Chapter 16

NATURAL DISASTERS AND CATASTROPHIES

CASE STUDY: KATRINA- THE WORST NATURAL DISASTER IN U.S. HISTORY

Hurricane Katrina struck on August 29, 2005, about 45 km (30 mi) to the east of New Orleans. The storm produced a storm surge of 3 to 6 m (9 to 20 ft) devastating much of the coastline of Louisiana and Mississippi. The situation in New Orleans turned into catastrophe when water from Lake Pontchartrain north of the city and connected to the Gulf flooded the city. Levees constructed to keep the water in the lake and protect lowlying parts of the city, collapsed in two locations and water poured in. Another levee failed on the Gulf side of the city, contributing to the flooding. Approximately 80% of New Orleans was under water from knee deep to rooftop or greater depths. New Orleans was founded over 200 years ago on natural levees of the Mississippi River, on what is now the French Quarter, and the only section still above mean sea level. Since its founding, the city has expanded to low lying areas with the help of levees, canals and pumps that in normal times keep the water out (see Fig. 16.1). The natural levees along the river have been fortified to prevent flooding. In the absence of flooding, sediment from the river is prevented from nourishing the surrounding marshes and swamps. Consequently, in the absence of this sediment supply, the wetlands cannot keep pace with rising sea level and subsidence due to compaction, and the city is becoming more vulnerable to hurricanes and flooding.

16.1 HAZARDS, DISASTERS, AND CATASTROPHES

● Natural physical, chemical and biological processes modify the landscape, occasionally with hazardous consequences. These include earthquakes, volcanic eruptions, landslides, hurricanes, tsunamis, wildfires, tornados, floods, heat waves, and droughts.

16.2 DISASTERS AND CATASTROPHES: TAKING A HISTORIC POINT OF VIEW

● If we do not learn from past experiences, we will suffer the same consequences again. This is certainly true of natural hazards, which are repetitive events. As a result, study of their history provides basic information for any hazard reduction program.

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A CLOSER LOOK 16.1: HURRICANE FORM AND PROCESS

● A storm is classified as a hurricane when its sustained winds reach at least 74 mph (119 km per hour). A hurricane is a type of tropical cyclone, which is the term given to thunderstorm complexes that rotate around an area of low pressure over warm tropical ocean water. Hurricanes start as large areas of unsettled weather spreading over a diameter of as much as 600 km (370 mi). Within this area is an organized mass of thunderstorms. The storm grows in size and strength as warm, moist air is drawn into the depression or central low pressure area and begins to rotate counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere. As warm water evaporates from the sea and is drawn into the storm, the energy of the storm increases. One of the most dangerous aspects of hurricanes is not the winds themselves, but the storm surge that causes coastal flooding. The storm surge, a local rise in sea level that results when hurricane winds push water toward the coast, may be several meters to more than 10 m (30 ft) high and may cause tremendous damage.

A CLOSER LOOK 16.2: LA CONCHITA LANDSLIDE 2005

● The small beachside community called La Conchita, located about 80 km northwest of Los Angeles, CA, experienced a disaster on January 10, 2005. Ten people were killed and 30 homes were destroyed or damaged when a fast-moving debris flow (a type of landslide) roared through the upper part of the community (Figure 16.8). The debris flow was a partial reactivation of landslide that occurred in 1995, destroying several homes but inflicting no fatalities. The 200-m (600-ft) high slope directly behind the community, is a serious and continuing landslide hazard for humans living there. La Conchita should never have been constructed at the foot of the slope. Landslides have occurred in this area for about 100 years, or at least since people started keeping track of those events.

A CLOSER LOOK 16.3: INDONESIAN TSUNAMI

● Within a span of a few hours about 250,000 people were killed, and millions were displaced as coastal areas around the Indian Ocean were struck by the series of tsunami waves produced by a magnitude 9 earthquake that occurred offshore of the Indonesian island of Sumatra. Tsunami waves come in as a series, and later waves may be higher than earlier ones. When the water from a wave retreats from the land flowing back to sea, the return flow can be as dangerous as an incoming wave. Tsunamis (the Japanese word that is translated as large harbor wave) are produced by the sudden vertical displacement of ocean water. They may be triggered by large earthquakes that cause rapid uplift or subsidence of the seafloor; by underwater landslides that may be triggered by an earthquake; by collapse of part of a volcano that slides into the sea; by a submarine volcanic explosion; or by the ocean impact of an extraterrestrial object, such as an asteroid or comet.

16.3 FUNDAMENTAL CONCEPTS

● Some general concepts useful in understanding the nature and extent of natural processes and hazards, and how they might be reduced, minimized or eliminated, are as follows.

- ■ Natural processes have service functions.
- ■ Hazards are predictable.
- ■ Linkages exist between hazards

- Linkages exist between different hazards and between the physical and biological environment.
- Hazards that previously produced mostly disasters are now producing catastrophes.
- Risk from hazards can be estimated.
- Adverse effects of hazards can be minimized.

16.4 NATURAL PROCESSES HAVE NATURAL SERVICE FUNCTIONS

● Nature provides a number of natural service functions for people and the biosphere. For example a river and its floodplain, together constitute a natural system, that provide a number of benefits. In most natural rivers, the water flows over the riverbanks and onto the floodplain every year or so. As a consequence:

- Water and nutrients are stored on the floodplain.
- Deposits on the floodplain contribute to the formation of nutrient-rich soils.
- Wetlands on the floodplain provide an important habitat for many birds, animals, plants, and other living things.
- The floodplain functions as a natural greenbelt that is distinctly different from adjacent environments and provides environmental diversity.

● In summary, physical processes linked to the biological environment produce a varied landscape. Without periodic disturbance from natural processes, such as earthquakes, volcanic eruptions, and floods, soils would not be as fertile, water would not as available, the land would not be as diverse, and the diversity of life would be reduced.

16.5 HAZARDS ARE PRETICTABLE

● Most hazardous events and processes can be mapped as to where they have occurred in the past and monitored in terms of present activity. On the basis of the location of past events, their frequency, patterns of occurrence, and precipitating events, some hazards may be predicted.

16.6 LINKAGES EXIST AMONG HAZARDS AND THE PHYSICAL AND BIOLOGICAL ENVIRONMENTS

● The links between hazards and the physical and biological environment is an important part of understanding the consequences. The eruption of Mount St. Helens in 1980, for example, severely disrupted the landscape and rivers. However, recovery since 1980 has been dramatic (Fig. 16.17).

16.7 HAZARDS THAT PREVIOUSLY PRODUCED DISASTERS ARE NOW PRODUCING CATASTOPHIES

● Human beings, have changed in the past few thousand years from a species of small numbers to over 6 billion people today. Consequently, people are living in large numbers in hazardous places (e.g. on a flood prone delta in Bangladesh). In addition, people alter the landscape in ways that can contribute to disasters. This is demonstrated by two events

in 1998, the flooding of the Yangtze River in China and Hurricane Mitch in Central America, and hurricane Katrina in 2005.

16.8 RISK FROM HAZARDS CAN BE ESTIMATED

● Before we decide what to do about a particular hazard, whether it be to protect homes, or cities, we need to estimate the risks. Risk for a particular event is defined as the product of the probability of that event occurring times the consequences should it occur. Determining the probability of an event occurring is often the most difficult and controversial part of evaluating the risk. Determining the consequences of a particular event is fairly straightforward and involves estimating property damage and loss of life on the basis of particular events.

16.9 ADVERSE EFFECTS OF HAZARDS CAN BE MINIMIZED

● We need to how to anticipate hazards and be more proactive in our thinking. Among the proactive choices that anticipate hazardous events are (1) land-use planning to limit construction in hazardous locations; (2) construction of hazard-resistant structures such as floodwalls, levees, and buildings; (3) protection of ecosystems on coastal floodplains and, wetlands that provide natural protection from hazards; and (4) a well-thought-out plan for evacuation and relief following a disaster. The relief and recovery phase of disaster planning is equally important (see Fig. 16.19).

16.10 WHAT DOES THE FUTURE HOLD WITH RESPECT TO DISASTERS AND CATASTROPHES?

● The frequency of disasters has increased significantly in the last half-century (Figure 16.21). This is due in part to the increase in human population density and the fact that more people are living in hazardous areas. Also, as a result of population pressure we often make poor land-use choices, selecting areas that are prone to frequent hazards such as flooding, wildfires, and hurricanes. Finally, we may be directly affecting the severity of some hazardous events, e.g. changing our climate.