Water Balance in Batheay Irrigation System for Mekong Floodplain Development
メコン氾濫原開発のためのバティ灌漑システムにおける水収支

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Cambodia faces flood from the Mekong river, which causes extensive destruction to human life, agricultural production and infrastructure every year. A floodplain, located between the Mekong and the Tonle Sap rivers and always affected by flood of the Cambodia Mekong, however, has a potential water storage for farming and a very huge area suitable for rice-based farming system. Studies to exploit the flood for water resources for the area, however, have not been well conducted yet. The Batheay irrigation system is located in the floodplain. In this research, the irrigation system is studied as a model site for future development of floodplain of the Mekong River and the Tonle Sap Great Lake.

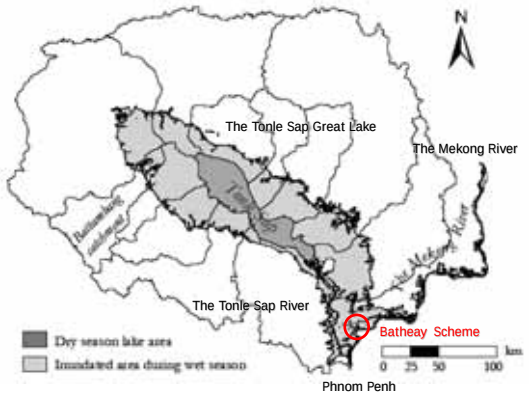

Figure 1: Catchment and floodplain of the Tonle Sap Great Lake and the Mekong River (source: WUP-FIN/MRCs)

In this work, we attempt to study water management of the Batheay irrigation system by analyzing water use pattern in the irrigation system and uncover effectiveness of the system. We then provide a development scenario for the floodplain of the Mekong and the Tonle Sap Great Lake.

As located in the floodplain, the irrigation system can take benefits not only from floodwater, but also sediment and fish. The system provides two basic food supplies, rice and fish, to the rural community. The merits of the system are as follows: 1- rice can be produced twice a year (rainy season and dry season) due to the exceptional characteristic of the irrigation system which is described below; 2- yield of rainy season rice is enhanced (high yield variety is initiated); 3- transportation facility is improved for dry and rainy seasons (ring dike is used as a transportation road); 4- fish harvest is another valuable benefit for the community.

Batheay Irrigation System

Batheay reservoir directly receives floodwater from the Mekong. It functions as both a reservoir and a paddy field. In wet season, dike around the Batheay reservoir prevents floodwater from entering the reservoir. Rainy season rice is grown inside the reservoir (Figure 1). After harvesting, gates around the reservoir are opened to receive floodwater. The water is stored for cultivating dry season rice outside the reservoir. At the end of dry season cultivation, water inside of the reservoir is concentrated in the deepest area of the reservoir. That is the time for fish harvest.

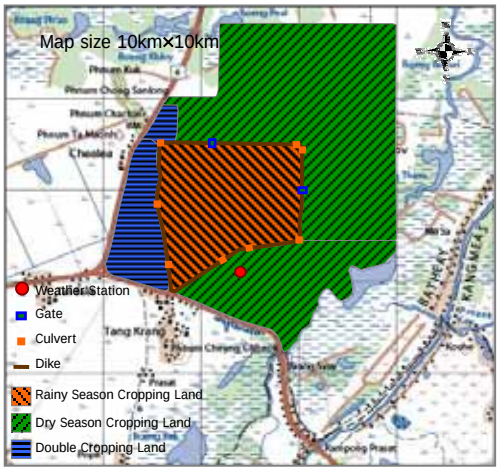

Figure 2: Command area of the Batheay irrigation system

Cropping Pattern of the System

Two kinds of rice, rainy season rice and dry season rice, are grown in command area of the Batheay reservoir. The cultivation patterns and time of growing of these rice varieties are described below:

Rainy Season Rice: Rainy season rice is grown inside the Batheay reservoir from May to September (Figure 2). Precipitation is the main water source for this type of rice.

Dry Season Rice: Dry season rice is grown outside the reservoir from December/January to March/April. In western area of the reservoir, rice can be grown twice a year as that area is not flooded in wet season (Figure 2).

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Keywords: Floodplain Development, Paddy Field, Reservoir Irrigation, Water Balance Model

Data Collection and Methodology

Since there is no topographical, hydrological and meteorological data of the Batheay irrigation system, a detailed topographic survey was done on the study area. Elevations of the structures around the reservoir are transferred to local reference. The terrain code is derived from the elevations. The digital elevation model of the reservoir is generated from the terrain code. Then, a correlation of water level, area and volume of the reservoir is established and used in calculation procedure of outflow from the reservoir.

Water level loggers were installed at all structures around the reservoir. Water level inside the reservoir is measured and used for estimating water released from the reservoir. At the same time, water level outside the reservoir at each culvert structure is used to investigate gate opening schedule.

Weather station was also set up in the command area of the system. The station is equipped with automatic loggers of precipitation, temperature, air humidity, wind direction, wind speed and radiation. From these basic meteorological data, reference evapotranspirattion is derived. Reservoir evaporation is also estimated from the evapotranspiration.

Results and Discussion

Infiltration rate from the reservoir is estimated in a period when there is no inflow to and outflow from the reservoir. Reservoir evaporation is assumed 85% of reference evapotranspiration and is found about 4 mm day^{-1}. The infiltration range from 2.8 mm day^{-1} to 4.4 mm day^{-1}, with an average of 3.2 mm day^{-1}. Daily reference evapotranspiration is in average of 4.6 mm day^{-1}.

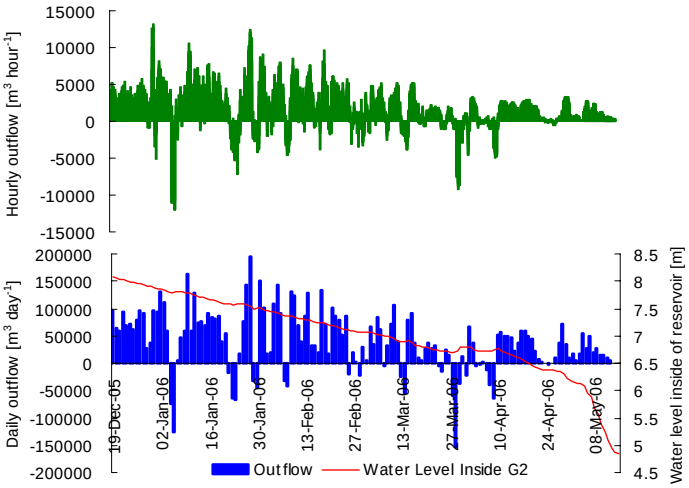

Figure 3: Hourly and daily outflow for irrigation

To eliminate wind and wave effect on error of water level data, 24-hour moving average filter is applied to the time series of water level. The water level in the Batheay reservoir is found decreasing 17 mm day^{-1} during the cultivation period. Average daily outflow from the reservoir is 72000 m^3/day. Available water stored in the Batheay reservoir for this cultivation season is 12 MCM, in which 8.1 MCM or 67% is from floodwater of the Mekong and 3.9 MCM or 33% is from precipitation (inflow period is from 20 August to 20 October 2006). Until this February 2007, total supply to the command area of the reservoir is 6.2 MCM, accounting for 62% of the total supplying volume (10 MCM), while 3.8 MCM or 38% of the volume in the reservoir is a loss, which is composed of reservoir evaporation (2.3 MCM or 23%) and infiltration (1.5 MCM or 15%).

Conclusions

With the Batheay reservoir irrigation system, farmer can grow rice twice a year, rainy season rice and dry season rice. Without this system, rice cannot be grown in both rainy season (flood) and dry season (shortage of water). As located in the floodplain, the system could take benefits not only from floodwater, but also fish and sediment.

Main water source for the reservoir is from floodwater of the Mekong. The water stored in the area of the reservoir can irrigate area double of the reservoir. The irrigation system is expected to be an irrigation model site for future development of the floodplain of the Mekong river and the Tonle Sap Great Lake of Cambodia.

Future Plan

The results shown on this report are only hydrological analysis of the Batheay reservoir. As future work, the hydrological and meteorological data will continue being monitored. The consumptive use in the paddy fields around the reservoir will be estimated. And finally, water use pattern of the whole system will be analysed.

Acknowledgement This research is supported by fund of the Core Research for Evolutional Science and Technology, Japan Science and Technology (CREST-JST).