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Background

- **State and Federal Governments now own roughly 1200GL of water entitlements (Cosier et al., 2010).**
- **More environmental water buybacks planned**
- **Environmental needs are unlikely to correspond with reliability profile of the purchased entitlements**
  - **Irrigation entitlements designed to be relatively constant over years**
  - **Environment more variable flow with years of floods and drying**

How will environmental water holder (EWH) operate?

- **Could trade water**
  - **buy in high supply years to “top up” floods**
  - **Sell in dry years – to ease consumptive use shortage, earn for wet year buying**

- **Could carryover**
  - **To maintain critical minimums for “ecological refuges”**
  - **In hope of topping up next years releases**

Irrigator and Policy Concerns about EWH operation

- **Irrigator concerns - Will EWH:**
  - **exacerbate drought shortages?**
  - **Lead to water price spikes?**
  - **exploit market power?**

- **Policy concerns:**
  - **Insufficient EWH flexibility could reduce ecological value of water?**
  - **Can arrangements to minimise irrigator economic harm be compatible with flexibility?**

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Modelling EWH Trade

- Case study Murrumbidgee EWH with:
  - Water entitlement = 30% of current irrigation entitlement
  - flexibility to buy and sell
  - but operating not to profit

- Questions - How does EWH trade influence:
  - ecological outcome?
  - Irrigation returns?

Model structure - Hydrology

- Water balance model
  - Rainfall generates runoff into dams and river reaches
  - Losses occur from evaporation, seepage, leaks
  - Water is released from dams by allocation rules or spill

- Sequential:

  Headwater runoff
  = Inflows reach 1
  - diversions
  – Δ (dam) storage
  - losses reach 1 + runoff reach 1
  = inflow reach 2
  - Diversions
  .
  .

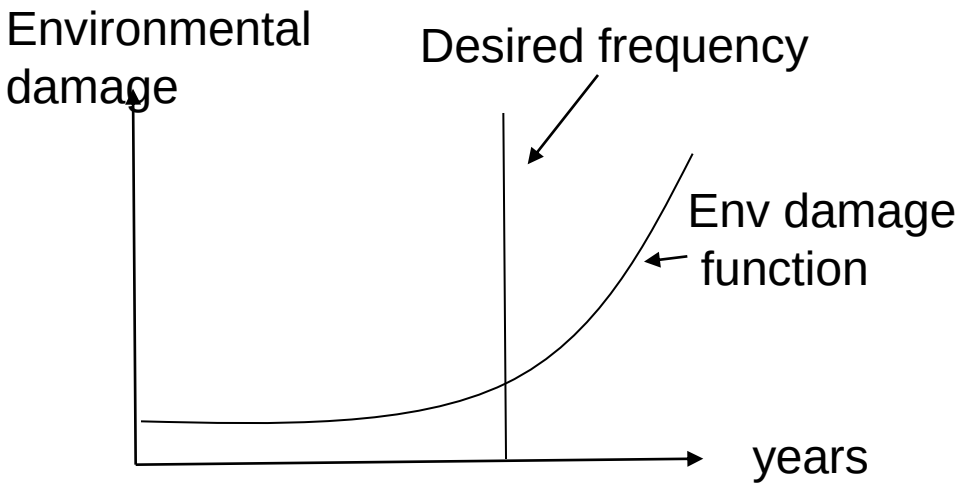
Model structure – Environmental Water Holder (EWH)

- MDBA goals for Murrumbidgee (4000 GL scenario)

flow	frequency
170 GL	15 years in 20
270 GL	7 years in 10
400 GL	6 years in 10
800 GL	5 years in 10
1700 GL	1 year in 4
2700 GL	15 years in 100

- EWH Objective – minimise ecological damage

= Exponent (desired – achieved frequency)



Model structure – Environmental Water Holder (EWH)

- Scenario 1 – no EWH trading
  - 30% of (currently) irrigation allocation each year
  - Released down river
- Scenario 2 – EWH trading; zero profit; perfect foresight
  - 30% of irrigation allocation each year
  - Can sell part to and buy
  - Price determined by irrigation supply
    - decreasing in allocation, increasing in EWH demand
  - Constrained to zero net profit over two years
  - Knowledge of this year, next years: flow, allocation, water price
- Scenario 3 – EWH trading; zero profit; future expectations
  - Same as scenario 2
    - Except past probability based flow, allocation, water price expectations

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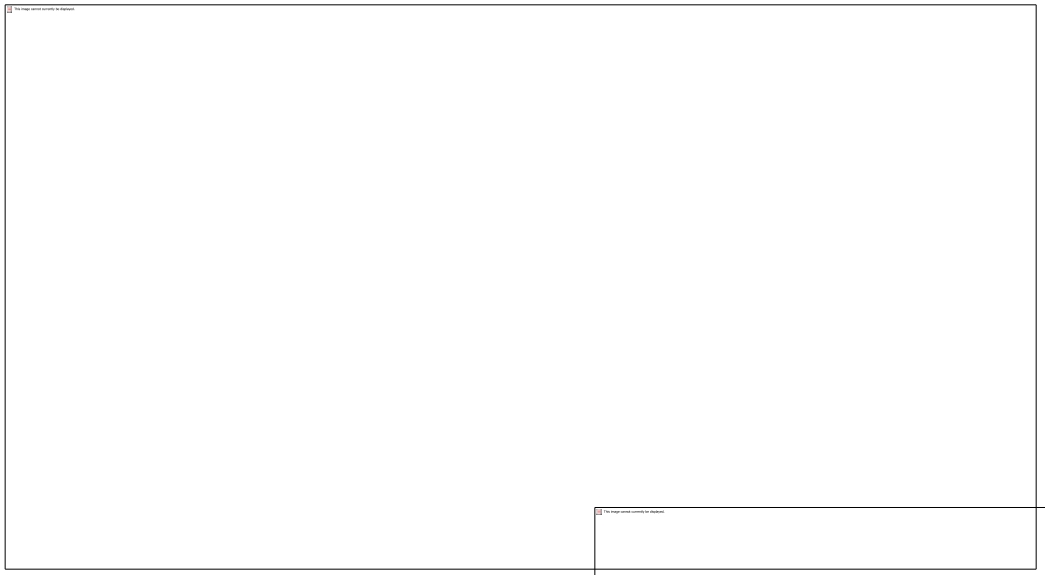
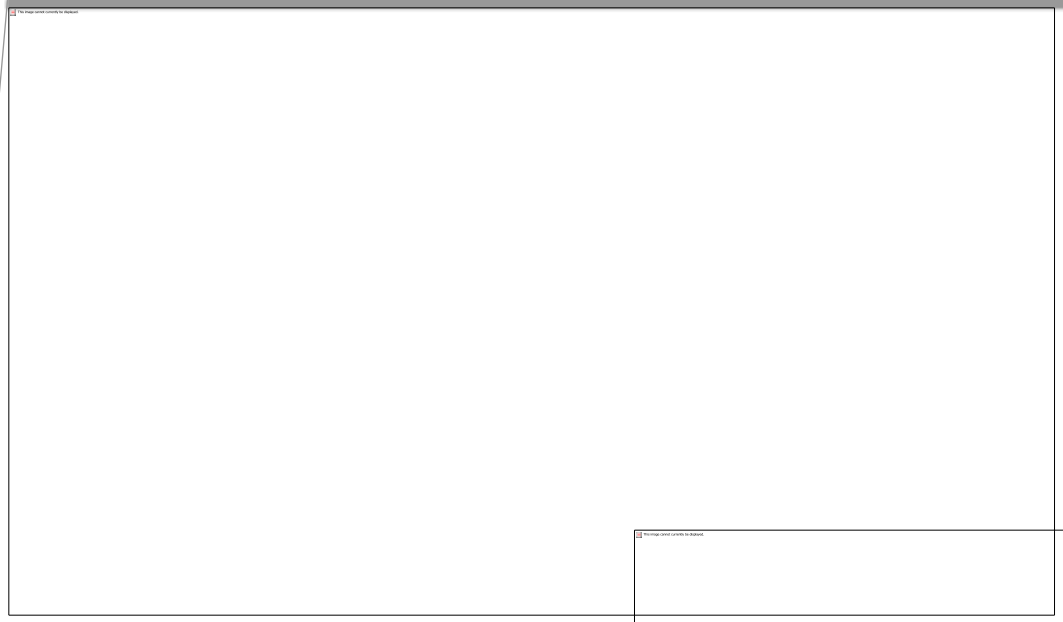
Results 1. extra flow dominates trade



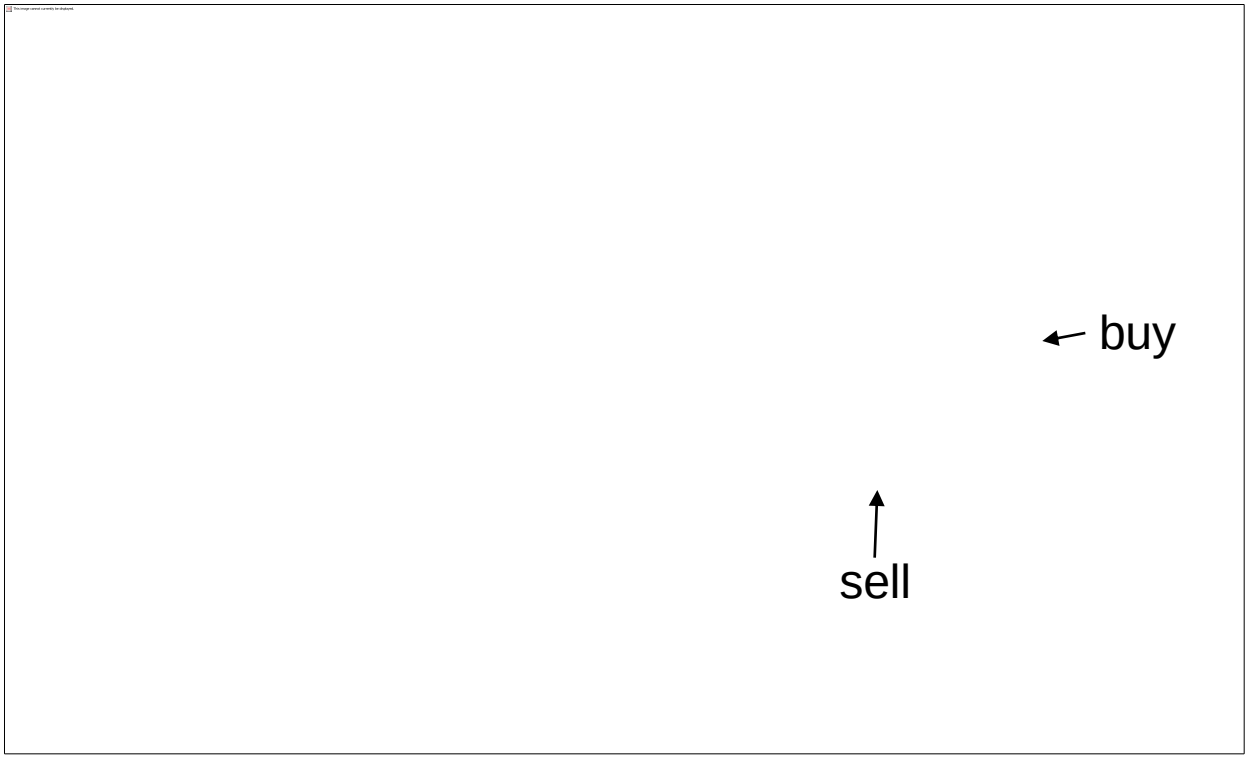
Especially in drought

Trade impacts most significant in drought

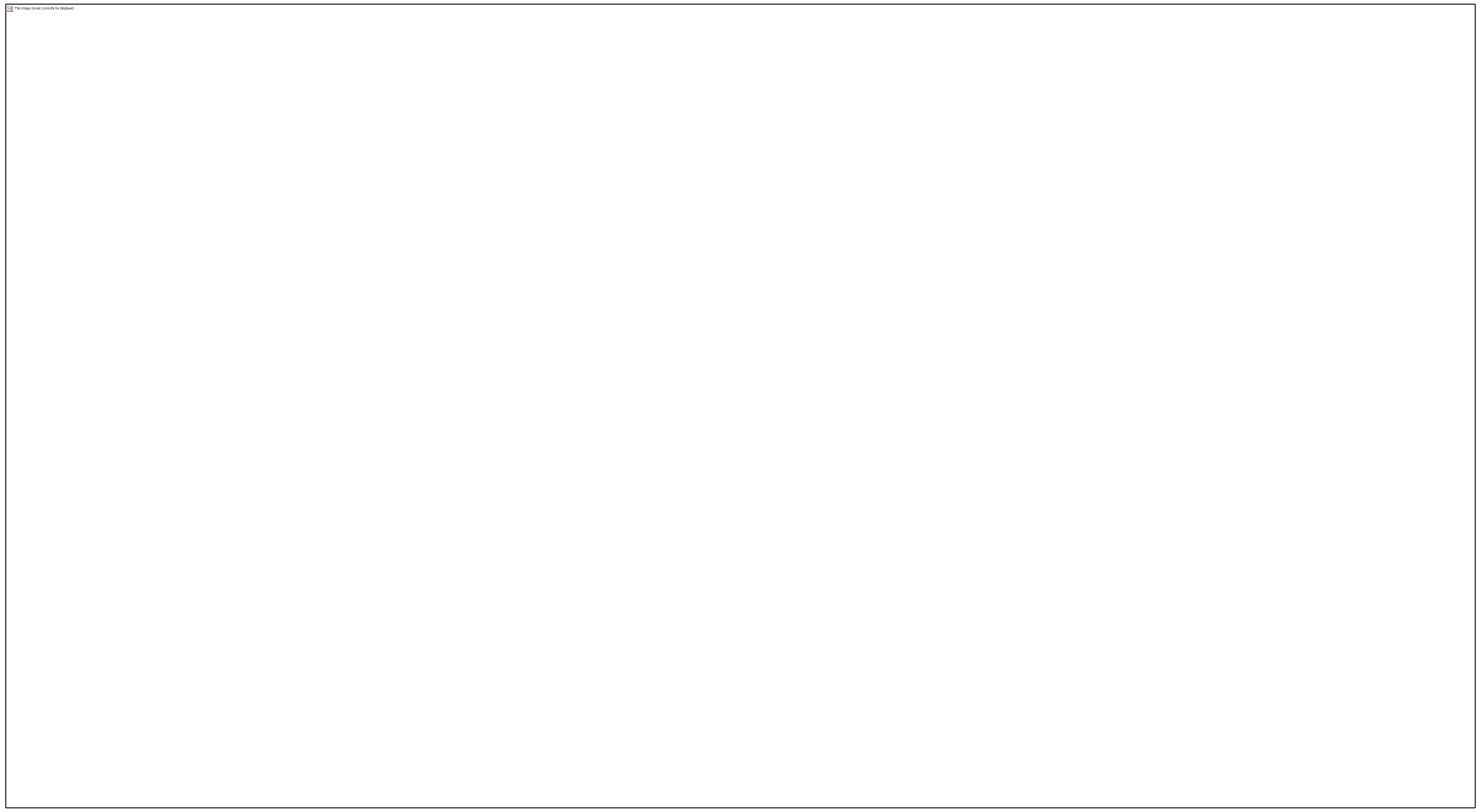


What drives environmental water trade

- Buy when allocation & potential for e-flow high, price low
- Sell when allocation & potential for e-flow low, price high



Expected value decisions not far off perfect foresight



Conclusions

- Environmental water holder may have motivation to augment supply in low allocation, buy when allocations are relatively high
- Coupled with an objective to not profit, expected outcome for irrigation could be less opportunity cost than if EWH did not trade
- Flexibility to buy and sell can improve environmental outcome

Future Research Directions

- Refine environmental impact index:
  - Doesn’t account for thresholds, restoration vs. conservation
  - May be possible to link to ecological response functions
- Examine longer time horizon
  - Current model is current year and one year forward
  - May be missing motivations in deep drought to spend water now (refuge)
- Consider strategic behavioral interactions and carry-over
  - Irrigators may learn to anticipate EWH strategy and seek rents

Ecosystem Sciences
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References

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