



KNOWLEDGE NOTE 2-7

CLUSTER 2: Nonstructural Measures

Urban Planning, Land Use
Regulation, and Relocation



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Reconstruction should include a range of measures to enhance safety: disaster prevention facilities, relocation of communities to higher ground, and evacuation facilities. A community should not, however, rely too heavily on any one of these as being sufficient, because the next tsunami could be even larger than the last. Communities also need to rebuild their industries and create jobs to keep their residents from moving away. The challenge is to find enough relocation sites that are on high enough ground and large enough, and to regulate land use in lowland areas.

FINDINGS

RECONSTRUCTION FROM THE GEJE

Reconstruction after the GEJE has been slow compared to the Hanshin-Awaji Great (Kobe) Earthquake that hit the city of Kobe and killed 6,400 people in 1995. The seismic shocks experienced in the GEJE affected a much broader area. A number of characteristics of the GEJE made reconstruction more difficult and lengthy.

First, since tsunamis tend to hit the same areas repeatedly over several decades or even several hundred years, some affected people want to reconstruct their houses at suitable new locations instead of the damaged sites. Although the rubble has been removed, full-scale reconstruction has not yet begun. Planning and local consensus-building for relocating communities to high ground has been attempted. It takes time to find them places to live, and to reach agreement as a community to move together to a safer place. Since it takes several years to rebuild completely, it is unclear whether local employment and population levels can be sustained.

Second, the radiation contamination from the accident at the Fukushima Daiichi Nuclear Power Station will last a long time and prevent the local people from returning to their homes. Reconstruction projects may be delayed since it is still unclear when or if people

will be able to return to their places of residence. There is also a concern that many people, especially younger families, may choose not to go back to their home towns.

While the nuclear accident in Fukushima was a bit less serious than in Chernobyl, it was ranked the same on the International Nuclear Event Scale. No major emissions of radioactive material from the collapsed nuclear power plants have been observed since April 2011. A ban or restrictions on land use will be introduced to prevent exposure to high levels of radiation. The government plans to reclassify the *Warning Zone and Planned Evacuation Zone* into three new categories: *Long-term Habitation Difficult Zone* (more than 50 mSv of Annual Radiation Exposure), *Prioritized Decontamination Zone and Decontamination and Possible to Return Zone*. All the nuclear power plants in Japan were shut down in May 2012 for maintenance and evaluation.

There are two tiers of local government in Japan, prefectures and local municipalities, which are responsible for disaster response and reconstruction. Municipal governments play the most important role because they are closest to the victims and the stricken areas. The prefectural governments are grappling with the broad reconstruction issues. For example, they have supported municipal governments in debris management by coordinating solid waste management facilities in the prefectures.

THREE ELEMENTS MUST BE ARRANGED

All reconstruction plans aim at rebuilding towns and communities that are resilient to major disasters. The most important lesson from the GEJE is that there are many disasters we cannot prevent. All we can do is reduce the damages. Sometimes we cannot predict, or even imagine, the severity of future natural hazards and so we will be unprepared. Although many breakwaters and tsunami dykes had been built in the stricken areas, the tsunami, nevertheless, destroyed or overtopped most of them, and poured into the towns and villages behind them. "Reducing damages" means first and foremost preventing the loss of human lives; property damage to houses, infrastructures, and various man-made facilities may be unavoidable.

Disaster risk management (DRM) consists of three components: disaster prevention facilities, community relocation to safer ground, and evacuation facilities. This approach was reflected in the government's basic policy on reconstruction, after the GEJE Reconstruction Council's report recommended a shift in DRM from prevention to risk reduction.

Disaster prevention facilities included tsunami breakwaters or dikes. It is important to recognize both their usefulness and their limitations as explained in KN1-1. Damages would have been even worse without them. At the same time, the facilities could not prevent huge tsunami to attack areas behind them. Most of the breakwaters and dikes will be rebuilt to be even stronger and larger. These facilities can only resist tsunamis of limited size.

Community relocation and redesign are also important ways of reducing damage. Clearly, when communities are located on high enough ground, the tsunami can't reach them. This was well known in areas that had been repeatedly hit. After the Showa Sanriku Tsunami in 1933, which killed about 3,000 people, the government promoted reconstruc-

tion on higher ground; but this policy could not be fully implemented since it was difficult to find suitable locations.

Evacuation facilities consist of escape routes and shelters. Escape routes should be easy to follow and clear of debris. Although evacuation drills and instructions discourage the use of vehicles, escape routes must nevertheless accommodate both pedestrians and cars as discussed in KN2-6. Evacuation shelters should be multilevel structures to accommodate evacuees safely as water levels rise.

All three components must be used together as a holistic system. Using only one or two elements is not enough. While disaster prevention facilities and the location of communities are based on forecasts and estimates, the actual hazard may be larger, and therefore, life-saving evacuation facilities will also be required.

Although these strategies are being applied in the reconstruction of tsunami-stricken areas, experience has shown that relocating communities to higher ground has been difficult to implement. And while relocation of communities and construction of evacuation facilities may be possible in newly reconstructed areas, people are also worried about areas that are under threat of being hit by tsunamis in the near future. In these areas, construction of disaster prevention facilities takes longer and the relocation of communities to higher ground is more difficult than in those areas destroyed by the GEJE: compensation has to be paid for the existing buildings, and consensus for relocation has to be built among the residents.

LEARNING FROM PAST TSUNAMI RECONSTRUCTION

The following three examples illustrate the challenges of reconstruction. Dikes alone cannot protect communities, so locating communities at higher elevations is key. However, it is difficult to find suitable locations and to sustain people's livelihoods.

LOCATING ON HIGHER GROUND SAVED LIVES AND PROPERTY

The Yoshihama fishing and farming village in Ohfunato city, in the Iwate Prefecture could successfully mitigate damages at the GEJE. The village could be relocated because of availability of land close to the original residential areas, local leadership and financial assistance from governments. The village began moving to higher land following the Meiji Sanriku Tsunami in 1896, which washed away almost the entire village. The residents found and developed the relocation site themselves, and the relocation was completed with government financial support after the Shouwa Sanriku Tsunami in 1933. Fortunately, there was a hill above the old village that sloped gently to the beach. The villagers moved all their houses onto the hill and turned the lowlands, where they had lived, into farmland. A three-meter high tsunami dike was built in the 1970's. In the GEJE, the tsunami hit the village, flooding most of the farmland, but not the residential zone. Only a couple of houses, located lower down, were washed away, and one person was killed.

PARTIALLY SAVE COMMUNITIES

Another example is the Touni-hongo village in Kamaishi city, in the Iwate Prefecture. This is a well-known village that relocated the entire community after the Shouwa Sanriku Tsunami in 1933 to a newly developed site on hilly ground nearby. One of the community leaders, who owned the land, donated it to the community. The Iwate prefectural government developed the relocation site with financial support from the central government. A hundred houses were moved to the new site and the old location was turned into farmland.

The GEJE tsunami flooded and washed away all 50 houses located on the lower ground, but it didn't reach the houses relocated to higher ground.

The houses on the lower level were built after the 10 meter-high tsunami dike had been constructed. Residential land use was allowed, because the dike was expected to protect the hinterland. However, the tsunami broke into the village at a point beyond the dike, and another tsunami wave came in through a tunnel on the road behind the village that connects it with the neighboring village. One of the reasons for building houses on lower ground is to make daily life easier for the elderly who have a hard time on steep slopes. Many similar cases exist of communities that were partially damaged because of lax land-use management that allowed building on low ground. Constructing large dikes may even encourage building on lower ground.

COMMUNITIES COMPLETELY DESTROYED

The final example is Taro, Miyako city, Iwate Prefecture. Taro was internationally known because of its huge and long tsunami dykes. Taro was hit by the 1896 tsunami, losing 1,867 people, about 83 percent of its population of 2,248; it was then hit again in 1933 and lost 911 persons, 32 percent of the population. This time about 200 out of 4,400 people perished. After the Shouwa Sanriku Tsunami in 1933, Taro considered following the central government's recommendation and relocating the entire community to higher ground. They could not, however, find a suitable site where the people could see the fishing port or build their houses facing south, among other important conditions. Because Taro was a large village, the residents finally gave up looking for a new site, and decided to build a dike around the residential area, and paid for it themselves.

After the first year of construction, the central and prefectural governments approved the project as a disaster prevention public work and provided the rest of the funding. A second dike with almost the same dimensions as the first one was built after 1960 Chilean Tsunami, to prepare for larger tsunamis.

But even with these two dikes, Taro, this time, was utterly destroyed. The newer dike closest to the beach was destroyed and the other was overtopped. There were several cases in Sanriku, where previously stricken communities had not moved but had simply added landfill. All of these incurred severe damage.

RECOVERY OF INDUSTRIES AND EMPLOYMENT

Another serious issue came up while planning for reconstruction: out-migration. A survey showed that the population had decreased by 46,000 between 2005 and 2010 before the disaster in the coastal municipalities ranging from the Iwate to the Fukushima prefectures. According residential statistics, the same area lost 57,000 people between March and November 2011 including about 15,000 people who were taken by the disaster. Therefore, if people are not strongly induced to stay in these areas through economic incentives such as industrial recovery and job creation, even more residents may leave in spite of the physical reconstruction (KN5-5).

This urgent need for development requires that part of the huge national reconstruction budget should be used to develop new job-creating industries and to attract entrepreneurs from outside the region.

The first step is to rebuild existing enterprises especially in the fishing and marine product processing industries including shipbuilding, freezing, and warehousing. We cannot, however, rely on these alone, since they have been gradually losing jobs to heavy international competition.

A second important initiative is setting up new industries that may increase future employment. All local government reconstruction plans include activities such as tourism, renewable energy production, and manufacturing of products that respond to local demand.

In Fukushima the outlook is worse. The government announced that certain parts of Fukushima will not be habitable for a long time because of high radiation levels. The government must therefore help people relocate.

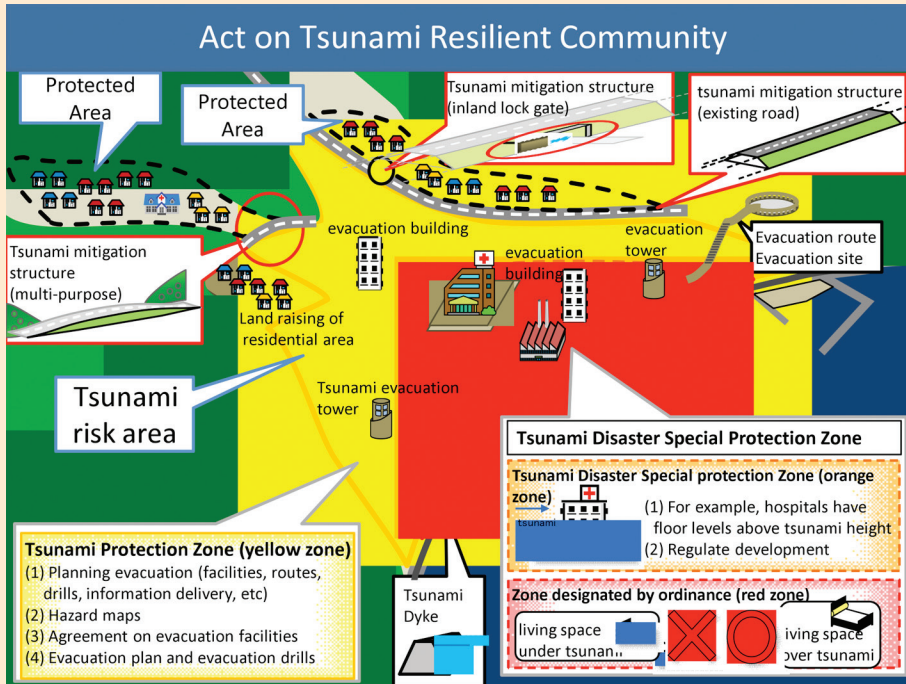
TOWARD BUILDING COMMUNITIES RESILIENT TO DISASTER

Local governments have not regulated land use in the affected areas from a perspective of DRM. Lowlands had been developed for residential, commercial, and industrial purposes. But economic development, urbanization, and population growth have increased vulnerability to tsunami damage along the coast. The population in the coastal areas of Iwate prefecture has tripled over the last century: from about 76,000 at the time of the Meiji Sanriku Tsunami in 1896 to some 274,000 in 2011.

The Japanese government is reinforcing DRM systems by introducing land use regulations based on lessons learned from the GEJE. The Act on Building Communities Resilient to Tsunami was legislated in December 2011 to prepare for low-probability, high-impact tsunamis (figure 1). The goal of the act is to protect human lives at all costs. The following approaches have been adopted:

- Multiple lines of defense, combining structural and nonstructural measures (Cluster 1, and KNs 2-1, 2-2, and 2-8),

FIGURE 1: Concept of Act on Building Communities Resilient to Tsunami



- Shifting from a “single line of defense” based on tsunami dikes to a “zone defense” using roads and other structures such as secondary dikes, and land use regulation,
- Practical measures for quick and safe evacuation, and
- Assessing tsunami risks based on local conditions, such as industry, commercial activities, history, and culture.

The Ministry of Land, Infrastructure, Transport, and Tourism has formulated basic guidelines on tsunami counter measures for prefectures and municipal governments. The guidelines specify that prefectural governors should categorize risk areas as “yellow zone,” “orange zone,” and “red zone.” In municipalities, mayors formulate counter measure action plans. The governors and mayors designate structures such as highway as disaster management facilities.

In yellow zones, where residents are likely to lose their lives, evacuation measures, such as evacuation shelters, drills and hazard maps, are required. In the orange zone where residents are highly likely to lose their lives, key facilities, such as hospitals, are to be set up in

tsunami resilient structures. In the red zone where residents cannot escape the tsunami, all buildings including residences must be tsunami resilient, such as having multiple stories that rise high enough to evade the tsunami waters.

Cost sharing and various incentives are used in implementing these measures. Local governments may provide the private sector with incentives to secure evacuation facilities. Additional floor-space ratios for evacuation spaces on high floors are given as bonuses. They may also be exempted from paying 50 percent of the building tax on evacuation space. Participating organizations share the costs of multipurpose structures. For example, DRM organizations will share the additional construction costs for roads used as secondary dikes.

The central government and local governments provide financial assistance for developing safe relocation sites on high ground. Community members must reach a consensus on relocation before it begins. The community bears the cost of building new houses, while local governments are responsible for developing the infrastructure associated with the relocation sites.

LESSONS

Tsunami-prone areas must be ready for recurring disasters. Reconstruction must include three key safety measures: disaster prevention facilities, relocation of communities to higher ground out of reach of the tsunami, and evacuation facilities. The community must not rely too heavily on any single one of these, since the next tsunami may be much larger than the last, and require a broader range of precautions.

Industrial recovery is indispensable for economic sustainability. In the absence of businesses and job opportunities, people will leave their disaster-stricken communities. Simply rebuilding houses will not induce people to stay; industrial recovery policies must also be strengthened.

Public-private partnerships are crucial. Enormous sums of public money are being spent on reconstruction projects and to stimulate the local economy. But this will end in several years. It is important to create as many business activities as possible to promote economic growth and opportunities.

Relocation is effective but implementation is a challenge. Three examples from past tsunamis illustrate that, although relocation measures are effective, they are not easy to implement. In the village of Yoshihama, houses that had already been relocated following a tsunami did not suffer from the GEJE. However, around the mountainous coastal village of Taro, finding suitable relocation sites was difficult; and in the village of Touni-hongo where houses had been relocated to high ground following a tsunami, lowland use could not be properly regulated.

RECOMMENDATIONS FOR DEVELOPING COUNTRIES

Understand and manage disaster risk. The Japanese experience illustrates that improper land use regulation leads to increasing damage from disasters. Urbanization in the lowland areas has made the eastern coast of Japan more vulnerability to tsunamis. Disaster risks must be properly understood and managed in urban planning.

Develop facilities, live in safe place, and prepare evacuation. The approach of integrating three elements: facilities, settling in safe areas, and evacuation can be used to manage disaster risk in developing countries. Since every country has its own geographic, socio-economic, and budgetary characteristics, and also faces hazards of different dimension, practical approaches will differ from country to country. Since most developing countries have limited resources for constructing facilities, they should focus on living in safe areas and putting rigorous evacuation measures in place.

Protect by zone and multi-line. “Zone defense” and “multi-line” approaches can be effective against tsunami, as well as other disasters such as floods, landslides and mud flows. Infrastructure, such as highways and railways, help mitigate disasters risk in both rural and urban areas. In the Philippines, a “MegaDike” constructed to protect against lahars, volcanic mud flows, from Mount Pinatubo, is also used as a highway. Disaster management organizations and infrastructure organizations should coordinate in planning and sharing the costs of multipurpose infrastructure (KN 1-4).

Promote relocation where feasible, acknowledging difficulties. As Japan’s experiences with tsunami disaster recovery illustrates, relocation to safer sites and land use regulation in risk prone areas are effective, but challenging to implement. Even though people may be ready to relocate to higher grounds right after a disaster, they may also change their minds, preferring to live in the lowlands because it is more convenient for daily life. After the Indian Ocean Tsunami in 2004, the Indonesian and Sri Lankan government tried to introduce similar regulatory approaches, but did not succeed because of opposition from the communities and limited enforcement mechanisms.