Water Accounting
Water Productivity Workshop, World Bank, December 2014
Organization of Presentation

• Overview of Water Accounting
• Australian Case
• Water Accounting Plus, and Application in the Nile (may be the other way around)
• Key Points
Some philosophy

- The main motivation for recent interest in water accounting has been to diagnose and understand the situation in over-allocated and rapidly developing river basins, especially those in more extreme climates, where water scarcity is incipient or cyclical.
  - In an ideal world, WRD and allocation frameworks based on adequate water accounting from an early stage, but this is rare.

- What is a good definition of over-allocation (or basin closure)?
  - \( \text{Eta} > \text{RF} \)? Already in big trouble as either mining stocks or have IBT
  - A limit of ecosystem resilience in surface and groundwater systems?:

- MDB: moving from 55% of MNLTF to 66% MNLTF
What is water accounting?

- All water accounting quantifies available water resources and their use, though constructing water balances, over time space, of varying complexity and detail.
  - Water use is not just about agriculture – but all anthropogenic and natural uses: (drinking water and sanitation, industry and processing, amenity, ecosystems, navigation, hydropower). Water accounting is also needed for the management of non-consumptive uses.

- Water quality is an important facet of water accounting, as quality constrains use.

- Data on flows, rainfall and basic hydrology (many ungauged catchments) is often thin in many parts of the world.
Water Accounting in Australia

- Began with area based licenses, as a share of diverted resources in surface irrigation & potable water supply systems: water is a State responsibility.

- Progressive volumetric conversion: c. 1930s-1960s in Victoria, & 1960s onwards in other states. Parallel licensing for other uses: S&D; DWSS; industry; HEP, mining.
  - accounts for stocks, diversions, losses, some return flows

- Volumetric metering & water charging progressively expanded – pumped diverters, groundwater (1990s) & unregulated rivers (NSW)

- River managers & bulk suppliers: eg State Water & Office for Water in NSW
Murray Darling Basin

- Murray Waters Agreement, 1915: shares to states
- Cap on licenses, 1986
- Cap on diversions at 1994 levels, 1995
  - Basin audits: continued increase in use
- Environmental water recovery:
  - “The Living Murray” & “Water for the Future”
  - purchase & transfer of approx 30% of irrigation allocation for environmental use – to 2019
Parallel Developments

- Bulk allocation process in Victoria, beginning 1980s – specify bulk entitlements for all suppliers and “institutional” users, rationalised against individual entitlements (licenses).

- WAMPs – Water Management Plans and Water Sharing Plans in surface and groundwater areas in NSW and Queensland

- “Connected Water” - dealing with double accounting of surface and groundwater (BRS, NWA, SKM report)

- Unbundling of licenses following activation of water trade in Victoria: license to apply, delivery share, entitlement (volume +)

- Sustainable yields (ref Climate Change & eco water) – MDB
Integrating accounts at National Level

- Australian Bureau of Statistics – composites of state accounts, ++ specific value of output of water uses.


- Victorian Water Register – the most sophisticated accounting tool at present: evolved to track all temporary and permanent trades (3 parts of unbundled license) plus all entitlements, deliveries, stocks and returns.
Experiments

- Carry over of unused entitlements in regulated systems (MDB) to next water year – now a common feature of all systems with varying carry over rules.

- Continuous accounting – surface and groundwater, from year to year (NSW): accounts zero when dams spill.

- Capacity sharing (stored water – surface and groundwater) – in Namoi and Gwyder Valleys, NSW (cotton areas)
Data and complexity – the real world

- Many countries have insufficient, or discontinuous, hydro-meterological data and flow monitoring data, so that effective water accounts can not be developed. Long run data is needed to understand variability at spatial and especially temporal scales.

- Ditto diversions, storages and especially groundwater stocks and flows.

- Some contend that even if such accounts were well prepared, complexity of outputs is too great for understanding and policy development?????????
Water Accounting+

independent estimates of water flows, fluxes, stocks, consumption and services
Progress

- Operational data platform established (www.wateraccounting.org)

- Partnership developed with UNESCO and FAO

- 15 sub-basins of the Nile processed, 6 years analyzed (2005 to 2010)

- Agricultural performance quantified (incl. crop type, acreage, yield, water productivity, rainfed water use, irrigation water use)

- Hydrological ecosystem services quantified and undergoing further refinement (incl. runoff production, atmospheric recycling, biomass production)
Atmospheric moisture recycling is significant.
Prediction of sub-basin discharges in the River Nile, using RS data, 2005-2010 (WA+) vs. Long term average flow: reasons for optimism?
Remote sensing estimates of rainfall and evaporation can help identify groundwater depletion (and recharge?) especially where there is no surface water input

- Comparing ET and P
- Comparing ET on irrigated plot with non irrigated plot
- Errors in groundwater use estimates compound of errors in RS assessment of rainfall and Et.
- Difference corrected with irrigation efficiency – gives actual discharge
- Recharge, generally requires additional ground based data and improves with the ability to model groundwater.
Nature of groundwater source and recharge – limits to accounting

- Shallow or deep aquifer
  - Shallow aquifer intensive interaction with surface water: conjunctive management, drainage/ retention, link to soil moisture
  - Deep aquifer is a strategic asset

- Annual or long-range cycle
  - Annual cycle (small basins, moderate rainfall) – overextraction can be corrected annually (ie shallow groundwater in Bangladesh)
  - Long range cycle – overextraction can be cause irreversible change

- Quality of groundwater
  - Limits scope for reuse
  - Health hazards related with overextraction
Limitations to RS/GIS based approaches

- Currently not feasible in high cloud cover (temperate and humid tropic regions)

- Need calibration to limit error propagation (small errors in two large components $P$ and $E_t$, relative to small residuals of stream flow (often 10% of RF in semi-arid basins) and groundwater recharge (a small fraction of streamflow, but a significant fraction of flood flows).

- In large basins, $E_t$ from irrigation is typically around 3% of gross $E_t$ across the basin (MDB and Nile): accounting for depletion differences with changing irrigation efficiency therefore needs to be tracked in the surface and ground water account.

- Cost and expertise.... likely to change.
Where to next?

- Plenty of options for discussion arising from these points.