DYNAMIC BEHAVIOR OF FLOOD IN LOWER CENTRAL PLAIN OF THE CHAO PHRAYA RIVER BASIN

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BACKGROUND AND OBJECTIVE

The Chao Phraya River flows from northern mountain area to the Gulf of Thailand. Its length is about 700 km and the area of its basin is about 160,000 km^2. From the combination of heavy rainfall peculiar to monsoon climate and high tide of the Gulf of Thailand, the severe and serious flood occurs frequently in rainy season from September to November. Because of its social and economic significance, the Lower Chao Phraya River Basin upper Bangkok Area becomes the target area for flood mitigation.

The main cause of flood is the low capacity of the river channel. The present flow capacity changes from the river mouth to upstream from about 3,000 m^3/s in Bangkok, 3,200 m^3/s in Bang Sai, 1,300 m^3/s in upstream of Ayutthaya, 2,900 m^3/s in Ang Thong, 4,500 m^3/s in Chainat and 4,000 m^3/s in Nakhon Sawan. The principle of the river flood control that the flow capacity never decreases in downstream direction is not satisfied. 1,300 m^3/s in upstream near Ayutthaya become a bottleneck and overtopping occurs in every flooding. In 1995 flood, overtopping flood occurred in almost whole river area. Bangkok area, however, escaped from large flood. The occurrence of flood in the Lower Chao Phraya River Basin assures the safety level for the Bangkok Metropolitan Area.

The target of the present study is how to design flooding area for mitigation flood disaster. For taking such way into practices, better understanding of unsteady behaviors of flood is necessary to examine the water movement in flooding of retention areas. Therefore, one-dimensional unsteady flood analysis method is used.

1. METHOD

The one-dimensional unsteady flow model is used in this study for analyzing hydrodynamics of flood occurred in 1995, 1996 and 2002. The study area is the Lower Chao Phraya River Basin from Chao Phraya Dam in Chainat to Pakkred in Nonthaburi. The model has 4 rivers and 3 canals with more than 100 cross sections. Every cross sections need roughness coefficient, which can be set in difference part of cross sections. In this model, we set 2 valves of roughness in each cross section as river channel and river basin. River basin is divided to 33 retention areas following irrigation projects and planning of road and dike. Time-dependent river discharge is given as three upstream boundary conditions, while time dependent water level as downstream condition. Tide level is also included in water elevation.

2. SIMULATION RESULTS

(1) In the present simulation, unknown factor is only roughness coefficient 'n'. The value of 'n' can be determined by the comparison of water level measured and computed in 2000 and 2001. As a result, the range of 'n' value is recommended between 0.020 and 0.028 $m^{-1/3}s$ in river channel and between 0.050 and 0.150 $m^{-1/3}s$ in river bank. The computations of unsteady conditions in 2000 and 2001 are in good agreement.

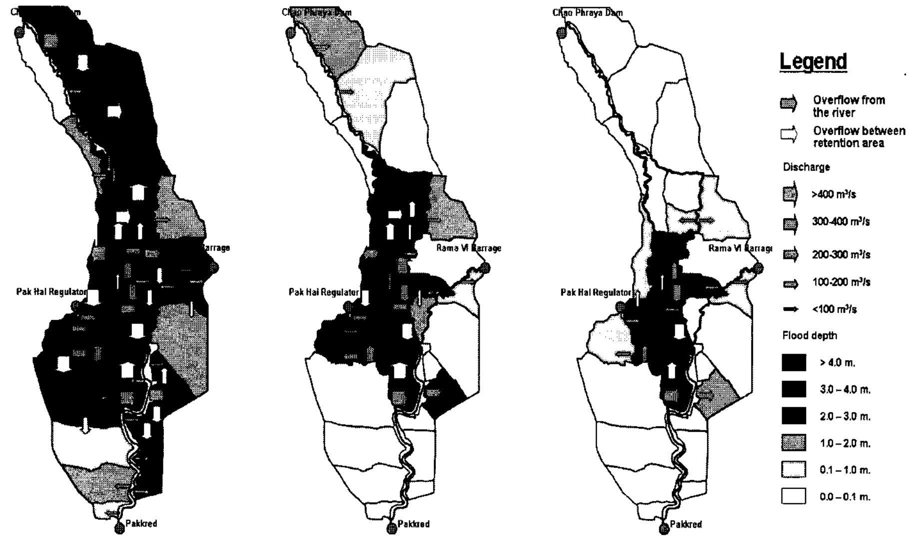
(2) The temporal change of flood depth computed in each retention area in the 1995 flood clarifies the dynamic behavior of the flooding water. In 1995, the flooding began on around 5th September and overflowed into MH6 retention area. Then, the flood water spilled over inner dike to the next retention area. The greater parts of the retention area has been affected by flooding direct river overflow and also by the spill-over between adjacent areas. Such situation continues until the end of rainy season.

(3) These simulations of 1995, 1996 and 2002 floods showed that flood started when discharge rate becomes larger than 3,000 m^3/s. On the other hand, the day when the residual volume decrease to zero, the inflow volumes approach to 3,000 m^3/s in three cases. The flow capacity of river channel can be estimated to be 3,000 m^3/s.

(4) Figure 1 shows the distribution of simulated maximum flood depth in each retention area and water movement by overtopping or spill-over inundation denoted by arrow. Dark arrows indicate over-topped flooding, and white arrow does inundation between adjacent retention areas. It is apparent that white arrows contributes water conveys. Rightly, the area of inundation increases with an increasing in the over-topped flow volume, and river discharge as well. The rough estimation of flood water volume is about 4,200, 1,000 and 800 million m^3 in 1995, 2002 and 1996 floods, respectively.

3. CONCLUSION

This study clarifies hydrodynamics and the flood behavior in the Lower Chao Phraya River Basin. Thailand makes rapid progress in economic, social and environmental aspects. This study is the first step to discuss how to make mitigation from flood damages.



(a) 1995 (c) 2002 (b) 1996

Fig. 1 Comparison of simulated maximum flood depth in retention areas and movements of flooding water