

## Classification of structure of water resource supply and demand in the Yellow River Basin of China

ICHINOSE, Toshiaki<sup>1\*</sup>, Akio Onishi<sup>2</sup>, Feng Shi<sup>3</sup>

<sup>1</sup>NIES / Nagoya Univ., <sup>2</sup>Toyama Pref. Univ., <sup>3</sup>Nagoya Univ.

Onishi et al. [2006] presented time-and-space structures of water resource supply and demand over the whole of the Yellow River Basin, broken down by county and month, and proposed a framework for analyzing a series of hydrological cycles-extractions, losses and returns-from upstream to downstream. Unfortunately, water resource volumes of surface water and groundwater were mixed together because of methodological limitations, and they did not manage to separate the effects of surface water and groundwater.

Ichinose et al. [2009] attempted to establish a spatial distribution of groundwater demand, for which concrete data is not publicly available, in a high-resolution grid. However, the seasonal dependency of agricultural extraction volumes is very large. Therefore, to understand the behavior of the groundwater, there is still a question of establishing extraction scenarios that accurately reflect agricultural records, instead of just setting up a simple irrigation model and estimating seasonal variations. When such extraction scenarios have been established, breakdowns of groundwater demand may be established for individual regions, and seasonal water resource adaptation measures that take account of the interaction with surface water may be considered.

Data on surface water usage structures is lacking and the reality is difficult to establish. In this study, we attempted to map out surface water usage structures by directly comparing the water usage structures estimated by Onishi et al. [2006] with the groundwater usage structures estimated by Ichinose et al. [2009], region by region. The year studied in Onishi et al. was 1997, and the year studied in Ichinose et al. was 1996. Ichinose et al. presented maps in which groundwater usage amounts for industry and for households, expressed in a grid, were aggregated by county. We used this data for our comparison.

First, we compared and analyzed breakdowns of groundwater demand by region in the Yellow River Basin. We selected 35 municipalities, covering the greater part of the yellow River basin, and assigned them to 12 small catchments, giving consideration only to morphological similarities in groundwater usage structures. The groundwater usage structures of the municipalities assigned to each small catchment were similar to one another.

In general, the upper catchments depend on surface water and the proportions used for agriculture are low, so seasonal variations in groundwater usage are small. By contrast, the middle and lower catchments have high levels of dependency on groundwater and the proportions used for agriculture are high, so seasonal variations in groundwater usage are large. This tendency is particularly striking on the Loess Plateau. The catchments that are furthest downstream are again dependent on surface water.

In spite of the similarities of groundwater usage structures, regions with complicated water resource supply and demand structures that include surface water can be observed among the small catchments. Particularly in the catchments of the middle reaches, the diversity in water resource supply and demand structures, which is related to conditions of access to the main rivers, is striking. Outside agriculture, surface water is mostly used by industry.

**Keywords:** Yellow River, ground water, water resource, urban, China

