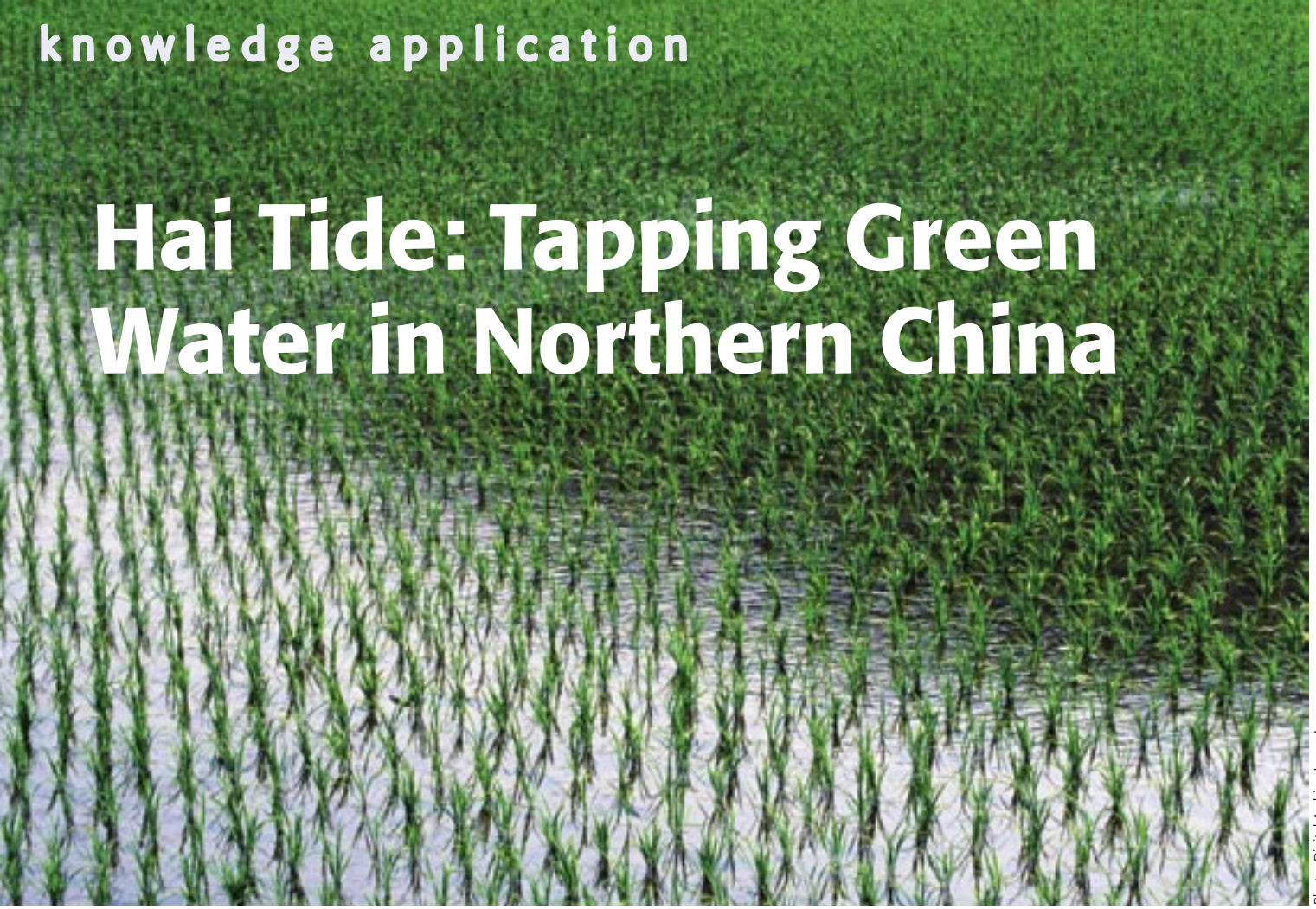
Hai Tide: Tapping Green Water in Northern China



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The Hai Basin – one of the seven main river basins of China – is one of the world's most depended upon river basins. It is also one of the most degraded. With some 130 million people, including those living in the Chinese capital of Beijing, depending on the basin and its water resources, the pressure placed on the basin is considerable.

The Hai Basin in China is currently experiencing serious physical water shortages and pollution. Ninety percent of the surface water resources are used; most branches of the river do not reach the sea. The availability of water resources is only 285 m^3 per head, while groundwater abstraction, pumped at 26 billion m^3/year, exceeds recharge by 7.2 billion m^3/yr. Beyond that, surface water is overused by 2.4 billion m^3/yr. This overexploitation, totalling 9.6 billion m^3/yr, has resulted in serious environmental degradation.

Urgent action is needed to change the hydrological state of the basin. A well-conceived longer-term water resources management strategy is essential as soon as possible. In the Hai Basin, the first steps to implementing such a strategy have begun with initial efforts to reduce useless evaporation, monitor evapotranspiration (ET) and allocate ET quotas, and work with local stakeholders.

Reducing Useless Evaporation

In water-short areas, water must be managed in terms of the amount used, not the amount diverted. For example, you can think of water for irrigation under two headings: the part that evaporates from ground and water surfaces and is consumed by crops, trees and weeds (in ET), and the part that returns to surface or groundwater systems. The part consumed through evapotranspiration is lost to the basin's water balance. Good management should reduce useless evaporation and transpiration that does not contribute to plant growth. There are several ways to do this, for example by reducing waterlogged areas, covering strips of soil with plastic, irrigating when evaporation is lowest (at night, not by day), using moisture-retaining mulches, stimulating greenhouse cultivation and replacing open canals and ditches with pipes. Good water management can also reduce plant transpiration by weeding, using water stress-resistant plant varieties, and fine-tuning deficit irrigation to actual crop water deficit.

Allocation of ET Quotas

The Global Environment Fund (GEF) Hai Basin Integrated Water and Environment Management Project will pilot water resources planning through allocation of ET quotas. The objective is to increase the volume and value of agricultural production in the demonstration areas while at the same time staying within a fixed consumption quota. The quota will be less than the current ET total, a goal that can be achieved only by reducing non-beneficial ET and raising crop water productivity – the yield and value of production per unit of ET. The project will work with local water user associations and farmers on irrigation and general management practices to improve their water productivity and to detect spots where ET can be reduced. Making real water savings implies reducing overall ET so that more water remains in streams, reservoirs, soil and aquifers. Simply making irrigation more efficient and reducing the amount of water it uses does not necessarily mean more water is available for the environment. Reducing irrigation water supply will certainly limit the amount that trickles away into the fields, but the impact on ET can be minimal, leaving total consumption unchanged. And reduced groundwater extraction for irrigation means consequent lower recharge rates. They cancel each other out, which yields little reduction of ET.

Satellite Monitoring of ET

The project uses a satellite remote-sensing technique to measure-target-monitor ET

at the basin level. The advantage of using satellite-based information is that the complex hydrological processes that govern ET no longer need to be quantified using other methods. ET is simply calculated from the energy used to convert water from a liquid into a vapour. Satellite monitoring undertaken between 2002-2006 has revealed that ET already exceeds precipitation and is depleting additional resources. This helps explain the basin-wide changes in water storage.

Working with Local Stakeholders

Implementing a real water savings programme clearly means working with local stakeholders. Sixteen counties in three different provinces have been selected to demonstrate the possibilities of achieving local water savings. Guantao County (Hebei Province) is one of the demonstration counties. High-resolution Landsat satellite data with pixels of 30 metres are being used to support practical irrigation management decision-making. The annual ET for Guantao County is 620 mm, 723 mm, 659 mm, 650 mm and 650 mm from 2002 to 2006. The major crops, such as wheat and maize, have been classified multi-spectrally by means of the same Landsat images. The impact of land use, crop types and irrigation practices on ET as well as on water productivity can be studied from these high-resolution images. An example of accumulated crop water consumption, biomass, wheat and maize water productivity is shown in Figure 1.

The imbalance between basin-wide inflows and outflows in the Hai Basin can be alleviated by introducing a stringent ET quota and groundwater extraction plan. The basin-wide saving needed in total ET is estimated at seven percent. Only a fraction of this can be achieved through central management, so savings in some localities will need to be as high as 15-20 percent. The challenge is to establish a breakdown of the basin-wide ET quota into maximum ET volumes allowed for each county. Advanced decision support systems will be developed that divide the basin ET quota into county-level quotas, using information on local precipitation, land use, crop types, groundwater table declinations, presence of groundwater, crop water productivity, and so on. Areas with high water productivity values should be required to reduce ET less than areas with low productivity. The satellite images will be used to establish crop yield and crop water productivity. Preparing Integrated Water and Environment Management Planning (IWEMP) at the county level includes establishing priority areas where integrated measures for real water savings can be applied to meet the target ET. The revolutionary approach is to shift from limiting supply to limiting consumptive water use. The provincial authorities need to develop legal and regulatory approaches to enforce such an ET reduction programme.

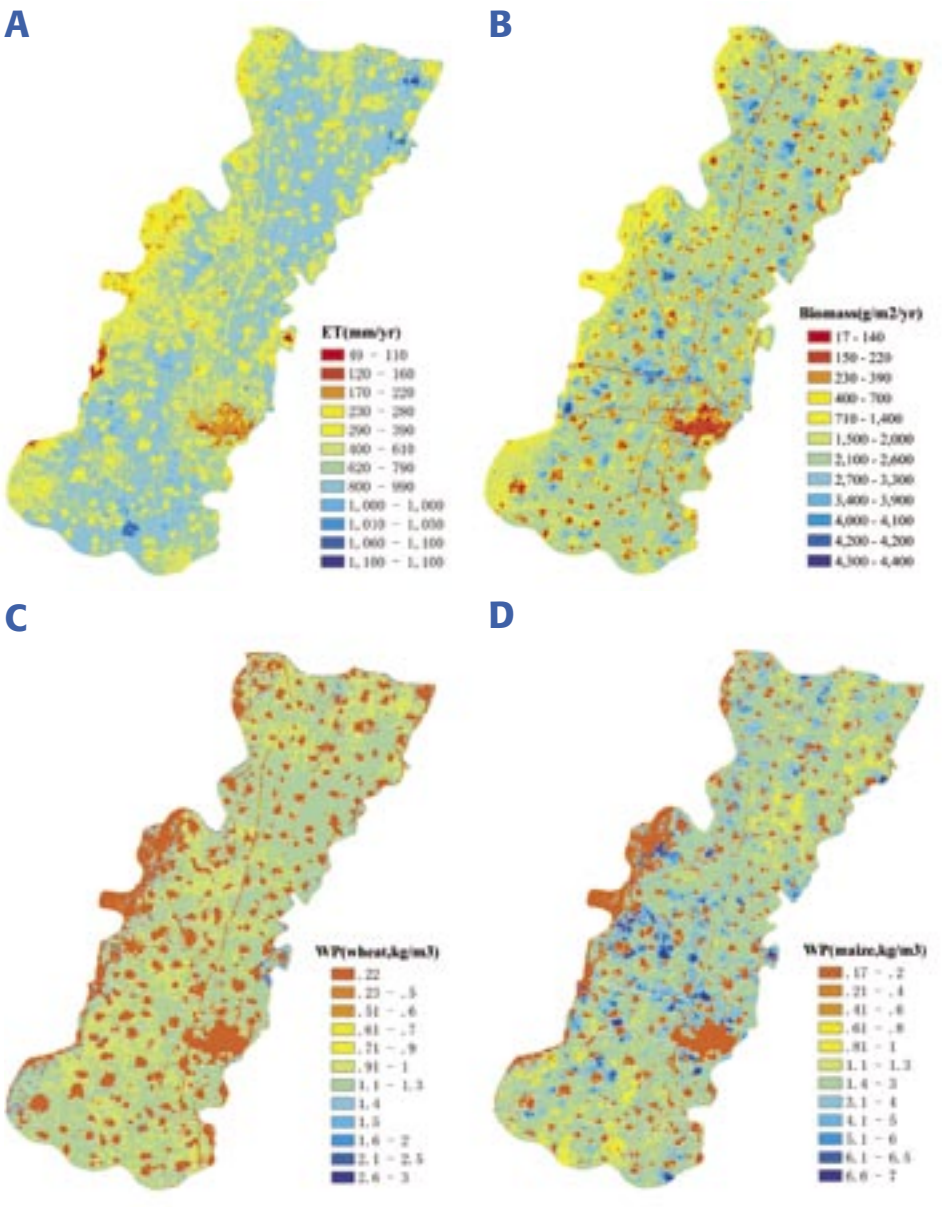

Figure 1: (a) ET, (b) Biomass, (c) Wheat water productivity , (d) Corn water productivity for Guantao County for year 2006 at a spatial resolution of 30 meters.

A Widely Applicable Approach

Water resources planning and management using ET units is useful wherever streams dry up and groundwater tables are falling. It makes particular sense where irrigated agriculture is the major water user. The approach is practical, aiming to make the use of water resources sustainable and to raise farmers' incomes. It helps to maximise agricultural production in water-scarce areas in a sustainable way. Its reliance on monitoring through remote sensing makes it widely applicable.

Authors

Wim Bastiaanssen, WaterWatch, The Netherlands and Delft University of Technology
Wu Bingfang, Institute of Remote Sensing Applications, P. R. China
Douglas C. Olson, World Bank, USA
Jiang Liping, World Bank, Beijing, P. R. China

More information

Ministry of Water Resources Project Management Office for the GEF – Hai Basin Integrated Water and Environment Management Project, GEF@mwr.gov.cn