

Historical land use changes and amount of damage in the tsunami affected area by the 2011 Tohoku earthquake, Kesenuma City, Japan

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A magnitude 9.0 earthquake struck the north western Pacific Ocean off north eastern Japan on 11 March 2011. The subsequent tsunami wrought destruction on a massive scale. Kesenuma City in Miyagi Prefecture was one of the most heavily damaged regions with more than a thousand people dead, a subsequent fire, and 230 people still missing. Kesenuma City is famous for fisheries, especially bonito and pacific saury. However, 2667 people worked primarily at the fishery in Kesenuma City in 2005, only 7.4% of the total employees. Many food processing factories concentrated in the center of Kesenuma, most located on reclaimed land, were totally destroyed. The 77 bank estimated that Kesenuma City lost half of its GRP and one-third of its employment from the earthquake.

We analyzed historical land use changes of the tsunami affected area of the city center using old topographical maps of 1913 and 1955, and vegetation maps of 1981 and 2011. In addition, we calculated the amount of damage within the area using the estimation of the 77 bank. The area consisted of 76.8% urban land use, 1.7% dry field, 17.9% rice paddy field, 0.3% grassland, 1.3% forest and 1.9% water body in 2011, and 9.0% urban land use, 0.7% dry field, 52.9% rice paddy field, 8.2% grassland, 13.7% forest and 15.4% water body in 1913. The area of urban land use dramatically increased more than nine times in 100 years while the area of rice paddy field sharply decreased from 52.9% to 17.9%. Most of the water body in 1913 had been reclaimed from the sea, where many food processing factories were located. The 77 bank estimated that the total amount of damage in Kesenuma City was 232.4 billion yen (1.95 billion USD), which was the annual production value of all companies located in the damaged area of Kesenuma City. We calculated the value per area for urban land use, dry field and rice paddy field. The result showed that 130.3 billion yen (1.11 billion USD) and 72 million yen (614 thousand USD) were lost by the 2011 tsunami in the area of urban land use and agricultural land use, respectively. If the land use composition had not changed since 1913, the amount of damage in the area would have been only 15.8 billion yen (135 million USD). Rice paddy fields had spread in the lowland in 1913, therefore, the estimated damage would be much lower than in 2011.

The government has been presented with plans for breakwaters along the coast. There are big debates about the plans because population has decreased in rural areas and construction and maintenance costs a lot of money. In the presentation a discussion in the area of Kesenuma City, where local people officially requested no high breakwater, will be introduced.

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