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Hari Srinivas

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Hari Srinivas

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Abstract

It is only recently that more attention is being paid worldwide to the impacts of a disaster in environmental terms, and understand the cyclical interlinkages between environmental degradation and disaster risk.

Two important environmental trends - land use/land cover change and climate change (resulting directly and indirectly from our lifestyles and consumption patterns) - lead to environmental vulnerability that increases the negative impacts of disasters. In fact, a disaster is a reminder that something is not right with our environment.

This chapter will explore the interlinkages of these and other environmental trends that is increasing the risks of disasters for vulnerable communities. It makes recommendations on how to create a common ground to take advantage of the positive synergies between environmental management and disaster management.

INTRODUCTION

The world is facing an increasing frequency and intensity of disasters - natural and man-made - that has had devastating impacts. The impacts of disasters, whether natural or man-made, not only have human dimensions, but environmental ones as well. Environmental conditions may exacerbate the impact of a disaster, and vice versa, disasters have an impact on the environment. Deforestation, forest management practices, agriculture systems etc. can exacerbate the negative environmental impacts of a storm or typhoon, leading to landslides, flooding, silting and ground/surface water contamination.

As reported by the secretariat of the International Strategy for Disaster Reduction (ISDR), the last ten years have seen 478,100 people killed, more than 2.5 billion people affected and about US$ 690 billion in economic losses.[5] Disasters triggered by hydro-meteorological hazards amounted for 97 percent of the total people affected by disasters, and 60 percent of the total economic losses

Meteorological and hydrological events, such as typhoons, are hazards that cause heavy rain, high wind and sea surges. But the real damage also happens due to the vulnerability of the people who lie in its path. Post-disaster assessment of hurricanes and typhoons have clearly illustrated that, along with disaster preparedness, proper management of the environment - its air, land, water, forests, and wastes, go a long way in reducing the risks and vulnerabilities associated with typhoons.

The November 2004 typhoons in the Philippines claimed over 1,000 lives and devastated the livelihoods of many more. The recent Indian Ocean Tsunami was even more distractive, with more than 150,000 lives were lost.

In the post-disaster phase, the high volume of wastes from disasters, from households and debris from forests and rivers, also constitute a major environmental concern for proper disposal. For example, rapid environmental assessments made by UNEP show that more than 1.2 million m^3 of debris is estimated to have been generated from the Indian Ocean Tsunami in the city of Banda Aceh alone.[11] study conducted by Japan's Ministry of Environment also showed that air pollution from urban and industrial sources has lead to increased acid rain by hurricanes and typhoons.[9]

The greater tragedy is that many of the losses due to disasters could have been averted. Logging, both legal and illegal, contributed to the incidence of flooding and landslides. There is now increasing understanding of priority being placed on the importance of wise environmental management for disaster risk reduction.

Around the globe, land use and land cover changes are eroding the natural buffers that protect communities from hazard risk. These same changes often erode people's capacity to recover from disaster. Other environmental changes, such as anthropogenic global warming, promise to create new challenges to the security and sustainability of communities around the world. There are, however, opportunities to reduce disaster risk, and enhance risk reduction.

> **The long Arm of Humans**
>
> Communities will always face natural hazards, but today's disasters are often generated by, or at least exacerbated by, human activities. At the most dramatic level, human activities are changing the natural balance of the earth, interfering as never before with the atmosphere, the oceans, the polar ice caps, the forest cover and the natural pillars that make our world a livable home.
>
> But we are also putting ourselves in harm's way in less visible ways. At no time in human history have so many people lived in cities clustered around seismically active areas. Destitution and demographic pressure have led more people than ever before to live in flood plains or in areas prone to landslides. Poor land-use planning; environmental mismanagement; and a lack of regulatory mechanisms both increase the risk and exacerbate the effects of disasters.
>
> *- Kofi Annan, former UN Secretary General*

We have only now come to realize that taking care of our natural resources and managing them wisely not only assures that future generations will be able to live sustainably, but also reduces the risks that natural and man-made hazards pose to people living today. Emphasizing and reinforcing the centrality of environmental concerns in disaster management has become a critical priority, requiring the sound management of natural resources as a tool to prevent disasters or lessen their impacts on people, their homes and livelihoods.

CYCLICAL INTERLINKAGES OF DISASTERS AND THE ENVIRONMENT

Communities worldwide have been facing an increasing frequency and variety of disasters, which have had a number of direct and indirect causes as well as effects. One of the key cause-effect factors that has received considerable interest is the environment (as shown in Figure 1). While much attention has been paid to the negative effects of disaster events on the environment, much less attention has been focused on the implications of poor environmental management practices and ecological degradation, which aggravates a disaster's impact.

Box 1: Environmental Degradation

The picture of cyclical linkages between the environment and disaster events is all too familiar: Environmental degradation leads to over-exploitation of remaining resources, destroying the buffers that natural ecosystems (such as forests, mangroves or coral reefs) provide. This results in reduced resilience of vulnerable populations and compounding the impacts of disasters that they face.

A number of threats to the environment, such as land degradation, deforestation, erosion etc. have had a number of impacts on recent disaster events. A quick observation of recent disasters from 1994 to 2000 show an increasing predominance of disasters that have their precedence in environmental causes, or impacts intensified by poor environmental management. Worldwide, the number of people affected by disasters, whether hydro-meteorological, geological or biological, and the economic loss resulting from the disasters have increased correspondingly. Disasters have particularly affected lower-income countries' GDP – for example, Hurricane Mitch caused more than US$ one billion in Nicaragua in 1998, which was more than 50 percent of its GDP.[2]

Many scientists have argued the correlation between extreme weather events (such as typhoons, storms etc.) and global environmental change - particularly within the Intergovernmental Panel for Climate Change (IPCC). Experts of IPCC and other institutions are increasingly linking the current trends of greater severity and occurrence of disasters to the rise in global mean temperatures, and associated changes in precipitation and wind velocities. These also appear to be influencing the occurrence of storms, drought and landslides.

A storm that struck Seychelles in September 2002 caused extensive economic damage to the islands of Mahe, Cousin and neighboring islands, significantly affecting its fragile biodiversity - both flora and fauna. The UNEP/OCHA Joint Environment Unit (JEU) identified problems such as ground water contamination, clean-up of debris in an environmentally sound manner etc. as a result of the disaster.[7]

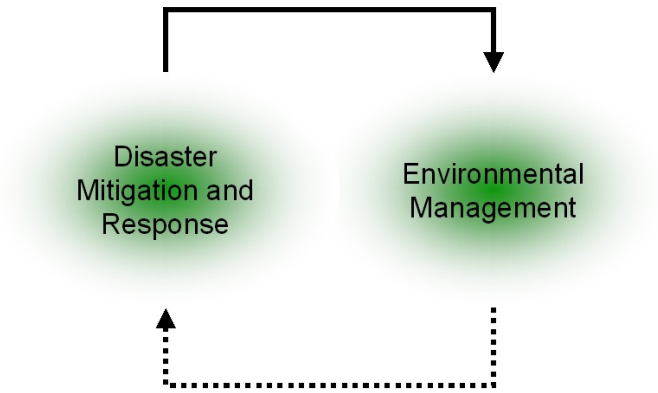

Figure 1: Disasters and Environment Interlinkages

Similarly, a rapid environmental assessment of Hurricanes Ivan and Jeanne that hit Haiti, Grenada and the Dominican Republic in September-October 2004, carried out by JEU, identified a number of environmental impacts including, for example, risks to ground and surface water in Grenada from garbage and destruction of vegetation, and exacerbation of pre-existing environmental degradation, etc. It concluded that action is needed in the longer term to fill major gaps in knowledge about environmental impacts of disasters.[8]

> *There is a clear need to reinforce the importance of environmental concerns in the entire disaster management cycle of prevention, preparedness, assessment, mitigation and response and to integrate environmental concerns into planning for relief, rehabilitation, reconstruction and development. This will also require the enhancement of capacities to undertake short and medium-term activities in disaster management based on long-term environmental considerations.*
>
> *- Klaus Toepfer, former Executive Director of UNEP*

While a strong case on the linkages between global climate change and natural disasters is yet to be built, there is clearer consensus on the effects of disasters on the environment, ecology and human settlements, and vice versa, environmental degradation factors that increase the impacts of disaster events. These effects also last far beyond the scope and timeframe of immediate humanitarian relief response activities.

To illustrate this point, Wisner et al. conclude that to reduce disaster risk – that is, no loss of life, restricted damage or food security, and achieve safe conditions – that is, protected environments, resilient communities, or preparedness, we will have to reduce pressures – that is, capacitated local institutions and communities, and supportive macro development activities, by addressing the root causes – that is, increased access to decision-making and resources, reduce systemic vulnerability.[14]

Changing ecological conditions can themselves provoke emergencies, or aggravate disaster events, by placing concurrent stresses on the environment. Mitigating these stresses and their effects has become an important component in global efforts to ensure environmental security. This was clearly illustrated in the analysis of the 'Tokage' typhoon (Typhoon no. 23 of 2004) that struck Japan . Deforestation, forest management practices, or agriculture systems can intensify the negative environmental impacts of a storm or typhoon, leading to landslides, flooding, silting and ground/surface water contamination. This was also illustrated by the 2004 hurricane and storm tragedies in the Haiti, and in the Philippines.

While the degree of protection provided by the environment depends on a number of factors, social and natural scientists have been working calculate the "prevention dividends" of protecting the environment. The following examples have been compiled by IUCN:[6]

- A study of the value of conserving upland forests that form the watershed for the Vohitra River in Eastern Madagascar estimated the net present value (NPV)7 of protection benefits at $126,700. This value arises from the reduced costs of flooding and the increased net market value when less paddy is damaged by flooding.
- Sri Lanka's Muthurajawela marsh, a coastal peat bog covering some 3,100 hectares, is an important part of local flood control. The marsh significantly buffers floodwaters from the Dandugam Oya, Kala Oya and Kelani Ganga rivers and discharges them slowly into the sea. The annual value of these services was estimated at more than $5 million, or $1,750 per hectare of wetland area .
- In Malaysia the value of intact mangrove swamps for storm protection and flood control has been estimated at US$ 300,000 per km, which is the cost of replacing them with rock walls.
- The 40,000 hectares of managed mangrove forest in Matang, West Malaysia yield $10 million in timber and charcoal and over $100 million in fish and prawns every year.
- Mangrove forests in southern Thailand provide an estimated $3,679 NPV per ha in coastline protection and stabilization.
- Shoreline stabilisation is also important for inland rivers. In the eastern United Kingdom, the loss of vegetation along riverbanks was estimated at US$ 425 per metre of bank. This is the cost of maintaining artificial bank reinforcement to prevent erosion.
- Mangroves and other wetlands, as well as coral reefs, contribute to coastal protection, as they are able to dissipate wave energy. In recent years, mangrove destruction has resulted in damage to the coastal road going into the Portland Ridge, Jamaica. It has been estimated that the

total coastal protection value was around US$3.55 million in NPV or nearly US$400,000 per year (with a ten percent discount rate).

- In Indonesia, the value of coastal protection afforded by intact mangrove forest is estimated at between USD 829/km – USD 1 million/km.

Box 2: Climate Change and Hazard Risk

Many of the impacts associated with climate change exacerbate or alter existing hazards, such as droughts, floods, storms and heat waves. Climate change is caused by the anthropogenic emission of greenhouse gases and leads to alterations in global climate patterns with shifts in local precipitation, temperature and weather patterns. According to the Intergovernmental Panel on Climate Change (IPCC) climate change will stress critical ecosystems and lead to water and food shortages this century.

Climate change is also expected to lead to forest fires. The summers of 2003 and 2004 saw heavy forest fires in southern Europe, particularly Portugal, as a result of the lack of rain and high temperatures. For countries where deforestation is a major cause of land degradation and changes in water flows – like many African countries – forest fires could have serious consequences for development.

Climate change has already been evidenced in many parts of the world. Scientists are careful not to attribute a single event to climate change, but they do acknowledge the growing frequency and magnitude of hazards in general.

Although climate change can be addressed by limiting activities that cause greenhouse gas emissions, scientists are in agreement that too little has been done so far. People will need to adapt to face the impact from the warming that is already unavoidable, due to past greenhouse gas emissions. The IPCC confirmed that adaptation to current weather extremes can increase resilience to climate change.[3] The first step to climate change adaptation begins with addressing existing vulnerabilities to current climatic extremes, linking directly with disaster risk reduction. It is also important to address the more subtle but ongoing changes in average climatic conditions and climatic variability, which by worsening vulnerability may impact coping capacity to deal with hazards. The required climate change adaptation measures, such as early warning systems, risk assessment and sustainable natural resource use, are—in practice—disaster risk reduction activities.

It has to however, be accepted that not all disasters have negative impacts. For example, not all disasters result in significant environmental impacts - many earthquakes have only minor impacts on ecosystems. Some extreme climate events can have positive

impacts on local environment - floods can help rejuvenate floodplain vegetation. Thus a 'disaster' may also have beneficial ecological consequences. However, these benefits tend to manifest themselves only months or years after the event. (e.g. rejuvenation of a forest years after a fire) or are not readily apparent (e.g. recharging of groundwater stocks after a flood).

We have only now come to understand these cyclical causes and impacts, and the realization that taking care of our natural resources and managing them wisely not only assures that future generations will be able to live in sustainable ways, but also reduces the risks that natural and man-made hazards pose to people living today. It becomes, therefore, important for us to see the cyclical linkages – of environmental degradation and their exacerbation of a disaster's impacts, and of a disaster's impacts on the environment.

A Sample of the Cyclical Interrelationships of Disasters and the Environment

Different types of disasters have different types of impacts on the environment, and vice versa, are exacerbated by different factors of the environment. The following table provides a quick snapshot of the various potential environmental impacts and exacerbating environmental factors.

Table 1: Disasters and their Environmental Impacts

Earthquakes	
Potential environmental impacts	• Natural gas leaks, household and industrial chemical releases from damaged containers. • Damage to industrial facilities resulting in toxic release. • Building waste debris, and potential mix of hazardous materials
Exacerbating environmental factors	• Topography and land cover • Building codes and urban planning/urbanization processes
Flood, storms, hurricanes, typhoons, cyclones	
Potential environmental impacts	• Sewage overflow and chemical releases from roads, farms and factories; • Hazardous debris – chemicals, medical and other materials as disaster debris; • water-damaged household chemicals (paint, pesticides, solvents); unsafe water supplies • Ground and surface water contamination • Loss of topsoil due to rapid drain of runoff.
Exacerbating	• Habitat and ecosystem destruction (e.g. coral reefs

environmental factors	and mangroves) • Deforestation and water siltation • Urbanization and land use/land cover changes
Forest fires	
Potential environmental impacts	• Loss of biodiversity and ecologically sensitive habitats. • Air pollution from smoke and haze
Exacerbating environmental factors	• Climate change • Deforestation and land use/land cover changes
Droughts	
Potential environmental impacts	• Habitat and crop destruction • Water scarcity
Exacerbating environmental factors	• Urbanization and unsustainable resource consumption • Deforestation and land use/land cover changes
Landslides	
Potential environmental impacts	• Damage/deterioration of habitat ecosystems • Land use functions, including agriculture • Ground and surface water contamination
Exacerbating environmental factors	• Deforestation • Land use/land cover changes

THE INDIAN OCEAN TSUNAMI AND ITS ENVIRONMENTAL IMPACTS

At 0058 GMT on 26 December 2004, a massive earthquake of magnitude 9.0 struck the coastal area off northern Sumatra in Indonesia. A number of after shocks also occurred, some of magnitude 7.1. These earthquakes triggered tsunamis that affected Indonesia and neighbouring countries in Asia (including India, Malaysia, Maldives, Sri Lanka, and Thailand) and the east coasts of Africa (including Somalia and Yemen), causing serious damage to the coastal areas and small islands.

While the final death toll will never be known, an estimated 250,000 persons have perished in the tsunami, majority of them women and children. Millions more have been displaced or rendered homeless . The damage from the tsunami was particularly severe as an increasingly percentage of the population, and many key cities and towns, lie within 50 km of the ocean edge.

The international response mounted to provide rescue and relief to the affected communities was unprecedented in its volume and scale, with national institutions, UN and international organizations, community groups and NGOs, and a variety of other entities coming together to provide different kinds of aid and services.

With the initial focus of the international relief and recovery efforts being on humanitarian aspects of the disasters, attention is now slowly shifting to longer-term rehabilitation and reconstruction, where environmental issues are coming to the fore. Recovery of environmental assets, such as water, land, forests and agricultural and fisheries areas, and eco systems such as mangroves and coral reefs, will require a concerted and integrated approach that will not only improve these assets, but will make them better prepared for future disasters.

Observations from the Affected Countries

A number of observations on the impact of the tsunami on the environment were recorded in the affected countries. These related to both natural as well as man-made aspects of the environment.

Solid waste and disaster debris remain the most critical environmental problem faced by the countries. The sheer magnitude of the disaster meant that the volume and nature of the disaster debris was far beyond the coping capacities of the cities and towns that were affected. Disposing these wastes in an environmentally appropriate manner, and recycling the waste where possible (for example, crushing of concrete and brick to produce aggregate for road and building construction) have been identified as critical priorities .

Combined with the issue of waste is that of hazardous materials and toxic substances that have been inadvertently mixed up with ordinary debris. These include asbestos, oil fuel, and other industrial raw materials and chemicals. Rapid clean-up of affected areas has also resulted in inappropriate disposal methods, including air burning and open dumping, leading to secondary impacts on the environment.

Contamination of soil and water was the second key environmental impact of the tsunami. Salination of water bodies such as rivers, wells, inland lakes, and groundwater aquifers has occurred in many of the affected countries. This has also affected the soil fertility of agricultural lands, due to salination and debris contamination, which will affect yields in the medium and long term. Some water bodies have been contamination by damaged or destroyed septic tanks and toilets, with sewage infiltrating the water supply system.

UNEP reported extensive damage to environmental infrastructure, buildings and industrial sites.[12] These include water and sanitation systems, solid waste disposal sites and waste treatment centers, particularly in urban areas (Maldives, Sri Lanka and Indonesia). Oil storage facilities have released oil and wastes into the environment, which have not been handled properly during the initial clean-up (Maldives and Indonesia).

But a number of good environmental practices, which mitigated the damage due to the tsunami, have also been observed. The 'first line of defense' afforded by healthy well-maintained coral reefs, mangroves, sand dunes and other coastal ecosystems such as peat swamps, provided protection from the tsunami, as evidenced by the damage assessments in Sri Lanka's Yala and Bundala National Parks .

A rapid assessment of the environmental impact of the tsunami conducted by the Stockholm Environment Institute showed a similar pattern - sand dunes, mangrove forests and coral reefs helped reduce the energy of tsunami waves in Sri Lanka by acting as natural barriers.[10]

Besides impacts on the environment, the tsunami also demonstrated the need for strengthening the capacities of environmental agencies at the national and local levels to handle disasters and emergencies and their environmental consequences. Besides loosing staff members, and facilities and equipment to the tsunami, the added responsibilities of relief and recovery planning and assessment highlighted the need for comprehensive capacity building in areas such as strategic environmental assessment, integrated environmental management, coastal zone planning etc.

At the local level, the lack of vulnerability and hazard mapping resources, and baseline demographic and other data, compounded the problem of carrying out comprehensive environmental impact assessments. This will clearly also affect the installation of community-based early warning systems and long-term disaster management and mitigation plans, as the rehabilitation and reconstruction phases of the tsunami response are implemented. Such information was also felt to assist future monitoring and disaster response strategies.

ENVIRONMENTAL VULNERABILITY - THE ISSUE

Healthy, productive and protective environments, social systems and economies are the basis of sustainable development and human welfare. The environment is the source of all our raw materials and absorbs the pollution from our activities. In turn, whilst going about our daily business (social and economic) we use the environment and convert its resources and natural services into those that directly support us. The problem is that all of these systems can be damaged, overloaded, or prevented from meeting our needs. By our own choices we can to a large extent determine our own quality of life, the condition of our lands and opportunities for future generations.

Vulnerability is a new way of looking at an age-old problem. Instead of focusing just on what has been going wrong in the past and the effects of hazards, vulnerability gives us the opportunity to focus on getting things right for the future. As a future-focused

approach, vulnerability is a way of using strengths and strategically improving weaknesses.

> "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." [5]

Vulnerability refers to the tendency of something to be damaged. The opposite of this is resilience, or the ability to resist and/or recover from damage. When we talk about vulnerability, we are automatically also talking about resilience because the two are opposite sides of a single coin. That is, something is vulnerable to the extent that it is not resilient, and visa versa.

The idea of vulnerability/resilience applies equally well to physical entities (people, ecosystems, coastlines) and to abstract concepts (social systems, economic systems, countries). The factors that cause the damage are known as hazards, each of which will be associated with some level of risk, or likelihood of occurring.

Why Focus on Vulnerability?

The vulnerability of our environmental, social and economic systems is made up of more than just the risk of disasters and good or bad management. It is not just about climate change, or globalisation, or trade agreements. It must also include an understanding of how well any system (environmental, social and economic) can cope with any hazards that may come its way and that might harm it.

It would be impossible to work towards good quality of life and growth for countries under a sustainable development model if no account were made of the damage that can occur from internal and outside influences.

As Figure 2 illustrates, a number of environmental drivers influence disaster risks, including climate change, loss of natural defenses and overall environmental degradation. But the environmental impacts of disasters – release of hazardous materials, debris, damage to natural resources etc. – create longer-term new and recurring vulnerabilities themselves.[13]

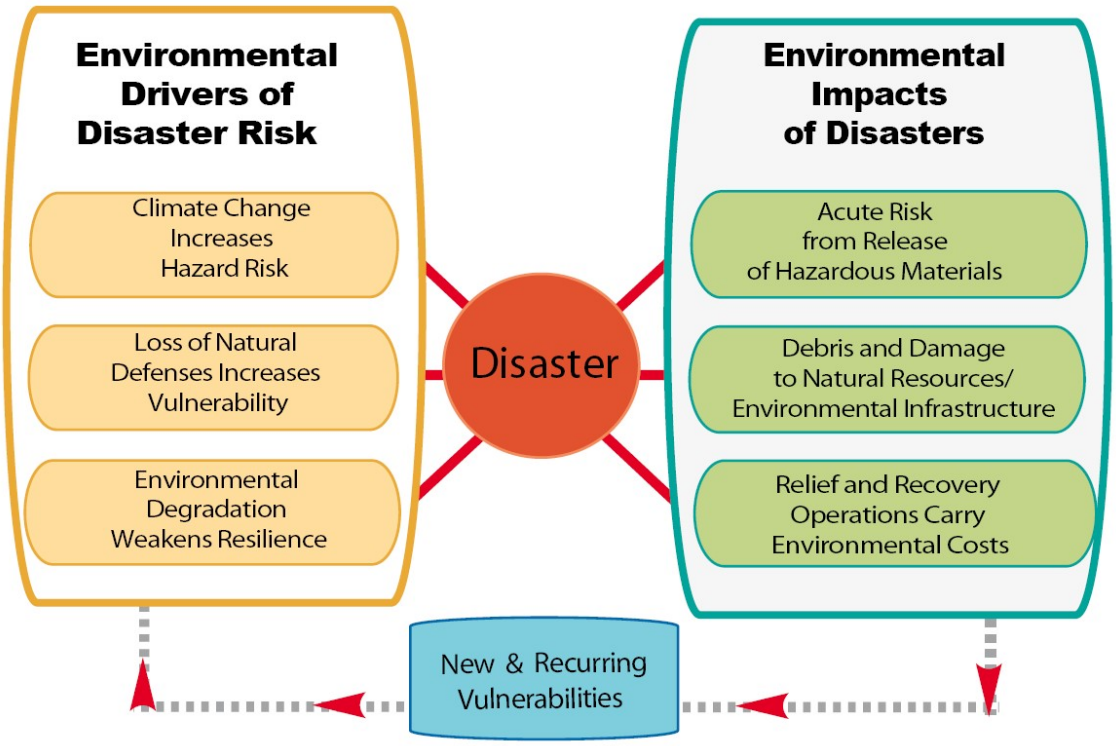

Figure 2: Environmental Drivers and Impacts of Disasters

Therefore, for development to be sustainable, we clearly need to learn to manage our vulnerabilities. We need to be able to understand and/or manage hazards, natural resilience and acquired resilience. This understanding for the first time opens up opportunities for improving our overall vulnerability because it forces us to examine the problem from all angles, instead of just focusing on the risk of disasters. Vulnerability management is emerging as a critical part of any sustainable development strategy.

The interesting thing about vulnerability is that it can be examined at different levels for different issues. That is, it can be used to look at a single issue, or to assess a complex entity such as a country.

ENVIRONMENTAL VULNERABILITY AND DISASTER RISK REDUCTION

At the core of environmental vulnerability action lies the need for comprehensive understanding of natural systems coupled with the application of management tools such as environmental evaluation and risk assessment can make a major contribution to a reduction of risks and mitigation of any impacts. An important aspect is the involvement of a broader range of partners in such a process, and to fully engage

the resources and interests of the private sector in prevention and mitigation. Business leadership of 'prevention' actions in civil society and industry needs to occur as a complement to government policies and institutional arrangements. Such an approach relies on industry codes and standards as a supplement to regulations, thus achieving enhanced reduction of civil society's vulnerability to potential disasters.

There is a need to highlight the role that comprehensive environmental management can play in reducing the risk of disasters, and to mitigate the consequences if they should nevertheless occur - both on human lives and on the broader ecology. We also need to explore the link between environmental systems and disasters, and also the synergies between man-made and natural disasters.

Specifically, we need to examine the need for a multi-stakeholder partnership that links local governments, private sector entities, and civil society organizations in order to facilitate more effective disaster prevention and mitigation. We need to compare successful partnership models between corporations, communities and the government, examining the way entities prepare for disasters themselves, as well as the need to be part of a larger partnership that strengthens local communities' ability to prevent, mitigate and recover from disasters.

Much work needs to be done in facilitating a sustained dialogue between different decision makers in the fields of both disaster and environment at global, regional and national levels. This dialogue will stem from raising greater awareness of the interface between disaster risk and environmental change, and identifying gaps in the understanding of critical hazards and risks at the local level. The dialogue will have to lead to new approaches in managing risk, and the environment, at the same time.

The focus should be on assessing global environmental conditions in order to identify potential environmental problems and new ways to address the complex effects of environmental change on sustainable development - requiring particular attention to be paid to the broad causes and effects of disasters. This will require the strengthening of capacities of developing countries and countries in economic transition to deal with environmental emergencies. Global meetings and initiatives, including the ISDR itself, have solidly endorsed the issue of emergency prevention, preparedness, assessment, mitigation and response, and strengthened the need to transfer know-how on environmental emergencies.

The increasing frequency and severity of man-made and natural disasters may well be changing the global environment. All of these threats to the environment have been apparent in recent disasters. Current response to disasters need to be based on the premise that disasters affect the environment when they have direct or indirect effects on ecology and human settlements that last far beyond the scope of immediate humanitarian response. Changing ecological conditions can provoke emergencies by

placing concurrent stresses on the environment. Mitigating the effects of disasters are primary components in global efforts to ensure environmental security.

It is clear that further coordination and cooperation on environmental matters depends on the global community's ability to set an environmental agenda for disaster management, and in particular, to pay attention to the environmental conditions that lead to disasters, and to natural resource management for disaster prevention and reduction.

There is a clear need to reinforce the importance of environmental concerns in the entire disaster management cycle of prevention, preparedness, assessment, mitigation and response and to integrate environmental concerns into planning for relief, rehabilitation, reconstruction and development. This will also require the enhancement of capacities to undertake short and medium-term activities in disaster management based on long-term environmental considerations.

ENVIRONMENT AND DISASTERS: A STRATEGIC IMPERATIVE

Incorporating environmental vulnerability within disaster management has been an elusive objective. There are a number of causes for this situation, both as a result of a lack of awareness and also misplaced priorities. In low-income countries hardest hit by disasters, developmental priorities are still placed on health, job creation and income generation, education, etc. Environmental protection receives comparatively lower priority in national policies and development plans. With disaster management, much of the focus is on immediate humanitarian relief, for both pre-disaster preparedness, and for post-disaster response.

Administrative obstacles and entrenched attitudes also exist. Disaster management and environmental management are, in many cases, handled by different administrative sections. For example, in Japan, the environmental management section of a local government deals with disaster waste only, and feels that it has no other role to play. The disaster management section usually deals with immediate evacuation, search and rescue, and coordination of post-disaster activities. Long term rehabilitation and development are managed individually by different sections, with little, if any, coordination among them.

To stop this vicious cycle of environmental degradation and the frequency and impact of disasters, it will be important to bring all these priorities together, developmental, environmental and disasters, particularly for developing countries, in realizing that the positive synergies and externalities that can result from this process.

Box 3: Chapter IV. Protecting and managing the natural resource base of economic and social development [15]

24. Human activities are having an increasing impact on the integrity of ecosystems that provide essential resources and services for human well-being and economic activities. Managing the natural resources base in a sustainable and integrated manner is essential for sustainable development. In this regard, to reverse the current trend in natural resource degradation as soon as possible, it is necessary to implement strategies which should include targets adopted at the national and, where appropriate, regional levels to protect ecosystems and to achieve integrated management of land, water and living resources, while strengthening regional, national and local capacities.

26. Develop integrated water resources management and water efficiency plans by 2005, with support to developing countries, through actions at all levels to:
(d) Develop programmes for mitigating the effects of extreme water-related events.

37. An integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, including prevention, mitigation, preparedness, response and recovery, is an essential element of a safer world in the 21st century. Actions are required at all levels to:

(a) Strengthen the role of the International Strategy for Disaster Reduction (ISDR) and encourage the international community to provide the necessary financial resources to its Trust Fund;
(b) Support the establishment of effective regional, sub-regional and national strategies and scientific and technical institutional support for disaster management;
(c) Strengthen the institutional capacities of countries and promote international joint observation and research, through improved surface based monitoring and increased use of satellite data, dissemination of technical and scientific knowledge and the provision of assistance to vulnerable countries;
(d) Reduce the risks of flooding and drought in vulnerable countries by, inter-alia, promoting wetland and watershed protection and restoration, improved land-use planning, improving and applying more widely techniques and methodologies for assessing the potential adverse effects of climate change on wetlands and, as appropriate, assisting countries that are particularly vulnerable to these effects;
(e) Improve techniques and methodologies for assessing effects of climate change and encourage the continuing assessment of these adverse effects by the Intergovernmental Panel on Climate Change;
(f) Encourage the dissemination and use of traditional and indigenous knowledge to mitigate the impact of disasters, and promote community-based disaster

management planning by local authorities, including through training activities and raising public awareness;

(g) Support the on-going voluntary contribution of, as appropriate, NGOs, the scientific community, and other partners in the management of natural disasters according to agreed, relevant guidelines;

(h) Develop and strengthen early warning systems and information networks in disaster management, consistent with the International Strategy for Disaster Reduction;

(i) Develop and strengthen capacity at all levels to collect and disseminate scientific and technical information, including the improvement of early warning systems for prediction of extreme weather events, especially El Niño/La Niña, through the provisions of assistance to institutions devoted to addressing such events, including the International Centre for the Study of the El Niño phenomenon;

(j) Promote cooperation for the prevention and mitigation of, preparedness for, response to and recovery from major technological and other disasters with an adverse impact on the environment in order to enhance the capabilities of affected countries to cope with such situations.

38. Change in the Earth's climate and its adverse effects are a common concern of humankind. We remain deeply concerned that all countries, particularly developing countries, including the least developed countries and small island developing States, face increased risks of negative impacts of climate change and recognize that, in this context, the problems of poverty, land degradation, access to water and food and human health remain in the centre of global attention…

41. Strengthen the implementation of the United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa to address causes of desertification and land degradation in order to maintain and restore land, and to address poverty resulting from land degradation. This would include actions at all levels to:

(d) Integrate measures to prevent and combat desertification as well as to mitigate the effects of drought through relevant policies and programmes, such as land, water and forest management, agriculture, rural development, early warning systems, environment, energy, natural resources, health and education, and poverty eradication and sustainable development strategies;

(e) Provide affordable local access to information to improve monitoring and early warning related to desertification and drought;

42. Mountain ecosystems support particular livelihoods, and include significant watershed resources, biological diversity and unique flora and fauna. Many are particularly fragile and vulnerable to the adverse effects of climate change and need specific protection.

Emphasizing and reinforcing the centrality of environmental vulnerability in disaster management has become a critical priority now, requiring sound management of natural resources as a tool to prevent disasters and lessen their impacts on people, their homes and livelihoods.

Meteorological and hydrological events, such as typhoons, are hazards that cause heavy rain, flooding, high wind and sea surges. But the real damage also happens due to the vulnerability of the people who lie in its path. Post-disaster assessment of hurricanes and typhoons have clearly illustrated that proper management of the environment – its air, land, water, forests, and wastes, go a long way in reducing the risks and vulnerabilities associated with such disasters.

The study and analyses of disaster management has to therefore intrinsically incorporate environmental management issues in order to develop strategies and policies that will lead to better disaster mitigation and risk reduction practices.

The Hyogo Framework of Action (HFA), adopted at the World Conference on Disaster Reduction in Kobe, Japan in January 2005, clearly outlined these interlinkages between broader disaster risk management and vulnerabilities due to environmental degradation:[4]

> " ... Disaster risk is increasingly of global concern and its impact and actions in one region can have an impact on risks in another, and vice versa. This, compounded by increasing vulnerabilities … points to a future where disasters could increasingly threaten the world's economy, and its population and the sustainable development of developing countries."

The HFA urges governments to pursue the "substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries" (paragraph 11). As such, it recognises both the role of environment as a trigger of disaster risk, and environment as among the Earth's components that are the most vulnerable to disasters. It cites "Reduce the underlying risk factors" as a Priority for Action and specifically recommends environmental and natural resource management and other efforts that:

> (a) Encourage the *sustainable use and management of ecosystems*, including through better land-use planning and development activities to reduce risk and vulnerabilities.

(b) Implement *integrated environmental and natural resource management* approaches that incorporate disaster risk reduction, including structural and non-structural measures, such as integrated flood management and appropriate management of fragile ecosystems.

(c) Promote the integration of risk reduction associated with existing *climate variability and future climate change* into strategies for the reduction of disaster risk and adaptation to climate change, which would include the clear identification of climate-related disaster risks, the design of specific risk reduction measures and an improved and routine use of climate risk information by planners, engineers and other decision-makers.

The starting point for reducing disaster risk and for promoting a culture of disaster resilience lies in the knowledge of the hazards and environmental vulnerabilities to disasters that most societies face, and of the ways in which these are changing in the short and long term, followed by action taken on the basis of that knowledge."

For example, Vietnam has taken concrete steps in operationalizing these principles. It has integrated DRR aims into the mandate of existing government agencies though integrating risk management into development policy. Examples of risk reduction activities undertaken by line ministries include:

- the Land Use Law, which regulates residential development to avoid construction in disasterprone areas
- the Law on Forest Protection which includes policy on afforestation and on forest protection, fire prevention and fighting
- government policy on managing coal mining to constrain pollution and environmental destruction
- enhancing the management of water sources, preventing pollution and waste of water, and limit-ing the impacts of riverine flooding.

Vietnam's Poverty Reduction Strategy Paper has the stated aim of reducing by half the number of poor people falling back into poverty due to disasters and other risks. This is to be achieved by 2010.[1]

There is a clear need to raise awareness and develop strategies in emphasizing the positive externalities of good environmental practices for disaster management, and the overall cyclical interrelations between environments and disasters. But there are a number of barriers that need to be overcome before this can happen. Some of the recommendations being made for this purpose include:

- Obtaining political commitment from public authorities. This objective needs to be addressed through increased intersectoral coordination at all levels, the adoption of risk management strategies and the allocation of appropriate resources, including the development of new funding mechanisms. Disaster reduction should be dealt with as a primary policy issue for which public authorities should assume responsibility and should be pursued as a crosscutting issue aimed at ensuring policy integration among various sectors and across topics such as agriculture, food security, health and education.

- Increasing public awareness and public participation to reduce vulnerability to hazards. This involves programmes related to formal and non-formal education and should be addressed through public information, education and multidisciplinary professional training. The media, schools and higher education systems, as well as organizations such as the Red Cross and Red Crescent and locally based NGOs around the world, have a crucial role to play.

- Fostering better understanding and knowledge of the causes of disasters through the transfer and exchange of experiences and by providing greater access to relevant data and information. The issues to be addressed in this context are: the assessment and analysis of gender-specific socio-economic impact of disasters; the construction of databases on disasters; the formulation of suitable coping strategies for different social groups; the introduction of early warning systems; and the promotion of relevant scientific research, which takes into account both indigenous or traditional knowledge and the development and transfer of new knowledge and technologies. Efforts to link natural resource management with disaster reduction should also be encouraged.

- Stimulating interdisciplinary and intersectoral partnerships and the expansion of risk reduction networking amongst governments at national and local levels, greater involvement of the private sector, academic institutions, NGOs and community-based organizations (CBOs). This will require effective coordination mechanisms, such as appropriate institutional arrangements for disaster management, preparedness, emergency response and early warning, as well as the incorporation of disaster reduction concerns in national planning processes.

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Global Development Research Center (GDRC)
Kobe, Japan

Tel: +81-50-5534-5535
Fax: +81-78-452-8414
Email: gdrc@gdrc.org
Web: http://www.gdrc.org/