Impact of the 2011 Japanese Earthquake: A Perspective on Sustaining Ecologically-Friendly Practice

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ABSTRACT

This paper provides an overview of the extent of the structural and ecological impacts to Japan from the 2011 earthquake and tsunami known as the Tohoku event. It also outlines how the necessity of rebuilding large portions of northeast Japan creates opportunities to incorporate sustainable, ecologically-friendly practices.

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Background

On March 11, 2011, at 2:46 pm local time, a magnitude 9.0 earthquake occurred approximately 130 km off the east coast of Japan (U.S. Geological Survey [USGS], 2011). Approximately 30 minutes later, tsunami waves reached the northeast coast of Japan, exceeding 15 meters in height at sea and even higher after hitting the shore (Cyranoski, 2011). In areas of subdued topography, the water raced inland over several kilometers, decimating large tracts of both urban and rural coastal areas. The combined effect of the earthquake and resulting tsunami are known as the Tohoku event.

Japan has a long history of dealing with earthquakes and their aftermath, including devastating fires and tsunamis, and uses advanced engineering and safety precautions such as tsunami warnings to limit the impact of earthquakes (De Boer & Sanders, 2005). Indeed, Japan is a leading country in earthquake safety (Cyranoski, 2011). Despite this preparedness, the Tohoku Event had devastating effects which will continue to be felt into the future. Approximately 15,000 people were confirmed killed, and approximately 10,000 more people were reported missing (Japan National Police Agency, 2011). Immediately following the event, approximately 163,000 people were living in temporary shelters (Reuters, 2011a). More than 46,000 buildings were damaged or destroyed (Reuters, 2011a).

Impact of the Tohoku Event

Transportation infrastructure was heavily damaged, including extensive damage to roads and rail lines. The Sendai airport was inundated by tsunami flooding (Fackler, 2011), and 15 seaports in the immediate

disaster area were closed for weeks (Inchcape Shipping Services, 2011). Water service was also disrupted. Thousands were without drinking water, with estimates as high as 1 million immediately following the event (Showstack, 2011). In addition, approximately 50 sewage treatment plants were damaged (Fountain, 2011), as were irrigation dams (Chinese National Committee on Large Dams, 2011). Communication services such as phone and Internet were largely intact (Vijayan, 2011), but electrical service was disrupted and rolling blackouts and electrical shortages were predicted to continue for a prolonged period due to problems with the electrical distribution grid (Williams, 2011).

One of the more troubling impacts from the Tohoku event was the damage to nuclear power plants along the coast. Although all the power plants withstood shaking from the earthquake, with 15 reactors undergoing emergency procedures to insert control rods into the core to halt uranium fission (Reuters, 2011b), the tsunami waves overtopped the sea wall at the Fukushima-Daiichi plant and irreparably damaged the backup generators which were needed to continue the cooling process (Sample, 2011). Without coolant, the continued decay of non-uranium products continued heating the fuel pellets to their melting point, causing meltdown (McCurry, 2011). This overheating led to explosions at some of the reactors at Fukushima-Daiichi. On April 12, 2011, the extent of the nuclear impact was rated a "7" by the International Atomic Energy Agency (IAEA), which is the most serious release of radiation on the international nuclear and radiological event scale.

To avert a large-scale meltdown, seawater was used as an emergency coolant at the Fukushima-Daiichi plant (Greenemeier, 2011). The corrosive nature of the saltwater rendered the reactor unusable in the future (Greenemeier, 2011). Because of the pressing need for fresh coolant, on April 4, 2011, 11,500 tons of radioactive water was released directly into the ocean (IAEA, 2011b). Damaged fuel rods (either spent rods in cooling ponds or rods in reactor core) were the source of release of radioactive isotopes of iodine and cesium into the air and water, and explosions at the plant led to a 20 km mandatory evacuation area, plus another 30 km voluntary evacuation zone (BBC News, 2011a). These zones were later revised outward, with evacuations also occurring outside the circular zones based on measurements of increased radiations levels (Willacy, 2011).

The Tohoku Event impacted nearly every measurable aspect of environmental health, including: air quality, water quality, food safety, housing, waste and sanitation, infectious disease and vector control, radiation, injury prevention, emergency preparedness, and toxicology (Ratnapradipa et al., 2012 provide a detailed discussion of environmental health impacts).

Ecological Sustainability

Japan has a long history of rebuilding following devastating earthquakes and fires. Being at the convergence of several tectonic plates, Japan has experienced devastating earthquakes numerous times throughout recorded history (De Boer & Sanders, 2005). The September 1, 1923 Kanto earthquake was one of the most destructive earthquakes in history, destroying much of the capital, Tokyo, and the nearby port city of Yokohama. The event took more than 100,000 lives through falling debris, tsunami, and fires. The cities of Tokyo and Yokohama were reestablished after the disaster with urban planning focusing on transportation efficiency, commerce, and national identity – although often in a contentious and dysfunctional political atmosphere (Schencking, 2006). Assuming a more unified political vision for reconstruction, the response to the Tohoku event provides an opportunity for areas of Japan to rebuild with guided urban planning incorporating a focus on ecologically sustainable practices. Improved sustainability can be achieved

with attention paid to numerous sectors of society as outlined below.

Transportation

Japan already had extensive rail service in place prior to the Tohoku event, and it is suggested that the rail lines be rebuilt and even expanded. Rebuilding and extending local bike paths also would promote ecologically sustainable practices.

Waste Disposal

As an island nation with land usage at a premium, Japan already had extensive recycling practices in place (Makinen, 2011). These need to be rebuilt and continued. The necessity of rebuilding damaged or destroyed waste water and drinking water treatment plants provides an opportunity to incorporate upgrades into the rebuilding process, such as incorporating energy conservation methods in the plant designs, and ensuring that the plants are rebuilt to accommodate projected population demands.

Energy

Japan relied heavily on nuclear power plants for its electrical power supply. With the long-lasting and yet unknown implications of the radioactive contamination caused by the Tohoku event, Japan should consider alternative energy sources and energy efficiencies at the consumer, community, and national levels. Creation of a unified national electrical power grid could improve efficient transfer of existing electrical supplies. Japan currently uses incompatible 50-hertz and 60-hertz systems (Williams, 2011). Examples of ecologically sustainable electrical generation systems include the use of wave turbines, wind turbines, and solar energy. As Japan is a volcanically active country, there are expansive geothermal reserves that could be exploited. At the consumer level, as homes are rebuilt in northeast Japan, geothermal and solar energy sources can be easily integrated. If Japan decides to continue using nuclear power plants, clearly, facilities need to consider worst-case scenarios to improve safety measures during reconstruction.

Building Construction and the Built Environment

Many advances have been made in recent years in terms of building design and materials to promote energy efficiency and ecologically-sustainable practices. As Japan repairs and rebuilds, these practices should be integrated wherever possible, for homes as well as commercial and public facilities. Examples of ecologically-sustainable practices include the use of recycled materials when possible or renewable local or regional materials (such as bamboo and local renewable woods) otherwise. Adequate insulation of exterior walls and roofs increases energy efficiency, as does the use of insulated windows. Building design optimizing natural lighting should also be considered. Another consideration is the incorporation of rainwater collection in building design, as well as the use of landscaping practices, such as strategic placement of trees for shade and windbreaks. These factors should also be incorporated in urban planning, in terms of where and how to rebuild. Does the constructed environment include green space? Does it optimize public transportation and the ability to walk and/or bike locally?

Aquaculture

Prior to the Tohoku event, Japan was second only to China in per capita fish consumption (Zabarenko, 2011). However, the tsunami destroyed large portions of Japan's fishing fleet, fish processing facilities, and aquaculture (Ydstie, 2011). Therefore, Japan must put substantial investment into rebuilding the damaged fishing and aquaculture portion of the economy. This is an opportunity to promote consumption of wider variety of smaller fish species rather than large predatory fish (tuna, shark fins, whale, etc) which bio-accumulate the most contaminants and therefore pose the greatest health risks. Less targeting of large predatory fish also benefits the long-term health of the marine ecosystems from which consumed fish are drawn (Sheffer et al., 2005).

Conclusion

Although the Tohoku earthquake and tsunami devastated large portions of coastal Japan and concerns about long-term radiological contamination, the country's response provides an opportunity for areas of Japan to rebuild with guided urban planning with a focus on ecologically sustainable practices. Incorporating sustainable practices is not limited to urban planning, however, and should include a focus on rebuilding the agriculture and aquaculture industries that were also damaged.

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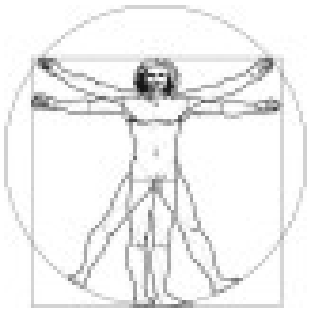

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