8) *Monitor and evaluate on a continuous basis*

Steps 7 and 8 are the implementation phases. This report shows how actions can be prioritized under step 7, but the report cannot cover step 8 until initiatives are actually being carried out. However, step 8 is a crucial element for successful community-based environmental management and monitoring and evaluation need to start as soon as the first initiatives are actually being implemented.

For step 7, the community needs to prioritize actions based on their importance for vulnerability reduction as well as their implementation feasibility. The options versus criteria matrix (See Appendix 5, Table 1) shows how such ranking can be carried out in all communities. Table 3 in Appendix 6 then shows

how options fare against criteria in Fondwa. From this matrix it is possible to determine short[11], medium, and long term measures:

- Short Term: APF, with the help of NGOs and the larger community, should focus its immediate attention on further developing a plan of action for (1) reforesting the area; (2) continuing the switch toward more sustainable agricultural practices; (3) utilizing the town's advanced educational system for promoting awareness; and (4) improving bad weather forecasting and coordinating early warning communication.

- Medium Term: The community also stands to gain from community-based efforts for improved watershed management and alternative energy development. However, these types of interventions will require more preparatory time and are more costly. Thus, these efforts should remain key goals to be implemented in the near future once funding can be secured and the initiatives can be planned carefully.

Step 8 cannot be carried out until initiatives are being implemented. However, the success evaluation framework (see Appendix 5, Table 2) enables communities to predict expected results and the corresponding level of success before engaging in a project. Predicting success can be very helpful to estimate and carefully think through what effects projects may be having both in terms of improved ecological soundness and a their impact on vulnerability reduction.

During project implementation continuous monitoring and evaluation allows communities to re-evaluate and adjust new practices if necessary. The same framework can then also be used to record actual measures of success. The University of Fondwa is an excellent communication tool that can record and disseminate best practice examples around the country for potential replication in other communities.

[11] Short term is defined as starting action as soon as possible; medium term is defined as starting implementation in 1 to 5 years; and long term is defined as starting implementation in 5+ years.

RECOMMENDATIONS - CHALLENGES FOR THE FUTURE

This section briefly summarizes key findings for the Fondwa case study, evaluates the robustness of the framework in more general terms, and projects challenges for the future.

Fondwa Case Study Findings: Applying the newly created framework to a case study community served two purposes. One, it allowed for a more detailed explanation of how the framework could work in practice. Two, it yielded valuable information for Fondwa community regarding their disaster risks and how they may want to tackle their vulnerabilities.

In summary, a community-based approach was determined to be highly feasible in Fondwa given their previous exposure to community-based efforts. Four ecological features (hillside reforestation, integrated watershed management, sustainable agricultural practices, solar and hydro energy projects) seem feasible environmental management practices that are very likely to increase Fondwa's resilience to natural disasters in the future. In addition, the community can use the environment as an early warning tool. Lastly, given Fondwa's advanced education system including primary and secondary schools, and the only rural University in Haiti, lends itself to further research and evaluation of this framework. Once community-based risk-reducing environmental management practices are being implemented, the University is a very suitable outlet to spread awareness about this best practice example, introducing risk-reducing environmental management in other communities across Haiti.

Is the Framework Robust? The application of the framework worked very well for the community of Fondwa. Ideally, it should be tested on other communities with different features. This way, robustness of the framework could further be verified or necessary adjustments could be made. One such case study community may be Caracol, a small coastal community in the north-east (Nord-Est) region of Haiti. While this community is about the same size as Fondwa, it will face different environmental threats and natural hazards. Also, this community does not currently have a strong community-based network. Therefore, it may be very valuable to evaluate how the framework can work for a community like Caracol. Yet, the application to Fondwa already showed the role the framework could play in natural disaster risk reduction.

In the Future… this framework needs to be re-evaluated once communities actually start using it. The framework should be seen as adaptive and flexible. Thus, it can be adjusted to integrate findings of what worked and what did not work. All communities using this framework in the future should realize that the framework sets up a process that is very much a step by step effort. Depending on the situation of each particular community, moving from one step to the next may take more or less time and resources. Yet, communities are encouraged to keep taking small steps in the right direction. With community buy-in into

the process, community-based environmental management tools promise to be a powerful tool for disaster risk reduction. The framework provided in this report serves as a guideline for communities on how to use these community-based environmental management techniques successfully for increasing their own resilience. In addition to applying the framework within Haiti, it is important to integrate lessons learned in Haiti with lessons learned elsewhere in order to draft guidelines that could help communities worldwide.

Natural disaster approaches around the world have moved from the theory of applying structural engineering measures to tame and control nature, to greater emphasis on forecasts and warnings combined with massive relief and recovery assistance, and finally to mitigation. Mitigation traditionally includes better preparedness via sound land use planning and improved construction design. This report has provided in depth insight into yet another dimension of mitigation: active risk reduction efforts via day to day community-based environmental management. It is hoped that the framework will help to translate theory into successful action on the ground.

APPENDIX 1: JOINT-DEGREE PROJECT LINKAGES

This appendix intends to clarify the linkage between my MPP Master's Project and my MEM Master's Project and how both will contribute toward sustainable development in Haiti. As mentioned before, my MEM MP will explore the history of natural hazards in the country as well as current and past environmental practices and their contribution to disaster risk and vulnerability. Deducting from lessons learned in the past and looking at good practice examples from other parts of the world my objective is to suggest sound environmental management techniques that will reduce Haiti's vulnerability and risk to natural hazards in the future. At the same time this initiative would provide a starting point to improve the country's devastated environmental situation.

My MPP project, on the other hand, will concentrate on the *UNDP mainstreaming initiative*, its policy dimensions, current UN projects and national disaster- as well as poverty reduction strategies in Haiti, and how to develop a feasible mainstreaming approach for this conflict-stricken and resource-poor country.

Figure 9: MEM MP and MPP MP Topic Linkages

Overarching Goal - foster sustainable development in Haiti via improved disaster risk reduction.

- ***MPP Sub-Goal*** – provide input on how to mainstream disaster risk reduction into Haiti's development policies /projects.
- ***MEM Sub-Goal*** – improve environmental management practices to reduce vulnerabilities and at the same time stimulate sound use of natural resources to tackle Haiti's devastated environmental situation.

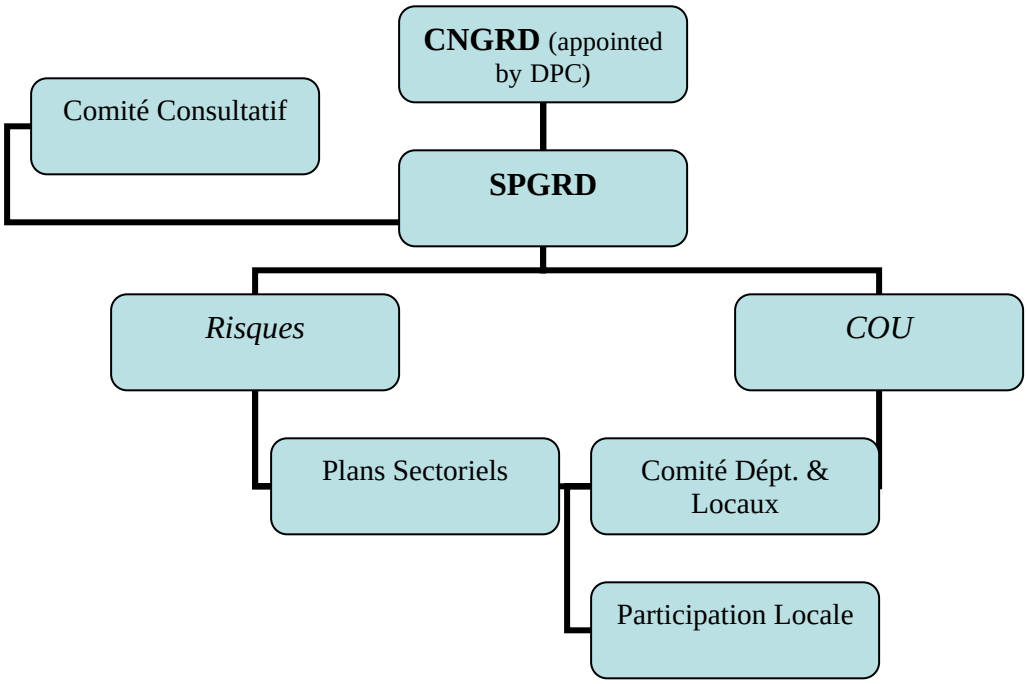
Approach – MEM MP stands alone; serves as scientific background to draft informed, feasible policy (MPP MP).

- ***MPP Methodology*** – policy analysis of Haiti's current vulnerability; comparison of Haiti vs. Dominican Republic disaster policies; identification of key contributors to risk; select criteria; draft feasible options; suggest broad implementation; predict impact on risk reduction.
- ***MEM Methodology*** – review past natural disasters and environmental practices; analyze best practices around the world; suggest how to adapt and implement sound environmental management on all levels to achieve disaster risk reduction and improve the environment.

APPENDIX 2: HAITI MAP WITH CASE STUDY AREA

Source: Adapted from (HaitiCulture 2001)	**Legend: Fondwa, Ouest Region –Case Study Area**

APPENDIX 3: HAITI'S NON-FUNCTIONAL NATIONAL DISASTER MANAGEMENT STRUCTURE



Explanation of Different Government Bodies:

CPD = Civil Protection Directorate
Responsibility: Appoints CNGRD; oversees all disaster-related government actions

CNGRD = National Disaster Committee
Membership: Minister of the Interior, Minister of Health, Minister of Public Works and Transportation, Minister of the Environment, Minister of Development, Minister of Social Affairs, Minister of Justice and Public Safety, Minister of Education, and President of the Haitian Red Cross
Responsibility: Centralized decision-making body;

Comité Consultatif = Consultative Committee
Membership: composed of several civil society members and science experts
Responsibility: Acts as oversight body to check and – if necessary – balance the actions taken by SPGRD

SPGRD = Permanent National Disaster Secretariat
Responsibility: Facilitates technical coordination for disaster response and the management of all actions planned in National Disaster Plan

COU = Disaster Management Branch of SPGRD

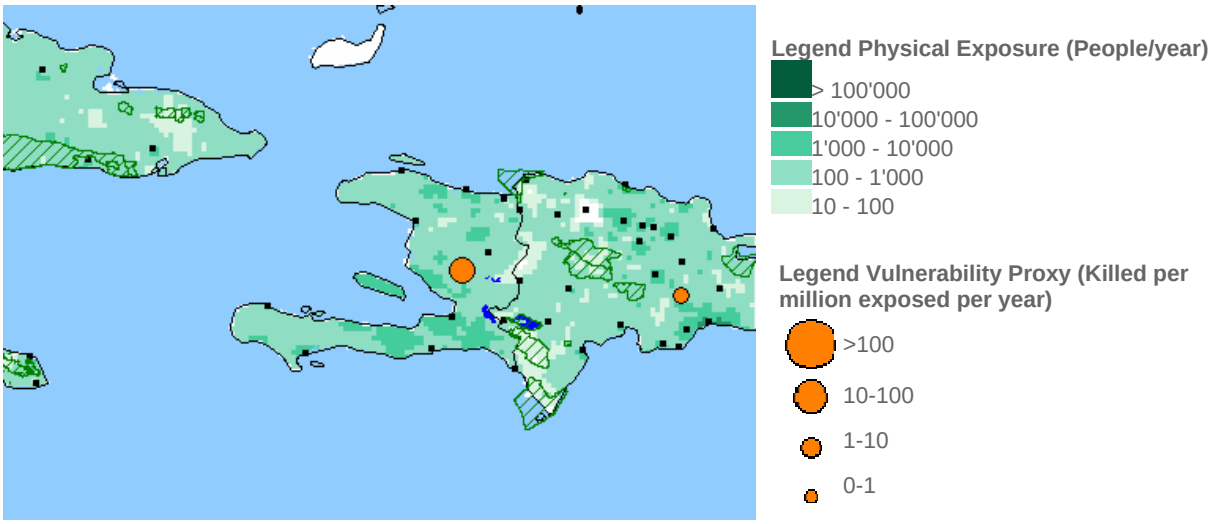
Risques = Risk Management Branch of SPGRD

Plans Sectoriels = Disaster and Risk Plans for various Government Sectors
Responsibility: SPGRD creates these plans in order to implement the National Disaster Plan

Comité Départmentaux & Locaux = Regional & Local Committees
Responsibility: SPGRD delegates responsibility for community and NGO involvement in management and implementation to regional and local institutions = decentralization.

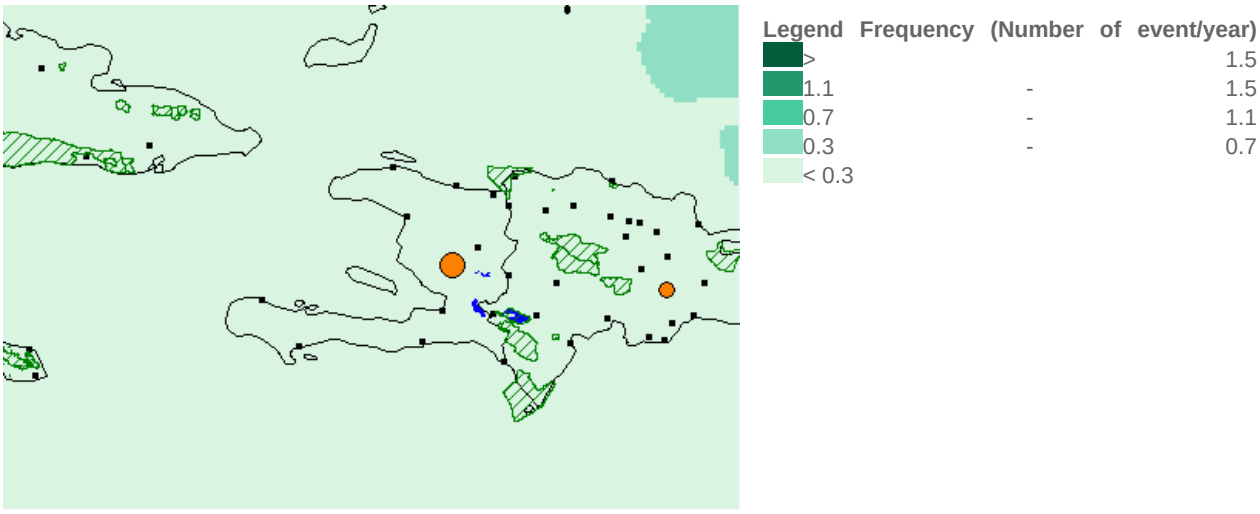
APPENDIX 4: HAITI'S EXPOSURE AND VULNERABILITY MAPS, BY NATURAL HAZARD TYPE

Cyclone Exposure & Relative Vulnerability



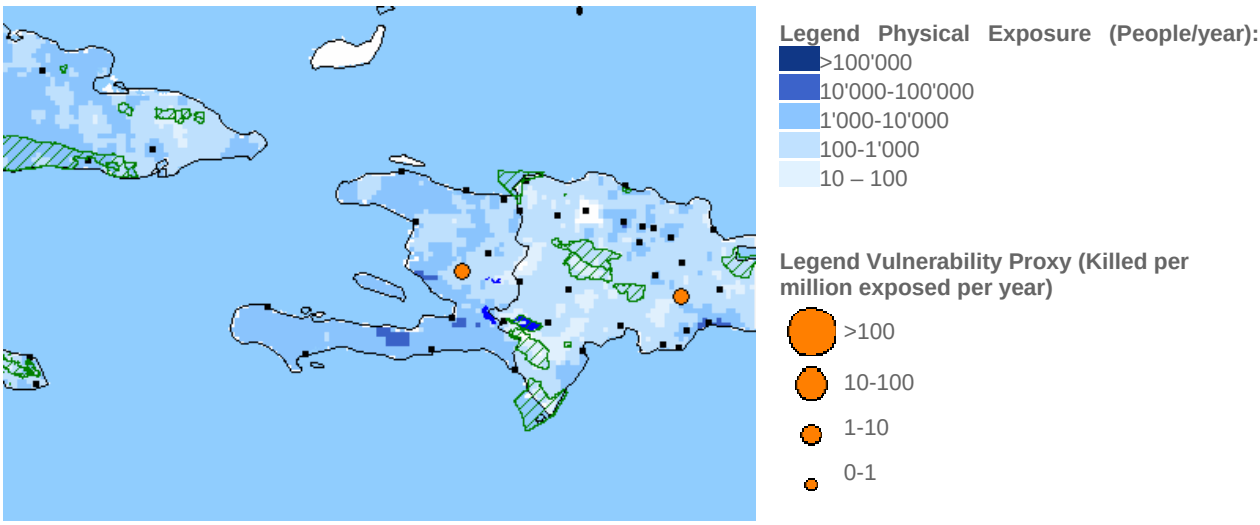
[Source: (CRED 2006)]

Cyclone Frequency & Relative Vulnerability



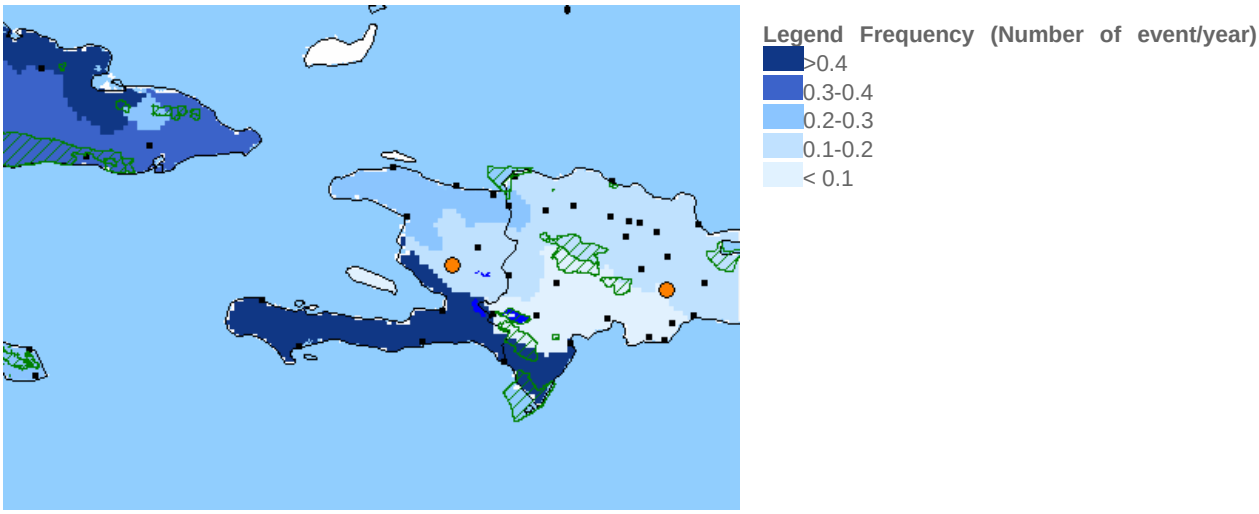
[Source: (CRED 2006)]

Flood Exposure & Relative Vulnerability



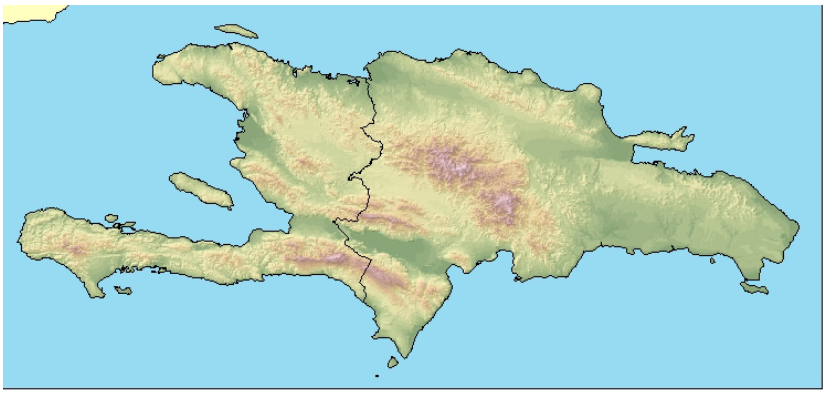
[Source: (CRED 2006)

Flood Frequency & Relative Vulnerability



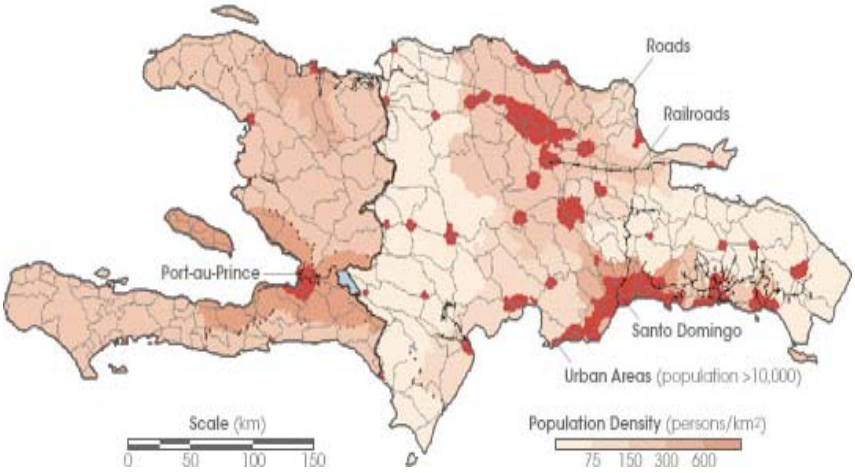
[Source: (CRED 2006)

Landslide Exposure (Topography)



[Source: (CRED 2006)]

Population Density



[Source: (Gubbels and Brakenridge 2004)]

APPENDIX 5, Table 1: Robust Framework for Evaluating the Introduction of Risk-Reducing Community-Based Environmental Management (CBEM)

Options / Criteria	Integrated Watershed Management	Reforestation		Sustainable Agriculture	Alternative Energy			Awareness, Education, Early Warning
		Hillside	Mangroves		Wind	Solar	Hydro	
Appropriateness of CBEM Approach	*Does the political / economic / social environment allow for the success of a community-based environmental management project? Is it financially feasible and administrable?*							
Administrative/ Technical Feasibility (capacity / financial viability)								
Political Feasibility (all roles clearly defined?)								
Cultural Feasibility								
No Viable Alternatives?								
CBEM Structure and Process	*Does the structural set-up and the management process allow for the community-based environmental management to succeed in generating the desired outcomes?*							
Legitimacy (acceptance; multi-stakeholder process)								
Public Participation/ Commitment (communication, trust, dialogue)								
Accountability/ Transparency								
Sustainability (longevity of CBEM structure)								
Fairness (equity in voice, power-sharing, opportunities)								
Conflict Management Structure (Dispute settlement; prioritization of issues)								
Flexibility/ Adjustment Mechanisms (Adaptive Management Structure – responsiveness to community needs)								
Effective Leadership (empowering local communities)								
Strategic Vision / Goals (Ecological, Economic, Social target setting)								
Overall Evaluation: Implement? (H= High, M= Medium, L= Low)								

[Scale: 5= Very High, 4= High, 3= Medium, 2= Low, 1= Extremely Low, X= Inapplicable]

APPENDIX 5, Table 2: Robust Framework for Evaluating the Success of Risk-Reducing Community-Based Environmental Management (CBEM) Efforts

Options / Criteria	Integrated Watershed Management	Reforestation		Sustainable Agriculture	Alternative Energy			Awareness, Education, Early Warning
		Hillside	Mangroves		Wind	Solar	Hydro	
CBEM Outcomes (compared to status quo)	*Does / can the project achieve its intended environmental and social goals / outcomes?*							
Ecological viability (accomplish goals in feasible time)								
Economic / Livelihood Benefits (incentives for continued participation)								
Self-sufficiency (management and finances not relying on outsiders)								
Social Benefits (i.e. public services; greater social cohesion, etc.)								
Increased Environmental Consciousness								
Enhancing resilience to Hazards?	*Does the project achieve its key target of reducing risks to environmental hazards?*							
Community's key disaster risk reduction goal (establish via situation assessment) (i.e. decreased flood impact; etc.)								
Reduction of Lives Lost								
Reduction of population affected								
Reduction of impact on livelihoods								
Improved ecological balance / resistance								
Overall Evaluation of Success (H= High, M= Medium, L= Low)								

APPENDIX 6, Table 3: Evaluating the Introduction of Risk-Reducing Community-Based Environmental Management (CBEM) in FONDWA, Haiti

Options / Criteria	Integrated Watershed Management	Reforestation		Sustainable Agriculture	Alternative Energy			Awareness, Education, Early Warning
		Hillside	Mangroves		Wind	Solar	Hydro	
Appropriateness of CBEM Approach	*Does the political / economic / social environment allow for the success of a community-based environmental management project? Is it financially feasible and administrable?*							
Administrative/ Technical Feasibility (capacity / financial viability)	3	4	X	4	1	3	2	4
Political Feasibility (all roles clearly defined?)	3	4	X	4	2	4	3	5
Cultural Feasibility	3	3	X	4	4	4	3	4
Viable Alternatives? (Yes / No)	No	No	X	No	Yes	Maybe	Maybe	No
CBEM Structure and Process	*Does the structural set-up and the management process allow for the community-based environmental management to succeed in generating the desired outcomes?*							
Legitimacy (acceptance; multi-stakeholder process)	4	3	X	5	X	4	4	5
Public Participation/ Commitment (communication, trust, dialogue)	4	4	X	4	X	4	4	5
Accountability/ Transparency	4	4	X	4	X	4	4	4
Sustainability (longevity of CBEM structure)	5	5	X	5	X	5	5	5
Fairness (equity in voice, power-sharing, opportunities)	4	4	X	4	X	4	4	5
Conflict Management Structure (Dispute settlement; prioritization of issues)	4	4	X	4	X	4	4	4
Flexibility/ Adjustment Mechanisms (Adaptive Management Structure – responsiveness to community needs)	4	5	X	5	X	5	3	5
Effective Leadership (empowering local communities)	5	5	X	5	X	5	5	5
Strategic Vision / Goals (Ecological, Economic, Social target setting)	5	5	X	5	X	5	5	5
Overall Evaluation: Implement?	Medium Term	Short Term	X	Short Term	Long Term	Medium Term	Medium Term	Short Term

[Scale: 5= Very High, 4= High, 3= Medium, 2= Low, 1= Extremely Low, X= Inapplicable]

APPENDIX 6, Table 4: PREDICTED Success of Risk-Reducing Community-Based Environmental Management (CBEM) Efforts in FONDWA, Haiti

Options / Criteria	Integrated Watershed Management	Reforestation		Sustainable Agriculture	Alternative Energy			Awareness, Education, Early Warning
		Hillside	Mangroves		Wind	Solar	Hydro	
CBEM Outcomes (compared to status quo)	*Does / can the project achieve its intended environmental and social goals / outcomes?*							
Ecological viability (accomplish goals in feasible time)	✓	✓	X	✓	No	✓	?	✓
Economic / Livelihood Benefits (incentives for continued participation)	✓	✓	X	✓	✓	✓	✓	✓
Self-sufficiency (management and finances not relying on outsiders)	?	✓	X	✓	No	No	No	✓
Social Benefits (i.e. public services; greater social cohesion, etc.)	✓	✓	X	✓	No	✓	✓	✓
Increased Environmental Consciousness	✓	✓	X	✓	✓	✓	✓	✓
Enhancing resilience to Hazards?	*Does the project achieve its key target of reducing risks to environmental hazards?*							
Community's key disaster risk reduction goal: decrease landslide and flood impacts on lives lost and physical infrastructure!!!	✓	✓	X	✓	No	?	?	✓
Reduction of Lives Lost	?	?	X	?	No	No	No	✓
Reduction of population affected	✓	?	X	?	No	No	No	✓
Reduction of impact on livelihoods	✓	✓	X	✓	✓	✓	✓	✓
Improved ecological balance / resistance	✓	✓	X	✓	✓	✓	✓	?
Overall Evaluation of Success (H= High, M= Medium, L= Low)	Promising	Very Promising!		Very Promising!	Goal for Future	Promising	Promising	Very Promising!

APPENDIX 7: Ouest Region – Severity of Hillside Deforestation

[Source: (Michel 2005)]

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