

Saltwater Intrusion and Post-Disaster Water Supply at the Niijima Island, Japan, under the Anticipated Tsunami by the Nankai Trough Earthquake

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An earthquake of 9.0 M_w is anticipated to occur along the Nankai Trough on the Pacific side of Japan in the coming 30 years (2011 to 2040) (Cabinet Office of Japan, 2011). Under the worst tsunami scenario, the coastal area of the Niijima Island, Japan, will be inundated by saltwater up to about 15 m a.m.s.l. (above mean sea-level) (Tokyo Disaster Management Council, 2013). Groundwater is the only freshwater source for the island, therefore, the water supply will be facing risks of saltwater intrusion. This study aims to simulate saltwater intrusion and aquifer recovery processes of the Niijima Island under such scenario, and to provide strategies for supplying freshwater in the post-disaster period. A numerical model of the groundwater system of the Island was developed by the FEFLOW code (Diersch, 2013). This model can solve both density-dependent groundwater flow and saturated-unsaturated flow problems. The modelling results indicated that, under the tsunami scenario of 15 m a.m.s.l., 1.2×10^6 m³ of seawater was introduced into subsurface within 60 mins, 3.7×10^6 m³ of freshwater resource was polluted, and eight years were required for the aquifer to be fully recovered by natural rainfall. It was discovered that some groundwater in the southeastern part of the island will not be affected by saltwater intrusion, and this survived portion of groundwater resources had the potential to provide water supply in an equivalent amount of the pre-tsunami level (338 L/person/day) without worsening the recovery processes. This study provides an example that the post-disaster water supply can possibly be ensured by pumping the unpolluted part of groundwater in the area, rather than by transporting freshwater from outside. This study has implications for the disaster preparedness regarding to tsunamis and tsunami-like events such as storm surges on other coastal areas where the geological settings are similar to those of the Niijima Island.

Keywords: Tsunami, Saltwater intrusion, Water supply, Numerical modelling, Niijima Island, Japan