



THE GREAT EAST JAPAN EARTHQUAKE

LEARNING FROM MEGADISASTERS



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On March 11, 2011, an earthquake of magnitude 9.0 occurred in the Pacific Ocean off the coast of Japan's Tohoku region. The quake shook the ground as far away as western Japan and lasted for several minutes. A half hour later, a tsunami of unprecedented force broke over 650 kilometers of coastline, toppling sea walls and other defenses, flooding more than 500 km² of land, and washing away entire towns and villages.

The devastation left some 20,000 people dead or missing, with most of the deaths caused by drowning. The tsunami leveled 130,000 houses and severely damaged 260,000 more. About 270 railway lines ceased operation immediately following the disaster, and 15 expressways, 69 national highways, and 638 prefectural and municipal roads were closed. Some 24,000 hectares of agricultural land were flooded. The areas worst hit were the Fukushima, Iwate, and Miyagi prefectures.

WHAT THE DISASTER HAS TAUGHT JAPAN— AND WHAT IT CAN TEACH OTHER COUNTRIES

The Great East Japan Earthquake (GEJE) was the first disaster ever recorded that included an earthquake, a tsunami, a nuclear power plant accident, a power supply failure, and a large-scale disruption of supply chains.

Learning from Megadisasters, a knowledge-sharing project sponsored by the World Bank and the government of Japan, is collecting and analyzing information, data, and evaluations performed by academic and research institutions, nongovernmental organizations, government agencies, and the private sector—all with the objective of sharing Japan's knowledge on disaster risk management (DRM) and postdisaster reconstruction with countries vulnerable to disasters. The Bank and the Japanese government hope that these findings will encourage countries to ensure that DRM figures prominently in their policies and planning.

Japan had not foreseen an event of this magnitude and complexity.



Photo: Kazuyoshi Nomachi, 2011

- ***It was a high-impact event with a low probability of occurrence.*** Because of enormous damage from the tsunami and moderate but widespread geotechnical damage, the GEJE event was the costliest earthquake in world history. Japan's Cabinet office has estimated the direct economic cost at ¥16.9 trillion, or US\$210 billion.
- ***It was a highly complex phenomenon, the effects of which cascaded to sensitive facilities.*** The earthquake and ensuing tsunami provoked fires at damaged oil refineries and a potentially catastrophic nuclear accident. The effects of the accident at the Fukushima Daiichi nuclear power plant have compromised Japan's energy supply, imperiled its environment, and threatened public health.
- ***Direct damage to major Japanese industries rocketed through supply chains around the world.*** In the second quarter of 2011, Japan's GDP dipped 2.1 percent from the previous year, while industrial production and exports dropped even more sharply—by 7.0 percent and 8.0 percent, respectively. Japan experienced a trade deficit for the first time in 31 years. In the wake of the tsunami, businesses that relied on Japanese electronics and automotive parts faced disruptions and delays in production, distribution, and transportation; they had to scramble to find alternate supply lines and manufacturing partners.

In coping with the GEJE, Japan's advanced DRM system, built up during nearly 2,000 years of experience with natural risks and hazards, proved its worth. The loss of life and property could have been far greater if the country's policies and practices had been less effective. The main elements of that DRM system are:

- Investments in structural measures (such as reinforced buildings and seawalls), cutting-edge risk assessments, early-warning systems, and hazard mapping—all supported by sophisticated technology for data collection, simulation, information, and communication, and by scenario building to assess risks and to plan responses (such as evacuations) to hazards
- A culture of preparedness, where training and evacuation drills are systematically practiced at the local and community levels and in schools and workplaces
- Stakeholder involvement, where the national and local government, communities, NGOs, and the private sector all know their role
- Effective legislation, regulation, and enforcement—for example, of building codes that have been kept current
- The use of sophisticated instrumentation to underpin planning and assessment operations.

Certain improvements would have made the Japanese reaction even more effective. Three are particularly important:

- Spreading a better understanding of the nature and limitations of risk assessment among local authorities and the population at large would improve collective and individual decision making, especially in emergencies. During the GEJE, commu-

nication about the unfolding disaster could and should have been more interactive among local communities, governments, and experts. Distributing hazard maps and issuing early warnings were not enough. In the event, the magnitude of the tsunami was underestimated, which may have led people to delay their evacuation, if only for a fatal few minutes. If local governments and community members had been more aware of DRM technologies and their margins of error, fewer lives might have been lost.

- Coordination mechanisms on the ground should be agreed on before the event. During the GEJE, coordination among various organizations, such as governments (national, prefectural, and local), civil society, and private organizations was not optimal. Local governments, whose facilities in some cases were wiped out by the disaster, had little experience working with other organizations on a large scale, and they received insufficient support from the central government in managing the new forms of cooperation. As it turned out, coordination with international relief agencies and donors offering exceptional assistance was simply not up to the unprecedented task.
- Vulnerable groups must be not only protected but also engaged. Understanding and meeting the challenges of the elderly, children, and women, both during the emergency and in its aftermath, are priorities for effective postdisaster response. Culturally sound solutions that take account of special needs among segments of the population should be planned in advance to enhance resilience and facilitate recovery and reconstruction.

The successes of Japan's DRM system, as well as the ways in which that system could be improved, are reflected in the lessons drawn from the GEJE and presented in the initial reports from the Learning from Megadisasters project.

EXTREME DISASTERS UNDERSCORE THE NEED FOR A HOLISTIC APPROACH TO DRM

Single-sector development planning cannot address the complexity of problems posed by natural hazards, let alone megadisasters, nor can such planning build resilience to threats. Faced with complex risks, Japan chose to build resilience by investing in preventive structural and nonstructural measures; nurturing a strong culture of knowledge and learning from past disasters; engaging in wise DRM regulation, legislation, and enforcement; and promoting cooperation among multiple stakeholders, between government agencies and ministries, between the private sector and the government, and between multiple levels of governance, from local to national to international.

Today, Japan is placing even heavier emphasis on recognizing and respecting complexity and residual risk, designing and managing systems that “fail gracefully”—that is, that mitigate damage to the greatest extent possible before succumbing to overwhelming force. The essence of the approach is to design and maintain resilient infrastructure capable of absorbing damage from natural disasters and failing only when an event exceeds all feasible and affordable measures. In the wake of the GEJE, Japan also recognized that additional efforts were required to plan and design measures capable of countering events of low probability but high impact.

PREVENTIVE INVESTMENTS PAY, BUT BE PREPARED FOR THE UNEXPECTED

Japan's extensive structural measures were very effective in protecting buildings and people from the earthquake. Although 190 kilometers of the 300 kilometers of dikes in the area collapsed, they decreased the force of the tsunami and, in some areas, delayed its arrival inland. All bullet trains stopped safely without casualty, thanks to a cutting-edge system of detecting the earliest sign of ground movement. The GEJE, however, exceeded all expectations and predictions in the extent of its ensuing tsunami, demonstrating that exclusive reliance on structural measures will ultimately prove ineffective and must be supplemented with nonstructural measures and a basic understanding of the uncertainties surrounding the estimation of events such as earthquakes and tsunamis.

Because it is not practical—from a financial, environmental, or social perspective—to build tsunami dikes 20 to 30 meters high, Japan's government intends to accelerate the current paradigm shift in its thinking about disaster management, complementing its structure-focused approach to prevention with soft solutions to achieve an integrated approach to disaster risk reduction. Understanding that the risks from natural hazards can never be completely eliminated, the new, balanced approach incorporates community-based prevention and evacuation and other nonstructural measures such as education, risk-related finance and insurance, and land-use regulation.

LEARNING FROM DISASTER IS KEY, AS JAPAN HAS SHOWN FOR THE PAST 2,000 YEARS

Japan has used the lessons of past disasters to improve its policies, laws, regulations, investment patterns, and decision-making processes, as well as community and individual behaviors. Investing in preparedness and a strong culture of prevention made all the difference in the Tohoku region when the GEJE struck. The Meiji-Sanriku Tsunami of 1896 killed 40 percent of the population in the affected zone, whereas the GEJE, a disaster of equal magnitude, claimed only 4 percent.* Evacuation drills and DRM education, staples of the country's schools, kept children safe in Kamaishi City. The famous "Kamaishi Miracle" was not really a miracle at all, but rather the result of a sustained effort to instill a culture of resilience and prevention based on continuous learning.

DRM IS EVERYONE'S BUSINESS

Japan's tradition of community participation in preparedness was a key factor in minimizing the number of lives lost to the GEJE. Community-based DRM activities are well integrated into the daily lives of most Japanese, ensuring that awareness of natural hazards is never far from their mind. The national and local governments formally recognize and support the involvement of the community in DRM through laws and regulations that define roles and commitments, through linkages with local institutions (such as *jichikai*, or neighborhood associations), and through participation in meetings at which decisions are made. During the GEJE, local governments and communities in affected areas served as first responders, managed evacuation centers, and promptly began postdisaster reconstruc-

* The Meiji tsunami occurred at night, whereas the GEJE struck during the day.

tion. Partnerships with the private sector were also critical. Rehabilitation could begin the day after the earthquake because *agreements* with the private sector were already in place. Quick payment of insurance claims allowed individuals and businesses to contribute fully to the rehabilitation effort.

SHARING EXPERIENCES WITH DEVELOPING COUNTRIES

Other countries can protect themselves from major disasters by adopting—and adapting as necessary—some of the measures taken by Japan, and by understanding the strengths and weaknesses of Japan’s response to the GEJE. To help them do that, the Learning from Megadisasters initiative will provide data, analysis, and insight in printed and Web-based formats (including e-learning), in face-to-face activities, in seminars presented through the good offices of the Global Development Learning Network,[†] and through a dedicated community of practice—all designed to build the capacities of government decision makers and other stakeholders in developing countries. A searchable set of online materials at various levels of depth and detail will serve as a focal point for this community of learning and practice on DRM. The knowledge base will grow as practitioners from around the world contribute their insights and expertise.

The first phase of the project delivered a set of 32 “Knowledge Notes” grouped into six thematic clusters:

- Structural measures
- Nonstructural measures
- Emergency response
- Reconstruction planning
- Hazard and risk information and decision making
- Economics of disaster risk, risk management, and risk financing.

The notes analyze and synthesize what worked, what did not, and why in the response to the March 11, 2011, earthquake and tsunami, offering recommendations for developing countries that face similar risks and vulnerabilities and providing a basis for future exchanges with experts and practitioners. To learn more about the program, visit www.worldbank.org/wbi/megadisasters.

[†] The GDLN, headquartered at the World Bank Institute, is a network of video-conferencing facilities in many locations around the world that can be mobilized on short notice for real-time meetings and workshops.

THE LAST WORD

No region or country is exempt from natural disasters, and no country can prevent them from occurring. But all can prepare by learning as much as possible about the risks and consequences of devastating events, and by making informed decisions to better manage both. To be maximally effective, and to contribute to stability and growth over the long term, the management of risks from natural disasters should be integrated into all aspects of development planning in all sectors of the economy.

