How should Multiple Disaster be considered in Measures against Natural Disasters?

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1. Characteristics of measures against multiple disaster

"Multiple natural disaster" ("multiple disaster") used herein is defined as a disaster in which the magnitude of damage becomes larger than the simple sum of the magnitudes of damage from independent occurrence of each disaster due to the outbreak of another natural disaster ("successive disaster") on the way of recovery from a natural disaster ("precedent disaster"). For example, occurrence of a flood on the way of restoring a river bank sunken by liquefaction of the ground due to earthquake. As we examined the past earthquakes and floods, 20 cases where an earthquake with a seismic intensity of 5 or more was followed by a flood exceeding the warning water level within a time duration of less than one month in the past 110 years, so it is difficult to say that multiple disaster rarely occurs.

However, measures against multiple disaster are not widely implemented. One of the reasons for this is considerable uncertainty added in setting a damage scenario required for examination of countermeasures due to the characteristic of multiple disaster that magnitude of damage in successive disaster greatly varies according to the condition of damage / recovery in disaster prevention facilities, houses, etc. resulting from precedent disaster since various ways of combination of magnitudes of precedent and successive disasters and time durations between the two disasters are possible.

This research is based on the understanding of the current situation that there is a restriction on implementation of measures focused on multiple disaster from the viewpoint of cost benefit, etc. and aims to study the effect of damage reduction in case of multiple disaster with the measures against disaster prevention / reduction in independent disaster as well as the crisis management measures that not only reduce damage but shorten, to the extent possible, the duration of restoration exposed to danger in which successive disaster may occur with an enormous number of potential death toll (e.g. over 10,000 people). With such understanding and aim, this research provides simulation procedures required in studying multiple disaster measures and identifies the considerations for studying measures by using cases of multiple disaster of earthquake and flood, modeling the conditions of restoration after precedent disaster as in detail as possible in reference to past disasters, and setting comprehensively the magnitudes of various earthquakes and floods and the duration of the occurrence between both disasters.

2. Results of simulation for model river

Figure 1 shows the results of simulation for the model river extending about 60 km (Earthquake: scale corresponding to the Nankai Trough Massive Earthquake, Flood: scale corresponding to that of the Fundamental River Management Policy). When evacuees of the earthquake return to their homes in accordance with restoration, if a flood occurs about 30 days after the earthquake (in the case of the model river in this research), the number of death toll will increase, but such increase can be reduced by accelerating restoration of the bank and restricting return of evacuees.

3. Conclusion

In case of multiple disaster, emergency response ability of on-site personnel is particularly required, and it would be effective for newly assigned personnel etc. to imagine in advance the situation of multiple disaster through practice using the approach discussed herein. Further, with the same approach, it is possible to study disaster reduction measures that combine various disaster prevention measures according to basins and regional characteristics. For example, earthquake-proofing of houses will reduce the operation of rescue from the collapsed buildings after the earthquake, and result in increase in the number of machines available for restoration of the bank and reduction of the duration of bank restoration, which consequently mitigates the risk of flood damage.

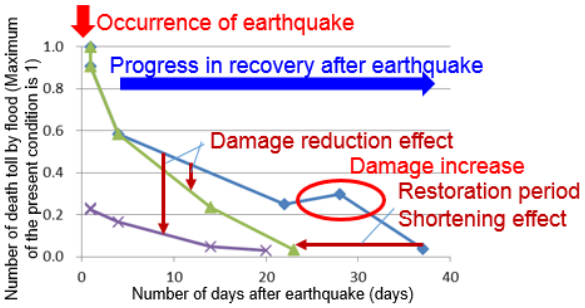

Figure 1. Example of Flood Damage Calculation by Point of Time after Earthquake

* Blue: Existing facilities, Yellowish green: Virtual expansion of material and equipment for bank recovery, Purple: Virtual earthquake-proofing of bank (the costs of the last two cases are almost the same)

[Reference]
1) ITAGAKI Osamu, MATSUURA Tatsuro, HATTORI Atsushi, 2014: Case Study on Characteristics of Effect of Damage Reduction Measures against Multiple Disasters of Earthquakes and Floods, The 14th Japan Earthquake Engineering Symposium, proceedings, pp. 1354-1363