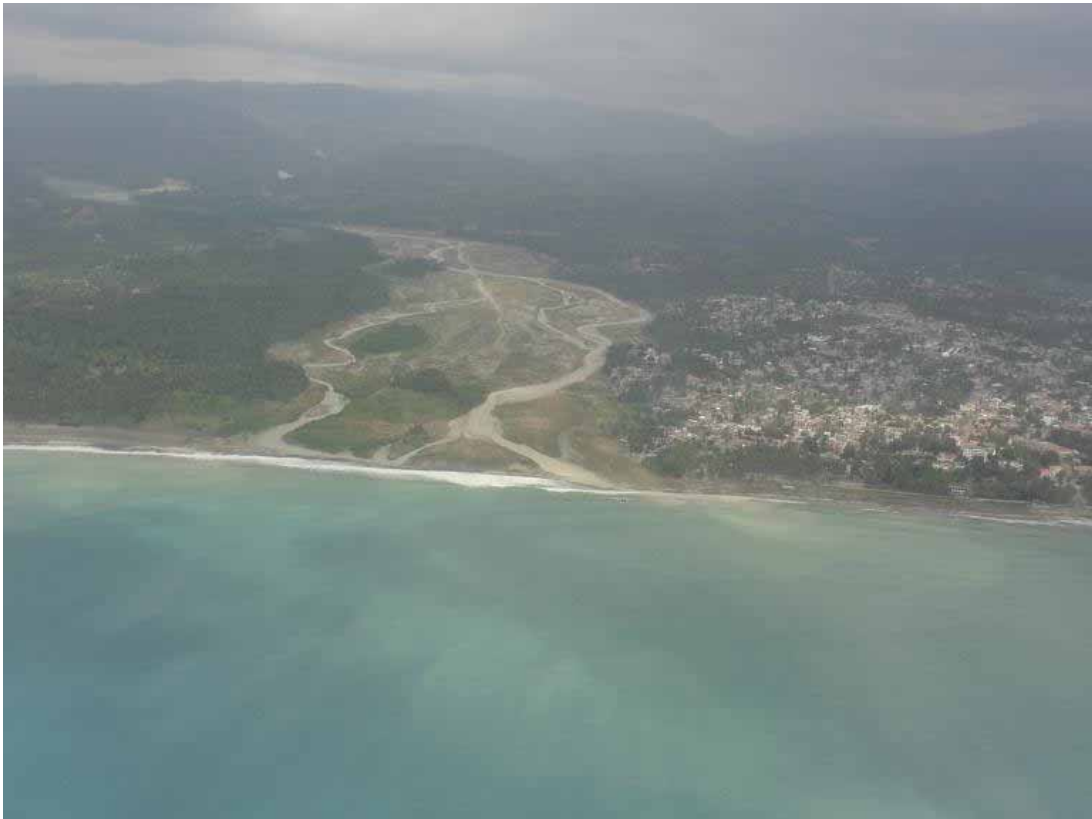




# Haiti Mission Report

20 January - 19 March 2010



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March 2010

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The remarkable resilience displayed by the Haitian people given the enormity of suffering they have faced offers hope for building back better.

## INTRODUCTION

### Country context

The Republic of Haiti is located in the Caribbean region, where it shares the island of Hispaniola with the Republic of Santo Domingo. Haiti is the poorest country in the Western Hemisphere, with 80 percent of the population living below the poverty line, and 54 percent in abject poverty. Two-thirds of all Haitians depend on the agricultural sector – mainly small-scale subsistence farming – for their livelihoods, and as such are very vulnerable to the impacts of frequent natural disasters, the effects of which have been significantly exacerbated by the country's widespread deforestation. Foreign remittances are the primary source of foreign exchange in the country, accounting for nearly a quarter of Gross Domestic Product (GDP), and representing more than twice the earnings from exports.

Haiti has suffered over the past decades from a lack of foreign investment, largely due to insecurity and limited infrastructure, a problem that has been compounded by a severe trade deficit.

### 12 January earthquake

On 12 January 2010, Haiti was struck by a 7.0 magnitude earthquake, the epicenter of which was located in the city of Leogane, near the capital Port-au-Prince. According to official United Nations (UN) estimates, the earthquake killed 222,570 people, injured an estimated 300,000 and left 1,000,000 homeless, making it comparable, in terms of human tragedy, to the South-East Asian tsunami of 2004 (which caused 230,000 deaths spread across fourteen countries). This catastrophic event was also characterized by severe damage to the capital city, where the majority of casualties were incurred, and by the enormity of its impact on humanitarian response mechanisms, due to the destruction of all lifeline buildings (ranging from the presidential palace to schools and hospitals).



The Haitian Government infrastructure was seriously impacted by the earthquake; above, the remains of the Ministry of Environment.

In addition to the severe damage in Port-au-Prince, several cities and villages in the south of the island were impacted, resulting in extensive death and destruction. The Government has estimated that some 250,000 residences and 30,000 commercial buildings collapsed or were badly damaged. The earthquake has thus led to significant population displacement, with many people, including some whose homes were not damaged, vacating the city and moving out into the open. The United Nations estimates that up to 1.9 million people are in need of food aid for the foreseeable future.

The United Nations, which had a large presence in Haiti prior to the earthquake, was also a victim of the tragedy, with 92 staff killed. The headquarters of the United Nations Stabilization Mission in Haiti (MINUSTAH) were destroyed, resulting in the demise of the Special Representative of the Secretary-General, along with many senior officials. Several other agencies suffered casualties, and most suffered loss of inventory and operational or programme data.

#### The international response

A massive international rescue effort was initiated immediately after the earthquake to assist the people of Haiti. The United States Government, various UN Agencies, the European Commission, the Red Cross and thousands of governmental and non-governmental organizations are currently active in Haiti, attempting to address the substantial material and social needs of the affected population. These services have included the provision of tens of thousands of temporary shelters, and a daily supply of food and water for impacted communities. In addition, measures to address the sanitation needs of affected populations have been initiated, although these will need to be further improved.

#### The environmental situation in Haiti prior to the 2010 earthquake

Haiti had serious environmental issues prior to the earthquake. These ranged from those caused by a lack of urban services (e.g. wastewater management and solid waste collection) to

soil erosion. Haiti's very sustainability had been significantly eroded by resource degradation, including severe deforestation. Environmental governance in the country was also facing severe constraints due to a lack of comprehensive legislation, institutional capacity and the wider economic reality of the country, which had relegated environmental management far down on the list of governmental priorities.



Severe deforestation in Haiti is clearly contrasted with the forest cover across the border in the Dominican Republic.

As a result, Haiti suffered significantly more than its neighbour the Dominican Republic during the frequent cyclones and tropical storms that hit the Island of Hispaniola, and in the rainy seasons. A cursory look at a “Google Earth” image of the island shows a clear contrast between the eastern and western parts. The eastern two thirds appear green (covered in forests and vegetation), while the western third appears almost completely brown (heavily deforested). Flying over the island, the contrast is even more striking. Not only are there more trees in the eastern part, but one can also see a better network of roads and transport infrastructure. In addition, no siltation from rivers – which makes the sea appear brown at the estuary – is visible.



Extensive deforestation and erosion greatly exacerbated physical vulnerability to the January 12 earthquake.

A comparison of key demographic statistics for the two countries further illustrates the contrast between the two parts of the island, and provides an indication of the vulnerability and coping capacity of Haiti’s population.

Table 1: Key demographic statistics for Haiti and the Dominican Republic

Indicator	Country	
	Republic of Haiti	Dominican Republic
Size in square kilometers	27,750	48,670
Population	9,035,536	9,650,054
Per Capita Income, in USD	1,300	8,200
Infant mortality	60/1,000 live births	26/1,000 live births
Life expectancy	60	73.7
Literacy percentage	53	87
Percentage GDP invested in education	1.4	3.6

As one drives through the country, the tragedy of Haiti is even more visible. It is not just that the hills of Haiti are more denuded, but that as a result a high level of soil erosion has also been ongoing for decades. Consequently, only a very thin crust of top soil is visible, often as little as an inch, supporting the vegetation on the top. Large quarries for excavating limestone for building construction can also be seen all over the country, with the result that rivers are almost white in colour, carrying chalky limestone sediments all the way to the sea. The sea turns white at the estuary, occasionally leaving a trail of the mix up to a kilometer into the turquoise sea water.

On the ground, unplanned urbanization and resulting environmental issues are clearly observed, along with significant levels of poverty. It is clear to any trained environmental eye that the roots of the unplanned urbanization and poverty are the same – the destruction of the natural resource base that can sustain local populations in their original places of residence and offer them a reasonable quality of life.

In comparing the two countries, it is easy to forget that although they have more or less the same population, the Dominican Republic has twice as much land cover as Haiti. The Dominican Republic’s success in preserving its environmental resources, including its topsoil, empowers it to sustain its population with far less pressure on its natural resources.

#### The environmental consequences of the disaster

The impact of the earthquake was magnified by the degraded environment, serving to create a humanitarian tragedy of epic proportions. The earthquake also increased the scale and scope of environmental degradation, generating tens of millions of tons of solid wastes in need of handling. In addition, overcrowded camps have become hotspots for environmental pollution, while reconstruction operations, when they are initiated, are expected to leave a significant environmental footprint.



## UNEP in Haiti

In 2009, working with the Government of Haiti, the William J. Clinton Foundation, the Earth Institute at Columbia University and various agencies of the United Nations, the UN Environment Programme (UNEP) formulated a comprehensive country-wide strategy known as the Haiti Regeneration Initiative (HRI), aimed at reducing poverty and disaster vulnerability in Haiti through the restoration of ecosystems and livelihoods based on sustainable natural resource management.



A UNEP expert inspects road damage in the days following the earthquake.

While making environmental sustainability technically more difficult to achieve due to the additional environmental destruction that has been caused and the shift in overall baselines for the country, the earthquake serves as dramatic illustration of the growing need for such a programme.

Thanks to senior staff on the ground at the time of the earthquake, UNEP has been an integral part of the international response effort, assessing the environmental impacts of the disaster, providing environmental expertise to partner agencies in the humanitarian system to integrate environmental concerns into relief and rescue operations, and continuing to promote the urgent need for long-term environmental regeneration.

## About this report

As part of this effort, UNEP undertook extensive field visits to the earthquake-impacted areas of the country. The following chapters present the key observations of this field work. These are presented as “snapshots” of the main areas of concern, aimed at providing an illustration of the overall situation. Specific recommendations are purposely excluded from this overview, and will form part of a flagship UNEP report to be launched by the summer of 2010.

## METHODOLOGY

The post-disaster context is generally characterized by a period of intensive activity and considerable confusion. Thousands of people, ranging from rescue workers to missionaries, descend upon the affected country, hoping to help the victims. Naturally, saving lives and providing immediate care to the living must always be the first priority. Conducting environmental assessments is not considered a priority at this stage, unless the emergency itself has disproportionate environmental impacts (such as the breaking of a dam), or is one that causes an environmental disaster (such as an oil spill).

In the absence of an acute environmental emergency, UNEP's objectives in the post-disaster setting are three-fold. First, UNEP seeks to ensure that the environmental situation does not become an impediment to the relief and recovery operations. This is done by providing targeted technical assistance on key environmental issues to relevant stakeholders. Second, it ensures that environmental concerns are mainstreamed into all the recovery and reconstruction plans that are formulated in the post-disaster context. Finally, it seeks to ensure that safeguards are built into the overall emergency response so that it does not cause additional environmental damage.

In order to give targeted assistance to agencies undertaking recovery and reconstruction operations, and to provide environmental inputs to the various UN and other planning processes, field visits are necessary. However, in the short period of time available between the event and when key decisions are taken, it is not always possible to conduct extensive site visits to all areas; nor is it always feasible to have a multidisciplinary team move around the country due to logistical difficulties.



The UNEP team flew over earthquake-impacted parts of the country, surveying possible damage to land masses, ports and the coastline.



In Haiti, the methodology for field visits had to be improvised in order to collect the maximum amount of actionable intelligence in the smallest possible amount of time, using minimal logistical support. As a result, the following approach was taken:

1. A helicopter flight covering all earthquake-impacted parts of the country was conducted, during which particular attention was given to evaluating those features that are most appropriately observed from the air (land slides, land subsidence, lakes, port).
2. Cross-country transect visits were undertaken by vehicle in all four directions from Port-au-Prince, to better understand the impacts across the affected area. These transects continued up to Meraguane in the West, Jiamni in the East, Gonaives in the North and Jacmel in the South.
3. Targeted visits were undertaken to areas that were known to be specifically impacted by the earthquake, such as internally displaced person (IDP) camps, landslide and subsidence locations, locations of mass graves, areas where demolition debris had been deposited, and hospitals where medical wastes had accumulated.
4. Scoping visits were undertaken to areas that could potentially be impacted by recovery activities, including proposed new campsites, waste management facilities and forests that could be harvested for charcoal.

All visits were conducted by a team of at least two experts, one being a national expert familiar with the geographical area and thematic issue investigated. The visits were documented and photographed, and periodic rapid environmental assessment reports were produced for dissemination via the humanitarian UN “One Response” website and network.

## OVERVIEW OF KEY ENVIRONMENTAL ISSUES

### 1. Disaster debris and waste management

#### *Managing disaster debris*

All disasters leave behind a trail of debris in need of collection, sorting, treatment and disposal. The management of disaster debris has become an integral component of post-disaster response, as illustrated by the number of experts specializing in disaster waste and NGOs active in the field of disaster waste management. Depending on the scale of the event, disaster waste management can become a billion dollar activity, as was the case following the collapse of the World Trade Center and the passage of Hurricane Katrina in the USA.

Unsurprisingly, even before experts had arrived in Port-au-Prince, email exchanges began circulating regarding disaster debris management in Haiti. Environmental experts were by now so cognizant of the challenges of post-disaster debris in developing countries that detailed guidelines on specific issues, including the handling of asbestos, were circulated.

The situation in Port-au-Prince presents a similar scenario to other earthquake-related disasters, with a large-scale destruction of buildings burying everything below. In addition, a number of buildings that are currently standing are unsafe for use and will need to be demolished, thereby producing even more debris.



The earthquake caused multiple building storeys to crumble onto each other, compacting everything within.

The immediate debris situation in Haiti was compounded by the fact that in the days following the earthquake, the municipal waste collection services collapsed, resulting in routine municipal wastes piling up on the streets. In addition, the heavy concentration of people in tents and camps in open areas is causing solid waste to be generated in new areas. The debris management situation is further complicated by the fact that even before the earthquake, Haiti did not have a reliable solid waste management system. There was a landfill

in Port-au-Prince – a large open area where solid waste was brought from all over the city – as well as some disposal trucks in circulation, and a few skips. In most other parts of the country, the situation was even more rudimentary, with populations often left with the task of disposing of any solid waste generated within their communities.

The most prevalent debris resulting from the catastrophe is large quantities of construction material, primarily concrete from hollow bricks or reinforced concrete structures. Communities and former building inhabitants have been collecting reinforcing bars as scrap iron. Similarly, where hollow bricks have not broken but rather collapsed, they are being collected for reuse.

Once homeowners and communities will have collected all the material that is safely recoverable, the problem of managing the millions of tons of disaster debris will remain. The ongoing management plan that was initiated by the US Army and funded by USAID is based largely on the collection of concrete in demolition debris and its removal to pre-designated areas where it can be safely disposed of, including in coastal areas.



The collapse of municipal waste management services in the immediate aftermath of the earthquake led to the accumulation of everyday waste alongside disaster debris.

As yet, no specific plan has been formulated for managing those components of the disaster debris that cannot be easily recycled. A significant challenge in this respect centers on the fact that ascertaining the nature of materials comprised in disaster debris is not always intuitive. For example, collapsed school buildings can become the source of highly contaminated debris, particularly when the collapsing building damages school laboratories, releasing various chemicals. Another example is supermarket freezers used for meat storage, which can lead to both explosive and biological hazards due to the degradation and fermentation of meat once the supply of electricity is interrupted. An indicative list of what constitutes disaster debris is provided in the box below. Each waste stream requires careful handling and separation, as mixing various streams leads to contamination of all waste, and thereby to environmental contamination.

**What is in a disaster debris pile?**

- E-wastes such as computers, telephones and TVs
- “White goods” such as refrigerators, washing machines, dryers
- Hazardous materials such as bleach
- Radioactive materials from hospitals, industries and laboratories
- Explosive gases from households, hospitals, industries
- Petroleum products from gas stations, power plants
- PCBs from transformers
- Ammunition from houses, army camps and police stations

In Haiti, the clean-up effort by the affected communities and the Government started in the days immediately following the earthquake. A month after the incident, disaster debris management became a priority target for cash-for-work programmes initiated by UN agencies, various NGOs and donors. Unfortunately, however, the planning process for debris management did not keep pace with implementation, leading to large quantities of disaster debris being dumped, often unsorted, in virtually every type of open space available, including ravines, drains, road sides, swamplands, waste management centers, river beds, rivers and the even the sea.

*Municipal solid waste management centres*

Municipal solid waste management in Haiti is similar to that of many developing countries, and is characterized by a culture of low wastage and high recycling, coupled with limited institutional management of the facilities for the disposal of those materials that cannot be reused or recycled.



Municipal waste services have resumed across Port-au-Prince, although coverage is still limited.



Port-au-Prince has all the elements of a waste management system in place: skips placed across various parts of the city, a number of waste collection trucks, and a landfill where waste is collected and compacted. The system also has a number of informal features, however. As a result of incomplete collection by the municipal authorities, waste is often dumped across the city, in rivers and in the sea. In addition, there are a large number of on-site scavengers who collect any recyclable materials from the landfill prior to waste incineration.

In many parts of Port-au-Prince, the lack of municipal services for solid waste management has led to environmentally unacceptable situations. The worst example of these is the concrete drainage channel close to the main bus station in Carrefour, which is in many ways the most active part of the city, and one of the most economically important. The channel, which leads into the sea, is filled with garbage that has completely blocked the drain. In the event of heavy rains, the blockage causes the drain to flood, spreading the accumulated waste material throughout the crowded surrounding neighbourhood. Indicative of current relief efforts, the drain which was originally littered with remnants of urban life (plastic bags, tin cans, soft drink bottles, etc.) is now also full of the styrofoam packaging that is used to provide food supply to displaced communities.



In many parts of Port-au-Prince, drainage channels are filled with solid waste. This causes localized flooding every time there is heavy rainfall.

This situation is replicated in many other parts of the city, where drains and ravines appear to be the preferred means of disposal for solid waste. This may be partly because of the ease with which waste can be tipped into these locations from high areas, and partly because it gets washed off every rainy season. Regardless, this activity is causing both unsightly scenes and environmental contamination.

The Port-au-Prince landfill, which is located in an area known as Truitier, comprises a large area covering hundreds of hectares. It is situated approximately one kilometer from the beach, and was originally a swamp, with the water table at ground level. It is clear that the site for this



landfill is inappropriate, a surprising choice considering that there are a large number of open quarries in the environs of the capital where the water level is much deeper and which would therefore have been far better options.

In addition to inappropriate siting, the landfill also suffers from inadequate control and improper operation. Although there was a partial fence around the area prior to the earthquake, there was also a community of scavengers living on the landfill. The scavengers routinely set solid waste piles on fire, creating a very unhealthy environment for themselves, as well as an unsafe situation for motorists driving in the area.

Following advice from experts, a number of cells for the disposal of excreta from the camps and healthcare waste from the hospitals were dug in the landfill. The immediate needs of the earthquake survivors and the need for expediency trumped the serious environmental concerns regarding this site, in particular the location of the water table at ground level.

The solid waste management situation in other cities is less organized than in Port-au-Prince. In Jacmel, the only other city where aspects of a formal solid waste management system can be observed, there is no specific location for the disposal of municipal solid waste. A new facility for the storage, sorting and composting of biodegradable waste has been constructed but is not yet operational. In addition, municipal waste is often dumped into the local river bed.

#### *Management of healthcare waste in Port-au-Prince*

Given the scale of the human tragedy caused by the earthquake, an unprecedented number of patients with varying traumas were taken to medical facilities and to temporary hospitals. Among the concerns for environmental experts was the lack of adequate facilities for the management of healthcare waste in Haiti.



Post-disaster environmental damage is often exacerbated by the absence of effective mechanisms to dispose of the medical waste generated by emergency response operations.

This matter was discussed between UNEP, the World Health Organization (WHO), and the Haitian Government, and it was agreed that a temporary facility to dispose of medical wastes would be created within the municipal landfill in Titanye. A design for the same was provided and the facility was promptly constructed. Additional steps to train staff, equip them with the required personal protective equipment (PPE), and to provide suitable containers for the collection of healthcare waste were also agreed.

Concurrent efforts were also initiated by NGOs to fabricate temporary incinerators in the Dominican Republic, with a view to bringing them to Haiti. Ideas to construct such facilities in Haiti were also discussed.

However, within the first week it was obvious that major leakage of healthcare waste was occurring from the system, including bloodied bandages and severed limbs, which were conspicuous by their absence. Although provisions had been made to procure a truck to collect healthcare waste from the seventeen hospitals in the city, only half-loads of waste were arriving on site after three days. Moreover, the material that arrived was constituted mainly of empty cartons from hospitals, and not the truly biohazardous medical waste for which the disposal site had been intended.

In early February, Dr Per Berg of Sweden – recruited by MSB (the Swedish Civil Contingencies Agency) and seconded to UNEP – arrived in Port-au-Prince as a technical expert to assist the Government in the management of biohazardous wastes. As part of this mission, he established a work plan to identify the shortcomings in the system, track its implementation and provide training support to the team.

The mystery of the missing healthcare waste was partly solved when investigations were initiated to ascertain where the hospitals were disposing of their medical wastes. It came as a great relief when it was established that a number of these hospitals had incinerators which had remained functional throughout.



A number of hospital waste incinerators remained functional following the earthquake, aiding in medical waste management.

It also became clear during this investigation that the system by which hospitals had arranged the collection of biohazardous wastes with the dedicated driver was not working well. To resolve this, the Government, supported by an expert from the US Army, developed a new routing plan covering the facilities which did not have resident captive incinerators.

In mid-February, a team from the Service Métropolitain de Collecte de Résidus Solides (SMCRS) (the municipal solid waste management authority) was provided with personal protective equipment and trained by the UNEP/MSB expert in the proper handling of biohazardous wastes. Unfortunately, despite measures to ensure that the cells containing medical wastes were built away from the scavengers (and the presence of eight trained staff who were instructed to guard them), they were set on fire for unknown reasons.

Dr Berg also visited hospitals in the interior of the country, including some in Petit Guave and Jacmel, which were mostly found to have their own functioning incinerators. These are all very basic and were therefore spared from the breakdown that affected more sophisticated electrical systems. The main shortcoming of these incinerators is that they do not function effectively without fuel.

In early March, containers for the segregated collection of biohazardous wastes arrived in Port-au-Prince after a long delay at the port in Santo Domingo. This was a major request from hospitals across the city to facilitate the collection of biohazardous materials on site. The containers were handed over to the SMCRS and distributed to various hospitals in Port-au-Prince and cities in the interior. In addition, a training session was conducted for hospital staff.

All the required elements for a functioning biohazardous waste management system are now in place, though confidence in the fact that the system is working may still be lacking.

## **2. Natural hazard, man-made tragedy**

### *A largely preventable tragedy*

The earthquake that struck Haiti on 12 January 2010 had a magnitude of 7.0 on the moment scale. It lasted 36 seconds and released energy equivalent to 31.6 megatons. The effects of the earthquake were felt as far off as Cuba, some 300 miles from the island.

The earthquake resulted in major losses of life and property, making it one of the worst disasters of this century, comparable to the South-East Asian tsunami in 2004. However, while the deaths in the tsunami were spread over 14 countries thousands of kilometers apart, all the fatalities in this case occurred within 100 kilometers of Port-au-Prince in an area covering only about 25 percent of the total geographical area of Haiti. The earthquake killed 222,570 people – one in every 45 Haitians – which is perhaps one the largest such ratios in history (major tragedies have typically occurred in more populated places). In addition, it devastated the capital city, demolished the presidential palace (along with numerous other ministries and Government buildings), destroyed the office of the United Nations (killing 92 UN staff including the Head of the Mission), and killed the leader of the opposition party and the capital's archbishop.

What makes the tragedy in Haiti so unique is the fact that it was largely preventable using existing knowledge of seismic activity and expertise in building construction. Haiti is known to

be located in a seismically active area. Port-au-Prince sits on at least two fault lines, and both have the capability to independently trigger earthquakes. There is a recorded history of earthquakes in Port-au-Prince, including some with loss of life and property. Earthquakes with a potential magnitude of 7 had been predicted by number of geologists (including some in Haiti). It would have been possible, and within the limits of current knowledge of earthquakes and available construction techniques, to build a city that would have withstood this earthquake and would have resulted in fewer casualties.

To prevent a tragedy on this scale in the future, one must ask hard questions and be prepared to listen to difficult answers. The possibility of another earthquake of similar magnitude in the future is a statistical certainty. If the death and destruction that were observed in January 2010 are to be avoided in the future, there are two ways forward, both of which are difficult, but feasible:

Shift the capital city to another area that is safer from natural hazards. It should be kept in mind that earthquakes are not the only, nor the most frequent, natural hazard in Haiti. In looking for an alternative location for Port-au-Prince, a multi-hazard based approach must be adopted, in addition to all other strategic considerations; and  
Rebuild the city taking into account the possibility of re-occurrence of earthquakes, as well as the fact that Port-au-Prince is vulnerable to other natural hazards, such as heavy rain and typhoons.

As noted above, both of these options are technically feasible, but politically difficult to enforce. What is likely to happen is a combination of the above, whereby some degree of urban decongestion is achieved through careful “social engineering,” disaster resilience is improved through better building codes (and enforcement of the same), and finally, by accepting that a certain degree of risk is inevitable and trying to mitigate it by establishing better early warning and emergency response measures.

#### *A concrete problem*

In disaster response circles, it is often said that “earthquakes don’t kill people, buildings do.” Nowhere has this statement rung truer than in Haiti. Of the 222,570 people who died in the disaster, only a handful was killed by the tsunami caused directly by the earthquake. Most died in their homes, their offices or in markets, hit by falling debris or crushed under the weight of the structures they happened to be in.

When the dust finally settles in Haiti, people will be able to identify the single most important agent of mass death and destruction: concrete. Indeed, if one factor led to this phenomenal tragedy, it is the lack of attention by engineers in the transition from wood-based to concrete-based construction that has occurred in Haiti over the past 50 years. Following the earthquake, old wooden buildings, sometimes up to three storeys high, could be found standing across the country. While many of these will need to be demolished, it is clear that the human toll of the disaster would have been significantly lower had the transition been made in a sound way.



Concrete hollow bricks were often incorrectly used as load-carrying building material, and collapsed easily during the earthquake

Concrete is such a popular building material in Haiti that it is used in all new construction work – for walls, roofing, floors, compound walls and columns. A number of key advantages help to explain why it is preferred over wood:

- With an abundance of limestone in Haiti, concrete can be made locally and cheaply in any part of the country;
- With increasing deforestation, wood-based construction is more expensive as timber is difficult to procure;
- Heavy construction based on concrete provides better protection against hurricanes;
- Concrete is easier to maintain than wood, which is easily affected by humidity; and
- Concrete does not create a fire risk, which is a cause of frequent damage and deaths in wood-based construction, particularly when buildings are close together.

While it is technically possible to design concrete buildings that can withstand 7.0 magnitude earthquakes, this particular engineering transition in Haiti took place in the absence of adequate building codes and supervision. As a consequence, a number of fatal mistakes were made.

First, limestone was used as a coarse and fine aggregate for making concrete for reinforced cement concrete structures. Unfortunately, limestone is not well suited for supporting heavy loads. Indeed it is clear from observations on the ground that a high proportion of lime in the concrete does not create adequate bonding to reinforcement bars. As a result, when the earthquake occurred, the concrete came off the reinforcement bars, making the columns and beams unstable and unable to behave as a single unit as designed, thereby failing the structure completely.

Second, concrete hollow bricks were used in virtually all building construction in the country, from low-cost housing to high-end buildings. When hollow bricks were introduced in the early 1970s, their intended use was solely to fill the spaces between the load-bearing elements of a



structure. The task of bearing the weight of the structure was quite rightly devolved to conventional bricks. But hollow bricks surreptitiously crept into civil engineering construction as an attractive building material. They were easy to produce, and did not require specialized technicians to make them. Moreover, there were no detailed specifications and the testing of products was not required.

In fairness hollow bricks, in addition to being easy to make and work with, have a number of advantages. In areas subject to heavy wind and rainfall, they provide stability, and in the past international donor agencies have promoted hollow brick construction as part of disaster risk reduction and community resilience projects in countries with similar vulnerabilities to Haiti. In places where the use of clay for brick-making has caused environmental damage – including threatening food security when paddy fields are used for extracting clay, for example – governments have promoted hollow bricks as environmentally desirable alternatives. Furthermore, building with hollow bricks requires far less cement (for bonding), no mortar and often no paint (both additional costs when conventional bricks are used), making them an unavoidable low-cost alternative and a standard element of construction in the developing world.



Disaster debris often contains a lot more than just brick and wood.

When the earth shook for 36 seconds on 12 January, all these structural elements were put to test – not only of static loads but also of dynamic stress. Hollow bricks, which were carrying loads they were not designed to carry, could not bear these additional stresses. Moreover, concrete which had little bonding with its reinforcement did not maintain cohesiveness. As the concrete came off, steel buckled, buildings collapsed, hollow bricks flew in all directions, and people were killed by the impact of falling debris, or crushed under their weight.

Finally, in the absence of proper building codes, trained engineers and effective enforcement, buildings were not designed or constructed taking into account their dynamic behaviours in a seismic situation.

In the reconstruction, there will inevitably be an instinctive reaction to return to wood-based construction, given how it has visibly survived the earthquake in many parts of the country. This would however be the wrong approach. The factors that made concrete superior (and wood problematic) have not disappeared as a result of the disaster. What is needed now is to

ensure better design factoring in all hazards, to decrease the dependence on limestone as the exclusive source of building construction material, and to develop and enforce building codes and quality control of building materials.

One of the most alarming trends observed in post-earthquake Haiti was that in the absence of a clear understanding of the role played by inadequate design and improper use of building materials, the same building materials are being used to execute repairs and to construct new buildings. This was noted even in the most impacted areas, where the man-made nature of the destruction is by now self-evident. It is imperative that these patterns be reversed to ensure that the vulnerabilities that led to tragic loss of life and destruction are not perpetuated.



The use of existing approaches to making concrete will rebuild the same vulnerabilities into future construction.

### 3. Chemical and industrial contamination risks

#### *Chemical and industrial pollution*

Earthquakes often trigger chemical spills and fires in industrial areas, gas stations and similar locations where chemical or potentially explosive substances are kept. In Haiti, however, no major cases of chemical contamination were reported, save for a limited hydrocarbon spill.

There are two main reasons for this fortunate situation. First, as mentioned previously, the earthquake was of medium magnitude, and as such did not cause the catastrophic collapse of slopes or well designed structures. Industrial storage sites for hydrocarbons therefore survived the earthquake without major leaks. Second, Haiti is not an industrialized country and therefore did not have many locations where chemicals, hazardous material or explosives were stored in industrial quantities.

In the early days after the earthquake, two events provided cause for alarm. First, in the main port of Port-au-Prince, the collapse of the quays caused a number of containers to be washed

into the sea. Fortunately, there is no indication so far that these containers contained any chemical or harmful substances.



After the earthquake, a number of containers in the main port were washed out to sea, causing some concern for potential contamination.

The second instance was that of a tank farm attached to the electricity generation facility in Carrefour, which suffered a rupture in a diesel tank that resulted in the spillage of fuel onto the adjacent land. This eventually found its way to the sea, creating a diesel slick a few kilometers long. The leak was plugged and the slick has since dispersed into the sea and evaporated. However the contaminated soil in the tank farm is still in need of an assessment and clean-up.

Beyond these two examples, the recovery team will need to focus on instances of small and dispersed chemical contamination in Haiti. This could include the following issues, which are not always obvious:

- Small quantities of various chemical substances that could be mixed with demolition debris from school laboratories and similar institutions;
- Quantities of bleach and other household chemicals that could be mixed with demolition debris from collapsed shops;
- Refrigerating chemicals from freezers, refrigerators and air conditioners;
- Hazardous substances from rotting meat in the debris of supermarkets and restaurants; and
- Industrial gases and paints mixed with demolition debris in workshops and hospitals.

If the possible presence of any of the above materials is anticipated by debris-clearing crews, these materials do not pose a threat to health or to the environment. However, if these materials are not identified and segregated at source, they will get mixed in with large quantities of demolition debris, converting it into hazardous waste.

### Where is the asbestos?

Shortly after the disaster, the environmental community started circulating guidelines on how to handle asbestos in the post-earthquake context in Haiti. This was prompted by disaster managers' experiences in the tsunami-affected countries and following the 2008 China earthquake, for example, where large quantities of asbestos were exposed, and ultimately contaminated even more demolition debris when they were all mixed up.

However, teams working on the ground in Haiti quickly noticed that asbestos was not used for roofing in the country. This was initially surprising, particularly considering that low-income countries typically use asbestos as a robust and economic alternative to more expensive building materials.

While there is as yet no definitive explanation as to why asbestos is not used in Haiti, one reason may be the periodic hurricanes that affect the country. Asbestos sheets are very brittle and are therefore likely to break during a hurricane, and become unusable. By contrast tin sheets, the preferred building material for low-income housing in Haiti, can be reused – even when they are torn off by storms.

### *The environmental impacts of mass graves*

A significant body of evidence, both anecdotal and photographic, confirms that the remains of the victims were brought in dump trucks to areas within Port-au-Prince and its environs, deposited into hurriedly dug pits and covered up. The question that needs to be asked is whether this practice is safe from a health and environmental perspective.

There are guidelines – primarily from the World Health Organization (WHO) – on the disposal of dead bodies following disasters. Three key points are clearly mentioned:

- The bodies of those killed by traumatic injuries do not pose a health risk to the people who handle them for disposal;
- For purposes of identification, each dead body should be photographed before it is disposed of; and
- For the sake of dignity and of possible future identification, dead bodies should not be stacked together in a pit.

In the case of Haiti, unfortunately, these recommendations were not followed for a number of reasons. The first is that the very large number of deceased simply overwhelmed the capacity of established systems to handle burials. Second, with the Government paralyzed due to casualties within key ministries and the destruction of property, the focus of surviving senior officials shifted to immediate survival (for themselves and their families) and to saving lives. As a result, the disposal of dead bodies was delegated to junior officials who were largely unaware of the WHO guidelines. In addition, it is now clear that international community did not provide the required attention or guidance to the issue at the appropriate time.



The remains of many victims were collected in trucks and disposed in hurriedly dug pits in Port-au-Prince and its environs.

It is important to note that even up to a month after the earthquake, it was not unusual to see dead bodies dumped along the roadside and in waste disposal piles. Some of these were collected and sent to mass burial sites, where they were buried in smaller pits. The situation concerning the disposal of victims is now more or less under control, although the same cannot be said about the bodies that were buried in mass graves.

This issue will need to be revisited for social and legal reasons, and it is assumed that at some point in the future, a more honorable burial will be provided to the victims, which could include an excavation of mass graves.

This section attempts to provide a dispassionate and objective look at the environmental impacts of mass graves, and to provide an assessment of the known locations from an environmental point of view.

A mass grave can have two types of environmental impacts. The first and perhaps most obvious, is that it can cause a major public nuisance as a result of biodegradation of flesh in anoxic conditions. This is likely to be the case in situations where the graves are shallow or where the top cover has been removed by animals or eroded by rain. The second possible impact is the potential contamination of water sources. This may happen due to the leaching of the chemical constituents of dead bodies and the microbes degrading them, and the proliferation of these in ground or surface water.

In all the burial sites visited by the UNEP team, graves were found to be very shallow and it is likely that foul smells will start to emanate from these locations in the months to come. While some of the locations are far removed from places of habitation and may not lead to a public nuisance, in others they are adjacent to settled communities and may cause significant difficulties.



Contamination due to leaching depends on how far above the groundwater table the bodies lie, whether there is any protective layer over them (like a tarpaulin or a body bag) and the nature of the surface cover. In the mass graves UNEP inspected, the surface cover was composed of soil that was neither well compacted, nor well supplemented by an impermeable layer around individual bodies, or indeed in the grave itself. A mitigating factor was that the locations visited by the team were all above the groundwater table. As a result, while some degree of leaching can be expected as rainwater seeps through the mass graves into the groundwater table, the impact will be limited as long as the areas do not flood for an extended period of time.

#### 4. Recognizing secondary risks and safeguarding critical infrastructure

##### *When earth moves: Landslides and related issues*

The impact of an earthquake on land masses is always visible, as the energy generated by the rupture of the fault is conveyed through land. This impact manifests itself in several ways on the land surface and is sometimes amplified on hillsides, resulting in landslides and rock falls that kill people, block roads and in some instances bury entire villages. In addition, heavy landslides can sometimes lead to the formation of temporary “quake dams” across rivers and heavy mud flows can be triggered. In rains that follow, mud flows often relapse, causing yet more damages.

The situation in Haiti follows this pattern, although on a smaller scale due to the relatively low strength of the earthquake. However, due to the geology of the hills and the pre-existing deforestation and degradation, the Haitian context presents additional challenges not encountered in other situations.



Before

After

In Haiti, 63 percent of the land surface has a slope of over 20 percent. Landslides following the earthquake took along swathes of trees, revealing limestone deposits below.

Indeed, the hills in Haiti are composed of limestone, with the vegetation surviving on a thin layer of topsoil that is sometimes laterite and at other times humus. The hills in the earthquake-impacted area are all highly deforested and subject to very significant soil erosion.

In addition, with limestone used as the main source of building material in the country, there are a large number of quarries in the impacted area. Finally, considering the significant population living on the hills and on planes beyond the hills, there are several roads that cut through limestone formations.

The following sets of impacts are currently visible in Haiti:

- A large number of landslides and rock falls can be found on the hills along the fault line, from Pétionville to Petit Guave. Landslides are, as expected, concentrated around the epicenter of the earthquake at Leogane;
- Wherever a quarry or road has cut into the hillside, the landslides have been exacerbated, bringing down large blocks along with the trees that covered them;
- Landslides have caused a number of road blocks along the Leogane-Jacmel highway and disruptions from rock falls continue to be reported;
- In at least one instance, a landslide led to the formation of a “quake lake” above the commune of Petit Guave, and caused considerable concern among the community living in the surrounding area; and
- There is evidence that the very high degree of erosion of exposed limestone faces will lead to considerable sediment transport into the sea during the rains. Indeed, the river beds are heavily covered in limestone sediments brought down during heavy rain.



Significant soil erosion caused by deforestation reduces the ability of top soil to support vegetation.

With current knowledge about the chemistry and geology of the rocks and climatic factors, the following situation can be predicted with some certainty.

In the heavy rainfalls that will invariably occur during the rainy season, there will be a significant number of landslides and mudflows along all the hills from Pétionville to Petit Guava, on the western side of the island towards Jacmel. This will lead to closure of the roads and the possible formation of additional “quake lakes.”

In addition, there will be a significant increase in sediment flows into the sea on both sides, leading initially to discoloration that will impact the natural beauty of the sea, and thereby likely impact on tourism. This excessive sedimentation will impact the mangrove forests in Petit Guave, the coral formations along both sides, and may also impact fisheries, at least in the shallow zone.



The upcoming rainy season is likely to increase sediment flows into the sea, potentially impacting mangrove forests, coral formations and fisheries.

The rivers barely support any fisheries; however, the rare existing ones will be destroyed by the chemical contamination of the river as the water flows through exposed limestone. Some chemical contamination of seawater will also occur, due to the high influx of lime from the river flows. There will be significant additional erosion from the hills during the next rainy season as many more faces have been exposed. This will continue throughout the coming years, until revegetation efforts succeed in stabilizing these surfaces.

The UNEP team received a number of independent confirmations of a tsunami-like phenomenon – where the sea withdrew to a distance and then returned with great force – along the coastline following the earthquake, but the ensuing waves were reportedly not very high and did not proceed beyond a hundred meters inland.

Finally, the land sank during the quake in some locations along the coast, submerging some houses and vegetation in the sea.

### *Safeguarding lifeline buildings*

It is a known fact that despite elaborate security precautions in most government headquarters, the aspect of safety management is often grossly overlooked. Individuals are as likely to trip, fall, and be subjected to electrical hazards in a presidential office or government building as they are in a large hotel. Although the security threat to the dignitaries and diplomats is obvious, there is often a tendency to assume that they are immune to safety risks. Naturally, such assumptions have no real basis.

A visit by the UNEP team to the Haitian presidential palace made it quite evident that even the most powerful men and women in the world are vulnerable to the risks posed by inadequate “workplace safety.” Indeed, the building collapsed completely during the earthquake and will need to be demolished.

It is customary for heads of state to occupy historic buildings as their workplace as well as their official residence. Although these old buildings are often retrofitted with modern amenities and security systems, basic safety issues are not always considered. In some situations, retrofitting buildings actually reduces their safety.

Haiti’s presidential palace (or National Palace or Palace of Government as it is sometimes called) was designed in 1912 by Georges H. Baussan, a leading Haitian architect who graduated from the Ecole d’Architecture in Paris and whose commissions included the City Hall of Port-au-Prince and Haiti’s Supreme Court building, both of which were also destroyed in the earthquake. It is now clear that what these buildings did not lack in elegance, grandeur, beauty or functionality, they lacked in seismic resilience.

In addition to the office of the President, the headquarters of the United Nations also collapsed, killing 92 UN staff, a tragic outcome for those responsible for coordinating relief and rescue operations.

The initial response and, to some degree, the ongoing response to the disaster have been impacted by the trauma faced by the occupants of these “lifeline” buildings. Yet, reasonably designed and reinforced structures would have withstood a 7.0 magnitude earthquake, so the question needs to be asked of why these critical buildings did not. There are two main reasons for this.



The presidential palace in Port-au-Prince was extensively damaged by the earthquake and will need to be demolished.

First, empirical observations show that societies integrate disaster preparedness into their planning best when a disaster recurs within a generation (33 years). Although Haiti has a history of earthquakes, major quakes occur much less frequently than that. Floods and

typhoons occur more often, with major events taking place every decade and recently with even greater frequency. As a result, architects and engineers chose sites, designed buildings, and used materials with a view to mitigating against these obvious hazards rather than factoring in the more remote – and as it turned out more fatal – possibility of an earthquake.

The second reason relates to our understanding of earthquakes. Much progress has been made in the second half of the 20th century in better understanding the nature of earthquakes and in designing earthquake-resistant structures. This knowledge was not available to those who designed the grandiose structures in the early 20th century, and certainly not to those who designed buildings before that. Evaluation of the existing buildings for their seismic resilience, while possible, is not an exact science; neither is completely safeguarding old buildings against earthquakes by retrofitting them entirely feasible.

The net result of the above factors – poor understanding of earthquakes, lack of building design codes, a loss of collective memory about more infrequent disasters, and, finally, a reverence for historical symbols – is that a number of buildings around the world are potentially unsafe for government use.

In disaster management systems, “lifeline” buildings are prioritized for improved construction and maintenance. These typically include hospitals (to treat victims), schools (to house refugees) and police stations (to manage law and order). Government buildings themselves are not routinely considered as critical buildings requiring specialized attention.

For countries around the world, the Haitian earthquake is a wake-up call that provides an opportunity to systematically assess the safety of critical buildings from a wide range of natural hazards. Governments should analyse the possible hazards threatening their key buildings, with a view to initiating a programme of “lifeline” building protection where necessary.

## **5. The challenges of post-disaster resettlement and reconstruction**

*Camps: One million people out in the open*

The Government has estimated that some 250,000 residential buildings collapsed or were badly damaged in the disaster. In addition to large-scale destruction of buildings and infrastructure, what distinguishes earthquakes from other disasters is that people are often so shaken by the experience that they express a natural reluctance to return to their homes. As a result, many of those who still have homes that are safe to return to prefer to stay out in the open for days, often months, before they regain the confidence to sleep under heavy roofing.

The situation in Haiti is no different. In the most heavily impacted areas, more than a million people now reside in the open, many of whom no longer have a home to return to. This mass migration of people has a significant environmental impact.

### **Siting of camps**

In the aftermath of the earthquake, displaced people set up camps wherever they felt safe (from the possible collapse of buildings) and secure (from expected looting). Environmental considerations were obviously not a concern, let alone a priority, in choosing these sites.



As a consequence, camps were established on closed streets, a children’s park, a football ground, a square outside the presidential palace, the ground below the Prime Minister’s house, outside the airport, near the MINUSTAH camp, near foreign embassies, as well as in hundreds of other locations. Along the road from Port-au-Prince to Leogane, the most sought after camp location is at the median of the road.



Hundreds of improvised camps that were set up across Port-au-Prince in the days following the earthquake.

There are currently no estimates of the number of camps or the number of people residing therein. While some listings of camps with sizes ranging from 100 to 5,000 people are available, there is need for far more systematic tracking by aid agencies, as well as documenting of their needs.

In the weeks to come, a number of the smaller campsites will be consolidated as people start to return to their homes or to those of their relatives, or to move towards the interior. For logistical purposes, camps will need to be consolidated into larger centres where, in addition to security, all essential services, including schools for children, can be provided. As the new camps are established, it is likely that a lot more people, including some who are living in tents within their houses, will move into the camps due to food security and educational opportunities for their children.

Environmental degradation can be observed at all of the sites (see detailed discussion below). As camps are closed, environmental due diligence, including thorough clean-up, will need to be carried out at every site before the sites can be returned to their original land use. Equally important will be an environmental assessment for all major new camp sites.



Vendors set up stalls all over Port-au-Prince, often within range of large uncollected waste piles.

### **Camp construction materials**

In the city of Port-au-Prince, camp accommodation is mostly quite rudimentary – tents made of wooden sticks supporting bed sheets. Camping tents are occasionally seen among the improvised shelters. In the more remote areas, however, camps are being constructed by cutting down small logs that are then screened by coconut leaves. At the moment, this choice of building material is not causing major environmental strain; however, unless these rural campsites are quickly converted into proper camps, a lot more extraction of timber can be expected for this purpose. It is important to keep in mind the nature of the materials that are to be used for camp construction, as this has the potential to cause severe environmental harm, particularly if materials have to be locally sourced.

### **Sanitation facilities in the camps**

As the camps sprung up without any planning, no systematic provisions were made for sanitation facilities. There were no separate facilities for men and women – neither for showers nor for toilets – and as a result people bathed wherever there was water available, and were forced to use open spaces for toilets. Although the overall situation has started to improve with the establishment of temporary facilities and some clean-up work in progress, it is still not to at an acceptable standard. Whether existing campsites are converted into long-term facilities or decommissioned as new facilities become available, these areas will need to be cleaned up and sanitized.

When new camps are established, a systematic approach to sanitation management must be adopted, including segregated toilets at an appropriate distance from places of habitation, regular collection of excreta, disposal of water from bathrooms and procedures for sanitizing the facilities at multiple daily intervals. In the Haitian context, particularly with the rainy season coming up, camp siting and development should make adequate provisions for a high rainfall scenario.



In the absence of adequate sanitation facilities in the camps, children bathe wherever they can find water.

### **Energy sources in the camps**

Cooking within the camps is undertaken almost exclusively with wood and charcoal, and usually takes place at the family level close to individual tents. This situation has environmental consequences:

- Health and safety issues including air pollution exposure as well as exposure to fire and the risk of it spreading through the tent, both of which will be magnified if there is rain and people start to cook inside; and
- Additional deforestation as communities scavenge for wood in cities and villages; the situation is compounded by the fact that many families who previously had access to bottled propane or kerosene do not anymore, making it likely that the need for charcoal will rise, further depleting forest resources in Haiti, and possibly even extending the environmental footprint into the Dominican Republic.

The sourcing of energy for camps will thus also have major environmental implications. For Haiti there will be no other option than a hydrocarbon-based fuel: neither the country, nor its neighbour can afford dependence on wood or charcoal for cooking fuel.

### **Water supply in the camps**

In Port-au-Prince, camp residents get water from the metropolitan supply, tankered water and 20-liter water bottles supplied by the World Food Programme (WFP). In addition, vendors selling water in small sachets have also been observed around the camps. It is unclear whether all of these water supplies meet drinking water standards, although UNICEF has been providing water purification tablets.

Once the proper camps are established, it will be important to assess and monitor:

- the water source used to supply the camp and water treatment provided;

- the quality of the water provided and any quantity concerns and;
- where the sewage is discharged.

Water security should be a key consideration in planning the siting of any new camp. As much as possible, the water supply should be from a perennial source.

#### **Solid waste management in the camps**

In addition to human waste, camps also produce the solid waste that can be expected from any human settlement. There is currently no designated area, collection system or disposal arrangement for solid waste management in the camps. Whenever proper camps are set up, these issues will need to be given due consideration as well.



The lack of solid waste management in IDP camps creates many health risks for residents.

#### *Caught between the hills and the sea: In search of a safe location for reconstruction*

In the immediate aftermath of the earthquake, a clear priority for aid agencies and the Government alike was the short- to medium-term resettlement of the displaced population.

Most of the damage occurred in Port-au-Prince, particularly in the hilly areas. The existence of another fault line starting from the hills of Pétienville and of the seismic gap there, coupled with the increased likelihood of another earthquake triggered by an exacerbation of that fault line by the 12 January earthquake, rendered the location unsustainable. As a result, UN experts and local counterparts quickly ruled out rebuilding in the hilly Pétienville area.





The presence of a fault line beneath the hills of Pétionville makes the area unsuitable for resettling impacted populations.

In addition, there was consensus between communities, the Government and NGOs that settling displaced people in low-lying areas around the city was not practical, given the real risk of flooding from heavy rains or cyclones.

In sum, there was no safe place for people to go, and no place where a disaster expert could conscientiously advise the Government to allocate space to resettle the affected population. The hundreds of smaller camps that were set up in the days following the disaster created a further challenge for the international relief effort. Their location and size made it difficult for the international agencies to provide the displaced with sanitation, security and food. Indicative of this were the challenges posed when communities settled on closed-off roads, making the provision of sanitation facilities difficult, or when more than 10,000 people established a campsite outside the presidential palace, creating logistical difficulties in delivering food that became a safety and security hazard.

In the absence of clear instructions from the Government, community-level decisions were made to identify empty plots of land and occupy them. While some of these settlements are safe, they are in many cases not environmentally appropriate. For example, one of the areas occupied by local communities is Morne Garnier, an area previously sanctioned as a national park, where the Government had initiated a re-plantation scheme that had had some success to date. However, this location has been completely taken over by the community, who are now so firmly entrenched that they have opened a temporary local government office of their original commune there. Although the Government is said to want to evict these people as a matter of urgency, recovering the national park may not be a priority in the absence of any alternative locations, and given the current relief climate.

Another large camp is currently expanding outside Port-au-Prince, beyond Titanye on the road to Gonaives. This elevated area, which overlooks the ocean, is in many ways an appropriate place to establish a temporary camp as it is removed from the fault lines and above the flood line. In the absence of any real organized framework for this settlement, however, there is a strong likelihood that the camp will become an opportunistic “land grab” as much as an emergency settlement. Of particular concern is that the settlements are being established without regard for the environmental hazards that have been witnessed in other camps, particularly those concerning sanitation and solid waste disposal.



*How (not) to decongest Port-au-Prince*

In the days following the earthquake, it was immediately clear to all those who visited Port-au-Prince that the scale of human tragedy could have been greatly mitigated if the capital city were not so congested. This raised a number of questions about whether it was initially a good idea to select Port-au-Prince as a capital city, particularly when it had been impacted by earthquakes and other natural hazards in the past. While no one was prepared to address the basic question of relocating the capital elsewhere, everyone was in agreement that some measure of decongestion was inevitable to ensure that the tragedy would not be repeated.

The UNEP team had the opportunity to be briefed about the Government's plans for reconstruction. The project was conceived with a vision that takes into account economics, environment and disaster risk reduction. It is premised on keeping people, including those who left Port-au-Prince in the immediate aftermath of the disaster, in the interior of the country by creating both urban services and livelihood opportunities there. It aims to identify the comparative advantages of each region (such as agriculture, tourism, textile production, and port facilities) and to connect these regions through high-quality transport networks.

According to Government estimates, over half a million people left Port-au-Prince in the days following the earthquake. In order to maintain the attractiveness of the regions, the UN team decided to make shelters available on a preferential basis to those who moved to the interior. It was also decided that all relief agencies and NGOs would provide essential support services – food, health, education, employment and counseling – in the regions. In addition, a system for host family support was initiated, whereby any family in the interior that was housing a displaced family member from Port-au-Prince would be given a lump sum, plus a monthly allowance to support them.



Many new camps were established in the environs of Port-au-Prince in the aftermath of the earthquake.

The plans appeared to be quite robust in both the short and the long term. It therefore surprised many that large camps continued to proliferate across Port-au-Prince, and to note that food distribution figures in the capital were increasing, not shrinking. The UNEP team wanted to understand the basis of this anomaly.

The team's work started with a visit to Gonaives, a province some four-hours drive from Port-au-Prince where according to Government records, 162,011 people relocated after the earthquake. The city of Gonaives was subject to political violence in 2004 and has suffered major floods, most recently in 2008, which led to significant death and destruction. Though it is situated in what is probably the agricultural heartland of Haiti, Gonaives is too frequently subject to natural and political dangers and as such is not an ideal place for populations to settle. Surprisingly, however, despite the movement of over 160,000 people to the province, not a single temporary shelter was established in Gonaives, which is the capital of the province. Rather, people dispersed in the province or were put up by their relatives.

It was also evident that in spite of the decisions taken in Port-au-Prince, there was hardly any UN or NGO presence in Gonaives to support those who had relocated there. While the Government had started a programme to register the displaced, it appeared as though the international relief apparatus still had no idea where people actually were.



A densely populated IDP camp situated in the middle of Port-au-Prince. Although half a million people left the capital in the days following the earthquake, food distribution figures are increasing rather than shrinking.

In the meantime, a number of initiatives were taken in Port-au-Prince. In order to ensure that funds were injected directly into the affected communities, a number of UN agencies and NGOs (supported by donors) started cash-for-work schemes. The UN identified vulnerable areas from which people needed to be moved, and the Government identified suitable plots to which they could be relocated. A design for transitional houses built with wood and tin was selected and prototypes started to be put up across town. The Government started discussions on purchasing additional land from private owners to facilitate relocation. In addition, there were proposals to transfer ownership of the plot to the people who would settle in these areas so as to allow them to re-establish their lives. The new areas would establish public services including schools, food distribution points, hospitals, and counseling services to prevent

gender-based violence. As some of these areas were further from typical residential areas and places of work, the international relief apparatus was deliberating over how to arrange for low-cost or even free public transportation to the city center.

While all of the ideas above are good and fit well within the overall humanitarian assistance framework in Port-au-Prince, they may be jeopardizing the longer term plans of decongestion. Indeed, people often react to incentives in unanticipated ways. If land ownership, social services, guaranteed employment and higher wages are provided in Port-au-Prince, individuals in the regions, even those who have not been impacted by the earthquake, will most likely travel directly to the city and set up a tent. Consequently, it is quite conceivable that there will be more people in Port-au-Prince when the reconstruction is over than when it began.



An informal economy quickly reestablished itself in earthquake affected communities, aided by livelihood initiatives promoted by the international community.

## CONCLUSION: TOWARDS ENVIRONMENTAL SUSTAINABILITY

The observations made above constitute the first steps in a long process that is set to culminate in an improved environmental situation in Haiti. Given the enormity of the environmental problems the country faced prior to the earthquake, including the lack of resources and institutional capacity for environmental governance, implementation of a new environmental agenda is likely to be a challenging task.



Sustainable development in Haiti is almost entirely dependent on the sustainability of the natural resource base, upon which 80 percent of the population depends for its livelihoods and sustenance.

Environmental improvement in Haiti is only achievable within the context of the overall sustainable development of the country. Conversely, sustainable development in Haiti is almost entirely dependent on the sustainability of the natural resource base, upon which 80 percent of the population depends for its livelihoods and sustenance. Although this statistic should make it easy to advocate for better environmental governance and improved capacity for environmental management, this has not happened in Haiti to date.



A preserved area of mangroves and coral reefs near Petit Goâve prior to the earthquake highlights the opportunities for the sustainable management of natural resources in Haiti.



In order for the situation to change, the following actions will need to be taken concurrently:

1. Explain how environmental sustainability is fundamental to the development of Haiti. Environmental degradation was not caused by the earthquake, but it is essential that it be addressed as a priority in the country's recovery. The post-earthquake situation provides an opportunity to focus the attention of the Government and international donors on this issue;
2. Prepare specific plans on how environmental sustainability can be achieved in the country, specifying the required enabling conditions;
3. Prepare specific plans to manage the environmental impacts of the disaster;
4. Integrate environmental considerations into the post-earthquake priority sectors of activity, including the reconstruction of Port-au-Prince, the improvement of infrastructure, the decongestion of the city and the creation of rural livelihoods; and
5. Strengthen the governance system to advocate, assist and monitor the suggested environmental improvement measures.



Rebuilding Haiti will require far more than brick and wood – it will require a substantial effort to bring back the country's environmental sustainability



## ANNEX 1

### Acronyms

EC	European Commission
GDP	Gross Domestic Product
HRI	Haiti Regeneration Initiative
IDP	Internally Displaced Person
MINUSTAH	United Nations Stabilization Mission in Haiti
MSB	Swedish Civil Contingencies Agency
NGO	Non-Governmental Organization
PPE	Personal Protective Equipment
SMCRS	Service Métropolitain de Collecte de Résidus Solides
UN	United Nations
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
USA	United States of America
USAID	United States Agency for International Development
WFP	World Food Programme
WHO	World Health Organization

## ANNEX 2

### **Environmental Assessment Team**

This report has benefited from the inputs and photographs of members of the UNEP team as well as several experts working with UNEP on the ground:

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