"River Development for Easy Escape from Flood " in Valley Bottom Plain of Hilly and Mountainous Area

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1. Reluctance to escape in actual evacuation behavior and flood characteristic that water level rises very quickly

It is reported as an actual evacuation behavior in case of a flood that many residents begin evacuation when they confirm change of status, such as inundation, with their eyes. Such evacuation behavior is psychologically interpreted as attributable to normality bias or cognitive dissonance, and may put local residents into a situation where they cannot begin "evacuation in a situation where enough time for safety is secured," which starts with evacuation recommendation etc. On the other hand, rivers flowing through hilly and mountainous area have a characteristic that concentration time is shorter and the speed of water level rising is faster than downstream alluvial river. Accordingly, inundation occurs "in an instant" and evacuation in enough time may be first of all difficult.

2. Viewpoint for preventing human damage by failure to escape

Considering such actual evacuation behavior and characteristic of flood flow as stated above, what measures should be taken in order to prevent human damage by failure to escape in hilly and mountainous areas?　We consider the following to be important --- (i) Easy recognition of a critical situation that comes into view, (ii) Secure some lead time necessary for evacuation even after recognizing a critical situation, and (iii) realization of these measures with facilities as a structural measure.

3. Attempt to create an "environment preventing failure to escape"

We attempted to create an environment for preventing failure to escape with numerical calculation assuming a large valley bottom plain where an open levee exists in a hilly and mountainous area over the years (discontinuous levee often installed in a rapid river). Specifically, we examined with numerical calculation whether the above-mentioned lead time would be secured for a long time by constructing a secondary levee behind the open levee. As shown in **Figure**, we focused on the time (two types of lead time) until inundation reaches the community after the start of inundation from the opening in the open levee or the start of flooding from the embanked reach of the open levee in the upstream. Even at the time when inundation would have reached the community in the case of no secondary levee (Left **Figure**), inundation does not reach the community when a secondly levee is constructed. Thus, increase in the two types of lead time is recognized (Right **Figure**).

4. Points of river development for easy escape

The following are the points in facility design to secure some time during which escape is possible even after recognizing a critical situation, such as nearby inundation.　(i) Extend lead time by limiting the inundation area for certain time even after flooding; (ii) Consider design suitable for the conditions of the target area, such as local scale; (iii) Demonstrate the effect in a wide range of excess external force; (iv) Secure an evacuation route effective even in case of a large-scale flood; (v) Combine non-structural measures for reporting the occurrence of critical situation more certainly; and (vi) Consider for the impact on daily life.

☞See the following for details.

1) Takeuchi et al.: Proposal of a Structural Design to Ensure Evacuation Time during Floods in Valley Plains, Civil Engineering Journal, Dec. 2017, etc.

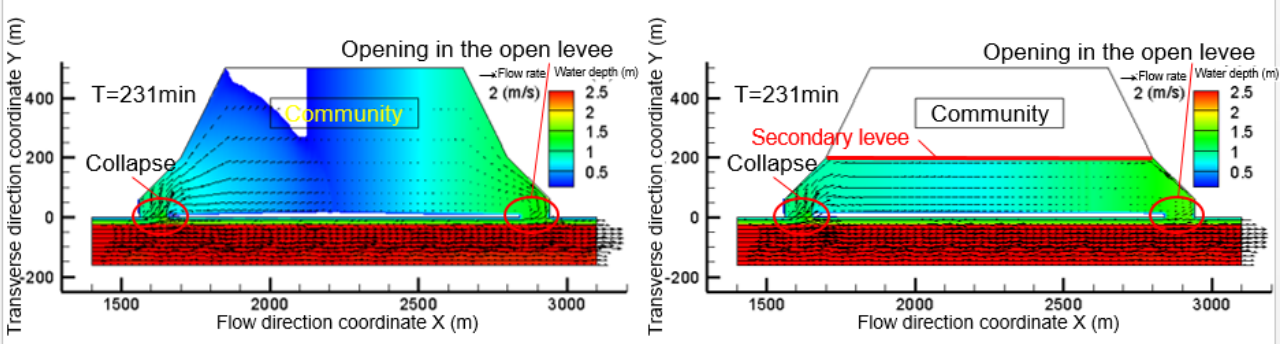

Figure: Changes in the inundation depth distribution by construction of secondary levee (increase in lead time)