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Less water and more nutrients: The Haihe River System of the Beijing-Tianjin area (China)

Benoit Pernet-Coudrier (1), Weixiao Qi (2), Michael Berg (1), Huijuan Liu (2), and Beat Müller (1)
(1) Eawag, Dübendorf, Switzerland (benoit.pernet-coudrier@eawag.ch), (2) RCEES, CAS, Beijing, China

After rapid economic development in the last two decades, China has witnessed a continuous environmental deterioration. Over 90% of the rivers are contaminated with untreated sewage, trace elements, and organic toxicants causing severe risks for man and the environment. In addition, northern China is facing severe water scarcity due to 25 years of drought and a growing urban population pushing for a more comfortable life stile. Rapid industrial development and farming practices relying on artificial irrigation have boosted the water demand, but Beijing's water crisis stems more from fragmented institutional system of water resource management and decades of short-sighted policies. Water shortages and poor water quality aggravate the situation threatening northern China's food security, economic development, environment and quality of life.

In collaboration with the Research Center for Eco-Environmental Science (RCEES) in Beijing we had the opportunity to study the main river system of the Haihe basin passing the two megacities: Beijing and Tianjin. During the first sampling campaign (17 sites in April 2009) we found the whole river system to be heavily contaminated with nutrients reaching several mg/L of bioavailable phosphorus and tens of mg/L of nitrogen, where the latter is mainly present in its reduced form as ammonium. These high nutrient concentrations stimulate algae blooms inducing fish death also due to oxygen depletion in the shallow Shahe reservoir and the downstream sections of the river. Inflow to the Shahe reservoir consists mainly of untreated sewage and the countless small sewers release untreated sewage to the river. Since several years the city of Beijing promotes the construction of state-of-the-art wastewater treatment plants (WWTP) without, however, a clear concept of the nutrient budget of the Haihe system (including the Bohai Bay) and an efficiency control. Meanwhile, sewage from rural settlings, livestock husbandries and drainage from agriculture are neglected. This has the effect that treated wastewater from 9 million inhabitants of Beijing has significantly better quality and dilutes the river water downstream with regard to nutrients. Nevertheless, the contribution of treated wastewater to the total nutrient load is not known. In that context a 15 months monitoring of the Haihe river system was performed with special investigation of effluents of WWTPs and campaigns with high temporal resolution sampling (hourly and daily measurements). We observed almost no seasonality for P and low variations for N under nitrate and ammonia forms. Budgets reveal that point sources like WWTP and untreated wastewater are the main sources for nutrients in the river system, whereas agriculture contribution is negligible.