For Reduction of Flood Damage Risk

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1. Introduction

In 2016, 6 typhoons hit Japan. This is the second largest number, next to 10 typhoons in 2004, in the observation record of the Meteorological Agency. From the middle to end of August, a total of four typhoons (Nos. 7, 9, 10, 11) landed in Hokkaido, Tohoku, and Kanto Regions and caused flood damage to many places. According to the Meteorological Agency, the landing of 4 typhoons during a month is one of the largest records in the observation history, and it is the first time that 3 typhoons landed in Hokkaido during a year including re-landing and that a typhoon landed in the Pacific coast of Tohoku Region. Of these typhoons, No. 10 caused particularly large floods across Hokkaido and Iwate as well as serious human damage with fatalities and missing persons totaling 27. Damages caused by these floods have some characteristics. First, in the small-and-medium-sized rivers that flow through a valley bottom plain where the level of development is comparatively low, there were many cases where bank erosion or riverbed degradation proceeded remarkably in connection with the flood and considerably changed the channel shape. As the result, many civil engineering facilities including revetments, levees, and bridges suffered damage, and some buildings along the river were also enormously damaged. Particularly, in the valley bottom plains with narrow width, since there are many buildings close to the river, there were some cases where a sharp rise in the water level caused human damage. There were also many cases where damage occurred to revetments or levees along the river flowing through the alluvial fan in the downstream.

For the year 2016, vulnerability of the land to flood was strongly recognized and the necessity to reduce the risk of flood damage was reconfirmed.

2. Risk of flood damage

The river administrator determines the design flood discharge in the basic policy for river improvement. The river administrator also strives to prevent a certain level of flooding in the river improvement plan, and also formulates and implements plans step by step by determining target years for mitigating damage from floods exceeding that level (excessive flooding). As river improvement proceeds, the maximum flow rate under which flooding can be prevented increases. However, even if a river channel or river management system is developed so that the design flood discharge in the basic policy for river improvement can be controlled safely, the possibility of flooding on a scale exceeding the design flood discharge still remains. Additionally, in a river under improvement, the possibility of flooding is higher the lower the level of improvement is.

In evaluating the necessity, validity, and effect of river improvement and vulnerability to flood in the river basin, it is favorable to evaluate properly the possibility of flood and the extent of damage caused by the flood. The indicator for quantitative evaluation of these factors is risk of flood damage, which evaluates the expected value of damage caused by flood in the river basin. The risk as an indicator represents the expected value of the damage caused by a certain event and is the sum of the products of the probability of damage and the extent of damage. For example, supposing the improvement level of a river responds to the flow rate that is evaluated to have the probability of exceeding that level being 1/100 during a year (flow rate with the probability of 1/100), damage from a flow rate under the flow rate with this probability will be nothing. However, since damage is caused by a flood that exceeds this flow rate, risk of flood damage can be evaluated by calculating the expected value of damage by flooding for such excessive flood (group).

3. For reduction of flood damage risk

Since flood damage is basically generated by excessive flood, two types of countermeasures are considered for reducing the risk of flood damage, i.e., reduction of excessive flood and mitigation of flood damage in case of an excessive flood, which are recognized as disaster prevention and disaster mitigation, respectively.

Promotion of facility development responding to the planned scale of flood, such as river improvement or dam construction, serves as the basis of flood control projects and is regarded as the disaster prevention measures up to the planned scale.

However, even if development of facilities proceeds so as to address the scale of the design flood discharge as mentioned above, a flood that exceeds that scale may occur. Further, if climate change proceeds, an external force (flood) exceeding the expected level

may occur more frequently. In the rivers where facility development has proceeded to a considerable extent, an enormous damage may arise once an excessive flood occurs. It is therefore important to respond seamlessly to floods in excess of the planned scale.

The report of the Panel on Infrastructure Development in August 2015, "Interim Report on Climate Change Adaptation Measures in Flood Disaster Field" also indicates (i) that facility development should be implemented up to the planned scale, (ii) that proper maintenance and renewal of facilities are necessary to ensure the performance of their functions, and (iii) that steady prevention of water disasters should be aimed by ensuring the above-mentioned items, and also proposes mitigation of disasters from an external force exceeding the capability of facilities by devising the operation, structure, development procedure, etc. of facilities, as well as promotion of community and regional development in consideration of disaster risk and improvement of preparedness for appropriate evacuation, smooth emergency activity, business continuity, etc. (See Figure.) In addition, "The Way of Flood Control Measures that Mitigate Large-scale Flood Hazards," reported by the same Panel in December 2015, also indicates the necessity to re-build a "society aware of water disaster prevention" and similarly points out that local governments, local communities, residents, enterprises, etc. as well as river administrators need to be aware that "the capability of facilities has a limit and a large flood that cannot be prevented by the facilities will certainly occur."

In response to the reports above, the River Research Department is discussing various measures focused on rivers and coasts including the following studies in order to contribute to mitigation of flood damage risk.

(1) Assessment of flood damage risk (disaster prevention / mitigation by facility development)

We are conducting a case study so that facilities with structures effective for disaster prevention / mitigation can be developed in an appropriate way. Changes in flood damage risk brought about across an entire river basin by facility development is estimated by modeling, in which external forces, including flooding beyond the development level, are taken into account.

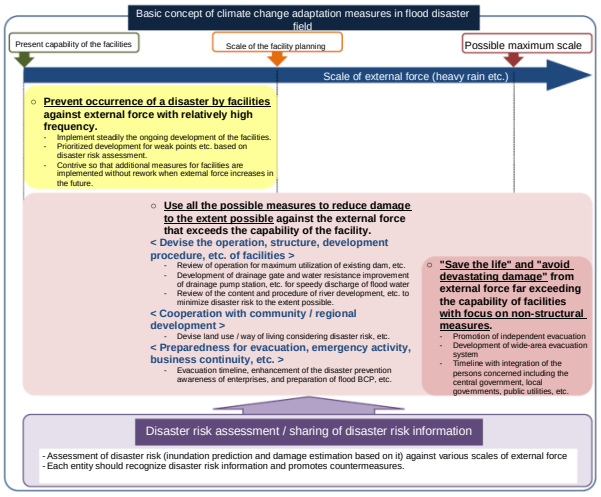

Figure: Basic concept of climate change adaptation measures in flood disaster field

(2) Facility maintenance for preventing increase in flood damage risk

We are conducting a study on the channel widening method that mitigates reduction of the channel due to re-deposition of sediment after channel expansion, a study on securing the safety of levees and revetments, and a study on monitoring and earthquake resistant performance inspection for dam maintenance.

(3) Community / regional development considering disaster risk

In order to contribute to the effective disaster reduction in urban area, we are studying disaster reduction in terms of both flood and inland water inundation damages, considering changes in external force due to climate change.

(4) Optimization of facility operation

We are studying on advanced dam operation based on various scenarios aiming to utilize the functions of present facilities more effectively.

(5) Risk communication

We are developing a system for "visualizing flood conditions" that can indicate the spatial and temporal variation in river water level in the case of a flood. This system should help improve the reliability of decisions on evacuation and efficient / effective levee protection activities.

River Department is going to proceed with necessary studies for the purpose of reducing flood damage risk.