Eliminating flood hazard information blank areas - Trial flood hazard mapping in small rivers

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1. Introduction

Torrential rains and floods are frequent and cause serious flood damage in many parts of the country every year. In order to prevent flood disaster, it is necessary to steadily develop flood control structures and, for floods exceeding the design scale of flood control structures, it is necessary to take measures to prevent / reduce damage as much as possible by devising land use, etc. in the floodplain (areas outside rivers where farmlands, towns, etc. are located). For this purpose, it is important to promote River Basin Disaster Resilience and Sustainability by All, in which various stakeholders in the basin collaborate to prevent / reduce damage throughout the basin.

In the promotion of River Basin Disaster Resilience and Sustainability by All, the flood hazard map showing the extent of possible inundation due to flooding plays an important role. In the 2021 revision of the Flood Fighting Act, one of the laws related to River Basin Disaster Resilience and Sustainability by All, rivers that meet the criteria specified by the MLIT (rivers flowing through the areas that include targets of protection such as houses) were added to the scope of designation of statutory flood hazard areas as those that should be warned of disasters due to flooding, in addition to the statutory Flood Forecast Rivers and Flood Water Level Informing Rivers required to communicate flood water levels. As a result, the target number of rivers for which statutory flood hazard areas should be designated by FY2025 has increased from about 2,000 rivers nationwide before the revision to 17,000 rivers. In order to achieve this target, the challenge is how to create flood hazard maps for the vast number and length of small rivers (Class A and Class B rivers other than the statutory Flood Forecast Rivers and Flood Water Level Informing Rivers) for which river channel data and flood flow data, etc., which are necessary for flood hazard mapping, have not yet been developed. Therefore, we have provided "Guidance for Flood Hazard Mapping in Small Rivers" (2020, Flood Risk Reduction Policy Planning Office, River Environment Division, Water and Disaster Management Bureau, MLIT and Flood Disaster Prevention Division, River Department, NILIM), which presents a method for flood hazard mapping in small rivers with using LP (aerial laser survey) data (**Fig. 1**), and conducted trial calculations (**Fig. 2**) by the NILIM and others for rivers requested by the prefecture in order to contribute to the solution of technical challenges, etc.

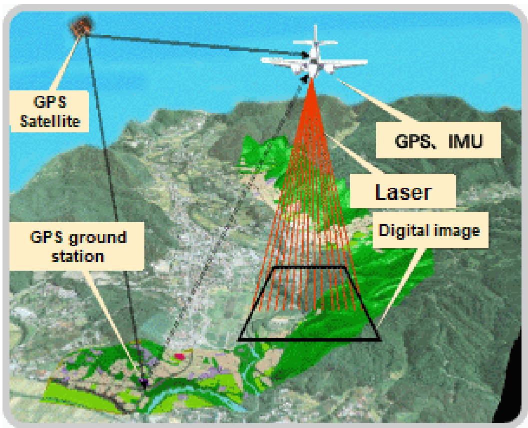


Fig. 1: Aerial laser survey

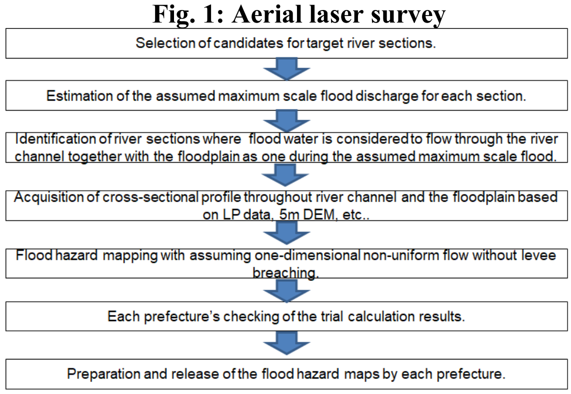


Fig. 2: NILIM trial calculation procedure

2. Identification of river sections

In response to requests from prefectures to the national government (MLIT) for trial calculations, we identified about 8,000 rivers (about 40,000 km in length) as candidate river sections for trial calculations by the national government based on the perspectives of availability of LP data stored by the Geospatial Information Authority (GSI) of Japan, early elimination of flood hazard information blank areas, etc. (Reference: The total number of Class A and B rivers in Japan is about 21,000, with a total length of about 120,000 km. In addition, there are about 14,000 locally designated rivers, extending about 20,000 km (as of 2021)). The basin areas of these river sections

were set based on the existing database or estimated based on GSI digital elevation model, and the assumed maximum scale flood discharge was calculated using a rational formula for each river section divided based on the confluences of Class A river or Class B river. We set the assumed rainfall duration with using the Krahen formula, and assumed the maximum rainfall intensity based on the "Method for Setting Assumed Maximum External Forces for Flood Hazard Mapping (fluvial flood and, pluvial flood)" (2015, Water and Disaster Management Bureau, MLIT), except when the prefecture's own setting is required. The runoff coefficient was finally set uniformly at 0.9 for both mountainous and plain areas, considering geological characteristics, etc. as well as the efficiency of the work.
Based on the calculated water level with the above flood discharge and topographical characteristics, etc., the trial calculation by the NILIM was focused on the river section (**Fig. 3**) where flood water is considered to flow through the river channel together with the floodplain as one during the assumed maximum scale flood. An efficient calculation method based on LP data has already been developed for this type of sections, and about 2,800 rivers in 26 prefectures across the country, extending about 12,000 km, were identified.

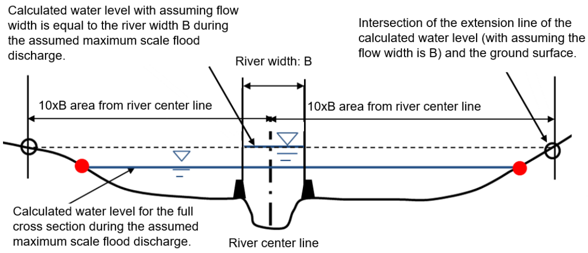
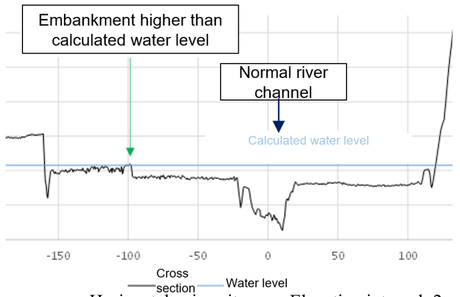


Fig. 3: Conceptual cross section of flood flowing through river channel together with floodplain as one

3. Acquisition of cross sections on the area throughout river channel and floodplain and flood hazard mapping

Based on existing LP data and a digital elevation model (5m DEM in principle, 10m DEM if not available) obtained from GSI, we obtained cross-sections at approx. 100m intervals in the direction of the flood flow. Figure 4 shows an example of cross-section acquisition. On the left side of the Figure is the road embankment, which may stop the spread of flood water in the crossing direction. If there is an opening in the embankment (e.g., box culvert), flood water may pass through it, but the opening cannot be read from the LP data, and field survey is required.
Figure 5 shows an example of flood hazrd mapping with using LP data. In the Figure, 10m DEM was used because 5m DEM was not available for the floodplain in the right section, and the section was clearly indicated when providing the trial calculation result to the prefectures because the resolution of the flood hazard mapping is different.



Horizontal axis unit: m Elevation interval: 2 m

Fig. 4: Example of obtaining the cross-sectional profile

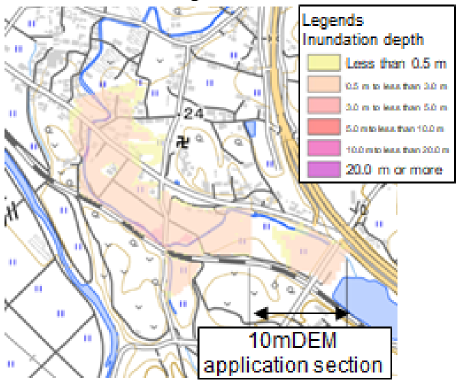


Fig. 5: Example of flood hazard mapping with using LP data

4. Conclusion

For the tentative version of the results of trial calculation by the national government, we inquired of the prefectures whether there were clearly unreasonable points in the results in a limited time, and checked and made corrections to the extent possible if there was any matter indicated. We would like to thank the relevant prefectural officials for their cooperation in checking the results of trial calculation.
In order to eliminate flood hazard information blank areas in small rivers, in addition to flooding pattern in which the flood flows through river channel together with floodplain as one, it is also necessary to create flood hazard maps of river sections that are considered to cause spread-type or storage-type flooding. We are going to continue the research and development.

☞See the following for details.
1) Guidance for Flood Hazard Mapping in Small Rivers
https://www.mlit.go.jp/river/shinngikai_blog/tyusyokasen/pdf/manual.pdf