Lessons from Great East Japan Earthquake

Comprehensive Disaster Risk Management
ADRC
February 12, 2013

Mikio Ishiwatari, PhD
Senior DRM Specialist, World Bank
1. Great East Japan Earthquake
2. Lessons
3. Issues
4. Holistic approach
Learning from Megadisasters

1. knowledge-sharing project by the World Bank and Japan
2. collecting and analyzing information, data, and evaluations performed by academic institutions, NGOs, government agencies, and private sector
3. sharing Japan’s knowledge on disaster risk management (DRM) and post-disaster reconstruction with countries vulnerable to disasters.
1. Great East Japan Earthquake
Summary of findings and lessons

Great East Japan Earthquake
- Low probability, high impact
- High level of complexity
- Widespread impact due to globalized supply chains

Japan’s DRM system
- Investment in structural and non-structural measures
- Culture of preparedness and learning from past disasters
- Multi-stakeholder involvement
- Legislation, regulation, and enforcement
- High-tech, sophisticated instruments

ISSUES
- Risk assessment and communication
- Coordination
- Protection of vulnerable people
2. Lessons from GEJE
Lesson 1: Preventive investments pay, but be prepared for the unexpected

- < 200 death by M 9 earthquake shaking
  - Building code & retrofitting works after Kobe EQ in 1995
  - EQ detecting system of Shinkansen

Investment against Tsunami
- Constructed 300km dikes with cost of USD 10bill
- Monitoring and warning systems: USD 20 million/Year
- Hazard mapping, simulation, education at school........
UrEDAS Safely Stopped all bullet trains, Shinkansen, before main wave.
Tidal observatory, etc., approx. 80 locations

Earthquake Phenomena Observation System (EPOS) (JMA)
Earthquake and Tsunami Observation System (ETOS)
(Sapporo, Sendai, Osaka, Fukuoka, Okinawa)

Tsunami wave height (tide level)

Tsunami forecast station

Command and Data Acquisition Center (CDAC)

Earthquake and Tsunami Observation System (ETOS)

Local meteorological observatory

Mass media, Prefectures, police, Japan Coast Guard (JCG), NTT

Municipality

Citizens, ships, etc.

JMA
Proper building code and enforcement can save human lives

Based on lessons learned from Kobe Earthquake in 1994, Retrofitting Work Promoted.
Budget line and investment are required

- Mikawa Earthquake (2,306 people) and Makurazaki typhoon (3,756 people)
- Kathleen Typhoon (1,930 people)
- Fukui Earthquake (3,769 people)
- Nanki Torrential Rain (1,124 people)
- Typhoon Toyamaru (1,761 people)
- Isewan Typhoon (5,098 people)
- Great Hanshin-Awaji Earthquake (6,437 people)
- Great East Japan Earthquake (15,854 confirmed dead as of 28 March 2012)

Death + missing

Budget (million JPY)

Share in national budget (%)
Lesson 2: Learning from disaster is key, as Japan has shown for the past 2,000 years

Culture of preparedness, where training and evacuation drills are systematically practiced at the local and community levels and in schools and workplaces;

Sendai city
<table>
<thead>
<tr>
<th>Disasters</th>
<th>Act on (2-1-2)</th>
<th>Institution, Plan (2-1-2)</th>
<th>Building Codes(1-1-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 Typh. Makurazaki 46 Nankai EQ 47 Typh. Catherine 48 Fukui EQ</td>
<td>47 Dis. Relief 49 Flood Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>59 Typh. Isewan</td>
<td></td>
<td></td>
<td>50 Building Standard Law (BSL)</td>
</tr>
<tr>
<td>73 Mt. Sakurajima, Asama eruption 78 Miyagikenoki EQ</td>
<td>73 Active Volcanoes 78 Large-Scale EQ</td>
<td>79 Tokai EQ Countermeasures Basic Plan</td>
<td>71 Amendment of BSL: RC standards</td>
</tr>
<tr>
<td>80 Special Financial Measures for EQ</td>
<td>83 Dis. Reduction Week</td>
<td>81 Amendment of BSL: new standard</td>
<td></td>
</tr>
<tr>
<td>95 Kobe EQ</td>
<td>95 EQ Dis. Countermeasures 96 Rights and profits of Victims 97 Resilience Improvement in Densely Inhabited Areas 98 Support for Livelihood Recovery</td>
<td>95 Dis. Reduction and Volunteer Day</td>
<td>95 EQ Retrofitting Law</td>
</tr>
<tr>
<td>2000 Tokai Heavy Rain 04 Nigata Heavy Rain Nigata Chuetsu EQ</td>
<td>00 Sediment Dis. 02 Tokai Tonankai EQ 03 Urban River Flood</td>
<td>01 Cabinet Office 03Policy Framework for TokaiNankai EQ 05 Policy Framework for Tokyo EQ</td>
<td>06 Amendment of Retrofitting Law</td>
</tr>
<tr>
<td>11 GEJE</td>
<td>11 Urban Development Resilient to Tsunami</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Relocation and land use regulation are effective, but difficult to implement

Yoshihama Town
moved to highlands in 1896, and Safe This Time

JICA
Lesson 3: DRM is everyone’s business

- Community play crucial role in every measures
- Insurance, as well as financial and fiscal measures;
Community-based DRM

Firecorps (Community-based & part-time volunteers) conducted various rescue activities at the risk of their own life,

- Gate Operation
- Tsunami Warning
- Tsunami Monitoring
- Lead Evacuation

Death and Missiong: 201+48

http://www.fdma.go.jp
3. Issues of GEJE
Issue 1
Risk assessment and communication

• Assessing risks and communicating them clearly and widely helps citizens make timely decisions to protect themselves
  – Hazard maps can give the public a false sense of safety, if not properly communicated
  – Better management of information and communication is crucial in emergencies and recovery operations

Sendai City

Cabinet office

Inundated Hazard Maps

14:49
3 minutes following earthquake

- Observed Mj 7.9.
- Issued tsunami information: 3 meters in Iwate and Fukushima, and 6 meters in Miyagi.

JMA
• Never top-down, but interactive communication.

• Governments and community members should (i) be aware of limitations of technology, and (ii) Never stick to a single scenario.
How did Japan (un)expect?
Issued 3 min. after earthquake
But,
estimated height: 3m
revised 6-10m
Risk communication

Have you see hazard map?

- 55% never saw
- 11% posted on wall
- 9% saw at home
- 12% map at home, but didn't see
- 13% no map at home, saw outside

Yes: 9%
No: 91%
When did you evacuate?

- Evacuated immediately after the shaking stopped: 57%
- Evacuated after taking some other actions: 31%
- Tsunami approached while taking some other actions: 11%
- Did not evacuate: 1%

Need link with community
Issue 2 Coordination

- **Coordination** mechanisms must be developed and tested in normal times, so that they are ready in emergency
Mayor’s death
Leadership
Issue 3 Vulnerable

- **Vulnerable** groups must be protected—and engaged
  - Gender
  - Handicapped
  - Elderly
4. Holistic approach
Extreme disasters underscore the need for a holistic approach to DRM

• Exclusive reliance on structural measures ultimately prove ineffective
  – Resilient structure: complexity and residual risk. “fail gracefully”
  – supplemented with nonstructural measures
  – understand uncertainties of estimation of events
We cannot prevent disaster

- “JPN DRM system heavily concentrated on structure measures, and had limitation in preventing damage” (Technical investigation committee, National Disaster Management Council)

- “Considering some 20,000 human losses and accident of nuclear power plants, we, engineers and scientists, were defeated.” (President, Japan Society of Civil Engineers)
We cannot prevent disaster

190km / 300km damage / total
We cannot prevent disaster
Dyke can decrease tsunami energy

With breakwater

Tsunami height
10.8 m

Run-up height
10.0 m

Tsunami height
8.0 m

6 min. delay

10m

4-m-height seawall

36 min for overtopping

Port and Airport Research Institute
We cannot prevent disaster
Forest can mitigate damage
Voice of Angel

crucial facilities never at risk area
Okawa Tragedy
preparedness plan

74 out of 108 students, or 70% of all students in Okawa Elementary School, are dead or missing.

Protecting children's statue was made in front of the school to pray bereaved family’s peace of mind.
To prepare for unexpected
Act on Tsunami Resilient Community

- Tsunami risk area
- Tsunami mitigation structure (multi-purpose)
- Tsunami mitigation structure (inland lock gate)
- tsuni.mitigation structure (existing road)
- Protected Area
- Protected Area
- Land raising of residential area
- evacuation building
- evacuation tower
- evacuation building
- evacuation tower
- Evacuation route
- Evacuation site
- Tsunami Disaster Special Protection Zone
- Tsunami Disaster Special protection Zone (orange zone)
- Tsunami Protection Zone (yellow zone)
  - (1) Planning evacuation (facilities, routes, drills, information delivery, etc)
  - (2) Hazard maps
  - (3) Agreement on evacuation facilities
  - (4) Evacuation plan and evacuation drills
- Zone designated by ordinance (red zone)
  - living space under tsunami
  - living space over tsunami

(1) For example, hospitals have floor levels above tsunami height
(2) Regulate development
• Set of 32 Knowledge Notes grouped into six thematic clusters - http://wbi.worldbank.org/wbi/megadisasters;
• A Capacity development program, which includes:
  – A community of practice: https://collaboration.worldbank.org/groups/login.jspa
  – A searchable set of online material, blended learning and Face to face capacity building program in selected countries;
  – In depth Capacity Development program in pilot countries.
Thank you
Mikio Ishiwatari, PhD
mishiwatari@worldbank.org