# Identifying Water Prices at Which Australian Irrigators Will Exit Irrigation: Results of a Stated Preference Survey

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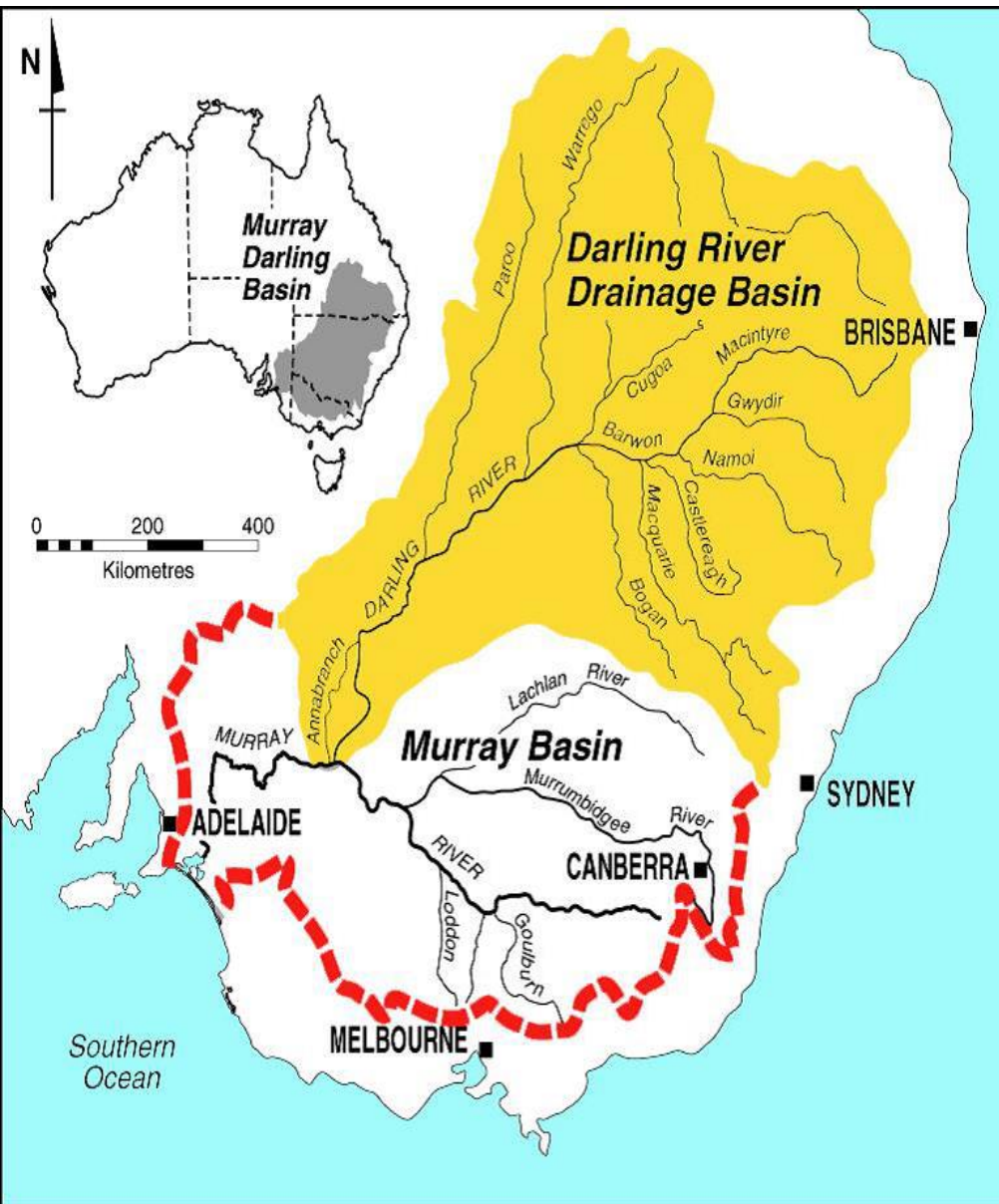**Vic Adamowicz**
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# Research Plan and Context



**Objective:** To investigate the preferences of irrigators in the MDB to sell all their water entitlements under exit package scenarios, and to calculate price elasticities

## WHY STUDY THE MDB?

- 1,000,000 km² (14% of Australia)
- Suffered enormously in the Millenium drought
- 80% of basin is agriculture
- 60% of Australia's irrigation with 40% of nations's farmers
- Population 2,000,000 across 5 jurisdictions
- Significant environmental values
- Australia's three longest rivers
- Home to 34 major Indigenous groups

# Policy Background

- Since the 1970s, the Australian government has implemented income smoothing and farm exit policies, to alleviate hardship and to provide a financial incentive to exit.

- In response to one of the worst droughts on record in the MDB, the Australian government initiated programs such as irrigation infrastructure investment, buying - back water, exit packages for small-scale irrigators, institutional reform (eg MDBA) and a new Basin plan.

- A $57.1 million Small Block Irrigators Exit Grant Package was implemented in 2008 to assist small block irrigators to exit. This required irrigators to sell all their existing water entitlements to the government, pull up their irrigation infrastructure and not farm on the land for up to five years.
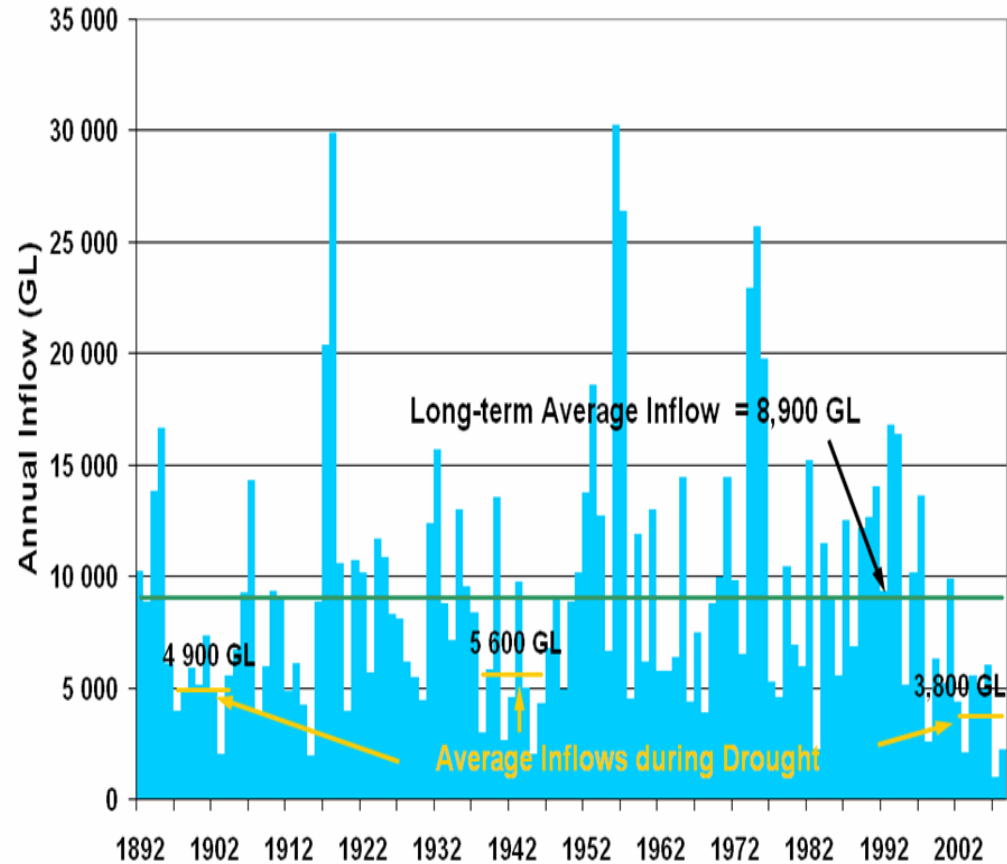
# Two Common forms of property rights in water
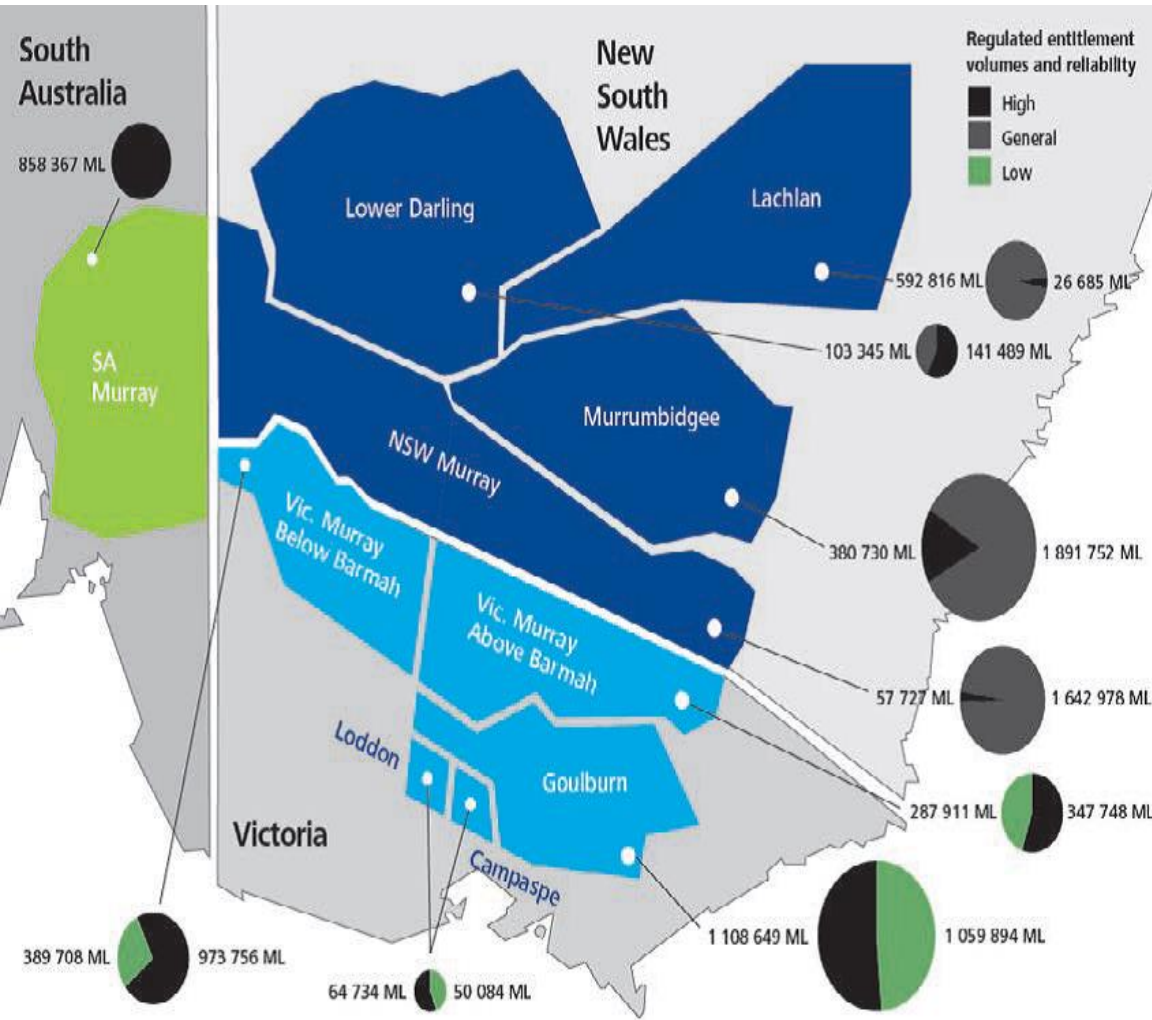


**Water Allocations**—(also known as temporary water) provide a specific volume of water to a water entitlement holder in a given year (season), based on announcements provided during the water year.

**Water entitlements**—(also known as permanent water rights) confer owner with perpetual access to a share of water from a specified consumptive pool. Regulated water entitlements have different levels of reliability (high, general and low) by region. NSW have traditionally held general security, Victoria high and low security and SA high security.

# Literature Review

- Farm exit is a phenomenon that has characterized the Australian agricultural industry for many decades, with farmers either choosing to voluntarily leave the farm or being forced to sell due to debt (Barr 2004, Pritchard et al. 2012).

- Marsden Jacobs and Associates (2010) studied farmer intentions to exit in the MDB in 2010, and found that exit intentions were associated with higher debt levels, a higher percentage of irrigated area, lower wellbeing scores and lower future optimism scores and a farmer age over 35.

- The effect of government policy on farm exit was widely investigated. For example, exit rates was found lower in regions with higher subsidy payments from the government in Western Europe (Breustedt & Glauben, 2007) and a price floor reduced farm exits of dairy farms in Connecticut (Foltz, 2004).

# Literature Review

- From an individual perspective, the theoretical foundation of farm exit is utility maximizing behavior by farmers (e.g. Kimhi 2000, Goetz & Debertin 2001).

- Farmers maximize the utility function ($U$) containing goods consumed ($c$), leisure time ($d_l$), non-pecuniary benefits of being a farmer (s) and exogenous shifters (α):

  $U=U(c, d_l , s, α)$

- The present value of expected future utility derived from farming as opposed to exit is:  $V_t = \int U_t(c, d_l , s, α)e^{-rt} dt,$

  where s=0 if the farmer quits and r is the discount rate.

# Literature Review

- The exogenous conditioning factors (α) that are linked with farm exit at an individual level include farmer-specific, farm-specific, economic, climatic and institutional factors.

- Particularly, α contains the most important element in the exit package: the monetary compensation for irrigators to exit the industry, in the form of price of water entitlements per megalitre (ML).

- In a given period t, farmers evaluate the expected future utility from farming ($V_{tf}$) versus exiting ($V_{te}$) and working in a non-farm (or off-farm) occupation, given the price per ML offered in an exit package.

| $/ML | expected future utility | Exit |
|------|------------------------|------|
| $p_1$ | $V_{tf} > V_{te1}$ | No |
| $p_2$ | $V_{tf} > V_{te2}$ | No |
| $p_3$ | $V_{tf} > V_{te3}$ | No |
| $p_4$ | $V_{tf} < V_{te4}$ | Yes |
| $p_k$ | $V_{tf} < V_{tek}$ | Yes |

# Survey Methodology

- Extensive quantitative research conducted:

  - 942 telephone surveys in irrigation districts across SA, NSW and VIC in 2010

  - Irrigators re-surveyed by mail in 2011

  - 535 farmers responded to hypothetical prices offered by an exit package.

- In our survey, we asked irrigators to answer the following question:

*"We would now like you to think about whether you would take up an exit package, where the package is based on the recent Federal Government program of the Small Block Irrigators Exit Grant Package (SBIEGP). The SBIEGP package required irrigators to sell all their permanent water to the Government in return for a package of financial benefits. Please fill out the entire table below – with either a "0" or an "All". At what amount would you consider selling ALL of your water from your farm for the exit package?"*

- Each irrigator answered in regards to the particular level of water ownership they held.
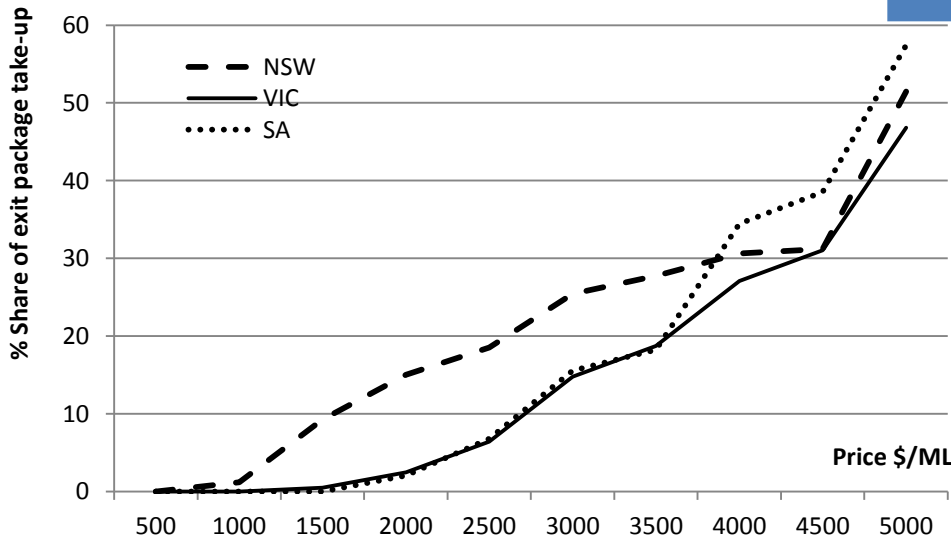
# Survey Overview

- The irrigators were presented with a list of ten prices on a payment card from $500/ML to $5,000/ML with an interval of $500.

**Payment card for Selling Water Entitlements under an Exit Package**

*Please treat each amount as an individual price that you may consider*

| Price ($ per ML) | Would you Sell? (i.e. 0 or ALL) |
|---|---|
| $500 | |
| $1,000 | |
| $1,500 | |
| $2,000 | |
| $2,500 | |
| $3,000 | |
| $3,500 | |
| $4,000 | |
| $4,500 | |
| $5,000 | |



**Overall Data Results:
Exit package take-up percentage by state and price**

# Regression methodology

- The following equation is estimated for exit package take-up:

$$ExitPackage_{ij} = \beta*Price_{ij} + X_i*\alpha + \varepsilon_{ij}$$

where: individual irrigators are indexed by i, price by j.

$ExitPackage_{ij}$ is a binary variable for which 1= irrigator i indicated he or she would take the exit package at price level j, 0 for otherwise.

$Price_{ij}$ is the exit package price for each ML of water entitlement,

$X_i$ is a vector of individual characteristics and

$\varepsilon_{ij}$ is an error term.

- For exit package volume, the equation is:

$$ExitVolume_{ij} = \beta*Price_{ij} + X_i*\alpha + \varepsilon_{ij}$$

where: $ExitVolume_{ij}$ is a continuous variable for the volume of water entitlements an irrigator i indicated he or she would sell under the exit package at price level j.

- After dropping observations with missing values, there are at least 1494, 1552 and 1029 observations for NSW, VIC and SA regression models

# Regression results—marginal effects by sub-samples

## Marginal effect estimates by sub-samples of irrigators

| | Exit Package Take-up | | | Exit Package Volume | | |
|---|---|---|---|---|---|---|
| | NSW | VIC | SA | NSW | VIC | SA |
| Age 40 and younger | 0.13 | 0.15 | 0.23 | 0.20 | 0.13 | 0.04 |
| Age 55 and older | 0.09 | 0.13 | 0.16 | 0.12 | 0.07 | 0.06 |
| Education level year 10 and below | 0.08 | 0.12 | 0.17 | 0.10 | 0.06 | 0.07 |
| Education level higher than year 10 | 0.10 | 0.13 | 0.17 | 0.18 | 0.11 | 0.05 |
| Believes in climate change risk | 0.11 | 0.15 | 0.18 | 0.18 | 0.13 | 0.06 |
| Do not believe in climate change risk | 0.10 | 0.11 | 0.17 | 0.16 | 0.08 | 0.05 |
| Risk taking | 0.11 | 0.11 | 0.17 | 0.14 | 0.09 | 0.06 |
| Risk averse or neutral | 0.10 | 0.14 | 0.17 | 0.19 | 0.11 | 0.05 |
| Have a succession plan | 0.09 | 0.11 | 0.11 | 0.14 | 0.09 | 0.08 |
| Do not have a succession plan | 0.11 | 0.13 | 0.20 | 0.18 | 0.11 | 0.04 |
| land value under 1 million | 0.10 | 0.13 | 0.18 | 0.09 | 0.05 | 0.03 |
| land value 1 million and above | 0.11 | 0.13 | 0.16 | 0.21 | 0.17 | 0.14 |
| % of irrigated area in horticulture is 50% or above | N.A. | N.A. | 0.17 | N.A. | N.A. | 0.05 |
| % of irrigated area in dairy is 50% or above | N.A. | 0.14 | N.A. | N.A. | 0.37 | N.A. |
| % of irrigated area in broadacre is 50% or above | 0.11 | N.A. | N.A. | 0.20 | N.A. | N.A. |

Notes: N.A. indicates that the number of farmers in this subsample is too small.

# Regression results—Elasticities

Price elasticity estimates for the exit package take-up and volume offered

| Price $/ML | Take-up | | | Volume offered | | |
|---|---|---|---|---|---|---|
| | NSW | VIC | SA | NSW | VIC | SA |
| 1000 | 0.73 | — | — | 0.10 | — | — |
| 1500 | 1.00 | 2.13 | — | 0.15 | 0.22 | — |
| 2000 | 1.23 | 2.54 | 2.87 | 0.21 | 0.31 | 0.35 |
| 2500 | 1.39 | 2.82 | 3.13 | 0.27 | 0.41 | 0.47 |
| 3000 | 1.51 | 2.97 | 3.23 | 0.33 | 0.52 | 0.60 |
| 3500 | 1.58 | 3.00 | 3.17 | 0.39 | 0.64 | 0.74 |
| 4000 | 1.61 | 2.91 | 2.98 | 0.46 | 0.77 | 0.89 |
| 4500 | 1.59 | 2.73 | 2.68 | 0.53 | 0.90 | 1.06 |
| 5000 | 1.54 | 2.46 | 2.30 | 0.61 | 1.05 | 1.23 |

Notes: All estimates are associated with p-values smaller than 0.0001.

# Key Conclusions

- One fifth of irrigators require a price premium of $1,600/ML over the relevant market price, which represents 174%, 81% and 89% over the market price at the time in NSW, VIC and SA respectively.

- Irrigators' exit package take-up is most responsive to price around $4,000 for NSW, $3,500 for VIC and $3,000 for SA.

- Effect of price has limited heterogeneity among NSW and VIC irrigator sub-sample groups in terms of the effects on their exit package take-up probabilities.

- If the aim is to encourage a greater number of irrigators to participate, targeting of certain groups is not needed. If the aim is to achieve the largest volume of water for the environment, it is more efficient and effective for the program to target some particular irrigator profiles.

# Thank You!

**And special thanks to our research partners
for their support on this project:**