Irrigation, return flows and groundwater circulation

Jacob Burke & Marcus Wijnen: Hydrogeologists: Water Global Practice

Don't be glib about groundwater flow – it is variable

- The relationship between surface flows, irrigation return flow and groundwater is not constant, may be twoway - and not necessarily a beneficial one.
- Including irrigation return flow in water balances requires an understanding of the relationship between canal supplies, irrigation return flow and underlying groundwater bodies.



Make real balances

Irrigation return flow may not reach the groundwater table underlying the irrigated area

- Aquifers may be separated from soils by impervious layers or field management, diverting percolating irrigation waters horizontally (Peninsula India);
- Boreholes may tap deep confined aquifers and transfer their depletion accounts up to unconfined superficial aquifers. (Mpongwe, Zambia)
- Aquifers may be so deep and de-coupled from recharge or returns (Nubian, parts of Umm er Radhuma-Dammam Aquifer System, Tawilah)
- In these cases irrigation return flow cannot be deducted from the total water abstraction rates . Don't take irrigation return flow as a 'fact'.



Groundwater quality matters

Irrigation return flows can be be rapid and transient in shallow alluvial spreads may result in quality problems that threaten long-term public & aquifer health

- Percolating irrigation water transmit nutrients and pollutants imprinting aquifers permanently
- Leaching requirements problems extend beyond the soil zone;
- Recirculation and <u>concentration</u> of naturally occurring geochemical signatures (Arsenic mobilization from alluvial aquifers, Fluoride from Basement Complex)



Planning Chennai's municipal supply – the impact of 40,000 shallow irrigation wells



Source: A.N. Charalambous and P. Garratt. *Recharge abstraction relationships and sustainable yield in the Arani-Kortalaiyarg groundwater basin, India*. Quarterly Journal of Engineering Geology and Hydrogeology 2009; v. 42; p. 39-50

A finite element model to calculate return flows from irrigation –at 40% of applied water



Calibration data



Irrigation abstraction regime over time



Relative contribution of return flows over time

