David Adamson

Lessons from Implementing the Murray-Darling Basin Plan

Firstly

- Thanks to my funding agencies
  - **ARC DECRA (DE160100213)** "Optimising the National Benefits from Restoring Environmental Flows"
  - **EU Centre for Global Affairs Annual Grant Program**, University of Adelaide, "Building lasting collaborative arrangements on water scarcity management between Australia and the EU
  - **The Centre for Global Food and Resources,** The University of Adelaide

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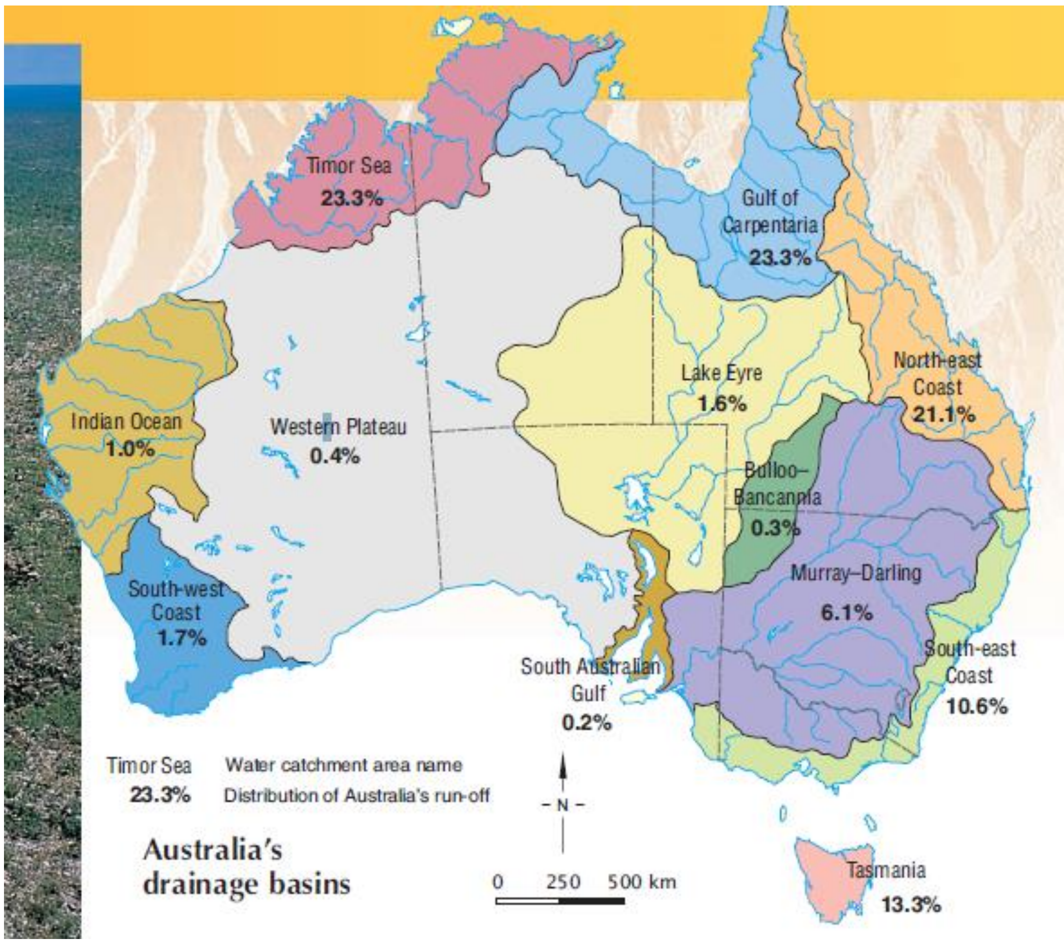
Outline

- Australia's Murray-Darling Basin
  - Uncertainty, non-convexity and irreversibility
- The Basin Plan (2,750 to 3,200 GL)
  - Common property
  - Restore the Balance (Buyback)
  - Sustainable Rural Water Use Investment Program (SRWUIP)
  - Role of trade
- Implementation
  - Capped Buyback @ 1,500GL
  - Difference between individual and the whole
  - Good policy design
- Environmental efficiency
- Concluding comments

Murray-Darling Basin (MDB)



- Australia's 3rd largest river basin
- It looks like a kidney and has the same function
- 1 million km²
- 440,000 Km² of river networks
- 2nd most variable inflows in the world

MDB

Wetlands
- 30,000
- 16 Ramsar sites
- 25,000 Km^2 (2.5%)

- Highly modified systems
- Over allocation water resources
  - Point and nonpoint pollution

Economic
- 80% = Agriculture
- 40-50% GVAP
- 1/3 value irrigation
- Irrigation only 2% area
- 50% of irrigators
- 50% all water used in irrigation

Population
- 10% inside
- 5% Adelaide

Real problem

- MBD has long droughts, interrupted by floods and a couple of nice years after that. Please don't assume a normal distribution.

- Out mantra should be **"Drought is coming"**

- Despite spending billions in infrastructure we can't make it rain!

- Drought events lead to a continuous cycle of
  - Policy reform & Funding
  - Millennium Drought & MDB Plan
    - Black Swan event that changed everything known about supply and reliability

Decision making & uncertainty

- Just & Pope (1978) outlined the stochastic production function approach
  - Helps to explain the variation seen in nature
- Just & Pope (1979) argued that stochastic production function is
  - Very restrictive formulation as changes in inputs directly relate to variance in output; and
  - Consequently provides little help in understanding policies designed to reduce the risk to output
- Stochastic production functions dominates the literature of risk and uncertainty when allocating resources.

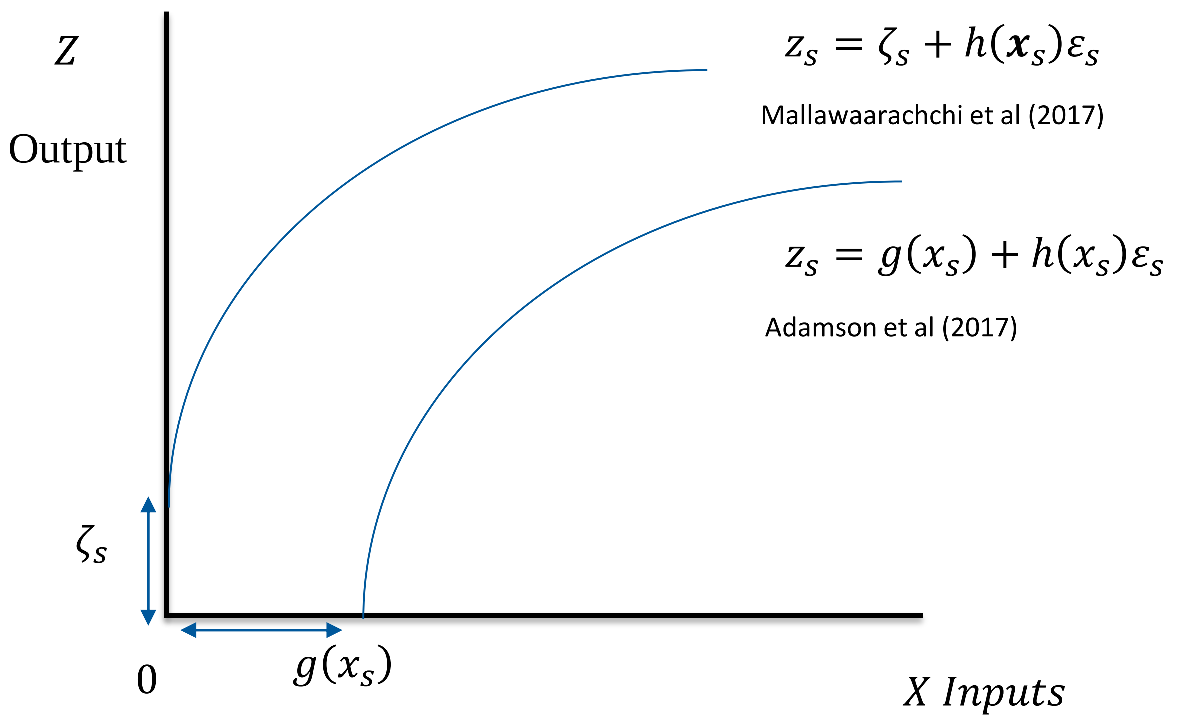
State-contingent analysis (SCA)

- Foundations are derived from Arrow (1953) and Debru (1959) work on state-space:
  - Nature = provides a complete description of the state-space of uncertainty ($S \epsilon \mathbf{\Omega}$)
  - possible states (s) are exhaustive, mutually exclusive, and real

- Chambers & Quiggin (2000) expanded on this
  - Dual optimisation
  - Decision maker has no ability to control what state occurs
  - Each *s* has unique management response, yields, prices, inputs and outputs
    - Grapes & dairy
  - Provides a mechanism for dealing with discontinuous functions (non-convexity)
  - Once a state is revelled all uncertainty disappears allowing for traditional approaches to deal with risk to be used

- Separates the uncertainty signal from the management action
  - Model a pro-active and adaptive decision maker

Understanding water use



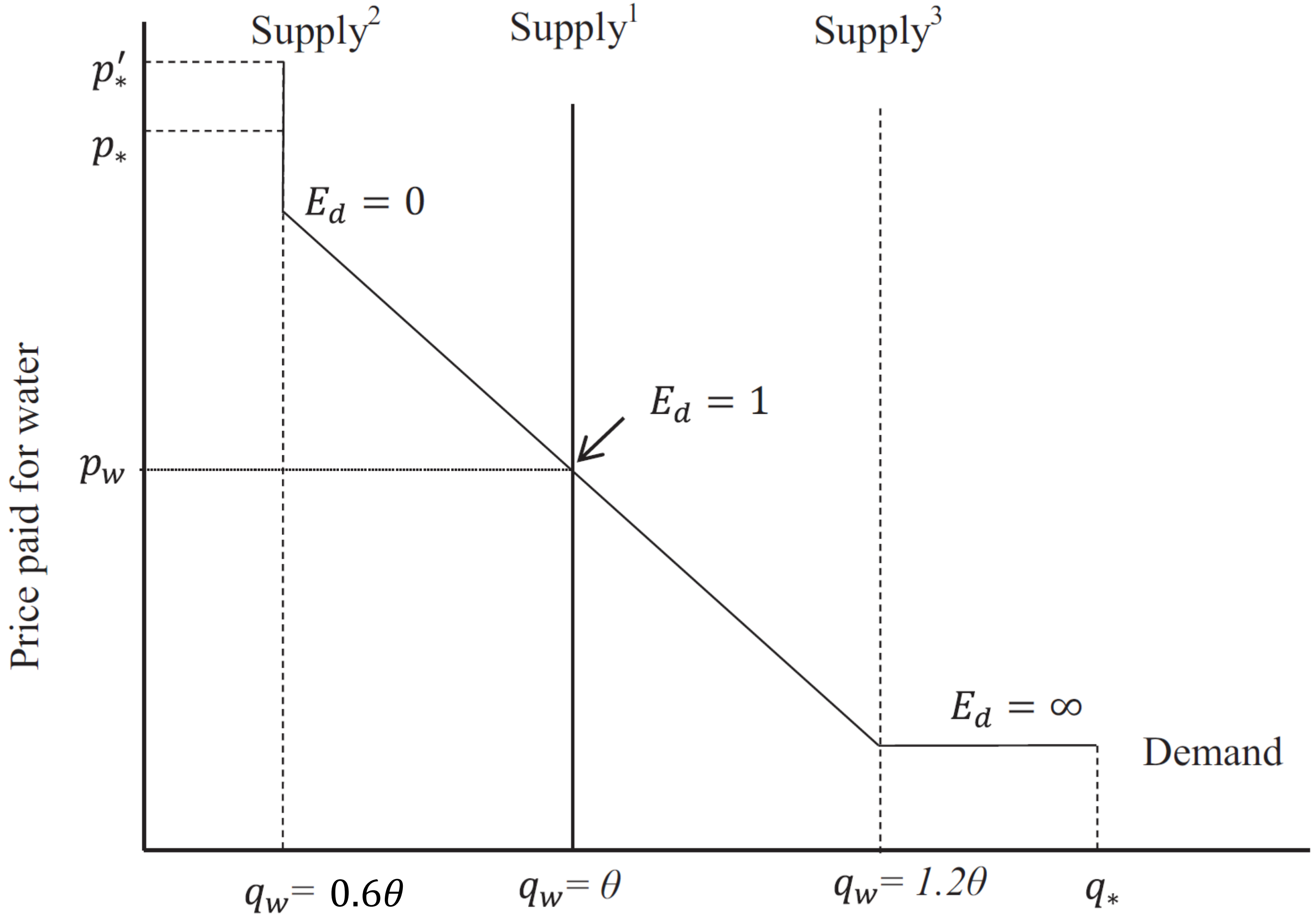
Stochastic versions of the SCA approach

Difference of water requirements by annuals and perennials

Can model the environment in the same way!

Adamson, D. (forthcoming) 'Irrigating the environment'

Understanding the value of water



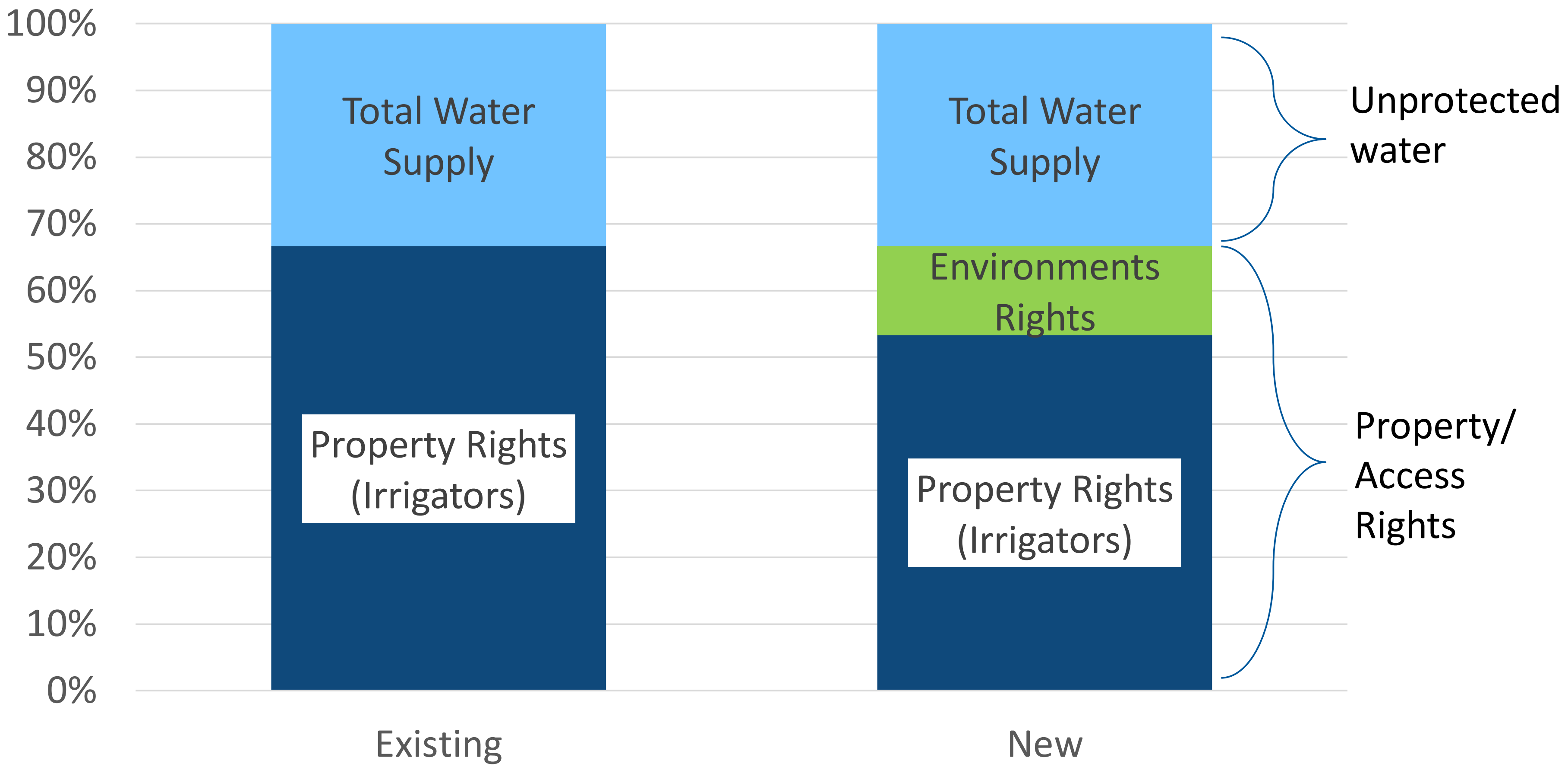
Murray-Darling Basin Plan overview

- MDB Plan (Plan)
  - Talk is limited to the surface water story only
  - National, not state focus

- Acknowledgement that supply augmentation and engineering based solutions to deal with the negative externalities are no longer justified
  - 1980's this transition started
  - 1994 CAP (forgot about the environment) but cemented rights

- Plan wants to transition 2,750- 3,200 GL of private water rights to the environmental manager (public trustee)
  - Adoption of the common property concept

Basin Plan designed to readdressed the initial ownership problem



Right structures

- MDB water rights have been developed to deal with highly variable water inflows
- High, general, supplementary
- Decoupled, allows for trade
- Each catchment in the MDB has a different bundle of rights
- These rights then have spatial and temporal reliability characteristics

Plan design overview

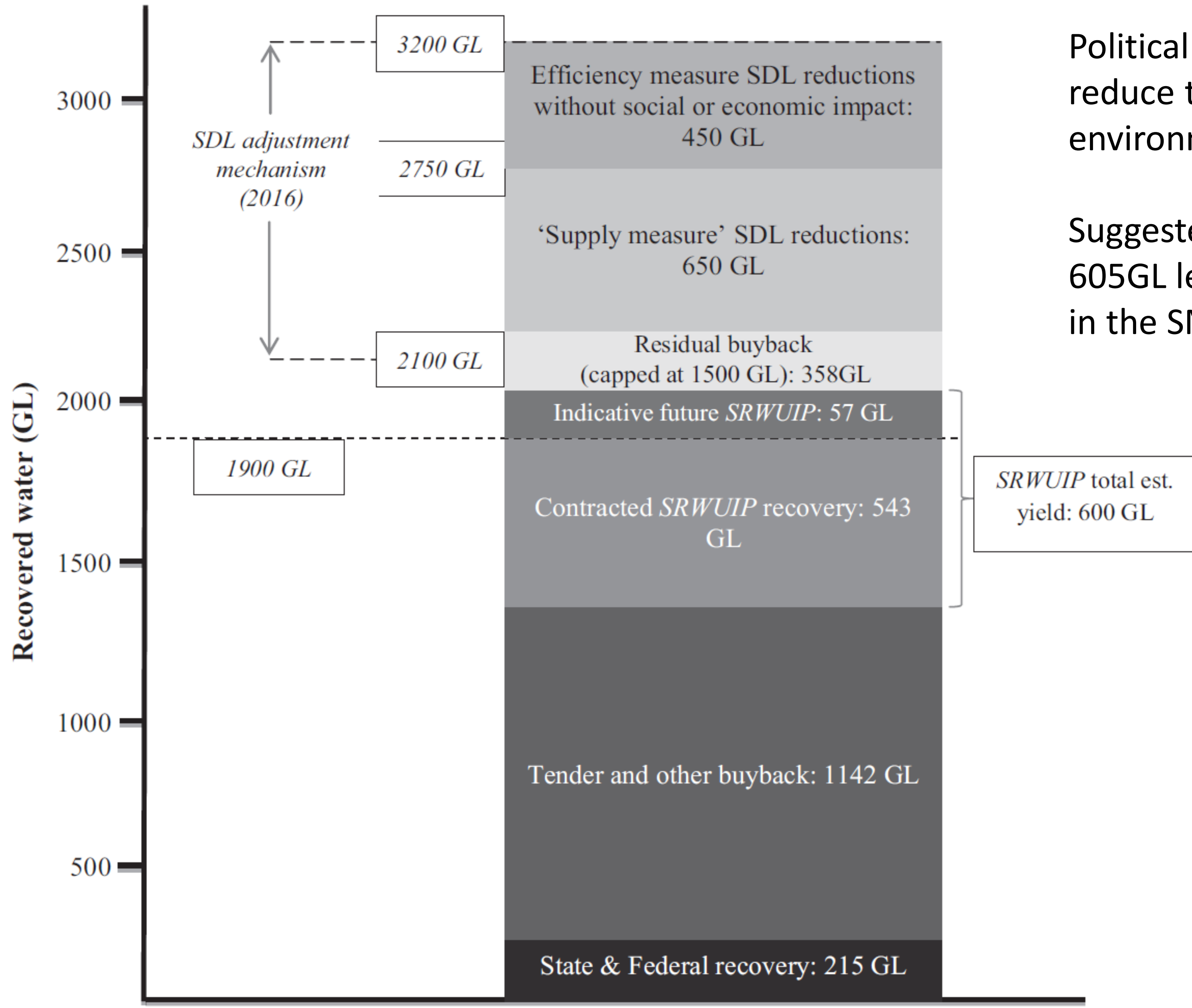
- Transferring water rights to the Environmental Manager
  - $3.1 billion: Restore the Balance (buyback of rights)
  - $7.8 billion: Sustainable Rural Water Use Investment Program (SRWUIP = investing in water use efficiency) (WUE)

- Environment Manager ends up with a set of rights that have spatial and reliability characteristics as irrigators
  - 3 sets of rights & in decreasing reliability
    - High, General, Supplementary

- Impediments to trade were removed

Implementation of the Plan

- Buyback capped at 1,500GL
- Rest must come from WUE (1,150 to 1,700GL)
  - Subsidised capital to upgrade
- Note, farmers can chose to participate or not too
  - No one is forced to participate
- Roughly where are we up to in this process



Political pressure to reduce the environments share.

Suggested that 605GL less in needed in the SMDB

Buyback

- Set up as a tender system where, the Environmental Manager would:
  - Advertise where in the MDB they wanted to purchase rights
  - Define their budget (non-exhaustive)
  - Farmers would submit non-binding bids defining
    - The rights for sale and the price of those rights
  - CEWH try to maximise the volume of water they could purchase
    - Volume = rights * reliability of right

Positive lessons

- Revealed the true social price of water
  - Social P ≥ Private P
- Know exactly what the environment is getting
- Encouraged private trade (allocation + entitlement)
- A lot of farmers loved it
  - Monetarised savings from water use efficiency
  - Helped some retire
  - Paid off debt and/or transferred resources new activities
- As more rights transferred to the environment, price of remaining consumptive rights increased
- $3.1 billion I can optimise purchases (current & future climates)

Negative lessons

- Scared the …. out of some in the wider community
- Farmers were too willing to sell
  - We need to stop that…
  - MOU on buyback
  - Senate reviews
  - Capped it

SRWUIP = Water-Use Efficiency (WUE)

- $7.8 billion to upgrade to
  - Farmers to adopt WUE technology,
  - Operator systems to upgrade delivery systems; and
  - Capital infrastructure to irrigate the environment efficiently

- 50-50 share of water savings

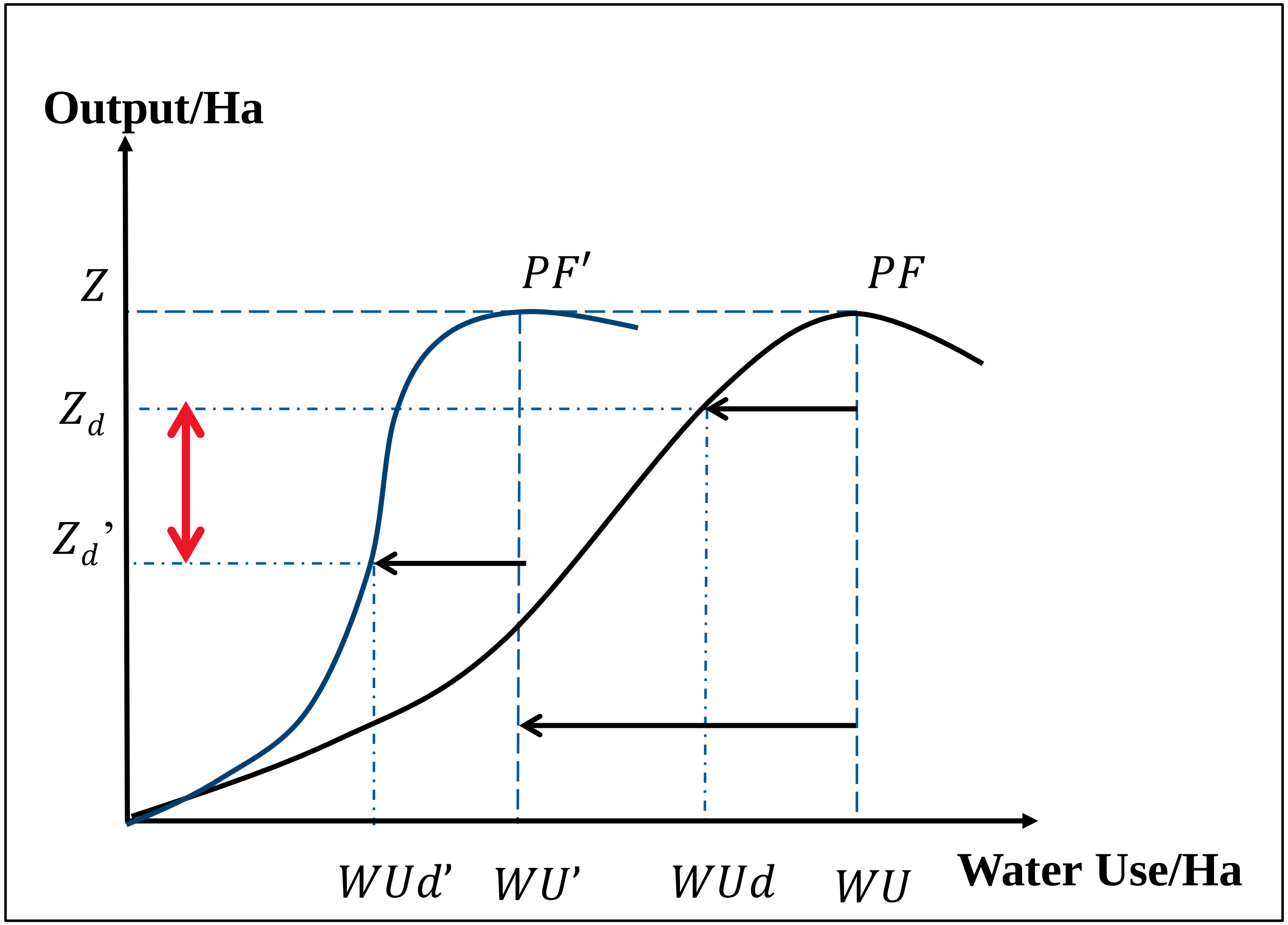
- There is a lot of love for this program but its an engineering solution! Not a market based one! So ignores what we have already learnt about engineering solutions and negative externalities.

A few WUE issues

- No base line on what the losses were, so its really hard to understand the benefits

- Fails to understand
  - Inefficiency can be good for resilience
  - Value of return flows
    - Cannibalise buyback
  - The area you need to upgrade
  - Other Comments

WSE: Issue A = Technical efficiency encourages inflexibility

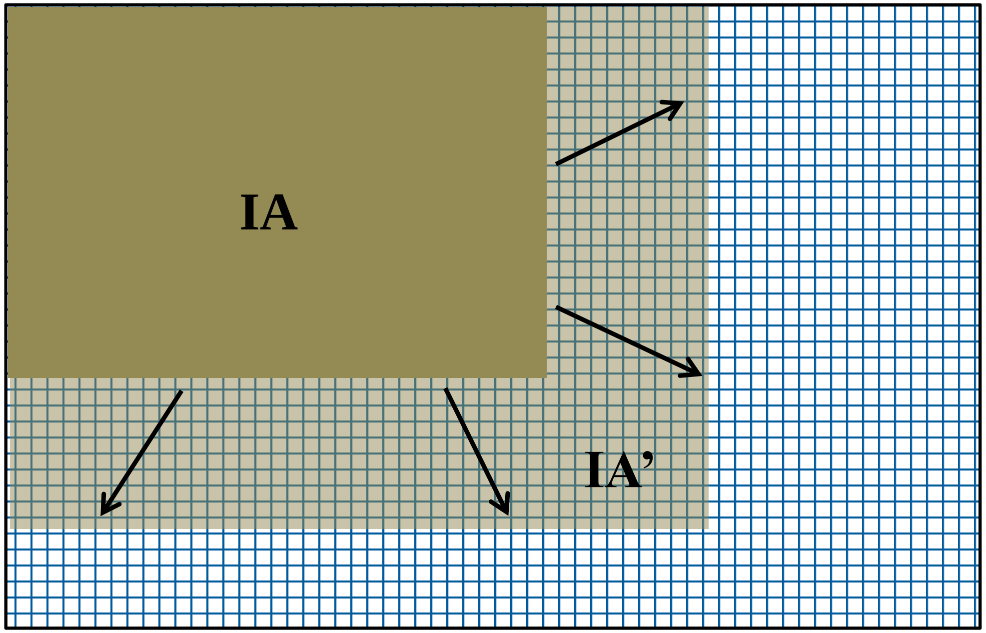


- Investment
  $PF \rightarrow PF'$
- Water saved
  $WU \rightarrow WU'$
- Drought
  - Old =
    $WU \rightarrow WU_d$, $Z \rightarrow Z_d$
  - New =
    $WU' \rightarrow WU'_d$,
    $Z \rightarrow Z'_d$

Loss=
$Z - Z'_d > Z - Z_d$

WSE: Issue B = Area irrigated increases

- Increase area irrigated



Jevons paradox (1865) or the rebound effect

WSE: Issue C = Reduced return flows

- As use water more efficiently there is less water returning to the river and environmental sites near irrigation districts
  - (Heard 2009)

B + C = problem

- So we have a problem.

- The more efficient Ag becomes, reflow declines. But society is subsidising the private gain but only taking 50% of the water from the efficiency gain.

- Therefore the net flow gain is .....

Lets do some basic arithmetic

- I need 3,200 GL of water for the environment

- Old technology used 10 ML/Ha, after subsiding we get a saving of 2ML/Ha from the new technology
  - Farmer gets 50% (1 ML),
  - Environment gets 50% (1 ML).

- If reflow was not a problem, then convert 3.2 Million Ha to get 3,200 GL
  - In the last decade, the maximum areas under irrigation was 1.8 million Ha, in 2010-11 there was only 1.2 Million Ha.
  - So we have basically upgraded all delivery infrastructure

Lets do some basic arithmetic (b)

- If reflow was 30% and now = 10%
- Old system (10ML/HA) 3ML/Ha of reflow
- New system (8ML/Ha). Assume all water reinvested (i.e. 1 ML used to produce another 1/8 Ha = total water use is 9ML over 1+1/8 Ha)
- Now the environment gets = Reflow 0.9 ML + 1ML from subsidy = 1.9 ML/Ha
- Since when as 1.9 > 3???? Therefore buyback is cannibalised
- This is the reason why I can not make the WUE solve for the entire Basin Plan and/or climate shocks
  - Partly overcome this now by breaking a huge number of logical assumptions and
  - Environment only benefits in some not all states of nature

WUE other comments

- Individuals benefit (micro), society worse off (macro)

- Rewards existing right owners, decreasing efficiency
  - General problem, when fail understand capital

  - Lock resources into an area prevents new people or areas emerging

  - Maximise B of program, reward the worst farmers

  - Cheaper to transition to perennials, so less annuals
    - **Drought is coming!**

Economic outcomes from both approaches

- Both Buyback & WUE reduce the Q of water available and therefore all water right owners benefit
  - Scarcity rent

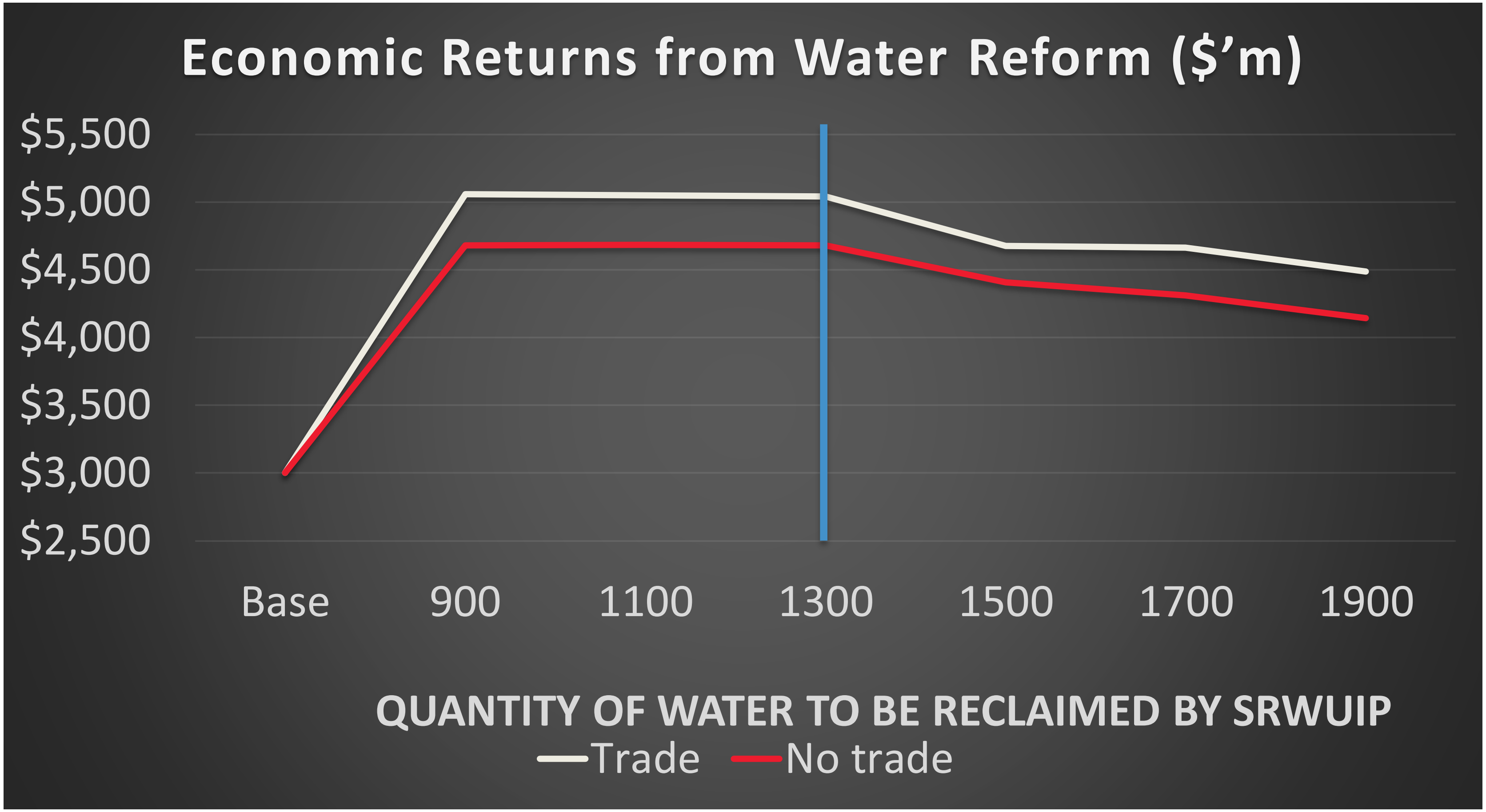
- As the price of a right increases:

  - Irrigator allocates its use to higher uses
    - Efficiency gain

  - Trade allows new farmers to enter the market and purchase rights to utilise resources (increased gains)
    - But prior unutilised water is now used creating environmental harm

  - But when we subsidise the cost of capital
    - Huge wealth transfers to existing irrigators
    - Preventing new farmers
    - Prevent the market from working

Modelling SRWUIP with Buyback



Adamson, D., Loch, A., Accepted. Achieving environmental flows where buyback is constrained. The Australian Journal of Agricultural & Resource Economics.

Good policy design, or dumb luck

- If you think of the MDB as a stalled economy, any water is good water to get it moving again
  - Unlikely to get what we thought we were getting
  - But its more than the environment had before!

- Second policy people were smart enough to predict some of these issues, and the Environmental Manager is allowed to buy and sell the environments rights as they learn to manage the system

- Costs a lot more money but... may end up with a better outcome

Efficiency & the environmental manger

- Environmental Manager, must be efficient
  - Can treat them like an irrigator in a model
  - Define environmental objectives by state into
    - Permanent & Ephemeral wetlands = Perennials and annuals
    - Flow and salinity targets (this is the exception to the irrigator)
    - Hard v flexible targets
  - Know right portfolio
    - What rights, where they are, and their reliability
  - Trade is double edged!
    - Encourages efficiency but can increase negative externalities
  - Find WUE savings were possible

See the environmental regulator does work in Chowilla.

It keeps the water out of the environment. Too bad it didn't keep the pests out.

Perhaps we need to remember!

- Difference between macro and micro issues

- Yes we can achieve water recover with minimal impact on irrigators but it comes at a cost to the public, society and the environment! Then the national benefits story is lost!

‘politicians in all tiers of government are talking about the environment, but they are still dreaming about more production’ (Connell 2007, p. 151 quoting Henry Jones)

- How do we influence the decision maker with the big pockets

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