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Source: Environmental Health Insights, 5(1)

Published By: SAGE Publishing

URL: https://doi.org/10.1177/EHI.S7250

Environmental Health Insights

EDITORIAL

Environmental Health Insights into the 2011 Tōhoku Japan Earth quake Disaster

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An earthquake of a magnitude of approximately 9 on the 0–10 (logarithmic) Richter scale occurred just off the coast of Japan on March 11, 2011. The earthquake epicenter was located in the Pacific Ocean approximately 72 kilometers east of the Oshika Peninsula of Tōhoku. This was the strongest earthquake to hit Japan in recorded history and has been estimated to be the fifth largest global earthquake since 1900. As a result of the earthquake, a tsunami ("tidal wave") was created which devastated large portions of coastal Japan, particularly in the densely populated coastal city of Sendai. The earthquake created tsunami waves up to 24 meters (77 feet) in height, which traveled inland as much as 10 km (6 miles). Current estimates (as of April, 2011) place the human death toll at approximately 11,000, with approximately 3,000 injured and 18,000 unaccounted for. In addition to the tsunami damage, the earthquake led to the collapse of the Funjinuma irrigation dam in Sukagawa, widespread fires, and declared emergencies at the Fukashima I and II nuclear power plants.The Fukashima plants contain a total number of six reactors, all of which have experienced problems. Explosions due to buildup of hydrogen gas have occurred at four of the Fukashima reactors, and meltdowns may be in progress at three of the Fukashima reactors. Other nuclear power plants affected include the Onagawa and Tokai plants. Radiation levels in Tokyo reached 20 times normal "background" levels on March 15, 2011 but have subsequently diminished.The earthquake also may have contributed to the March 13 Shinmoedake volcano eruption in Southern Japan. The World Bank estimates total monetary damages of up to 20 trillion yen, or 235 billion U.S. Dollars (USD) and the Japanese government estimates that damages could exceed 25 trillion yen or 300 billion USD. This could make it the most expensive global natural disaster in recorded history.

As could be expected from a disaster of this magnitude, environmental health hazards and associated risks extend across a wide range of media, including contaminated air, water, soil, food, and waste. Citizens have been evacuated from a 20 km (12 mile) radius of the Fukuskima I Nuclear Power Plant and a 10 km (6 mile) radius of the Fukushima II Plant. These evacuation distances have now (April, 2011) been extended to 30 km (20 miles). There are concerns of water contamination from radioactivity and other contaminants, with over a million people without water (although services are slowly being restored). It is likely that in addition to soils contaminated from seawater and mud from the tsunami, soils exposed to high radiation will require remediation. Japan has restricted the export of selected food products until the potential for contamination has been evaluated. Currently foods banned for export from northeast Japan

Environmental Health Insights 2011:5 21–22

doi: 10.4137/EHI.S7250

This article is available from http://www.la-press.com.

include spinach, cabbage, broccoli, cauliflower, turnips and milk. Many countries have placed restrictions on food import from Japan, including normally large importers such as China and Korea. In addition to the inconceivable amounts of waste debris generated from tsunami destruction, radioactive waste in the form of contaminated water and melted fuel rods have also been generated. These nuclear power plant emergencies have resulted in a global reconsideration of the safety of nuclear power as well as a concern that low-level radiation may be transferred around the globe via water and air.

A primary environmental health concern following floods is the complex "sludge" generated from ocean debris and sand, destroyed construction debris, organic wastes (e.g., sewage, manure and dead animals, including humans), organic and inorganic chemicals (e.g., from local business, industry and residential homes). This sludge may contain biological (e.g., pathogenic microbes); chemical (e.g., toxic organic and inorganic chemicals and organic solvents such as gasoline and oil); and physical (e.g., construction debris, automobiles, and personal belongings as well as radioactive materials) contaminants. Once this sludge has settled and begun to dry, it becomes even more difficult to move as it tends to "set", similarly to cement or concrete. Once the surface of this sludge becomes dry, it can contribute to airborne (windborne) dust and debris. Winds may carry contaminants long distances from sites of initial deposition. This sludge and its components may also attract scavenger animals and mechanical and biological pest vectors that may increase the risk of transmission of infectious disease. Additionally, there is the ecological question as to what effect the waste that was washed back out to sea will have on the sensitive shoreline ecosystem.

Unprecedented international efforts are underway to control the damage already caused by the earthquake as well as limit additional damage. Future efforts will focus on remediation of the contamination and rebuilding of damaged structures as appropriate. Global debates are underway concerning the future of nuclear power plants in light of the failure of redundant safety systems in Japan's nuclear power plants. Some have also suggested that locating nuclear power plants near the ocean should be reconsidered. While the cost of cooling water is reduced by this practice due to seawater availability, it also makes these plants more vulnerable to flooding. As in New Orleans, Louisiana following Hurricane Katrina, it may be decided that some areas are left undeveloped (at least for the short-term) to limit future vulnerability. Additional information may be obtained from the international websites listed below.The Japanese government and international governments appear to suggest that related environmental health risks are currently low, but as in the case of many previous natural and human-made disasters, the environmental degradation and related health hazards and risks may not be fully realized for decades.

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