

Re-thinking of Land use planning at coastal area in Japan after Tsunami disaster

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1. Introduction

One of the five most powerful earthquakes in the world since modern record-keeping, which was a magnitude 9.0 (Mw) undersea megathrust earthquake off the coast of Japan, occurred at 14:46 JST (05:46 UTC) on Friday, 11 March 2011 (Ministry of Land, Infrastructure, Transportation and Tourism, Great East Japan Earthquake report (106), 6 Feb. 2012). The earthquake triggered powerful tsunami waves that reached heights of up to 40m in Miyako, Iwate Prefecture, and which, in the Sendai area, travelled up to 10km inland. The Japanese National Police Agency confirmed 15,860 deaths, 6,011 injured, and 3,281 people missing, as well as over 372,000 buildings damaged or destroyed. Although most coastal area has invested the huge seawalls which stand up to 12 m high, the tsunami simply washed over the top of some seawalls, collapsing some in the process. This tsunami was beyond the assumption scale of the seawall design greatly, but the equivalent scale tsunami was occurred at same area in the past several times, e.g. 869 Jogan tsunami, 1896 Meiji-Sanriku tsunami, 1933 Sanriku tsunami, etc.

2. Why is the history repeated?

Japan is narrow and steep mountainous island country surrounded by the sea. About 35% of populations are concentrated in coastal lowland area, almost same as inundation area of this 2011 tsunami, within 10km from coastline and up to 30m from sea level. In this Sanriku area, people moved to hills after every tsunami disaster, however they gradually back to lowland again. Even if a lot of monuments, which warned of the danger of the tsunami, were left, the memory of their danger has gradually faded and the history has been repeated over and over again. While some villages, which keep staying on the hills, have avoided this 2011 tsunami disaster.

3. Design with nature

One of the big issues of land use in coastal area is that the city area got too close to the sea. Because the population has been increased until in 2005, we needed to develop more urban area and farmland. The development of coastal area brought economic growth. But the expanse of the city resulted in the increase of enormous cost to maintain their infrastructures, e.g. roads, water and drainage services, and seawall to protect the properties. These developments destroyed natural settings in coastal area and their ecosystem services, especially from coastal sand dune. One of the most important ecosystem services of coastal sand dune is the coastal defense as natural dike. In Netherland, the coastal sand dune is strictly protected instead of seawall. In addition with the coastal defense, coastal sand dune supply dune water as drinking water in Netherland. Everard et. al. (2010) showed that the coastal sand dune provided not only support biodiversity, but also a wide range of ecosystem services. In Japan, most coastal dunes were lost caused by erosion, development, planting coastal forest, and establishment of seawalls. But now, Japanese populations have decreased to since 2005. Especially in the Tohoku region, populations decreased to since 1970s and the abandoned farmlands have rapidly increased since 2000. We should consider the setback from the coast and the restoration of coastal sand dunes as reconstruction plan. In this plan, the seawalls are not necessary, coastal forest moving to more inland area where will work well, and landfilled road, which stands seaside of the city, being inner dike instead of the seawalls. 2011 Tsunami disaster has showed that the liner protection, e.g. huge seawall, could not prevent their damage. The new reconstruction plan should be made effective configuration of these multiplex defense structures of land use to reduce the damage of tsunami, considered the landscape, population trend and future vision.

References

Everard M, Jones L and Watts B (2010) Have we neglected the societal importance of sand dunes? An ecosystem services perspective. *Aquatic Conservation: Marine and Freshwater Ecosystem* 20, 476-487.