

Extending evacuation options to shelters outside cities can help increase efficiency of flood responses

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Scientists from the Division of Policy and Planning Sciences at the University of Tsukuba studied ways to make flood evacuations more efficient by allowing for routes that cross municipal boundaries. They estimate that the nearest shelter for 24% of citizens in Japan are actually

located in another city, and that optimizing response plans this way can reduce evacuation time by 14%. This work may significantly improve public safety and overall preparedness for natural disasters.

The increasing intensity of flooding around the world may lead to the need for wide-area evacuations from at-risk areas, even across administrative boundaries. In extreme cases, everyone in a certain region must be evacuated to a designated [shelter](#). However, under the current [disaster response](#) system, the responsibility for creating [evacuation plans](#) falls primarily on city-level governments, and the effects of [evacuation](#) to shelters across municipal borders had not been investigated.

Now, scientists at the University of Tsukuba have found that, by comparing the required evacuation time to available shelters with or without the restriction that people stay within their own city, a significant increase in efficiency occurs if cross-boundary evacuation is allowed. To do this, they compared intra- and cross-boundary evacuation routes in Japan, selecting all 733 cities with flooding risk based on the expected inundated area data, then using [census data](#) to map the population density of the country with a 500-meter grid. "While faster in many instances, our plan will likely require intermunicipal cooperation or coordination by higher levels of government, such as prefectures," first author Professor Sunyong Eom says.

In any case, moving out of the immediate area of flooding is often a necessity. It can be expected that about 30% of the designated shelters would be in areas also impacted by inundation, so they cannot be safely used. Thus, evacuees would have to find alternative shelters further away. However, the team noted that the option of cross-border evacuations may not improve efficiency in all situations. They identified certain bridges and railway crossings that might become bottleneck points that cause longer evacuation times compared with intra-boundary routes during a mass evacuation in heavily populated cities.

Another finding relates with the spatial range of intermunicipal cooperation required for effective cross-border evacuation. Even though there is an increasing need to prepare for these routes, the complicated relationships between many cities may pose an obstacle to intermunicipal evacuation plans. Their findings can provide information to promote effective cooperation by identifying the cities that have to participate.

"Our work represents a first step towards understanding the improvement in disaster response that is possible when certain constraints are lifted," author Professor Michitaka Umemoto says. The current research was limited to people evacuating on foot. Future studies may include other modes of transportation, such as private cars or [mass transit](#), and would help to inform local and central governments on updating existing evacuation guidelines.

More information: Sunyong Eom et al, Cross-border evacuation and intermunicipal cooperation during large-scale flood disasters, *International Journal of Disaster Risk Reduction* (2022). [DOI: 10.1016/j.ijdrr.2022.103159](https://doi.org/10.1016/j.ijdrr.2022.103159)

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