

Using rainfall predictions to improve dam flood control methods

MITSUISHI Shinya, Head

OZEKI Toshihisa, Researcher

Water Management and Dam Division, River Department

(Key words) Rainfall prediction, flood control, prior discharge

1. Introduction

It has been pointed out that under the effects of global warming, it is highly probable that extreme rainfall phenomena will continue to occur with increasing frequency. On the other hand, the Ministry of Land, Infrastructure, Transport and Tourism has been constructing fewer dams in Japan in recent years, so it must enhance the functions of its existing stock of dams in the future.

This research project was undertaken in order to minimize flood damage downstream from dams by predicting rainfall with high spatial resolution suitable to manage dams in dam catchment areas where large-scale flooding has occurred in the past, by studying a more effective flood control method (Fig. 1) which maximizes the full capacity of dams, and by verifying the applicability of this new method under actual floods including super large floods.

2. Rainfall prediction and rational dam operating methods

Rainfall was predicted by performing prediction calculations in 2km meshes through down-scaling by a meteorological model developed and released in the United States, and based on predictions by the Meteorological Agency (20km meshes) at the time of actual floods with reference to the occurrence of local torrential rainfall and the dam's catchment basin area. The predicted inflow was obtained by calculating the initial loss in the area upstream from the dam, the primary runoff, and rainfall loss based on the maximum underground water holding capacity and its reduction curve, then finding the effective rainfall by reducing the hourly rainfall by the rainfall loss, and then obtaining the product of this value and the catchment area.

The total inflow during the predicted period which has been calculated and the dam's free capacity at the time of the prediction were compared to perform a flood control simulation which performs operating judgments every hour.

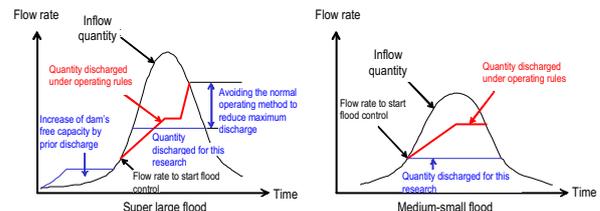


Figure 1. Comparison of Flood Control Effectiveness

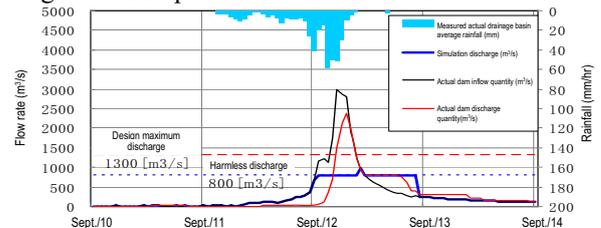


Figure 2. Results of Simulation of the Flood of September 2000 at the Yahagi Dam

3. Simulation results

Even when a super large flood has occurred, as shown in Figure 2., prompt adjustment operations sharply reduce the maximum discharge more than when normal operation based on the operating rules is performed, and it is possible to restrict inundation damage by many floods. And damage to downstream regions by many medium and small floods can be prevented by holding the discharge below the harmless discharge level.

4. Conclusion

While flood control effectiveness can be enhanced by using rainfall predictions, prediction errors may endanger flood control or water use. In the future, the Division will conduct research to accurately clarify characteristics including errors in rainfall predictions and reflect them in flood control operation judgments in order to minimize these risks.

[Sources]

1) S. Mitsuishi, T. Sumi, T. Ozeki: Dam Operations Using Precipitation Forecast by Weather Research and Forecasting Model, Journal of Japan Society of Dam Engineers, 20(2), p94-104, 2010

2) S. Mitsuishi, T. Ozeki, T. Sumi: Applicability of a New Flood Control Method utilizing Rainfall Prediction by WRF, Journal of Japan Society of Hydrology and Water Resources, Vol. 24, No. 2, p21-31, 2011
HP : http://www.nilim.go.jp/lab/fdg/page/ronbunn_1.htm