How Will We Survive the Era of Rising Flood Disaster Risk and Uncertainty?

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(Keywords) flood risk, adapting to climate change, uncertainty, disaster mitigation, regional development

1. The challenge, "increasing risk and uncertainty"

Figure 1 shows an example of a trial calculation to clarify the increase in torrential rainfall by global warming till the end of this century, and how this will increase the flood flow rate, required amount of river improvements, and the possibility of flood inundation of land protected by levees. The three solid lines show differences between climate change prediction models used to estimate torrential rainfall.

According to this trial calculation, torrential rainfall will increase by approximately 1 to 1.3 times, the flood flow rate by 1.1 to 1.4 times, and the possibility of inundation (frequency) by 1.8 to 5 times. The required amount of river improvements is an index of the degree of river improvements (improving the capability to safely carry a flood discharge by improving the river course, or lowering the flood discharge flow rate itself by flood regulation facilities) that will be necessary in order to safely handle flood discharge caused by a torrential rainfall of the target scale of flood control planning (basic guideline to river improvement). This will also be between 1.6 and 3.4 times higher than it would be without global warming.

Even if torrential rainfall increases by 20% to 30%, etc., the two indices on the right side of Figure 1 will be the multiplier orders. The nearer the items of required quantity of river improvements and inundation potential are to countermeasure items, the greater the impact of global warming. Although the precision of climate change prediction models has been greatly improved, because of its amplification characteristic, the increase multiplier of the required quantity of river improvements and inundation potential based on global warming impact will have a large range of estimation. Thus, there is considerable uncertainty in the foundation for adapting to this and the increased risk.

2. Not hard-to-soft displacement theory

In view of these challenges, people may consider that now is the time to switch from relatively expensive hard countermeasures (building disaster prevention facilities to improve rivers) to soft countermeasures (measures other than building facilities), but this is over-simplistic.

Constructing facilities to reduce the frequency of inundation disasters is uniformly effective, including for the flood plains where all people need protection.

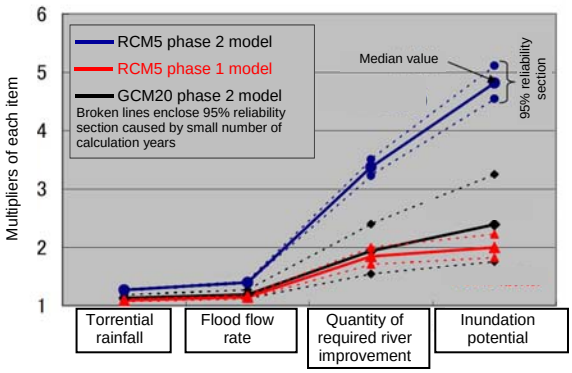

Figure 1. Change of flood control related quantities caused by global warming (The multiplier is the ratio of the end of the century to the present time: the simple mean value of 109 Class 1 river systems: Estimated based on climate change prediction models by the Meteorological Research Institute: RCM5 phase 1, GCM20 phase 2, and RCM5 phase 2)[1)]

But once a flood exceeds the capacity of a facility, a severe disaster may result. On the other hand, assuming that various countermeasures such as suitable evacuation systems based on warnings, or urban development considering evacuation and damage mitigation have been carried out, it is not easy to prevent severe damage. The important point is not to pursue a single magic solution, but to pursue the best mix of diverse countermeasures including both hard and soft countermeasures.

3. What circumstances will be created?

Figure 2 shows the form of this "best mix." Facilities prevent disasters caused by the following dangerous phenomena under external forces considered for planning and design (phase on the right side of the figure). If the scale of a dangerous phenomenon exceeds this external force (including cases where the handling capacity of a facility is exceeded while the structure is being built) it is impossible for a facility to completely prevent all risks. Even under such circumstances, by ensuring good city development using various methods, and by providing methods of escape and survival, severe damage will not occur (phase on the left side of the figure.)

Therefore, simply stacking the three building blocks—facilities to prevent or mitigate disasters, good city development, and methods of escaping or surviving—for the phase on the left side of the figure,

will not be sufficient. These must be firmly bonded with each other. Bonding means that good city development that considers how facilities prevent or mitigate disasters is practiced, and that methods of escape or survival which fully reflect such development are provided.

4. Producing knowledge contributing to the creation of circumstances

As research on technology policies to create the world shown in Figure 2, it will be necessary to consider three broad pillars. First, refining the method: providing facilities. In addition, maintenance of facilities will be improved and rationalized while clarifying the relationship with the way functions are displayed, information (including weather predictions, when real time or circumstances allow them) will be used to improve the functioning of facilities, the renovation of existing facilities will be expanded, and facilities groups will be treated as systems and the combinations will be optimized for the areas protected from flooding.

Secondly, the ways in which damage occurs when a dangerous phenomenon exceeds the handling capacity of a facility will be clarified more than in the past. For each river system, the relationship of the scale (external force) of the dangerous phenomenon with the damage which could occur will be clarified, and characteristic properties, speed, or points of an abrupt increase in damage for example, or the existence of tipping points or peaking trends, etc. will be confirmed. This requires a good knowledge of how each facility functions and the state of the protected region.

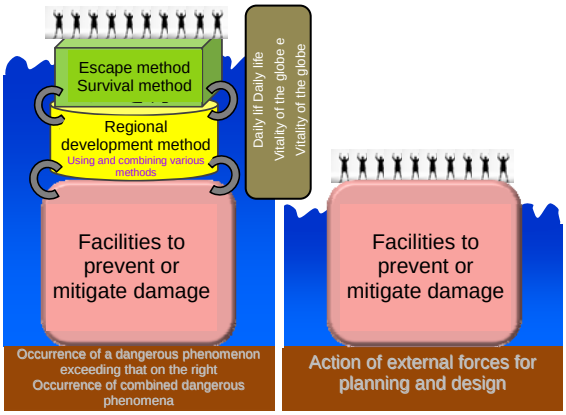

Figure 2. What circumstances will we create in order to intelligently face flood disasters?

Thirdly, based on obtained knowledge and long-term prospects for the way damage occurs, good regional development including towns, and methods of combining methods of escaping and survival will be completed. This study will incorporate two-way exchanges to provide feedback to improve ways that facilities functions. These three pillars will, acting together, be introduced where countermeasures can be continuously checked and expanded centered on multilateral flood risk assessment efforts. The Tsunami Disaster Prevention Regional Development Law enacted in December of last year is an important precursor to the framework of the policies shown in Figure 2. A study should be done on applying such efforts to all flood disasters.

Needless to say, the daily lives of people are not intended to prevent or mitigate disasters. Their main role is normal daily life rooted in each region. How is the world shown in Figure 2 harmonized with normal daily life? Can any innovation allow harmonization that increases the vitality of a region? Answers to these questions will require a deeper and broader vision.

References

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