

# Research and Activities of the River Department Contributing to Basin-Wide Flood Management

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## 1. Introduction

The extensive flooding in Kyushu, the Chubu District and other parts of Japan caused by torrential rains in July of 2020 is still fresh in memory, and heavy rains also triggered severe flooding in western Japan in July 2018. The East Japan Typhoon (Typhoon Hagibis) in 2019 caused damage in various parts of the country, and the cost of flood damage for the year was the largest since record-keeping began. According to an analysis by the Japan Meteorological Agency and the Meteorological Research Institute, the effects of climate change affected the torrential rains that actually occurred in the heavy rains of July 2018 and in the East Japan Typhoon of 2019.

In July 2020, the Council for Infrastructure Development of Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) issued a report entitled "Basic Strategy for Climate Change Adaptation Measures against Water-Related Disasters," which recommended i) Change of the basis of flood control planning from the actual results of past rainfall and storm surge events to the future precipitation predicted from climate change and ii) Change to sustainable flood control measures called "Basin-wide Comprehensive Flood Management," which are conducted with the cooperation of all stakeholders in the entire river basin. "Basin-wide Comprehensive Flood Management"

has been positioned as a key measure in MLIT's "Meeting the Challenge of Disaster Prevention and Mitigation in an All-Out Struggle – Disaster Prevention and Mitigation to Protect Human Life and Livelihood."

## 2. Basin-wide comprehensive flood management

Basin-wide comprehensive flood management is a concept that includes further acceleration of basic flood control countermeasures such as construction and improvement of levees and construction and renovation of dams, together with countermeasures for water-related disasters (disaster prevention and disaster mitigation) with the cooperation of all concerned parties related to the river basin. It is a strategy for promoting i) Countermeasures for preventing and reducing floods as far as possible, ii) Countermeasures for reducing objects of damage and iii) Countermeasures for damage mitigation and early recovery and reconstruction by integrated hard and soft countermeasures corresponding to the special features of the region, in which the entire river basin, including not only the catchment area and river area, but also the flood plain is treated as a single basin. **Fig-1** shows examples of countermeasures i) to iii).

## 3. Research and activities of River Department contributing to basin-wide flood management

### (1) Outline of activities

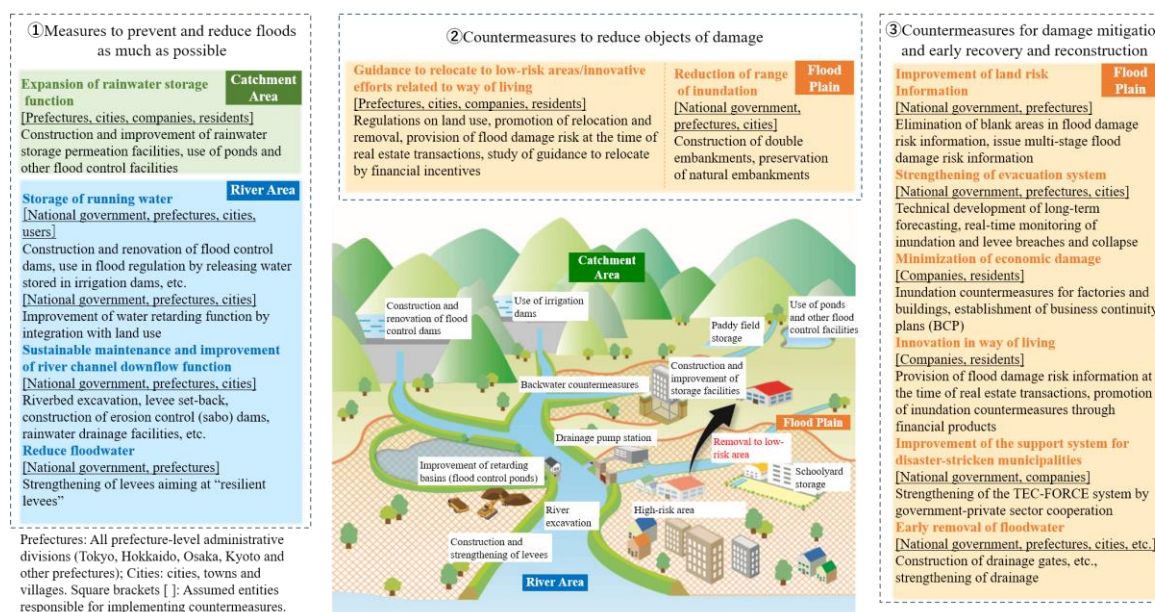


Fig.-1 Outline of "Basin-wide Comprehensive Flood Management" ([https://www.mlit.go.jp/river/kasen/suisin/pdf/01\\_kangaekata.pdf](https://www.mlit.go.jp/river/kasen/suisin/pdf/01_kangaekata.pdf))

The River Department has conducted research on climate change adaptation measures from an early date through NILIM activities such as the “Climate Change Adaptation Group.” The research and activities carried out by the River Department, either in the past and presently in progress, are also useful in the basin-wide comprehensive flood management described above. **Fig.-2** lists the research and activities of the River Department classified according to the 3 types of countermeasures for basin-wide flood management. Together with “Research on facilities” contributing to i) in Fig.-1, it is also necessary to consider future efforts to evolve “Research on information provision” that will contribute to ii) and iii). The following introduces examples of research related to these efforts.

<p>① Countermeasures to prevent floods as far as possible In addition to basic research on construction and improvement of river channels and levees and maintenance (new construction) of dams:</p> <ul style="list-style-type: none"> <li>✓ Research on characteristics of rainfall considering climate change</li> <li>✓ Research on a levee structure with resistance to collapse during overtopping</li> <li>✓ Research on strengthening the flood regulation function of dams (advanced operation)</li> <li>✓ Technologies for promoting dam renovation</li> <li>✓ Research on coastal embankments with resilience against high waves</li> <li>✓ Research on techniques for predicting beach profile change corresponding to rising sea level, and measures for strengthening coastal protection facilities</li> </ul>
<p>② Countermeasures to reduce objects of damage</p> <ul style="list-style-type: none"> <li>✓ Research on methods for evaluating flood damage risk [Related: “Manual on Flood Damage Risk Evaluation (Draft)”]</li> <li>✓ Research on flood estimation information [Related: “Manual on Flood Estimation Mapping for Small Rivers” etc.]</li> <li>✓ Study of manual on storm surge inundation estimation mapping</li> </ul>
<p>③ Countermeasures for damage mitigation and early recovery and reconstruction</p> <ul style="list-style-type: none"> <li>✓ Research on flood estimation information [Related: “Manual on Flood Estimation Mapping for Small Rivers” etc. ] same as above</li> <li>✓ Research on heavy rain monitoring by radar rain gauge [Developed technology: XRAIN ]</li> <li>✓ Research on technologies for visualization of degree of flood risk [Developed technology: Flood Damage Risk Lines ]</li> <li>✓ Research on provision of flood risk information [ Developed technology: Real-Time Inundation Prediction System (in trial stage) ]</li> <li>✓ Development of coastal lapping height prediction system</li> <li>✓ Research on support for water-related disaster prevention activities</li> </ul>

Fig.-2 Research and activities of River Department contributing to basin-wide flood management

## (2) Research on information provision

Research on flood estimation information is related to the development of technologies for advance provision of information on inundation danger, such as maps of assumed inundation areas (flood hazard maps), etc. This type of information is useful for advance disaster prevention, for example, in improving evacuation plans, guiding residents to move to low-risk areas, etc. Although flood inundation estimation maps are provided for large rivers, the River Department is conducting research aimed at providing information quickly and efficiently by using airborne laser survey (LP: Laser profiler) data, targeting medium and small rivers for which hazard information is not available in many cases. The department also issued the “Manual on Flood Estimation Mapping for Small Rivers” in 2020, reflecting the results of research so far, and is now working to further upgrade its content.

In research on flood risk information provision to support countermeasures for damage prevention and mitigation when

inundation occurs, we are developing a real-time inundation prediction system that distributes inundation prediction information to those concerned, covering the time period from the present to 1 hour in the future, within 10 minutes after receiving rainfall and river water level data, etc. This technology will support timely and appropriate evacuation, etc. by providing information immediately before inundation occurs. Although this system was developed from the viewpoint of countermeasures for prevention and mitigation of inundation damage in large cities, the River Department is now studying expansion of the system to assumed flood inundation areas, including rural and agricultural areas, because disasters frequently occur in areas outside large cities when residents are caught in flooding while moving by automobile. We are also developing a method for effectively utilizing the information from this system in water-related disaster prevention.

## (3) Research on facilities

Research on a levee structure with resistance to collapse during overtopping is linked to levee strengthening measures as a response to crisis management, and contributes to minimizing the damage caused by inundation even in case overtopping occurs. Although several construction methods can be considered as strengthening measures, at present, there is some latitude (uncertainty) in their effects. Therefore, NILIM is conducting large-scale levee experiments and studying levee design and management. It may be noted that this research is not limited simply to overtopping resistance performance for crisis management, but is also considered to be linked to study of the basic performance design of levees.

In research on strengthening of the flood regulation function of dams, the aim is to support dam operation management in order to increase their flood control effect, while considering the latitude (uncertainty) of predictions, by utilizing “ensemble forecast precipitation” information. At present, all dams in Japan, including irrigation dams, practice preliminary release of water to secure a larger empty capacity for floodwater storage in advance, when judged necessary for flood control. However, we would like to link this research to a study of preliminary release to enhance the flood management effect in the total river system.

## 4. Conclusion

The River Department is conducting research on river improvement and management as such, as introduced in part here, and is also studying provision of information related to the risk of flood damage in river basins. While research on river improvement will continue to be our main focus in the future, we also hope to support the development of the new technology of long-term flood forecasting utilizing the “Flood Damage Risk Lines” technology developed by the laboratory.