Benefits of Water Institutional Reforms in Reducing Murray-Darling Drought Cost

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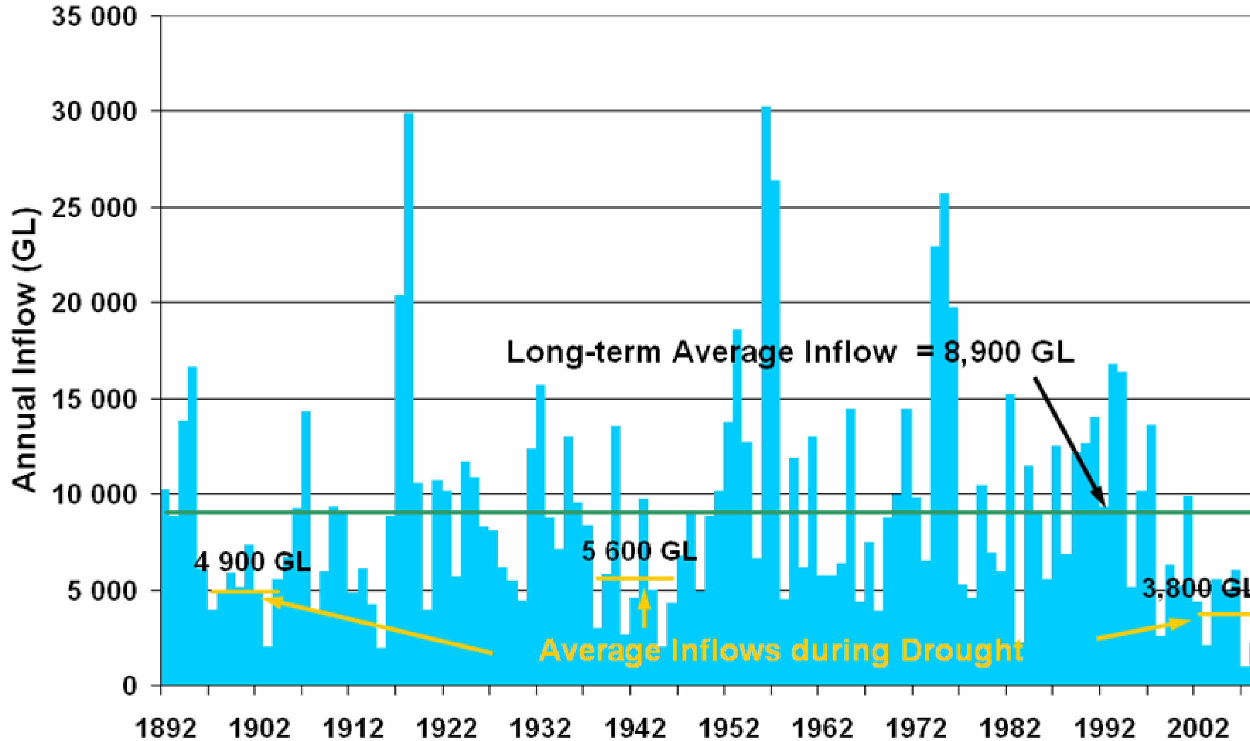
COUNTRY	RIVER	RATIO MAXIMUM over MINIMUM ANNUAL FLOW
BRAZIL	AMAZON	1.3
SWITZERLAND	RHINE	1.9
CHINA	YANGTZE	2.0
SUDAN	WHITE NILE	2.4
USA	POTOMAC	3.9
SOUTH AFRICA	ORANGE	16.9
AUSTRALIA	MURRAY	15.5
AUSTRALIA	HUNTER	54.3
AUSTRALIA	DARLING	4705.2

Australia faces highly variable water supply & severe drought



Murray-Darling Basin Inflows

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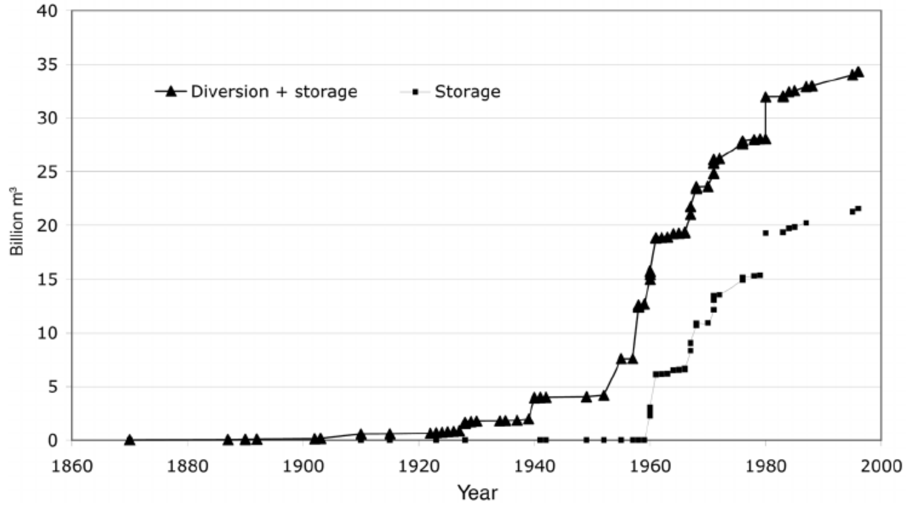
Historic infrastructure & institutional drought response

Federation Drought 1895-1902:

- **Cooperative States agreement to ensure navigable river**
- **major storages and weirs**

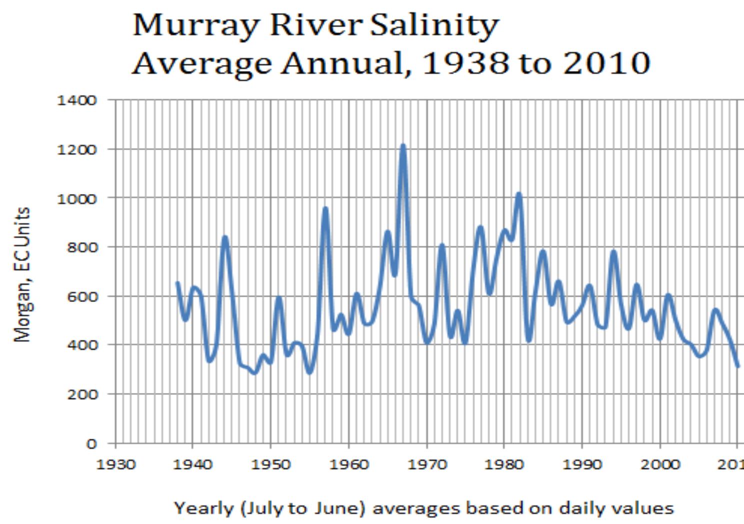
Mid-century Drought 1938-45:

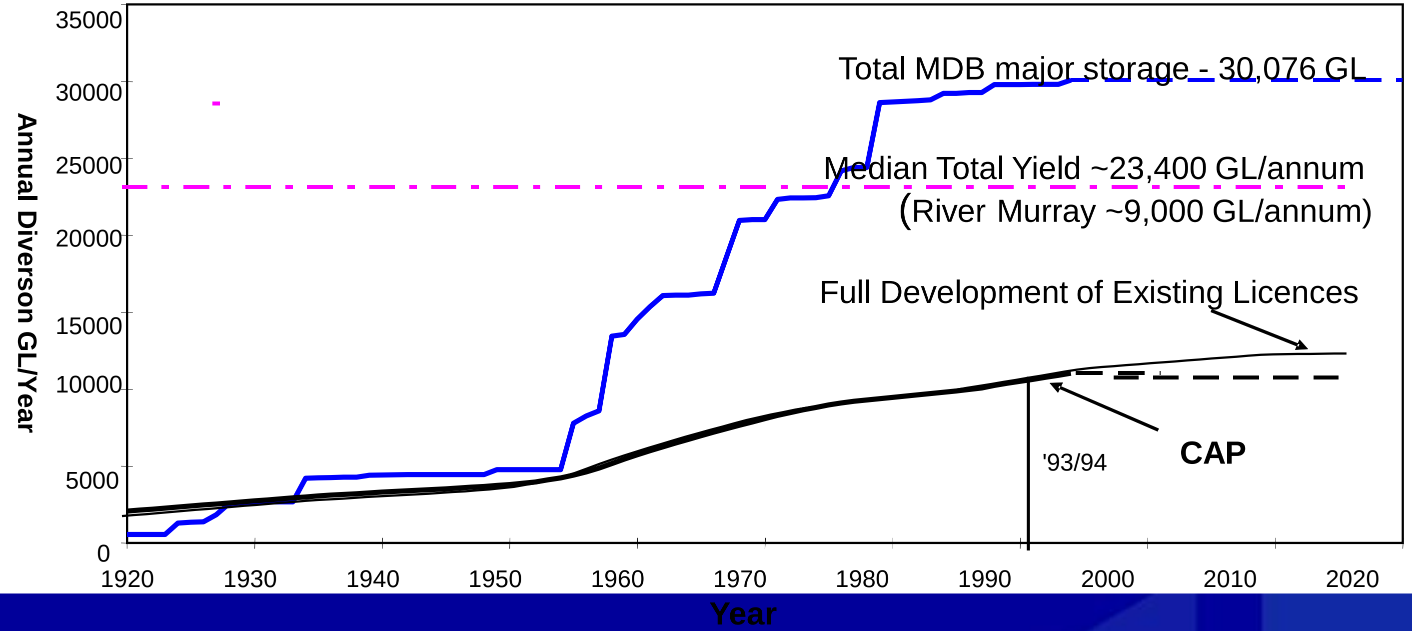
- **Inter-basin transfer/hydro-power**



1980's-90's water institution developments – response to growing allocation

- **salinity threatened end of system urban water supply**
- **Low flow Environmental threat to River Murray Delta**





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Key context: Keating era micro-economic reforms in many sectors (e.g. floating currency)

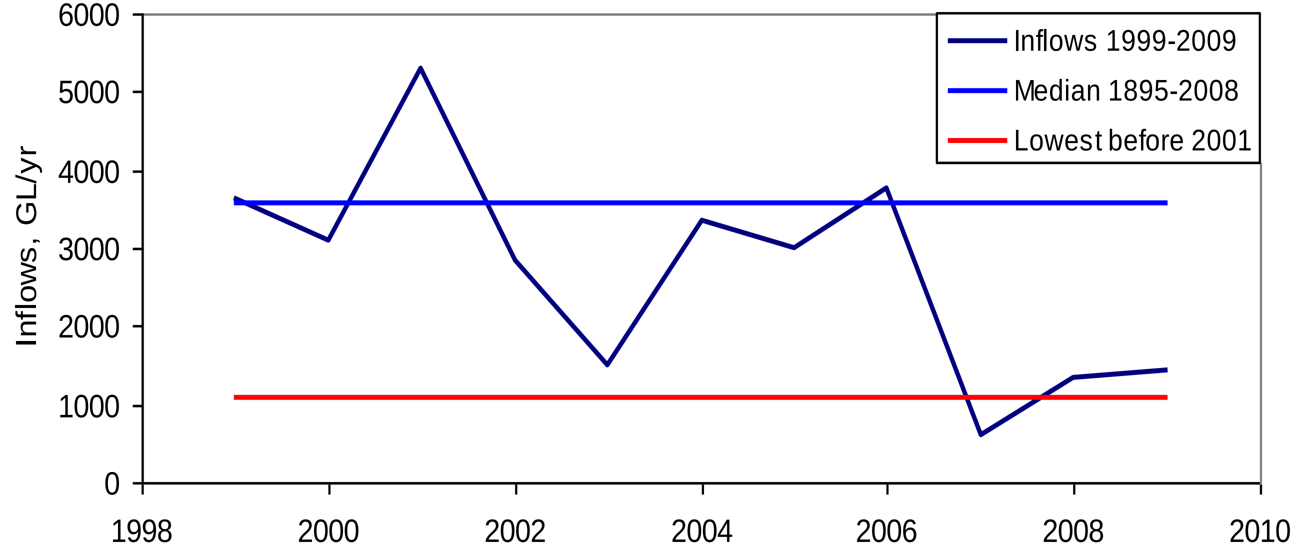
"National Water Initiative (NWI) 1994

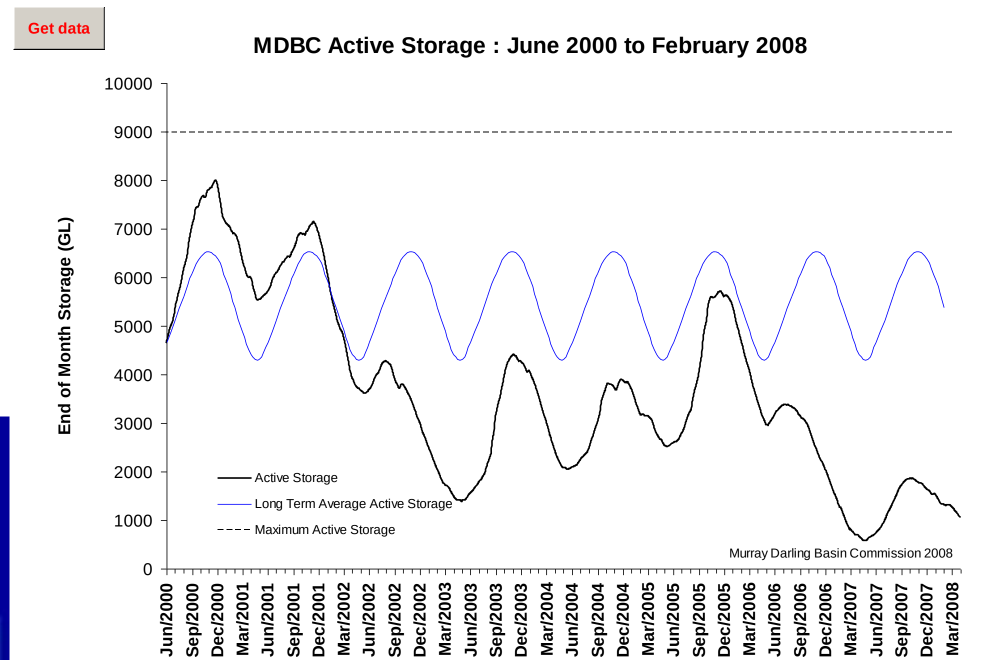
- **Capped diversions at 1993/4 levels**
- **Individual water property rights**
    - Volumetric & metered
    - Automatically adjusted "allocation" in scarce supply (shares of storage)
    - Tradable Independent of land
- **Deliver critical human water & required conveyance first (municipal, industrial + stock)**
- **Aspiration for cost reflective and full cost pricing in infrastructure investment**
- **Incentive payments for State to comply**

(Connor and Kaczan, 2013)

NWI proactive water planning reduced cost in the "Millennium Drought"

Worst drought in recorded history led to empty storages and emergency planning In 2007





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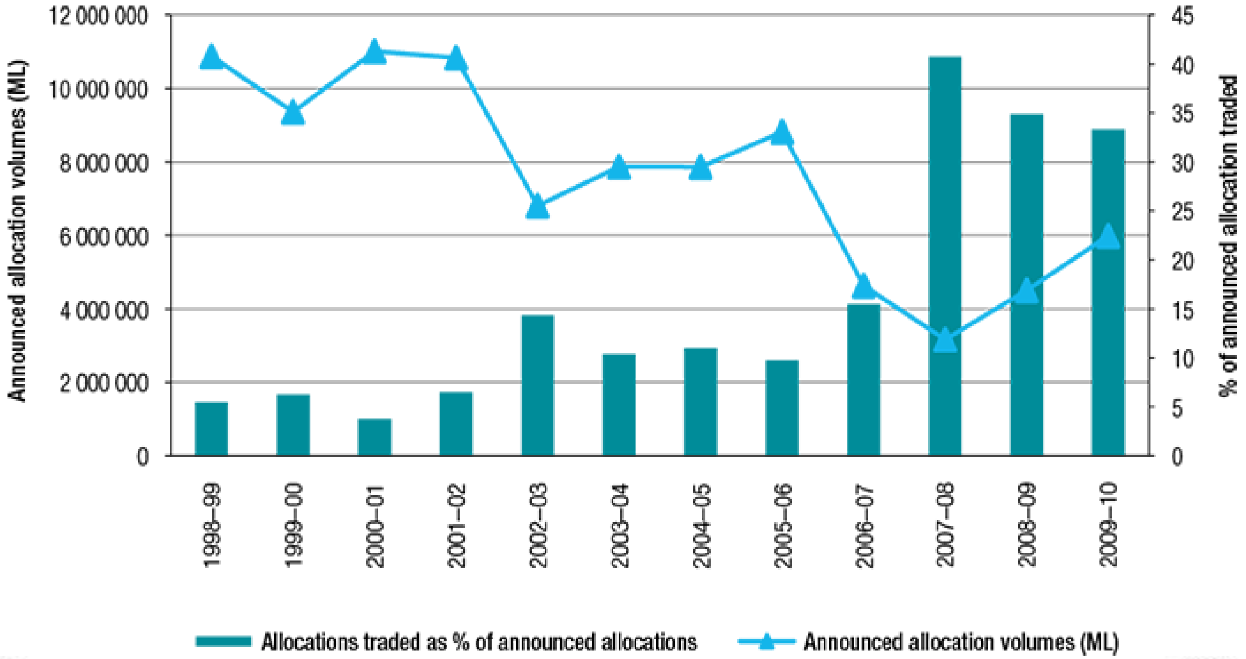
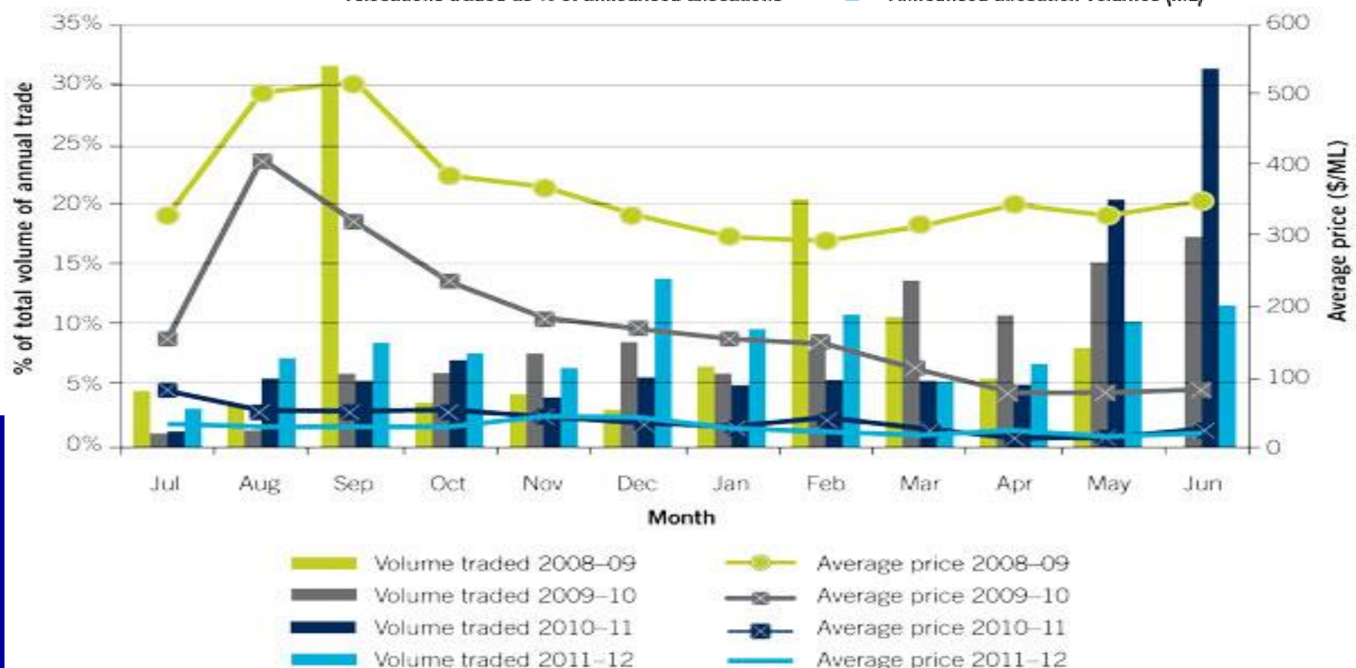
water trade provided irrigators an adaptation mechanism

1/3 of all irrigation traded at height of drought 2008/9



improved farm income in drought by $0.5-1 billion (10-20%)



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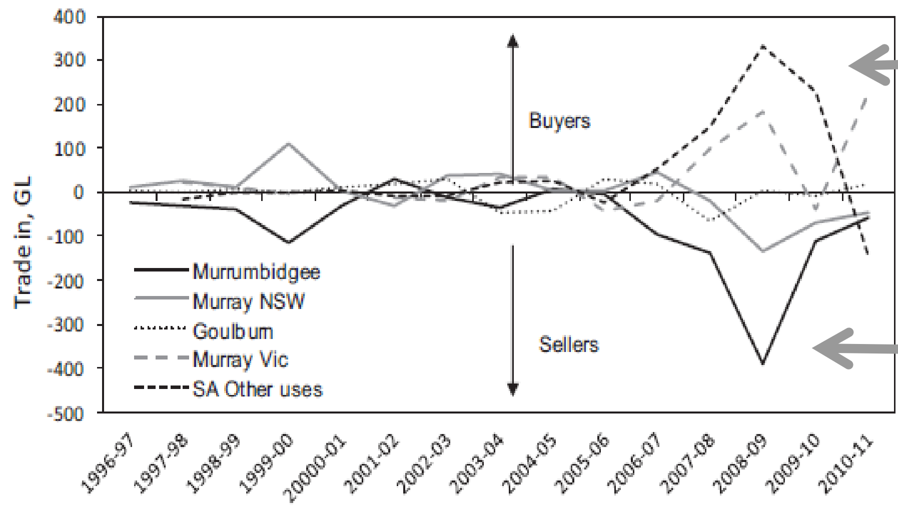
Water traded from low value annual to high value perennial irrigation

- allowed sustaining high value perennials

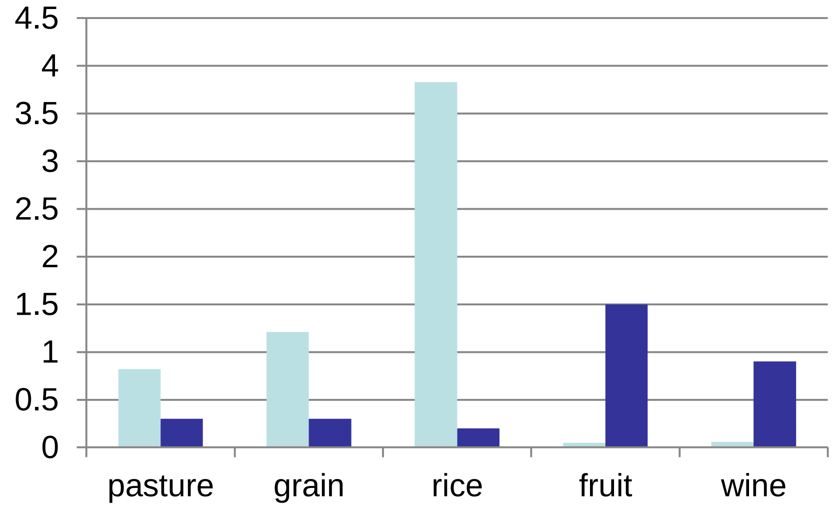
- provided higher income to annual crop farmers than irrigation would have



To Fruit & wine

From rice, pasture, grain

(Connor and Kaczan, 2013)

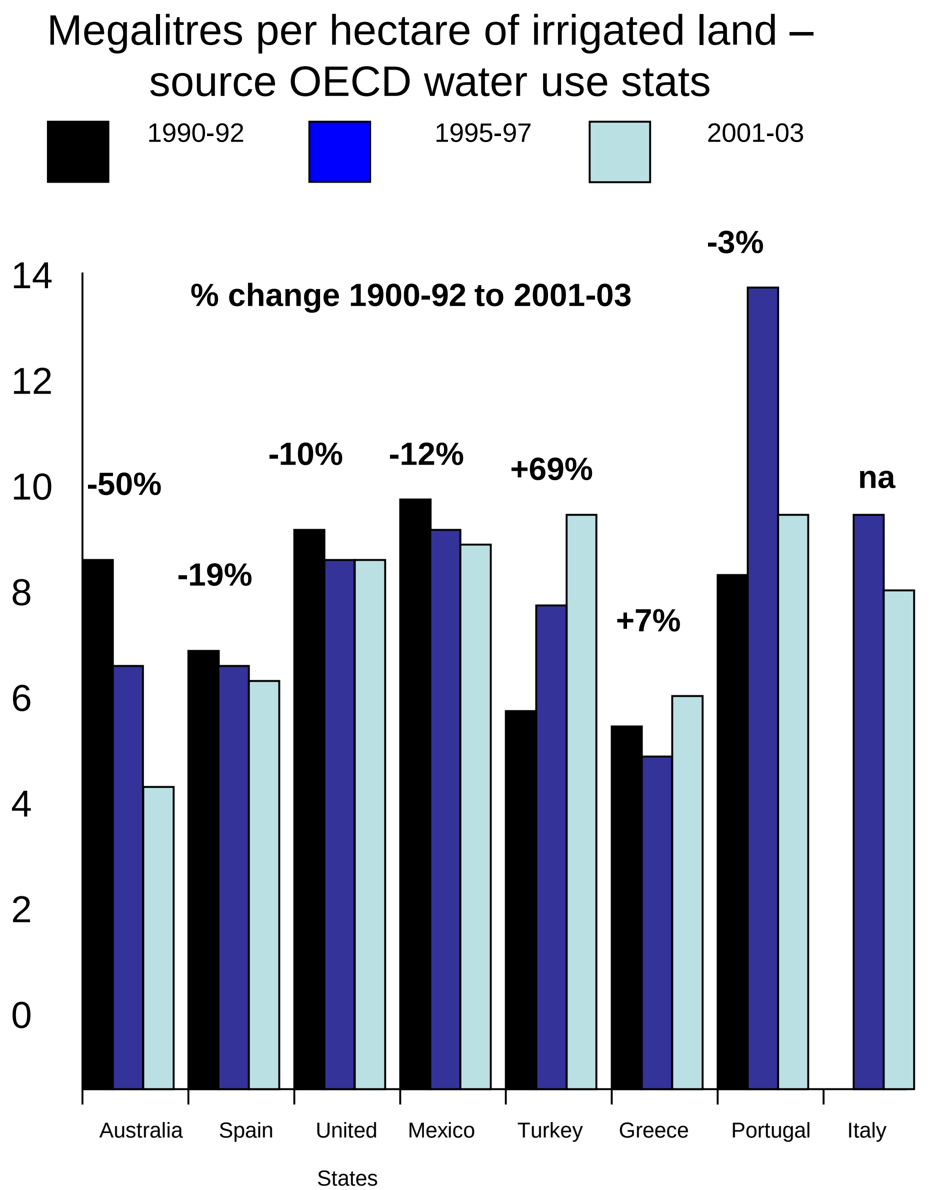


Δ%irrigated area/Δ%irrigation water supply

$1000/m3

(Connor et al, 2014)

Co-benefit: introduction of tradable water rights drove irrigation efficiency improvement



Lessons from Australian water trade

Great benefit in drought
–Flexible dynamic reallocation from low to high value
-Equity advantage over water pricing – loser's are compensated

Challenges:
-Establishing necessary preconditions
-losses of return flow, activation of unused water =instream flow changes
-Speculation, exploitation
-Facilitating learning

Conditions enabling water trade

Water property right:

-metered, volumetric, independent of land

-defined as share of available water

-Penalties for over-withdraw (enforcement);

-Banking style use and trade registry system;

-Ebay style (instantaneous, low cost) trading platform;

-Quick transfer, pre-approved conditions on trade

Other cost reducing institutional reforms

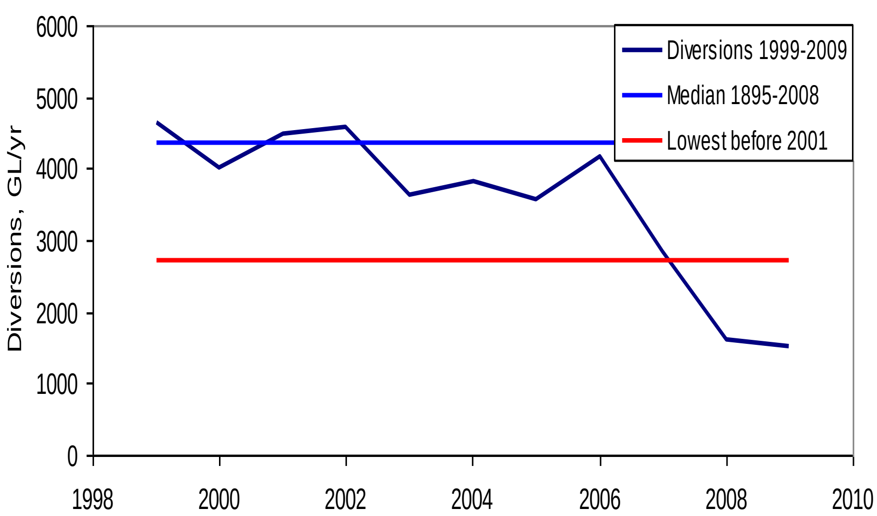
1. Individual (as opposed to system level) carry-over (2006)

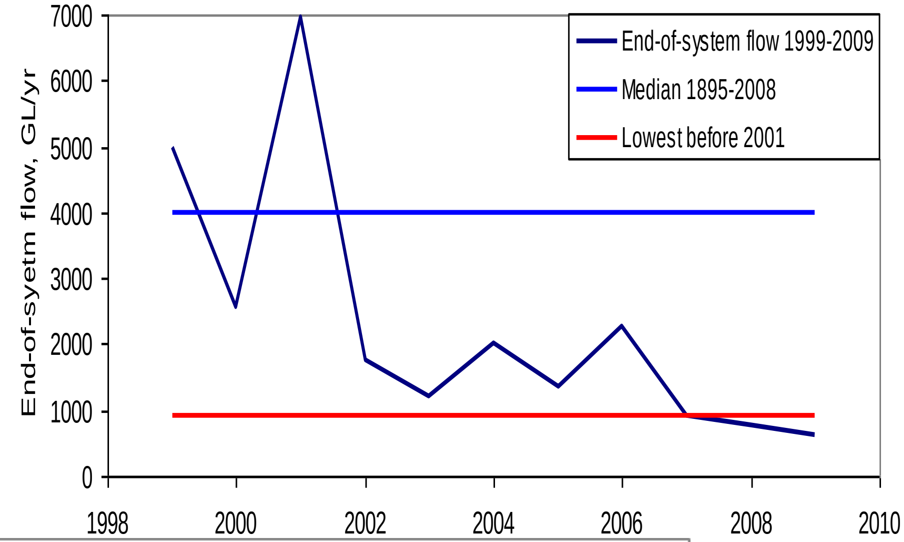
- 400 GL of 1600GL total allocation carried over in 2009
- Estimated value ≈ 10% irrigation return increase

2. MDB salinity credit trading (2001):

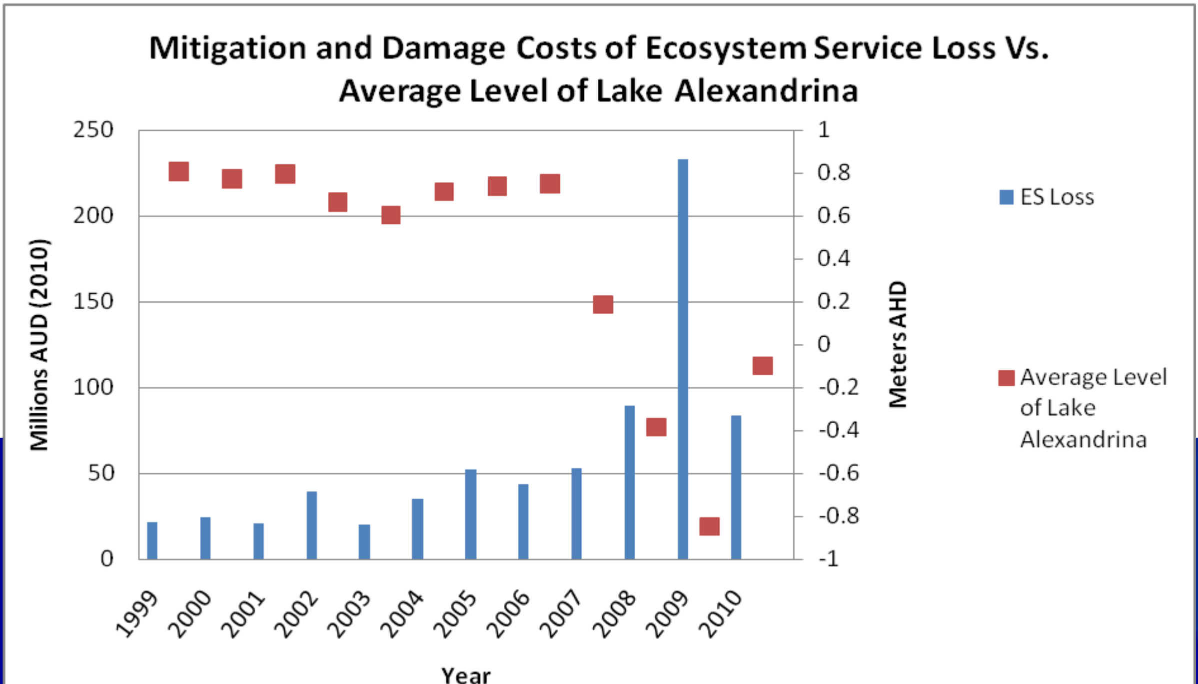
- “capped” salinity contributions by each state;
- salt “debit” accounting system
- Offset “debits” with agreed “credit” actions
- Efficient results
  - states built “salt interception” in other states where cost effective
  - lower cost non-infrastructure measure:
    - “salinity impact” zone irrigation charges encouraged irrigation at low salinity impact locations

Unresolved issues - Environment (residual water claimant) suffered with high ecosystem service cost





Kirby et al. (2014)



Adapted from Banerjee et al, 2013

Unresolved issues – contingencies for even worse drought not yet premeditated

- **2006-7 was worse than “worst case” planning scenario – previously thought to be conservative:**
    - Near zero irrigation water
    - Dilution flow to maintain end of system salinity target unmet
    - Wetlands cut-off and dried out to reduce evaporation, maintain minimum municipal industrial supply conveyance
    - Very close to not meeting critical human water needs
- **Worse drought is very possible with climate change**
    - a number of measure have been taken (new desal plants, some environmental water reallocation)
    - But not yet formal risk assessment based contingency planning

Unresolved issues – inefficient high cost infrastructure investments

Irrigation – Massive public infrastructure investments to save water (≈$200k to every MDB irrigated farm):

- **Mostly in "legacy" projects with inefficiencies**
- **Crowds out private transformation (with efficiencies from: flexible delivery timing, scale economies)**
- **locks water into areas of low return, prevents new entry efficient resource use**
- **for rural income support objectives other (employment diversificiaton) investments are superior**

Urban water supply – Massive public infrastructure investments for drought proof water supply across Australian major cities during drought

- **Mostly desalinisation –**
- **Little risk based economic evaluation with additional options & contingencies to identifying lower cost, higher reliability, and**
- **Little consideration of ecosystem impacts in urban water options analysis** (Kandulu et al., 2014)

Unresolved issue – future "legacy" and ES cost of adaptations mostly poorly understood & accounted for

Little studied costs

- **Future vulnerability costs of drought groundwater substitution** (Hornbeck and keskin, 2014)
- **Lost future productivity, ecosystem services from:**
    - short term water salinity (Connor et al., 2012)
    - long term soil salisation, acidification drought impacts

Little studied adaptations:

- **Carbon, water, energy nexus & trade-offs in future**
- **And strategic policy with climate change growing food and water demand** (Connor et al, 2016)

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