



Damage/Needs Assessment

In the Affected Area of
The 2011 off the Pacific Coast of Tohoku
Earthquake and Tsunami



11th of April 2011

SEEDS Asia, OYO International Corporation and Kyoto University



About this Report

At the onset, we sincerely express our greatest sorrow to the victims of the earthquake and tsunami. Our survey was conducted to understand current needs and draw certain lessons. This report summarizes the key observations from the field trip undertaken between 1st of April and 5th of April 2011. At the end of the report, basic analysis is provided on what worked and what did not. A few recommendations towards short and medium term recovery are given. This is a modest step towards a long-term recovery lessons.

Acknowledgements

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Team Members

Rajib Shaw [Associate Professor of Kyoto University and Chairperson of SEEDS Asia]

Yuko Nakagawa [Chief Operating Officer, SEEDS Asia]

Koichi Shiwaku [OYO International Corporation and Member of SEEDS Asia]

Tomoko Shaw [Manager of OYO International Corporation and Member of SEEDS Asia]

Fumito Kaneko [General Manager of OYO International Corporation and Member, SEEDS Asia]



Contacts

Rajib Shaw [shaw@global.mbox.media.kyoto-u.ac.jp]

Yuko Nakagawa [yuko.nakagawa@seedsasia.org]

Koichi Shiwaku [shiwaku@oyointer.com]

About the Cover

The middle photo is from Rikuzen Takata of Iwate prefecture, where there were several thousands of pine trees as the coastal green belt. All the trees are broken in the disaster, leaving only one tree, as the symbol of hope for the future. The photo on the top is the damages in Taro in Miyako town, where a 10 m high, and 2.5 km long dyke was constructed. The photo in the bottom is the devastated area in Kesenuma port, where a major fire broke out due to leakage of oil.



Contents

Introduction

Overview of Earthquake and Tsunami

Survey Schedule

Observations in Surveyed Areas

Iwate Prefecture

Miyako city[including Taro]

Kamaishi

Tono-city

Rikuzen Takata city

Ofunato city

Miyagi Prefecture

Kesennuma city

Yamamoto town

Watari Town

Iwanuma city

Natori city

Sendai city

Summary

Damage and Issues

People's Needs

What Worked Well

Key Initial Learning





Introduction

A massive earthquake of magnitude of 9.0 occurred Friday 11 March, off the Pacific coast of the northeastern part of the Japanese main land (Tohoku Region), causing devastating damages. The Japan Meteorological Agency (JMA) named this earthquake "The 2011 off the Pacific coast of Tohoku Earthquake" (JMA, 2011). In addition, this earthquake caused the large scale of tsunami which hit Tohoku and Kanto Region. Because of the earthquake and tsunami, more than 12,000 people were died and the number of the missing persons is more than 15,000 (NPA, 2011). The survey team which consisted of SEEDS Asia, OYO International Corporation and Kyoto University conducted the survey in Iwate and Miyagi Prefecture, the most affected area by the tsunami, in order to understand the damages by the earthquake and tsunami and to grasp the needs of the local community and the government. This report is the summary of the survey.

[NPA (National Police Agency) (2011). The damage information by The 2011 off the Pacific coast of Tohoku Earthquake (version 10:00, 6th April 2011), <http://www.npa.go.jp/archive/keibi/biki/higaijokyo.pdf> , accessed in April 2011. (in Japanese)]

Overview of the Earthquake and Tsunami

Table 1 and 2 and Figure 1 are the overview of the earthquake and tsunami provided by JMA (2011).

Table 1 Earthquake Details

Date and Time	11 March 2011 14:46 JST (05:46 UTC)
Magnitude	9.0 (interim value; the largest earthquake recorded in Japan)
Hypocenter	N38.1, E142.9 (130km ESE off Ojika Peninsula) Depth 24km (interim value)
JMA Seismic Intensity (refer to Figure 1)	7 (Max): Kurihara City of Miyagi Prefecture 6+: 28 cities and towns (including Wakuya Town, Tome City, Osaki City, Natori City) in Miyagi, Fukushima, Ibaraki, and Tochigi Prefectures 6- or weaker: Observed nationwide from Hokkaido to Kyushu



Source: National Geographic



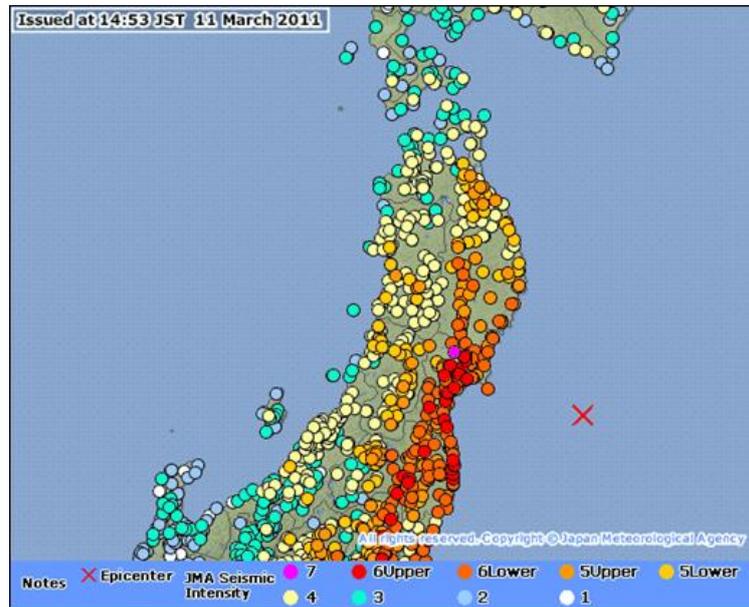


Figure 1. Seismic intensity map for The 2011 off the Pacific coast of Tohoku Earthquake (JMA, 2011)

JMA (2011). The 2011 off the Pacific coast of Tohoku Earthquake, -Portal- http://www.jma.go.jp/jma/en/2011_Earthquake.html, accessed in April 2011.

Table 2. Tsunami warning and advisories

Date and Time	Action	Number of Areas (Total : 66 areas)		
		Warning (3m or higher)	Warning (Up to 2m)	Advisory (About 0.5m)
11 March 2011 14:49 JST (05:49 UTC)	Issued	3	5	15
11 March 2011 15:14 JST (06:14 UTC)	Increased	6	7	23
11 March 2011 15:33 JST (06:33 UTC)	Increased	10	24	11
11 March 2011 16:08 JST (07:08 UTC)	Increased	17	19	17
11 March 2011 18:47 JST (09:47 UTC)	Increased	17	19	18
11 March 2011 21:35 JST (12:35 UTC)	Increased	17	22	19
11 March 2011 22:53 JST (13:53 UTC)	Increased	18	21	19
12 March 2011 03:20 JST (18:20 UTC)	Increased	18	21	27
12 March 2011 13:50 JST (04:50 UTC)	Decreased	4	11	26
12 March 2011 20:20 JST (11:20 UTC)	Decreased	0	4	21
13 March 2011 07:30 JST (22:30 UTC)	Decreased	0	0	15
13 March 2011 17:58 JST (08:58 UTC)	Lifted	0	0	0

Survey Schedule

Table 3 shows the survey schedule and Figure 2 shows the survey areas.

Table 3. Survey schedule

Day	Activities/Survey areas
1st April 2011	Reached to Morioka, Iwate
2nd April 2011	Iwate Prefecture (Miyako-city (including Taro area), Yamada town, Otsuchi-cho, Kamaishi- city, and Tono-city)
3rd April 2011	Iwate Prefecture (Rikuzen-Takata- city, and Ofunato-city) and Miyagi Prefecture (Kesenuma-city, Minami-Sanriku-town, and Ishinomaki-city)
4th April 2011	Miyagi Prefecture (Yamamoto-town, Watari-town, Iwanuma-city, Tohoku University)
5th April 2011	Natori-shi, Sendai, and leave Miyagi Prefecture



Map source: Google map

Figure 2. Survey areas

Observations in Surveyed Areas

This section is the survey report on the affected area and other related area where the team surveyed with emphasis.

Iwate Prefecture

Miyako-shi (including Taro area)

Taro area was damaged by the tsunami caused by Syowa-Sanriku Earthquake, which occurred in 1933. After the event, 10-meter dikes are built to prevent damages by future tsunami. But the area had devastating damages by the tsunami this time. Figure 3 shows the dike and damages. Figure 4 shows the buildings which survived from the tsunami because of the dikes. Most of the houses and buildings are flooded and collapsed by the tsunami. But some buildings are remained. From this result, it was identified that the dikes could not prevent tsunami damages but that they are effective to some extent.

Figure 5 and 6 show fishes which had been kept in storage. These fishes planned to be carried to other places but these were damaged because of the tsunami. Therefore, the fishes will be disposed. The survey team visited the Miyako Fishery Association to understand damages and needs on fisheries. The main works of member of the association are fishing and aquaculture. Because of the tsunami, many members lost their own fish boat. In addition, it is impossible to do aquaculture because the members lost equipments for it and many kinds of things including rubble, car, waste, and others were flooded to sea. Therefore, the members can not start their work. Other problem is insurance. All members did not purchase insurance for their own properties. If such member starts their works, they have to purchase equipments or ships by themselves. In addition, most of fisheries are elderly. According to the interview, the average age of the fisheries is around 60 years old. It was expected that it is seriously difficult to recover fishery industry in Miyako without any external help.



Figure 3. Damages by the tsunami in Taro area



Figure 4. Buildings which survived during the tsunami in Taro area



Figure 5. Damages to frozen fish in Miyako area



Figure 6. Destroyed truck is lifted from sea in Miyako

Kamaishi city

In Kamaishi, there are two tsunami evacuation building officially decided by the local government for evacuation. The survey team visited one of them shown in Figure 7. The number of stories of this building is eight. The first to third floors are used for offices and fourth to eighth floors are residential spaces. There are also road near this building for evacuation in tsunami situation. One of inhabitant told the tsunami came to the third floor of this building. Local residents were evacuated in this building and the road temporarily. In addition, he mentioned they had evacuation training 3rd March. It is expected that the training was effective for local people to re-realize the place for evacuation and how to do in tsunami situation.



Figure 7. Evacuation building [8 storey building with evacuation more than 4th floor]



Figure 8. Damages by the tsunami [left: transported ship, and right: destroyed cars]

In addition, he explained the situation after the tsunami. Kamaishi city was severely damaged (refer to Figure 8). Because of the tsunami, communication system like mobile phone and internet were out of order for a week. Therefore, local government could not transfer information to outside area, and other local government or people outside could not know the situation of Kamaishi city. Japan Self-Defense Forces reached to the city one week after.

Tono-city

Tono city is not located in affected area by earthquake and tsunami. But the social welfare council is the place for volunteer coordination for the affected area of Iwate Prefecture (refer to Figure 9 and 10). Many volunteers stay there. They move to affected area in the morning and came back in the evening. Then they have meeting in the night time. However, in the affected area, proper amount of necessary things man power, or resources should be sent to proper places through volunteer activities. It means volunteer coordinator should be emphasized. But this council does not have the person or organization who can concentrate on coordination work.



Figure 9. Meeting with social welfare council



Figure 10. Inside of social welfare council

Rikuzen-Takata-city

This city was devastated. Figure 11 is the government office building and Figure 12 is the surrounding area of the building. The government office building is damaged and it is possible for the government to work there. It is expected that all of documents, facilities, and equipments were severely damaged. Around the government building, most of houses and building were flowed. It is difficult for local people even to find their own property or belongings.



Figure 11. Damaged local government building



Figure 12. Damages by the tsunami

Ofunato-city

Ofunato city is also one of the most affected cities/town but the government building was survived. After the disaster, FM station was set up in the government building. One of the affected people is in charge of management of FM station. The role of the FM is to transfer information of the government and community safety. The survey team visited the person who in charge of the FM (refer to Figure 13). He was also affected and lost job and house. He emphasized to transfer information by FM to affected people because any communication tools could not work properly. The affected people

have various needs to survive in disaster situation. FM has the possibility to solve this problem. Figure 14 shows the radio booth on the air. The girl who is on the right side is fifteen years old. If the disaster did not happen, she would enter high school this April. But the government cannot start schools. Therefore, she came there and contributed to FM broadcasting. Generally, the role of new FM station in disaster situation is to make recovery smooth. Actually, the license of FM station was given for three month. Ofunato city consists of coastal/plain area and mountain area. In Iwate prefecture, damages by earthquake are not much. It means most of the damages were caused by the tsunami. Therefore, houses in the mountain area are not damaged severely. He mentioned the gap of people's awareness between two areas as future expected problems in this city. His aim of the FM is community development through the FM as well as disaster recovery/reconstruction.



Figure 13. Meeting with person who is in charge of community FM

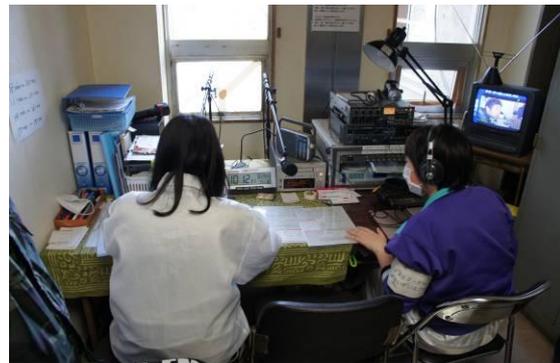


Figure 14. High school student giving message through FM

Miyagi Prefecture

Kesennuma-city

Kesennuma city is severely damaged. In this city, heavy oil was flow out and it was burned. Therefore, many burnt pieces of rubble are seen in the city (refer to Figure 15). The city was devastated. Train could not run in this area because rail tracks are also damaged (refer to Figure 15).



Figure 15. Damages by tsunami and burnt areas

Yamamoto-town

Yamamoto town was heavily damaged by the tsunami because it is located in plane area (refer to Figure 16). But the government building was remained. In the first floor of the building, FM station was established. The roles of the FM station were similar to that of Ofunato city. The person who is in charge of management of FM station is a person who retired from TBC (Tohoku Broadcasting Company). He moved to live in this town after his retiring. Because he was an announcer in TBC and had several connection due to his working history, he and local community could establish FM station. He has similar aims on FM station which the person in Ofunato city has. The FM station invites government persons including the town mayor and asks them to announce the current status and future plan for recovery and reconstruction (refer to Figure 17). As mentioned before, the person who is in charge of the FM station emphasized the radio should be utilized for community development as well as prompt and appropriate recovery and reconstruction. Inviting the government persons is one of challenges to achieve it. Because of this challenge, FM station can make the linkage between local community and the government. He is considering that FM station would be able to be continued for community development if the local government understands the importance of FM station.



Figure 16. Damages by the tsunami



Figure 17. Town mayor giving message or explanation on the town through FM

Watari-town

Watari town is the next town to Yamamoto town and these towns are located in the same county named as Watari-gun. The government building of Yamamoto town was being used even after the disaster but the building of Watari town was not. But temporary offices were provided from outside. In the temporary offices, the government could continue recovery works and others. Next to the office, FM station was established (refer to Figure 18 and 19). The person who is in charge here had the connection with the person at FM station in Yamamoto town. Therefore, Watari town

could establish FM station smoothly. The person at FM station told the situation in this town. In disaster situation, the community wireless system to provide local community with tsunami warning was out of order. It is one of reasons to increase human damage in this town. Additionally, recent houses have high performance of noise barrier. People can not hear announces from the system when they are driving cars. Because of these reasons, the wireless system is not appropriate for the current life style. As another issue, she pointed the cost to prepare the same kind of wireless system again in this town. It is expected that cost for it is higher than cost to distribute radio to all persons in this town. She pointed out that local government should provide warning through radio in emergency situation.



Figure 18. Temporary government office



Figure 19. Community FM station

One of the big problems in tsunami affected area is how house rubbles is demolished earlier to start recovery and reconstruction works. Under the general government works, house owner asks the government to demolish. But the government has more works in emergency situation, compared to general time. In Watari town and other city/town, house owners can express their decisions on demolition, using the flags (refer to Figure 20). House owners select one of color flag from three flags and give it to their own house. Red means houses and rubbles round house can be demolished by the government or appointed companies. Yellow means only rubbles around houses can be demolished and green shows any demolition is not necessary. Because of this, it is easy to understand house owner's decision and the government can start recovery works earlier. This system has an advantage because the local government respects house owners' decisions with flexibility. At the beginning, house owners can choose green flags, however after searching for their belongings in the rubbles in and around their own houses, they can change the green flag to yellow or red flags.



Figure 20. Three kinds of flags to show the house status

Iwanuma city

In Iwanuma city, the local government is providing information the damages in the city and government recovery work in front of the government building (refer to Figure 21). The government can this kind of works because the building was safe to the officer can concentrate to recovery works. From this, it is obvious that the government building is important. The survey team visited the office of the social welfare council in this city. The social welfare council is also working effectively. The council coordinates volunteers who came to this city. The staff told external help is not so necessary for coordination works but some recovery works like removal of clay or mud and house moving needs more volunteers (refer to Figure 22).



Figure 21. Information on damages and recovery works which were provided by the government



Figure 22. Meeting with social welfare works

Natori city

Sendai airport is located in Natori city. The airport is the biggest one in Tohoku area and it is not available because of the disaster (refer to Figure 23). Therefore, relief goods or other necessary things needs to be carried from other airport of Tohoku area or on the road. In the residential area of Natori city, there is the small hill (refer to Figure 24).

This place is a temporary evacuation place for Tsunami but this hill was also attacked by the tsunami. Figure 25 is the memorial thing for the tsunami this time. Some survived people visit this hill to pray. Figure 26 is the memorial stone for the tsunami caused by Syowa Sanriku Earthquake in 1933. The history of that tsunami was mentioned on the stone, as is described that the earthquake occurred at 2:30am on 3rd of March, 1933, followed by the roar of tsunami in 40 minutes, be aware of tsunami after earthquake. The stone was established on the hill in November 1933, 8 months later of the tsunami but flowed by the tsunami. It was considered that local community people visited the hill and knew the past tsunami there before the tsunami and their awareness had been raised. But, the tsunami this time was much larger scale than the past one.



Figure 23. Damages around the airport



Figure 24. Hill for tsunami evacuation in residential area



Figure 25. Memorial things on the hill



Figure 26. Memorial stone flowed from the hill

Sendai city

Iwate and Miyagi Prefecture are the most affected prefectures by the Tsunami. This time, the scale of the earthquake was also historically much bigger one. But collapsed houses or buildings by earthquake are rarely seen in Iwate Prefecture. In Sendai city and other city/town in Miyagi Prefecture, some damages by the earthquake are seen.

For house, clay tiles on roofs were damaged. Some large scale building in Sendai city had damages on the structure (refer to Figure 27). However, completely destroyed houses or buildings could not be seen in the both prefectures.

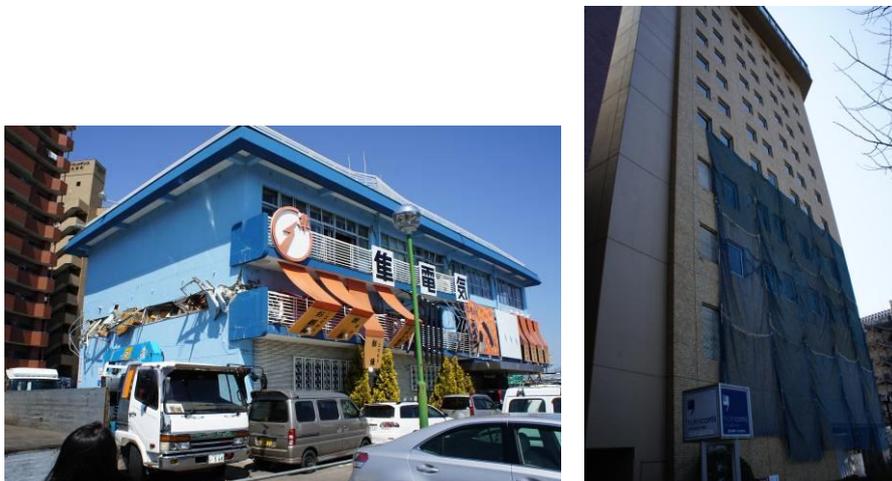


Figure 27. Building damaged by the earthquake

Summary

The survey team went around the several affected city/town in Iwate and Miyagi Prefecture. The following are the damages/problems, needs, and findings by the earthquake and tsunami. Based on these, suggestions and future plan are pointed to conclude the survey.

Damages and Problems

- **Individual residences and government building:** Damages by the earthquake is not much. Most of damages are caused by the tsunami. Therefore, damages are seen in coastal area and plain area.
- **Industry:** Fishery industry is heavily damaged because the tsunami attacked coastal area. Other industry or shops were also damaged.
- **Isolated area:** Because communication system was down, Kamaishi city could not transfer the information to outside area.
- **Temporary evacuation place:** Some of evacuation place worked effectively. But human damages were increased in plain area because the number of evacuation place is few, compared to largeness of area.
- **Safety confirmation:** In local government or evacuation centers, local people are giving information of their safety or information to looking for other persons. These are paper base information. Therefore, it is expected that nobody knows which is new or which is not necessary already.

- **Amount of rubble:** Tsunami is different from earthquake. In case of tsunami, it is almost impossible to understand whose property. But rubble should be demolished for recovery reconstruction.
- **Community wireless system:** In case of big hazards, the system [bousai musen in Japanese] is damaged and it does not work properly.

People's Needs

- **Temporary house and spaces:** Many people lost their own house. These people are staying evacuation places. Temporary houses are necessary but it is necessary large spaces to build.
- **Equipments and resources to start works:** To start works again, equipments need to be prepared but it takes cost. If people cannot earn money, they cannot survive in emergency situation and their life after the reconstruction.
- **Job:** Job is related to the need mentioned above. Many people lost their jobs. In reconstruction process, it takes much cost to recover their own lives. Therefore, job hunting is one of the most important tasks for affective people.

What Worked Well

Early warning system: The earthquake occurred at 14:46, the tsunami warning was provided at 14:49, and was on the JMA [Japan Meteorological Agency] website at 14:50. The tsunami warning in Japan has two parts: tsunami warning and tsunami advisory. A map is shown in the TV with three different colors, red [major tsunami, with more than 3 m], orange [up to 2 m], and yellow [height about 0.5 m]. The red and orange colors are warning, and yellow one is advisory. The estimated arrival time is also shown in the JMA website. People evacuated to the nearby places, however the height of the tsunami was beyond expectation.

Past earthquake and tsunami and its impacts: The affected area was hit repeatedly by major earthquake and tsunami: on 15th June, 1896, on 3rd March 1933, and also on the 22nd May 1960 Chile earthquake and tsunami. In 1896, more than 22,000 people died, a local culture of “tendenco” emerged from it. In 1896, many people wanted to look for their family, neighbors after the tsunami, and the tsunami arrived meanwhile. This culture has a deep meaning, which is built on the mutual trust. People were taught to be evacuated, with the trust and belief that their family members will also take proper shelter. This culture of “tendenco” saved many people's lives.

Infrastructure measures: Due to past several events in the same area, infrastructures like sea-dykes were built in several places. The 10 m high, 2.5 km long dyke in Taro,

Miyako town in Iwate prefecture is a classic example of this. Although part of the dyke was damaged, and tsunami overflowed the 10 m dyke, it surely reduced the impacts of the event. In Kamaishi, in Iwate prefecture, tsunami evacuation building was built with instructions, and people were safe who evacuated above 4th floor.

Evacuation drill and disaster education: Several areas performed regular disaster drills on 3rd of March [the day of 1933 earthquake and tsunami], which was just one week before the disaster. Disaster education was also performed in several schools, and the impact was that in Kamaishi, 5 out of 2,900 school children died. The middle high school students took shelter in the higher areas, along with the nearby elementary school children.

Strong Earthquake risk reduction measures: in spite of a 9 magnitude event, and with intensity 7 [in JMA scale, which is equivalent to XII in MMI], there was insignificant impacts on buildings and infrastructures. Although liquefaction was observed in the soft soil in reclaimed land, the buildings were safe in most cases. The destruction is mostly concentrated in the narrow zone of 4-5 km along the coast. If there were added damages on earthquake, the situation would have been worse.

Key Initial Learning¹

Linking hard and soft measures [combination of infrastructures and education]: it is of extreme importance that the risk reduction measures need to be locally customized, and there needs to be a balance approach of soft [education, awareness] and hard [infrastructures] measures. Based on the local topography and physical features, this balanced mix is required to be customized.

Early warning system is effective when it is properly perceived: Although there was an early warning issued immediately, people underestimated the height of the tsunami due to repeated occurrences of earthquakes, and a “feel safe” mis-perception prevailed. Proper perception is required to take necessary actions.

Evacuation order and its effectiveness: Although the evacuation advisory and evacuation order are issued, people usually take their own judgment. To enhance the proper decision of people, it is required to mention the expected height of the tsunami in the evacuation order and advisory.

Providing different scenarios and reviewing disaster risk management plan: This disaster was extreme catastrophe, similar to that of Jogan Earthquake and Tsunami of

¹ There would be lots of lessons learned in due course. This part summarizes some of the emerging learning issues, which appeared from the field survey.

869 AD. To provide and explain 2-3 scenarios such as worst, medium, and light scenarios to residents is necessary and according to these scenarios, disaster management plans need to be reviewed. After reviewing evacuation plans, it may require private lands to be designated for evacuation sites.

Investment in risk reduction pays: This disaster shows that the investment in risk reduction pays to save people's lives, both in terms of preventive and educative measures. Japan has been a role model for earthquake risk reduction, however, it needs to incorporate more multi-hazard risk reduction measures.

Dissemination of information to future generations: In several areas in the affected region, dissemination of past experiences through storytelling to the school children from the old people. This is considered as an important educational tool. In Natori, there was the memorial stone to explain the past tsunami. For future generation as well as current generation, the experiences this time should be shared.

Customized information sharing: Community FM was working effectively to transfer government information to community. The need of customized information sharing between the affected people and government is very important, and this can be done through need survey and provide need specific programs through radio.

Importance of the government building: If government building is survived, the government can start response and recovery works earlier. In addition, the government can spare spaces for community.

Volunteer coordinator: In case of big disasters, many volunteers come to affected area from outside. Volunteer coordinator is necessary to distribute proper volunteers to proper area. This should be considered as a full-time specialized work, with access and knowledge to different mapping tools and social networking system.

Reconstruction and community development: Several areas were completely devastated. Even if disaster did not happen, some of the local governments were in verge of declination, and several villages became marginal villages due to its higher aged population. Keeping this mind, it is necessary to integrate reconstruction and community development with new livelihood concept and looking at the far future, while serving the need of the near future.

Reduction of gap between affected and non-affected people: This time, damages by earthquake is not prominent. So people in higher areas were not affected much, while the whole coastal neighborhood in the same town or village has been destroyed. In the future, it is expected that there would be a gap between the affected and non-affected people. Reconstruction process should include non-affected people as well as affected people in order to make safer and comfortable society cooperatively.

Data back up and preparedness of temporary offices of local government: If local government had data of community, they can start recovery works earlier. Local government should prepare backup data and temporarily offices so that they can use when necessary.

Utilization of convenience stores: There are lots of convenience stores in Japan. We could also find several within a few kilometers distance in the remote areas of Iwate and Miyagi. We saw many people coming to buy things to the stores. The convenience stores are useful resources for exchanging information among the residents. Most people come from far places to local government offices. For some useful information for residents, it can be exchanged at convenience stores.

Sharing process of recovery and reconstruction: Many victims have lost hopes for future. This mental devastation makes people physically weak; sometimes people who had needed only a little assistance became unable to walk. The past experience of recovery and reconstruction process needs to be shown to the affected people, so that they can have some visions for future. Local governments are in difficult positions to show the steps until things are confirmed. However, precedent cases like Kobe, Niigata can be shared by the disaster experienced and non-governmental organizations which have expertise in disaster recovery and reconstruction.

Way of cooperation and understanding characters of Tohoku region: People in Tohoku (North East) region, especially Iwate Prefecture are known for reserved characters. Right after the devastated Tsunami, when evacuees who lost houses and properties, have no foods and water, they are saying to the TV camera that “there are other victims who may be worse than me, or I can survive such situation because I have experienced wars”. People in the Tohoku tend not to talk much but they have firm determined idea inside. You may find them exclusiveness and cautiousness to others. This also means they have very tight relationship among themselves. Victims are helping victims. Student victims are helping the elderly. Many of those who lost parents seem to be raised by relatives, which has clear distinction from urban communities like in Kobe. The tight relationship within the relatives and communities, the silent and strong inner spirit of Tohoku need to be respected and the way of assistance from outside need to be somehow reserved and stepped back.

End Note:

An old grandfather in the affected area told us that there were bottles of juice scattered from the convenience store after the Tsunami. His grandchildren wanted to drink the bottle of juice, because its water supply had stopped for several days and they have surviving with water from the mountain stream. The grandfather firmly told his grandchildren to bear with the water, because the bottles obviously belong to the shop. Our team was impressed by the high spirit handed down to the grandchildren even at the time of crisis. We would do whatever assistance we can make, to continue transferring this spirit to future generations.

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