A pilot conjunctive water supply system
Deyang, China
Title: A pilot conjunctive water supply system for Deyang, City of China. Demonstration of integrating a wetland park and artificial groundwater recharge with pre-treated river water for urban water supply in Deyang City, China

Period: February 2014 to September 2016

Co-finance:
- Netherlands Partners for Water programme
- Deyang Municipal Government

Partners:
- UNESCO-IHE Institute for Water Education
- World Waternet, Amsterdam
- MetaMeta
- Eijkelkamp Soil & Water
- Deyang Department of Housing, Urban & Rural Planning and Construction
- Deyang Department of Water Affairs
- Deyang Water Supply Company
- Chengdu University of Technology
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Design: Huahui Engineering Design Group

Construction:
- Chengdu Jinxi Garden Construction Company

Components:
- Production well: 3 with a total capacity of 3000 m³/day
- Observation wells: 8 with automatic dataloggers
- Water quality monitoring: 3 multi-parameter dataloggers
- Two infiltration basins: 4,040 m²
- Constructed wetlands: 4,455 m²
- Sedimentation basin: 525 m³
- Coagulation ponds: 68 m³
- Dosage: Polyaluminium Chloride
- Water intake pumps: 2 with a capacity of 135 m³/hour
- Visitor centre
- Wetland park area: 3 Ha

Functions:
- Urban water supply
- Groundwater recharge
- Public recreation
- Public education
- Scientific research

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**Background**

The Deyang area, located in the Sichuan Basin in southwest China, was struck hard by an earthquake in 2008. Since then, reconstruction has taken place with a tremendous speed and the urban population grew exponentially. The city’s water supply system cannot meet its rapidly growing water demand. Deyang is not the only city with this problem.

Currently, two-thirds of all Chinese cities don’t have sufficient water the whole year round. On top of that cities suffer from severe water pollution caused by rapid development. Water scarcity and water pollution cause a loss of 11.2 billion USD in industrial output every year. The cost of the impact of insufficient water quality on health has been estimated at 3.9 billion USD per year.

In Deyang, a pilot artificial recharge water supply system was developed and tested. This system benefits from the technology as introduced in the Amsterdam dune system that forms the main source of drinking water for the city of Amsterdam. This artificial recharge water supply system increases groundwater storage, maintains constant water supply and improves water quality.

**Activity overview**

» Project **inception workshop** in Deyang, China: The inception workshop was held in Deyang City in February 24-28, 2014. During the project inception, the Dutch and Chinese project teams selected a site and water source for the pilot water supply.
system in Deyang City; estimated Chinese co-finance for the construction; defined specific tasks and responsibilities of each project partner; and engaged water supply companies from Beijing, Tianjin, Xi’an, Chengdu, and Jinan cities in the project.

» Project training course in The Netherlands: The training course was held in The Netherlands from September 14 to 27, 2014. Fourteen participants from key partners attended the course. The training course consisted of lectures on artificial recharge and wetland technologies, site visits to Amsterdam Dune water infiltration system, Vinkeveen surface water treatment system and Amsterdam wastewater treatment plant; visits to all Dutch partners (UNESCO-IHE, Waternet, Eijkelkamp, and MetaMeta); and discussions on the conceptual design of Deyang pilot.
Design of the Wetland Park and pilot project: A Chinese landscape design company was hired to make an engineering design of the integrated wetland park with pilot components. The water treatment and infiltration components are embedded in the wetland park such that the wetland part has multiple functions as a recreational park, but also drinking water production.

Construction of the Wetland Park and pilot project: The construction started in October 2015 and finished in July 2016. Main components of the construction are: pumping house for Mianyuan river water intake, dosage system, coagulation ponds, sedimentation basin, sludge processing room, wetlands, infiltration ponds, pumping wells, observation wells, and a visitor centre.
» Field test of the pilot project: Three field tests were conducted to ascertain operations of all components, to determine dosage rate and pumping rates, and to analyse water qualities. The first test was done in March 2016. This test identified several deficiencies in hydraulic conveyance and dosage system. Several improvements were made subsequently. The second test was conducted in June 2016. Further improvements were made according to the results of this test. The third test was
done in August 2016. Results show that coagulation and sedimentation can effectively reduce turbidity of river water. Constructed wetlands further reduce suspended sediment and nutrient concentrations. The water is of good quality for infiltration. Three production wells can produce the designed yield with good water quality.

» Project information dissemination: The visitor centre serves for public education on water and ecosystem protection and management.
Project activities were reported several times by local news media. Project brochures were prepared and distributed. A final project seminar was held on September 22, 2016 in Deyang City. An opening ceremony was held in the park with attendance of Mayor of Deyang City and Counsel-general of The Netherlands in Chongqing. The wetland park was officially opened to the public. The project seminar presented project results and discussed scale-up activities in other cities in China.

Project results

» An integrated wetland park with urban water supply production: This unique site integrates a recreational wetland park, artificial groundwater recharge, drinking water production, public education, and scientific research. Its multiple functions are complementary to each other. For example, the constructed wetland not only serves a recreational function, but also the function of improving source water quality for artificial recharge. The recharge pond serves a groundwater recharge function, but also contributes to the scenery of the park. At the same time, 3 million liter of drinking water is produced daily.

» A monitoring system for safe operation of the water system: Automatic water quality instruments (EC, Turbidity, Temperature, DO) continuously monitor water quality of intake source water, effluent water from the sedimentation basin, and inflow water to the recharge pond. The system can be switched off whenever the water quality doesn’t meet the standard. Furthermore, water levels in Mianyuan River, recharge ponds, and six observation wells are continuously monitored. These data are important to understand dynamics of water system and can be used to optimise the operation of the system.

» Trained local staff for the management and operation of the water system: A core group of qualified technical staff is essential for the long-term operation and maintenance of the system. Deyang Water Supply
Check of a pumping well on June 28, 2016

Coagulation ponds on June 29, 2016

Sedimentation basin on June 29, 2016

Water level control pond on August 29, 2016

Constructed wetland on August 19, 2016

Infiltration ponds on August 19, 2016
Company is made responsible for these tasks. They took part in the field tests and were trained in the operation of the system.

» A visitor centre for public education: The whole park serves as a visitor centre; project information is displayed outside as well as inside. Icons are shown for each component of the park. The visitor hall displays information relevant on water resources and environmental protection. The public has free access to the park for relaxation and environmental education.

» A research base for scientific research: Chengdu University of Technology uses the site for scientific research by MSc and PhD students. Data collected from automatic instruments provide excellent conditions for scientific research on the efficiency of source water pre-treatment, functions of the constructed wetland, and optimization of infiltration and pumping. Students and staff from a local colleague in Deyang City have also interests to do experimental tests.

» A showcase of Sino-Dutch cooperation in water management: There is a long history of Sino-Dutch cooperation in water management. This site serves another showcase for successful cooperation.

Scale-up prospects

» Large scale project in Deyang City: Deyang City has a plan to build a large wetland part in the north of city where a similar artificial recharge and abstraction using aquifer for storage will be constructed.

» Artificial groundwater recharge project in Beijing City: Two workshops have been organised to develop a demonstration project on artificial groundwater recharge in Beijing City. A project proposal was approved by Beijing Water Authority and Asian Development Bank for financing Beijing pilot.

» Artificial groundwater recharge project in Jinan City: Jinan Water Supply Company attended project kick-off workshop and
made a plan to implement an artificial groundwater recharge project. This project has been implemented since then.

» Contribution to sponge city programme: In order to solve urban flooding problem in conjunction for the management of water scarcity, China started a programme called “Sponge City” construction. In the first round, 16 cities were selected to construct sponge cities from 2015 to 2017. Fourteen cities were selected as sponge city programme in the second round in 2016. The key elements are collection and storage of rainwater, infiltration to groundwater, and use of stored water for water supply purposes. Deyang pilot is one of examples of sponge city project. Use of constructed wetland to collect and purify rainwater and runoff, store the water in the aquifer with artificial recharge methods, and use of infiltrated groundwater for water supply will become the key components for sponge city programme.