

# Environmental Problems and Their Management: A Literature Based Case Review on Haiti Earthquake

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## Abstract

On 12<sup>th</sup> January, 2010, Haiti faced massive earthquake of magnitude 7.0 on Richter scale with an epicenter about 17 km south-west of Port-au-Prince, the capital of the country. More than two hundred thousands people lost their lives with the property worth billions of dollars. The main objective of the study was to review the environmental services, like, solid waste management, excreta disposal, water supply and sanitation, immediately after the occurrence of Haiti earthquake were studied. For this purpose, we used the secondary data about the Haiti earthquake, environmental problems encountered and their management based upon the internet resources. It was estimated that 75% of the health services were delivered by the private non-profit sector and 5% by the for-profit sector during Haiti earthquake. Following the rescue and rehabilitation, the initial 30 days of earthquake faced some issues and challenges, such as, lack of communication, threat to spread of communicable diseases, managing of dead bodies and rising need of medical care. Waste management and water supply services have been identified as major areas requiring much attention as from the example of Haiti earthquake.

**Keywords:** Earthquake, Environmental problems, Drinking water, Sanitation, Haiti.

## Introduction

Earthquake, generally, the natural shaking of earth, is a natural geological disaster, caused by the breaking and shifting of rock beneath the Earth's surface (Nwana, 2004). Scientists are not able to predict the earthquakes but they can analyse the past records of the earthquake and can forecast the tentative date for the coming earthquakes. Single earthquake may take the lives of hundreds of thousands of people and the property loss of billions of dollars. If it happens in the developing countries, the result will be more disastrous as they lack the basic mechanism for surviving during the disaster. It will take many years for the developing country to revive from the effects on earthquake. Magnitude of earthquake is measured in Richter scale, which ranges from 1 to 10. We can not feel the earthquake of magnitude 1, whereas the earthquake with magnitude 10 is very destructive.

Haiti, a caribbean country, faced the earthquake of magnitude 7.0 on Richter scale in January 12, 2010. The epicenter of the earthquake was 17 km south-west of Port-au-Prince. It is estimated that more than 200 thousands people lost their lives due to the earthquake whereas 2 million people were left homeless. The main reason for the death of huge number of people, although the earthquake was of magnitude 7, is the concentration of population in the capital city (one-fifth of the total population live in capital Port-au-Prince) and lack of the building

codes for safe houses. More than 50,000 building (residential and commercial) were collapsed due to the force of the earthquake. Property loss due to the earthquake is estimated to be about \$11.5 billion. Major areas affected by the earthquakes were Port-au-Prince, Petit Goave, Leogane, Gressier, Carrefour and Jacmel. An attempt has been undertaken to study the environmental problems during the Haiti earthquake and the steps taken for their management based on the available material on the internet.

## Methodology

We used the secondary data about the Haiti earthquake, environmental problems encountered and their management based upon the internet resources. It's a descriptive study of environmental services, provided during the disaster. The main objective of the study was to review the environmental services, like, solid waste management, excreta disposal, water supply and sanitation, immediate after the occurrence of Haiti earthquake.

## Results and Discussions

It was estimated that 75% of the health services were delivered by the private non-profit sector and 5% by the for-profit sector. There were about 9000 - 1000 NGOs cited during the period of disaster (PAHO, 2011a). During Haiti earthquake the World Food Programme (WFP) provided US\$ 3 million

blank supplementary feeding for children, whereas, US\$ 1 million were provided by PAHO/WHO to support basic health and nutrition services for pregnant women and young children. Food was provided to 70,000 school-children through the “Education for All (EFA) Project”. A summary-

table, regarding situation analysis, responses, issues and challenges during initial thirty days, has been presented in Table 1, based on the information available from Pan American Health Organization (PAHO, 2011a).

**Table 1. 30 Days of Haiti disaster.**

	Situation analysis	Response	Issues/challenges
First week Jan 12- Jan 18	The UN assessment of the situation through helicopter at day 3. Ministry of interior estimates severely affected population to be one million. Death toll accounted as 13000.	About 600 injured people were treated by MSF at day 2 Health cluster was formed by world health organization (WHO). Search and rescue team rescued 90 lives altogether.	Communication handling and identification of the dead bodies
Second week Jan 19- 25	Estimated 112,250 deaths and 194,000 injured People seeking shelter ranges from 800,000 to one million.	The main medical storage and distribution facility under PAHO/WHO provided medicines and medical supplies for free to 50 organisations working in hospitals and clinics. Water distribution continued at 115 sites for about 235,000 people. Provision of waste management started in hospitals, including an appropriate disposal of amputated body parts.	Tetanus diseases, a major concern due to the halt of immunisation programme Problem with follow-up of the post-surgical patients Issues regarding proper information management
Third week Jan 27-Feb 3	112,392 died and 196,501 people were injured by the earthquake. The number of displaced people ranged from 800,000 to one million.	The WFP food surge continues, since the onset of emergency WFP reached to 1 million.	The need for the establishment of post-operative facilities. Increase number of homeless people - hospitals having difficulty to discharge patients. Over one thousand people were amputated and 50 people paralysed from spinal cord injuries. Medical waste management services were used only by two hospitals.
Fourth week Feb 5- 11	Data under verification	Over 780,000 people were provided with safe drinking water (5 liters per person per day) through water tankering and water treatment plants at 300 sites across Port au Prince, Léogâne and Jacmel. 211 lives were rescued by international and national search and rescue teams.	The need of rising overall medical care. Acute respiratory infections as the main cause of morbidity

### Solid waste and debris management

During the earthquake in Haiti, a lot of debris (mostly construction materials from the buildings), e-wastes (computers, TVs, etc.), white goods, like, refrigerators, washing machines, radioactive

materials from hospitals, petroleum products from gas stations, hazardous chemicals from laboratories, colleges, hospitals, etc., were generated. The solid waste generated by the victimised people used to

pile up on the streets. So, proper management of this waste was very essential. A considerable amount of the waste was supposed to be generated. The waste was disposed in the outskirts of the Port-au-Prince by the haulers and the recyclable waste was recycled by the community of the scavengers. The recyclable part (e.g., iron rods, reusable wood parts, bricks) was recycled, whereas other wastes, like, wood and plastics, were burnt. Haiti lacked debris removal plan and management of debris remained the major challenge for months after the earthquake. Many buildings were collapsed and the streets, yards, sidewalks and canals of Port-au Prince were filled with about 25 million cubic yards of debris (DesRoches et al., 2011). Projects supported by Oxfam helped in the daily waste collection, promoting the hygiene practice, drainage clearance in the camps areas, whereas, in the urban area the drainage clearance project, neighbourhood waste collection system, recycling support programme were installed. Local residents, themselves, were unable to remove big chunks of building materials, which required machines (Booth, 2010). Condition of hazardous waste management later on improved as the provision of waste segregation (PAHO, 2011b). Moreover, construction of settlement ponds to hold and treat about 25,000 m<sup>3</sup> of sludge also contributed in keeping the area clean.

### **Excreta management and disposal**

Providing safe excreta disposal facilities was another challenge after the earthquake. Oxfam began the service of managing the excreta by digging the pit latrines and constructing the raised latrines over 1,000 liter plastic containers. Desludging truck was also provided in order to take the sludge from pit latrines. People used to put other waste in the container, so the problem was faced while emptying the container. Portable toilet was also provided but was more problematic as it has to be cleaned everyday or other by the service provider. The cost of cleaning each toilet was \$ 20, that means the service was expensive and the provider also could not provide the demanded toilet, due to the lack of de-sludging tank and the regular traffic jam in those areas. The problem was during the disposal also as it was dumped in the open holes at the dump sites rather than into the waste stabilisation ponds or other treatment systems.

As the piped water was absent, the sanitation was to be water-less. For that purpose the first approach was, Oxfam along with NGO named SOIL (Sustainable Organic Integrated Livelihoods) built compost toilets in all five camps (SOIL, 2011), where urine was either diverted to soakway or collected for agricultural purpose. After each excreta disposal, small amount of bagass from sugarcane was used. So the mixture was collected in plastic drums and was taken to the composting site each

week. These types of toilets were preferred as they were less smelly (SOIL, 2011). The second approach was systemisation of already existing “flying toilets” - using a plastic bag for defecating and throwing it away. Biodegradable bags (named as Peepoo) were provided with urea, which prevented bad smells and many people liked this system of toilet for freedom of access (Patel et al., 2011). The bags were collected everyday by the service provider and were taken to the composting plant.

### **Health care facilities to the victims**

As, almost all of the health care facilities in the affected areas were damaged and the health personnel were forced to provide the services in open spaces, like, parks and fields (Pape et al., 2010). Thirty out of forty-nine hospitals were damaged costing more than 195 million dollars (Government of Haiti, 2010). The water supply source was also damaged so the spreading of diarrhoea was thought as the people drank unsafe water (ICRC, 2010). Due to the contaminated water; infant mortality and the illness in the children were high and many diseases, like, typhoid, cholera, diarrhoea, were observed related with the contaminated water usage. The same scenario was observed in various parts of the affected areas of Haiti. ICRC provided dressings, medicines and medical material kits. Besides ICRC, healthcare services were provided by the people and organisations from various parts of the world. Another organisation, named a “World Vision”, distributed the hygiene kits, which included the necessary items, like, toilet rolls, soap and toothpaste and mosquito nets, were also distributed. These things were distributed not only in the emergency phase of the disaster rather throughout the year (World Vision, 2011). Immediate public health risks were wounds and injuries, water/sanitation/hygiene-related and food borne diseases, diseases associated with crowding, vaccine-preventable diseases and routine immunisation coverage, vector-borne diseases and zoonotic diseases, etc. (WHO, 2010). Both fixed and mobile health camps were provided in 11 camps of the capital city (World Vision, 2011). WHO with other local NGOs provided about twenty thousand coloured plastic bags for health care waste and one thousand containers for safe disposal of sharp needles (PAHO, 2011b).

### **Shelters for the victims**

Providing the living space for the victims during a massive disaster, like, Haiti earthquake, was a great challenge and the victims were provided with the living space on the open area. As the number of victims was very high, 1.5 million homeless people (TRF, 2010), the space availability for each family was very low. They were provided with a tent (temporary housing), where all the members of a

family were accommodated. As the people were living very adjacent to each other, the volume of waste generated was very high and thus the victims got the diseases, like, diarrhoea and cholera. Some of the organisations, like, USAID, UNHCR, Rotary Club, World Vision and various other donors helped in reducing the shelter problems by providing the fund and manpower for construction of buildings. Afterwards, the victims were eventually shifted in well built house (not as previous but better than tent). As the disaster was massive and funds could not reach to all the people, many of the victims were still living in the tents.

### Supplying water and food to the victims

Extracting ground water for drinking purpose was not a good solution for getting rid of the water-related problems. Rather the people relied upon the supplied chlorinated water, bottled water, water purification tablets, etc. Hydration Technology Innovations deployed more than 24,000 HydroPacks, for the earthquake victims, which were powered by filtration technology, called as, Forward Osmosis (WQP, 2011). Some other measures were using filtration system named Lifestraw, PUR Packets (coagulant powder for removing suspended solid and microbial pathogens), Solar Disinfection System (SODIS) etc. Table 2 shows a brief compilation of drinking water supply.

**Table 2. Drinking water distribution during Haiti earthquake.**

Organisation	Supply of resources
<b>FIJI water</b>	136 thousands bottled water
<b>World Vision</b>	190 million liters water more than 700 latrines and 600 showers for victims Food for more than 229 thousand households for more than first three months Trained more than 14 thousand Haitian with income generating activities, like, cassava processing
<b>Nestle Water</b>	3 million liters bottled water

### Disposal of medical waste including dead bodies

Before taking the decision on the disposal of the dead bodies various factors, like, social and cultural acceptability, soil condition, ground water level of the area, religious beliefs of the people, etc., have to be considered. Disposal of the dead bodies during the disaster situation was a hard task and it was the same during the Haiti earthquake too. Thousands of the dead bodies were seen lying on the streets of Haiti. There was a fear in the public that the dead bodies might spread the diseases (BBC, 2010). The easiest way to manage such a large number of bodies was to bury them. Before burying, no proper measures for identifying the dead people were taken which misled the people, who were looking for their relatives. As a dead body will start decaying after 12 hours, so they were buried without their identification. As the majority of the people in Haiti was Roman Catholic, so the disposal of the body was not the problem. The affected communities and the Government started cleaning from the day immediately following the earthquake. The Port-au-Prince landfill site of Truitier was later rejected due to presence of watertable at ground level, inadequate control and improper operation. The management of health care waste was then a major issue. Meanwhile, UNEP, WHO and Haiti government decided to creat temporary landfill site in Titanye. The established-team trained the staff and provided the personal protective equipment. It started

collecting the healthcare waste from seventeen hospitals in the city. The functional incinerators in the hospitals also aided the process of managing health care waste (UNEP, 2010a). Yet according to a report, which was a field research done from the day of earthquake provided a different scenario (Gupta and Sadiq, 2010). Most of the dead bodies from buildings were removed by the people and kept on the roads, sidewalks, and open places. People kept the dead bodies where there was enough space, such as, parking lots. The dead bodies were collected by bulldozers, trucks and then were dumped in trenches and covered with mud. The researchers often saw dead bodies in the open trenches lying with rubble during their field visit to Titanye.

### Situation after Haiti earthquake

After the massive earthquake in Haiti, different cases of fatalities were reported due to different diseases. Sudden outbreak of cholera in October of 2010 claimed the lives of more than 8000 people with a total of more than 650 thousand reported cases (Gelting et al., 2013). Joint security assessment findings highlighted the widespread perception of insecurity among Haitians living in displacement camps. The cases of rape, other violence, theft and prison escapees and gang members posed serious threat to disabled people, children, women and girls (MINUSTAH Human Rights Section, 2010). A recovery assessment,

conducted by the Red Cross, suggested that the environmental degradation of Haiti, will eventually take long-term effort to stabilise, restore and improve the environment (IRFC, 2010). Environmental issues, like, deforestation, soil erosion, pollution and overused land, were depicted as hindrance to immediate response and recovery (UNEP, 2010b). The study conducted by University of Michigan showed that 100% of the population described access to housing as a major problem in comparison to just 2.3 per cent prior to the earthquake (UMSAS, 2010). There were about 357,785 people internally displaced living in 496 camps, among which 52% were women as of the end of October 2012. About 72,038 displaced people (264 out of 541 camps) did not have access to water and toilet affecting more than one internally displaced person out of six (Amnesty International, 2013).

### Conclusions

After Haiti earthquake disaster, many countries and the organisations contributed from their side though initial three days of Haiti earthquake went without any effort of rescue and rehabilitation. Lack of communication facilities was one factor identified as responsible for this situation. The community adopted recovery of materials from the waste but removing the construction debris was a big problem as it required large machinery. Biodegradable bags, such as, peepoo, were used for the excreta disposal. It could be a good example in disaster where sewers system and water supply were compromised. The safe drinking water supply was a huge challenge, where filtration system named Lifestraw, PUR Packets. Solar Disinfection System (SODIS) were used but the affected people were heavily dependent upon the bottled water supplied by the donors. Most of the victims living in camps were in threat of rape, violence, etc., posed by the prison escapers. Despite of all the efforts towards environmental sanitation, the population in present is still affected by the rising cases of cholera since the day of earthquake. After the massive earthquake, major displaced population lacks the basic access to water and toilet facilities. The preparedness towards disaster is the most important step to cope with the consequences. Waste management, water supply and communication services were identified as major areas requiring much attention in Haiti earthquake which can be prime focus area of every sector of the national and international community in order to cope with any upcoming disaster.

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