Development of Flood Inundation Model of the Mekong Delta

Khem SOTHEA*, Akira GOTO**, Masakazu MIZUTANI**

Introduction

The Mekong Delta is an important region for agricultural development in Cambodia and Vietnam (**Fig. 1**). The flooding season sometimes results in serious damage to agricultural production and human welfare in the deltaic area. Due to the deep inundation for a long period, the degree of freedom of cropping patterns in the farmland is forced to be a limited one. Though full flood control of such a large river as Mekong River may not be feasible, the possibility of diverse cropping patterns will be increased, if we can alleviate the flood situation to some extent (i.e. semi-control of flood) by some facilities like embankments, control gates and pumps for delaying the start of inundation and helping early recession of inundation. Therefore, it is very important to delineate the flood extent in the deltaic areas for providing the basic information for the semi-control of flood and agricultural development purposes in the region.

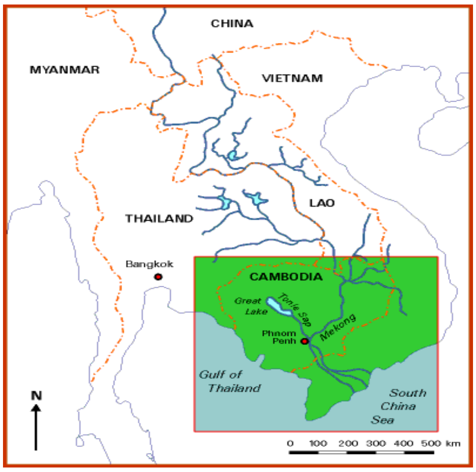

Fig. 1: The watershed of Mekong Delta's outline

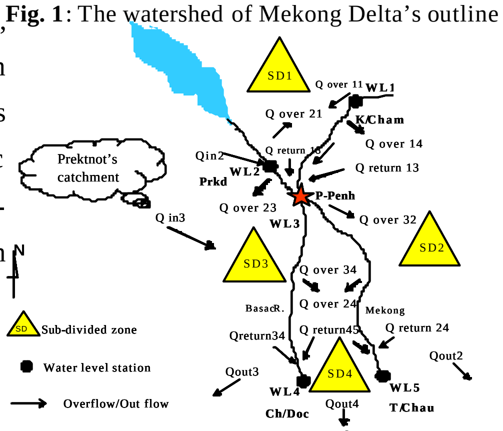

Fig. 2: The modeling scheme of Mekong Delta

Water balance and discussion

The first step of the study was conducted by the three basic models; the Mekong runoff model (from Chiang Saen to Kompong Cham), the Tonle Sap Lake water balance model and the Delta water balance model. The Mekong and Tonle Sap models were used for calculating the inflow to the Deltaic area. The Delta water balance was analyzed by the inflow and outflow from the main rivers and the inundated area. The daily change in water level of inundation was estimated based on the relation between storage volume and water level *(V-H)*. The main rivers (Mekong, Tonle Sap, Basac) are dividing the Delta into four zones as illustrated in **Fig. 2**. **Figure 3** shows the structure of inflow and outflow, for which formulas connecting rivers and floodplain as below were used:

For complete overflow: $Q_1 = m_1 B * h_1 \sqrt{2gh_1}$ (1)

For submerged flow: $Q_2 = m_2 B * h_2 \sqrt{2g} \sqrt{(h_1 - h_2)}$ (2)

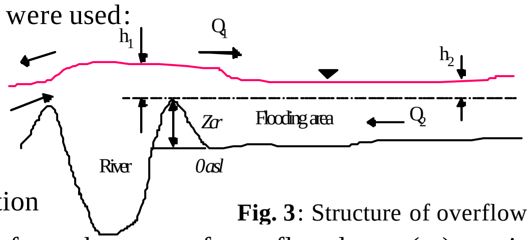

Fig. 3: Structure of overflow

where, ì$_1$ and ì$_2$ are discharge coefficient of overflow or return flow between river and flooding area, *g* is acceleration due to gravity (g =9.81 m/s^2), h_1 and h_2 are water stages from the crest of overflow levee (m), z_{cr} is wire crest elevation (m), *B* refers to a width of overflow or returned flow (m).

**United Graduate School of Agricultural Science, Tokyo Univ. of Agri. and Technology, ** Utsunomiya University.*
Key-words: *Mekong Delta; Water Balance; Flood Inundation Model; GIS*

Considering each zone as a storage reservoir, the water balance of inflow and outflow was formulated. During the first analysis (Sothea *et al* 2003), only zone 3 (SD3) was estimated. This report is to present the finally obtained outputs of the calculated water level from the rest zones. **Figure 4** is showing those results in comparison with observed water level at upstream and downstream of the Mekong Delta. The simulated results show that inundation depth ranged in between water levels of upstream and downstream and reached as high as about 8 meter in 1996 and 1997. Though the roughly estimated *V-H* curves were employed for the calculation, the obtained results were considered reasonable ones. Due to the lack of available data, the inundation depth could not be compared with actual values. However, this analyzed water balance was considered to provide the basic frame for modeling in the Mekong Delta. For more accurate modeling of inundation of the Delta, it is necessary to collect detail data on the topography as well as water level records. Next step for the inundation study of the Mekong Delta needs to consider the distribution of water on floodplain, using a hydraulic model and Geographic Information System (GIS) technique.

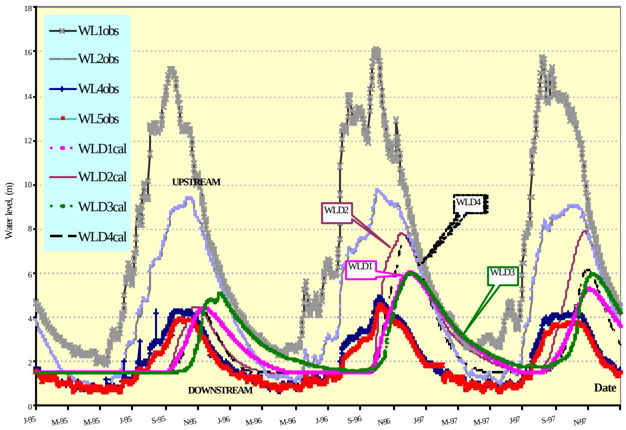

Fig. 4: Estimated water level of Deltaic areas

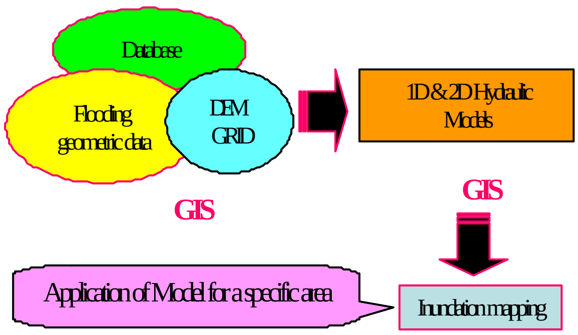

Fig. 5: Flood Inundation Model's component

Future Plan

The recently popular method to analyze flood inundation is combinations of a one- dimensional (1D) model for river flow routing and a two-dimensional (2D) model for inundation depth as well as water movement on the floodplain as presented by Kazama *et al* (2002) and De Roo *et al* (2000). The present study tries to employ the similar approach together with GIS for simulating flood water and the inundation extent in the Delta (see **Fig. 5**). The model application will particularly focus on analyzing inundation of a specific area for examining the possibility and effectiveness of semi-control of flood for improvement of agricultural land conditions of the area. This research is partially supported by CREST of the Japan Science and Technology Agency.

Reference:

1. De Roo A.P.J., Bates P., (2000). *A simple floodplain inundation model to assist in floodplain management*. New Trends in Water and Environmental Engineering for Safety and Life, ISBN 90 5809 1384.
2. Dong T.D., (2000). *VRSAP Model and its application*. Hydrologic and Environmental Modelling in the Mekong Basin. Technical Support Division. Mekong River Commission MKG/R.00017. (p.236-245).
3. Kazama S., et al (2002). *Relationship between inundation area and irrigation area on flood control in the lower Mekong*. Proceedings of the 13th APD/IAHR, 2002.
4. Sothea K., Goto A., Mizutani M., (2003). *Hydrologic analysis on inundation in Mekong Delta, Cambodia*. (Last year's presentation). Proc. of Annual Meeting 2003, JSIDRE.