

Smart Markets for Water: Answer to Australia's Water Crisis?

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Q: Why is water thinly traded?
A: Transaction costs!

Q: Why do water markets have large transaction costs?
A: Water is a publicly shared resource,
so each user affects other people and the environment.
Therefore, society must vet the transactions.

Solution: Just automate vetting of the transactions!



What are the transaction costs for water markets?

- searching for trading partners,
- uncertainty and measurement,
- price discovery,
- bargaining and writing contracts,
- enforcing contracts.

Markets for oil, milk, and books
have similar transaction costs,
but have active markets.

What is different about water?
"Politics"?
Interest groups?
Variability of supply?
Cost of infrastructure?

CANEGROWERS

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Your path: The Industry > Classifieds > Water Trading Register

Water Trading Register
Bundaberg

Buy
Buy: temporary transfer, 2007/2008 financial year, phone DR 399.

Buy: Zone AA, Up to 150ML Permanent Trade. Phone DR Tow

Sell
Sell: Zone AD. 30ML Tempo Trade (until June 2008). \$200/ML

Sell: Zone AD, 100ML Temp Trade (2007/08 water year), \$500

www.canegrowers.com.au/information-centre/classifieds/water-trading-register.aspx

Most goods & services are traded one-to-one.

No one else is affected by this exchange.

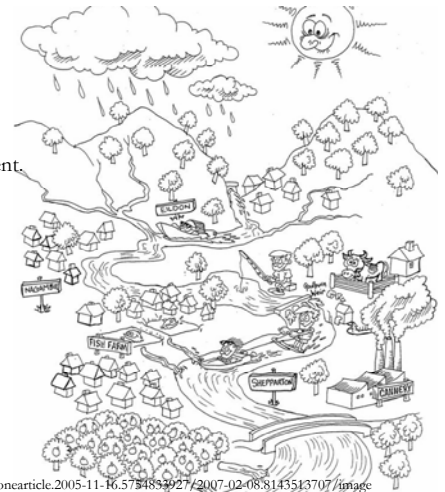


fotsevis.typepad.com/photos/ndia_rajasthan_photo/barber.html

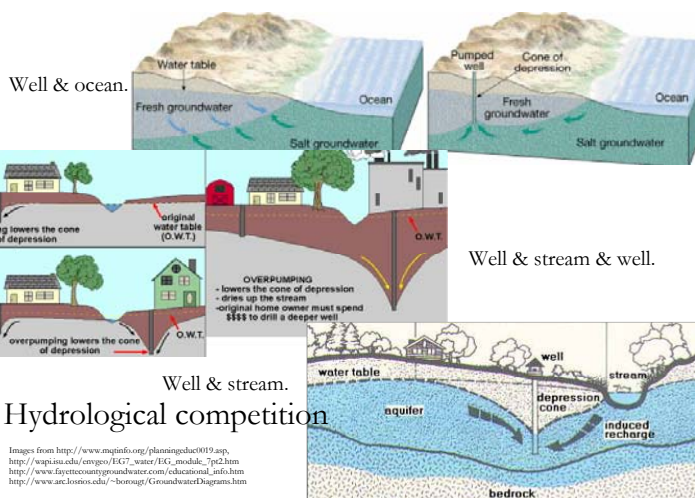
Water is different.

Everything affects
everything else,
especially within a catchment.

Water is a public resource,
even if rights are private.



www.catchmentcapers.org.au/catchment/plonearticle.2005-11-16.573483927/2007-02-08.8143513707/image



Images from <http://www.mqinfo.org/planningeduc009.asp>,
http://wpi.msu.edu/emges/EG7_water/EG_module_7p2.htm
http://www.flycatchergroundwater.com/educational_info.htm
<http://www.arc.louisiana.edu/~boonage/GroundwaterDiagrams.htm>

Society manages the commons via government.

Thus, a transaction cost
to change rights
to the commons.

Water Act 1989
No. 80 of 1989

Part 3—Assessment of and Accounting for Water

(3) Water may be allocated by the Minister under—
(aa) an environmental entitlement; or
(a) a bulk entitlement granted to an Authority under Division 1 or 3 of Part 4; or
(ab) a water share; or
(b) a licence to take and use water issued under section 51; or

Queensland Government

Natural Resources and Water

Topics Services and resources About NRW Get involved

Home → About NRW → Legislation, standards & policy → NR&M Policy Register → WMU/2005/2208 → Procedure →

Irrigation water permit: overview

Should a licence holder want to take a volume of water additional to their annual entitlement for irrigation purposes, they would need to do so under the authority of a water permit. Sections

NZ water consents
cost ~NZ\$5,400,
and take 8 weeks.

www.nrw.qld.gov.au/about/policy/documents/2208/page_4_13.html, www.dms.dpc.vic.gov.au/Domino/Web_Notes/LDMS/PublAwToday.nsf/2184c6274798392ca256da50082bf3e/C20E6A18961F2E17CA2573090022D9E2/\$FILE/89-80a085.pdf

The transaction costs are large and universal.

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Everyone has transaction costs with water.

Users, government, and environmentalists. Result is contention.

Traders of surface water can be matched nearly one-to-one.

So water markets are active *only*

when water is controlled with reservoirs and canals.

Users want expensive solutions of steel, concrete & pumps.

They *still* have high transaction costs.



Ground water is uncontrolled.

Can't trade 1-to-1. Timing problems.

Even worse with runoff.

Point source pollution can be regulated,

but regulating non-point source pollution is hard.

education.melbournwater.com.au/
content/primary/thomson_reservoir.asp

Typical analysis for water: economic optimization.

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Use LP to simulate a market with shared complexity.

Data: v = estimate of water value, e.g. crop prices,

A, b = hydrology, e.g. reservoir & network of pipes,
and maybe required environmental flows.

Dec. variables: q = how much water to take.

Model: max vq , subject to $Aq \leq b$.

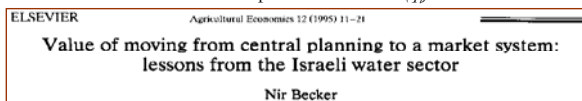
Dual values give market prices.

References:
Becker 1995
Newlin et al 2003
Draper et al 2003
Tisdell et al 2004
Yu et al 2005
Wang et al 2003
...

Solution? A "perfect market".

An interesting academic exercise.

We don't know users' profit functions $v(q)$.



How can we get users' profit functions?

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Ask them! Like



Allow users to bid for water,

declaring their value functions over the internet.

Eliminates transaction costs. Voluntary system.

www.oztion.com.au/
vshops/item.aspx?
itemid=3102926

More sophisticated than an ordinary on-line auction.

A **smart market** in each catchment.

Use LP to clear a market under constraints.

Requires a market manager to oversee the auction.

Only a little work on smart markets for water.

Surface water: Murphy et al (2000), Cummings et al 2004.

Ground water & general case: Raffensperger & Milke.

Difficult, you think?

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Smart markets are already in active operation for:

- electricity,
- natural gas,
- school catering contracts,
- radio frequency spectrum,
- MBA course enrolments,
- many others.



Electricity & natural gas are here in Australia.

High reliability requirements,
more stringent than needed for water.

Australian catchments already have good hydrology models.

Just add LP & a web page for bids!

Use existing institutions for trading.

Much cheaper than steel, concrete & pumps!

Enabling confluence of technologies:

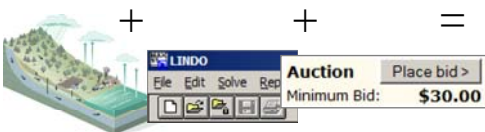
- hydrological simulation,
- computation power for simulation & LP,
- internet to transmit users' bids, prices & quantities,
- real time monitoring.

Smart markets for water

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A smart market allows benefits of a modern options exchange.

- Contract fulfilment backed by the exchange.
- Parties are anonymous.
- Market manager enforces regulation to ensure fairness & transparency.
- Markets are orderly, especially during stressful conditions.
- Key: low transaction costs!



Naked sun-orchid, www.rbg.vic.gov.au/rbg_cranbourne/highlights_of_the_bushland/wildflowers

Remaining issues & future work

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Initial allocations? Already well sussed via politics.

Stochasticity of rainfall? The correct market LP may need to be an SLP.

A deterministic model may be "good enough".

So much gain to be had by reducing transaction costs!

Future work: multi-commodity smart markets for water.

- surface & ground water,
- nitrate, phosphorus & salt,
- sediment & impervious cover – prevent flooding,
- hydrological effects of deforestation.



This is one of humanity's most important environmental issues.

Collaborators welcome!