Rivershed Management in the Yellow River


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Purpose: Water is the key element for human. Water shortage disturbs agriculture, industry, and daily lives of residents. Reusing and saving water corresponds to the production of water resources. The Yellow River basin has been suffering from water shortage, so that in the Weihe basin (See Figure 1), a major tributary of the Yellow River, hydrological process and aquatic environment polluted by discharged substances were analyzed for creating better sustainability by using an integrated model on water quantity and quality.

Fig.1 Weihe basin and observation point (Basin area: 140,000km^2)

Model development: Many types of hydrological and water quality models have been used to simulate water resources distributions, water supply/demand, pollutant fluxes, and water quality in river basins. These models are known to be useful to estimate water budgets and water quality, however, there is no study that tried to integrate these models to propose an integrated water resources management system. Therefore, in this study, an integrated model on water quantity and quality which involves domestic, industrial and agricultural water use, is developed.

Modeling and simulation results: Figure 2, below, presents the structure of the integrated model on water quantity and quality. It is based on SWIM (Soil and Water Integrated Model), and is constituted with five sub-models; a hydrological model, a mathematical model of pollutants from point sources, a mathematical model of pollutants from non point sources, a sediment erosion model, and a water quality model. The hydrological model of SWIM is, however, not applicable to the natural hydrological cycle in the basin area with over 10,000km^2. Instead, GBHM2 (Geomorphology Based Hydrological Model) is applicable to basins with over 10,000km^2 like the Yellow River Basin. Beside, in order to improve accuracy of GBHM2, the artificial water utilization calculated by using GIS and satellite images was added to it as input data. Pollutant fluxs from point sources were calculated by using basic units, and those from non point sources were derived by using EPIC (Erosion Productivity Impact Calculator) and the nutrient discharging model in SWIM. Sediment erosion amounts were calculated by MUSLE (Municipal Universal Soil Loss Equation). Concentrations of water quality items; SS, BOD_5, DO, NH_4^+-N and NO_3^--N, were estimated, based on the 1-D advection-dispersion equation.

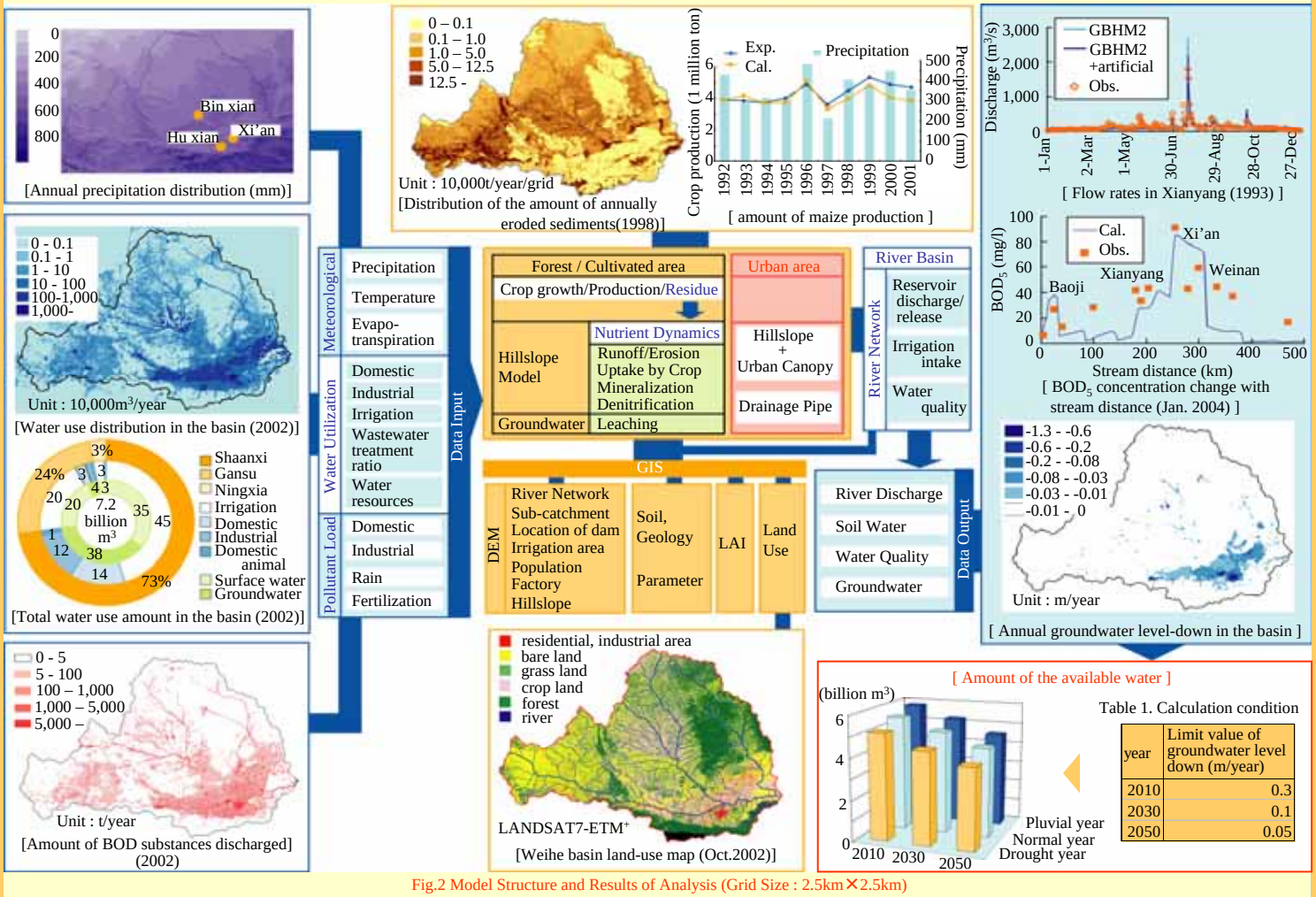

Table 1. Calculation condition

year	Limit value of groundwater level down (m/year)
2010	0.3
2030	0.1
2050	0.05

Fig.2 Model Structure and Results of Analysis (Grid Size : 2.5km×2.5km)

CONCLUSION: Observation results, such as river discharge, water quality and groundwater level in the Weihe basin, were simulated with high accuracy by using this model with suitable parameters. Then, the available water was estimated about 4 billion tons in the drought year. This value is less than the water demand in the basin. To achieve sustainable development, in consequence, it is important to equip saving-water systems. In future, integrated model on spatial economy, water quantity and quality will be developed to design sustainable development of the basin under constraints of water supply, then effective allocation of water resources will be investigated through the cost benefit analysis with water-saving measures in every sector.
This model is applicable to any basins in any regions for effective water use.