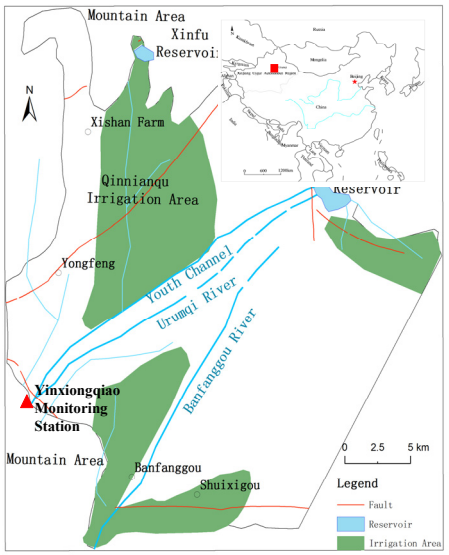
Water resources management using artificial groundwater recharge to replace shallow surface water reservoirs: An example from Xinjiang, China

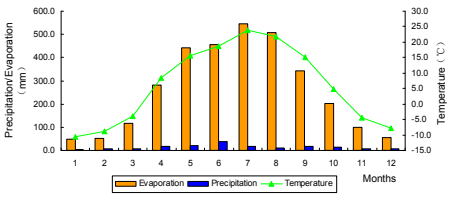
Zheng Yuejun [1, 3], Li Haitao[1], Li Wenpeng[1], Dong Xinguang[2], Wolfgang Kinzelbach[3]
1. China Institute of Geo-Environmental Monitoring, Beijing, China;2. Department of Water Affairs, Xinjiang, China;3. Institute of Environmental Engineering, ETHZ, Zurich, Switzerland

Overview

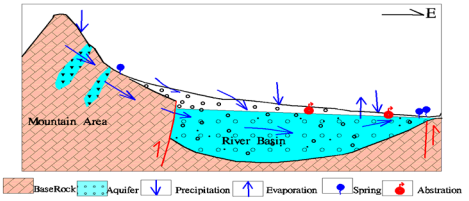


Basic information on the study area

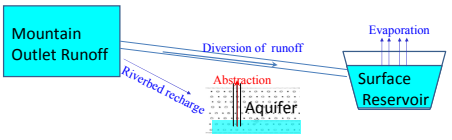
- Located in Northwest China, on the southern margin of the Dzungarian Basin.
- Arid and semi-arid area, continental climate zone.
- Altitude from 900m to 1600m.
- Long term precipitation 100-400 mm/a, evaporation about 2200 mm/a.
- Urumqi river is the main river, feeding a shallow surface reservoir constructed for storing the water.
- Mountain outlet runoff is almost the only water resource feeding the river.
- Big space and time differences of water resources distribution.
- Youth canal diverts mountain outlet runoff directly to Wulabo shallow surface reservoir.
- Surface water is wasted by evaporation from the reservoir, while at the same time groundwater is overpumped.



Yearly distribution of precipitation and evaporation

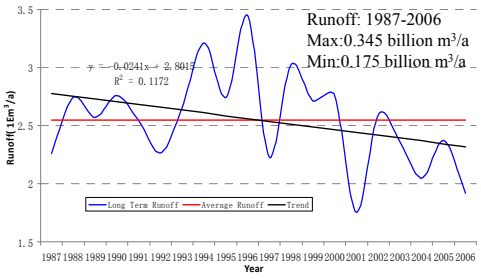


Sketch map of groundwater recharge, runoff and discharge

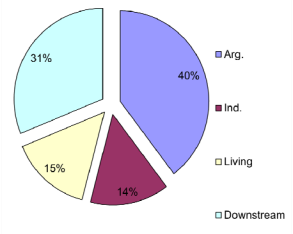


Present water resources utilization pattern

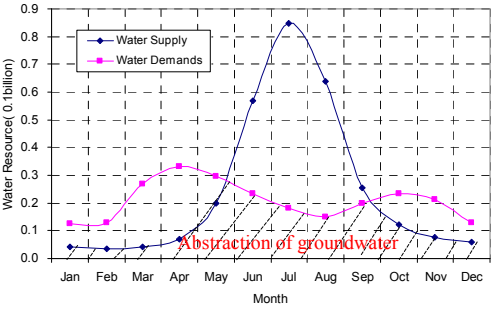
Water resources supply and demand analysis



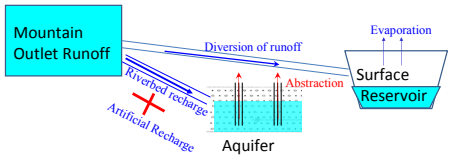
Long term runoff observed from Yingxiongqiao Monitoring Station



Total water supplied 0.25 billion m³/a
Groundwater abstraction 0.105 billion m³/a
Surface water supplied 0.145 billion m³/a

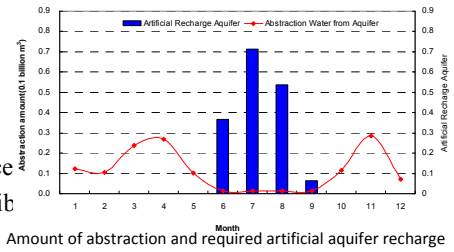


Water supply and demand distribution over the year



Vision for sustainable resource utilizatio

Using artificial groundwater recharge to replace the shallow surface water reservoir and, contrib te to sustainable water resource utilization.

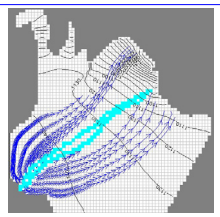


Amount of abstraction and required artificial aquifer recharge

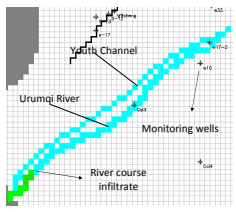
Abstraction of groundwater (0.136 billion m³/a, with increase of 0.021 billion m³/a); Artificial groundwater recharge (0.168 billion m³/a in total, subtracting the runoff in Banfanggou river and the current recharge in Urumqi river course, the required additional Urumqi river recharge is 0.069 billion m³/a)

Modeling and results

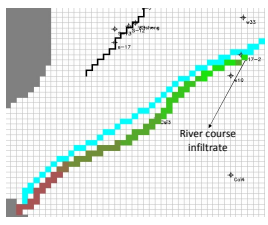
- A saturated zone groundwater model was developed using MODLFOW under PM8.0
- The natural river course's infiltration capacity has been simulated
- Artificial groundwater recharge should be combined with an upstream mountain reservoir under construction, controlling river flow such that all water released to the natural channel can infiltrate into the ground



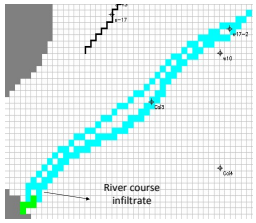
Simulated groundwater levels and pathlines



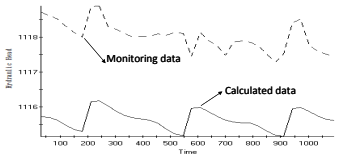
Simulated river infiltration rate in Jan.



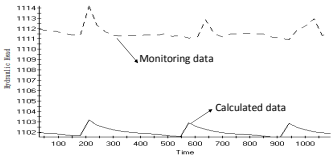
Simulated river infiltration rate in July.



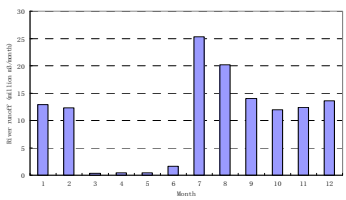
Simulated river infiltration rate in Dec.



Calculated and measured groundwater levels in monitoring well w10



Calculated and measured groundwater level in monitoring well w17-2



The artificial recharge using river flow in natural river course