



Australian Government

Australian Bureau of Agricultural and  
Resource Economics – Bureau of Rural Sciences



# Estimating irrigation farm production functions with ABARES survey data

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# Motivation

- Why estimate production functions?
- Water input demand curve
  - price responsiveness to changes in water availability
  - relevant for water policy
  - important input into economic models
- Limited empirical studies
- ABARES irrigation survey provides a rich data set

# Survey of irrigation farms in the MDB

- ABARES standard survey method (e.g. AAGIS)
  - Detailed physical and financial information
  - Unbalanced 'rotating' panel
  - Supplementary irrigation specific detail
- Three years and counting (2006-07 to 2008-09)
- 850 sample points per year
  - 10 per cent of population
- Coverage of three industries and ten regions

# Survey of Irrigation farms in the MDB



# Survey of irrigation farms in the MDB

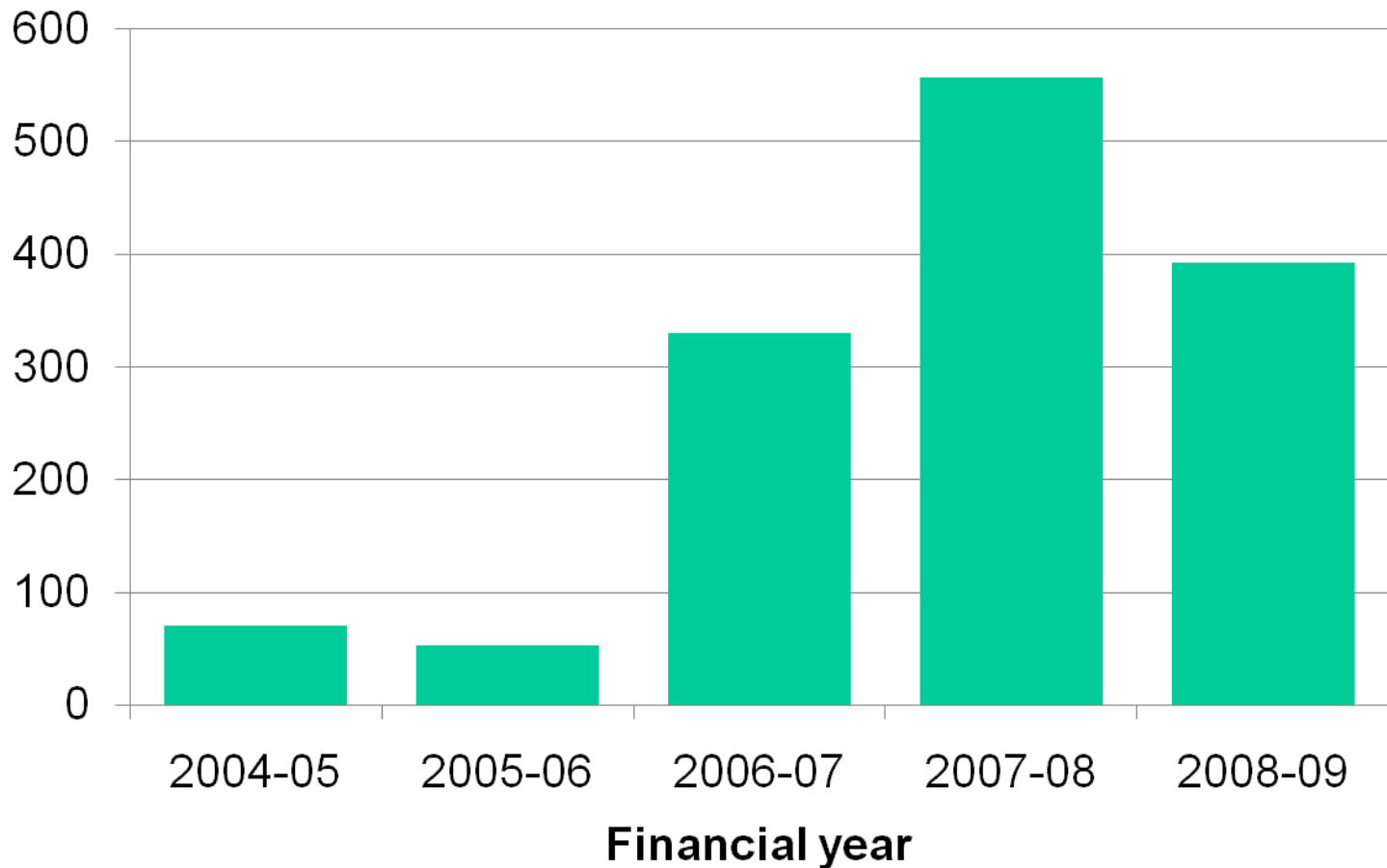
## Farm vs 'Enterprise' level

| Industry            | Enterprise            | Commodities produced                      |
|---------------------|-----------------------|---|
| <b>Horticulture</b> | 1. Pome Fruit         | Apples, Pears etc.                        |
|                     | 2. Stone Fruit        | Peaches, Apricots, Cherries etc.          |
|                     | 3. Citrus Fruit       | Oranges, Lemons, Mandarins, Grape Fruit   |
|                     | 4. Table Grapes       | Table grapes, sultanas, currents etc      |
|                     | 5. Wine Grapes        | Wine Grapes                               |
|                     | 6. Vegetables         | Potatoes, Tomatoes, Onions, Pumpkins etc. |
|                     | 7. Other Horticulture | Almonds, Olives, Berries                  |
| <b>Broadacre</b>    | 8. Cotton             | Cotton                                    |
|                     | 9. Rice               | Rice                                      |
|                     | 10. Wheat (Irrigated) | Wheat                                     |
|                     | 11. Wheat (Dry land)  | Wheat                                     |
|                     | 12. Other Broadacre   | Other grains, Oilseeds, Pulses, Hay       |
|                     | 13. Beef              | Beef                                      |
|                     | 14. Sheep             | Lamb, Wool                                |
| <b>Dairy</b>        | 15. Dairy             | Milk                                      |

# Seasonal conditions

Water allocation average market price (Murray)

Average Price  
\$/ ML



# Enterprise level variables

- **Output**
  - Quantity Harvested, **QTY**, (*Tonnes*)
  - Quantity Sold, **SOLD**, (*Tonnes*)
  - Gross Receipts, **REC**, (*\$ 2008-09 prices*)
- **Water**
  - Quantity of water applied, **WATER**, (*Megalitres*)
- **Land**
  - Crop area planted, **AREA**, (*Hectares*)
- **Tree Capital**
  - Number of Trees, Tree age structure, **TREE\_CAP**

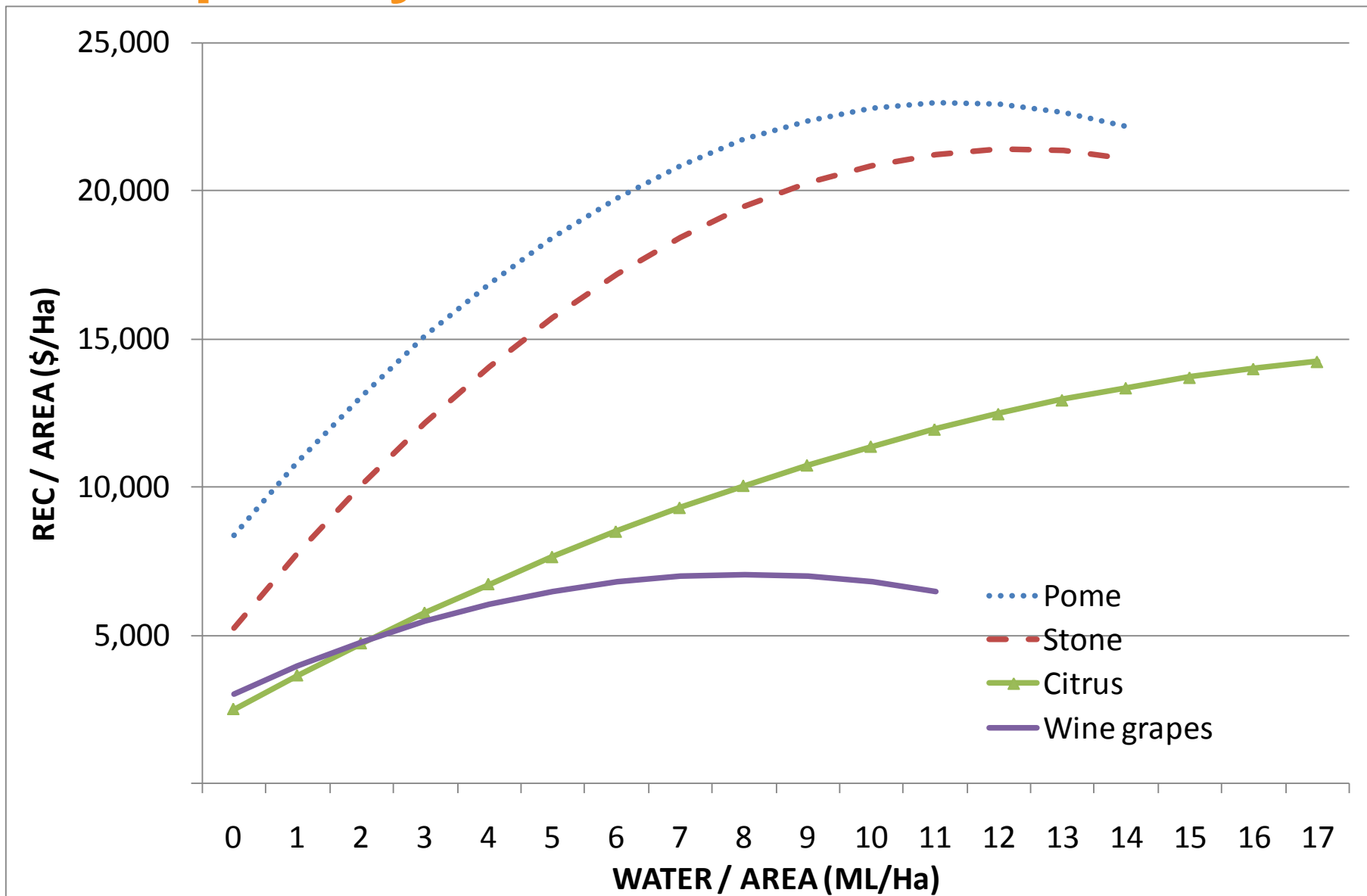
# Farm level variables

- Total productive land, **LAND**, (*Hectares*)
- Market value of farm capital, excluding land and water capital, **FARM\_CAP**, (*\$ 2008-09*)
- Cost of labour, imputed family labour and hired labour, **LABOUR**, (*\$ 2008-09*)
- Cost of all other materials and services, **MAT**, (*\$ 2008-09*)
- Winter and Summer season rainfall, **W\_RAIN** and **S\_RAIN**, (mm)
  - Matched to farm location via GIS

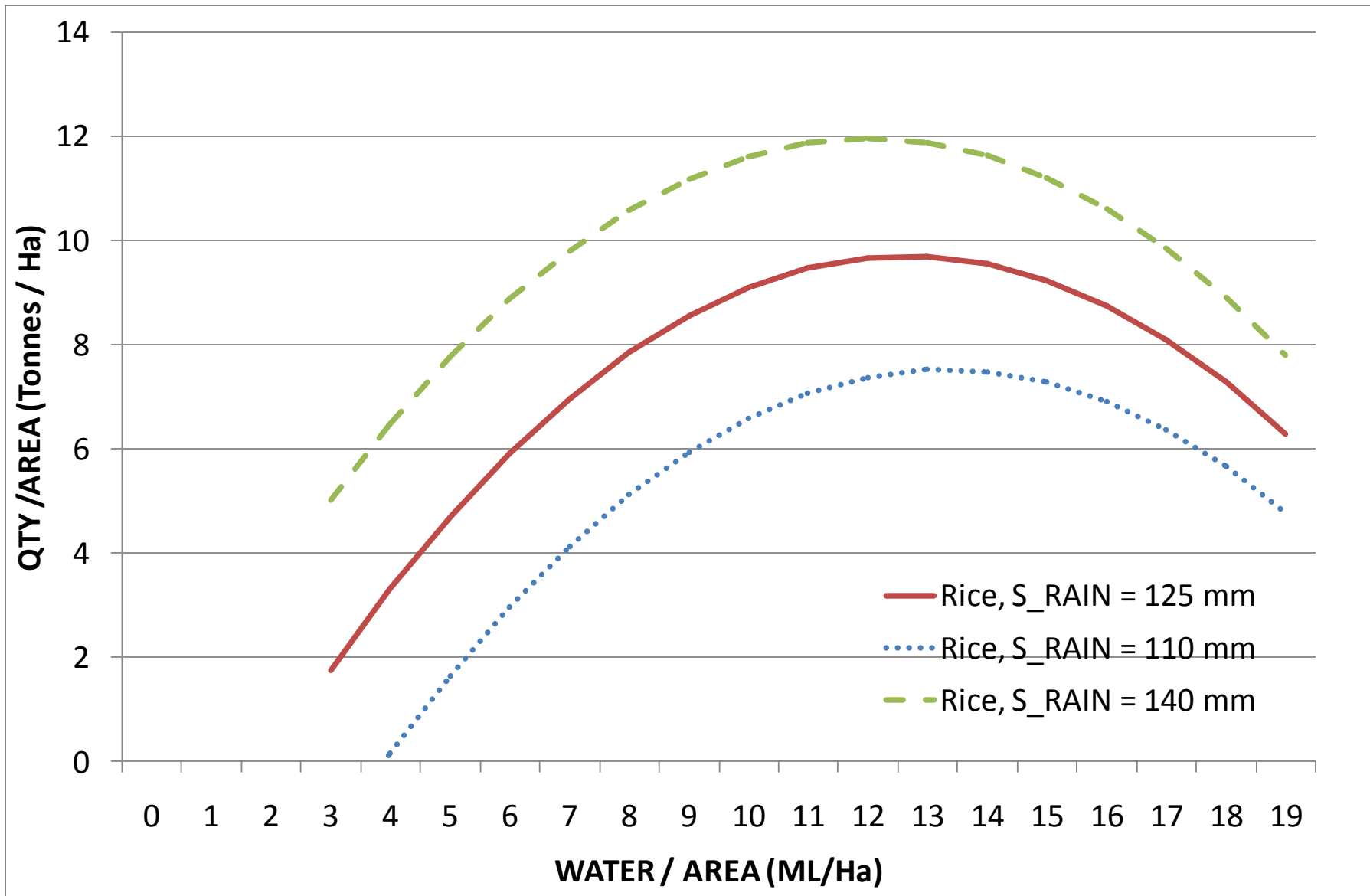
# Enterprise yield functions

- **Dependent variable**
  - Quantity yield ( $QTY / AREA$ )
  - Receipts yield ( $REC / AREA$ )
- **Explanatory variables**
  - $WATER / AREA$
  - $TREE\_CAP / AREA$
  - $W\_RAIN$  and  $S\_RAIN$
  - State and time dummies
  - Interaction terms
- Quadratic functional form, estimated via OLS

# Enterprise yield function results



# Enterprise level production function



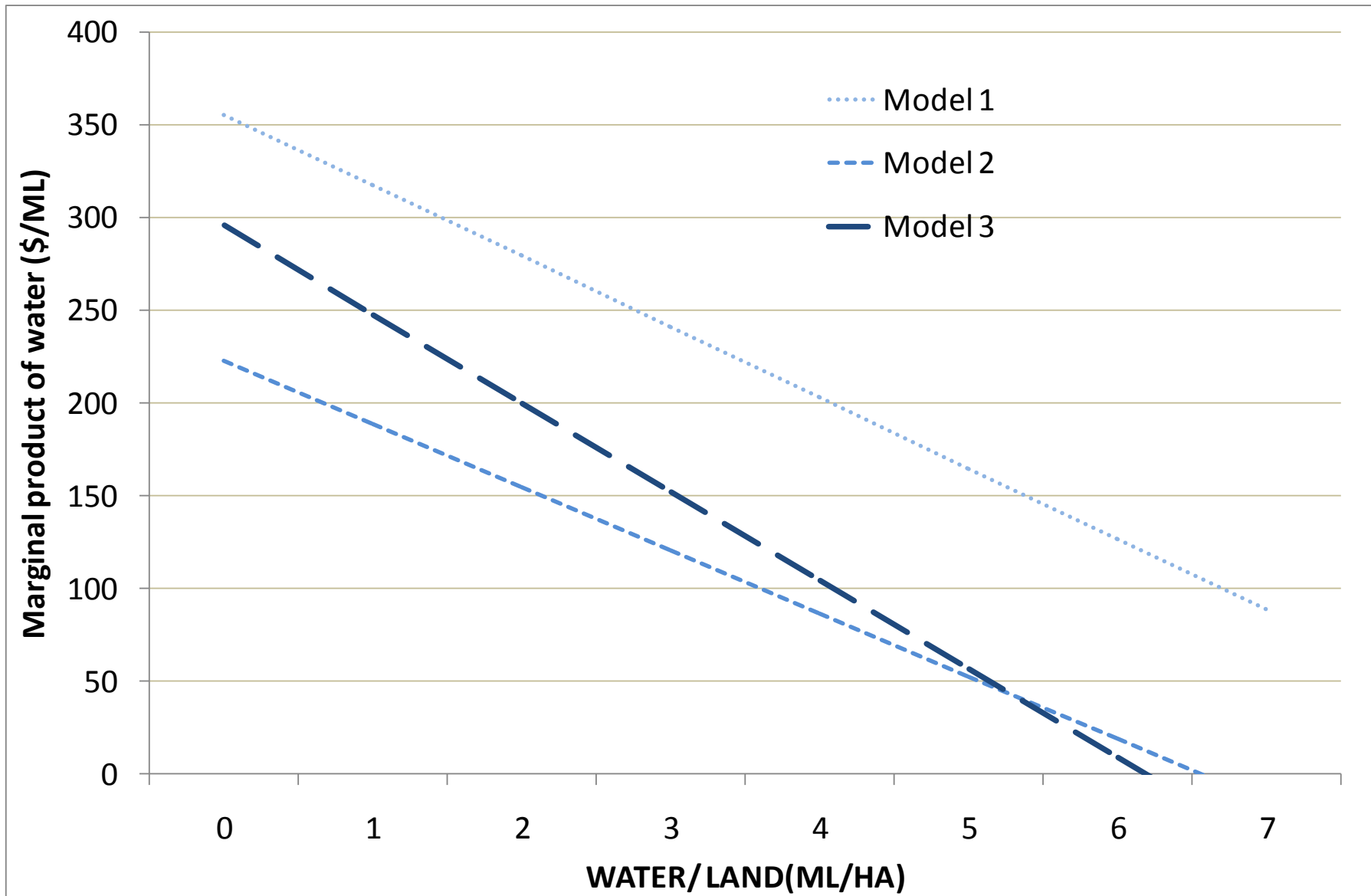
# Farm level production functions

- **Dependent variable**
  - Total receipts ( $\sum REC$ )
- **Explanatory variables**
  - *LAND,  $\sum WATER, TREE\_CAP\_F, FARM\_CAP, MAT, LABOUR, W\_RAIN, S\_RAIN$*
  - Year dummies, interaction terms
- Estimated for four farm groups:
  - Southern MDB Horticulture, Broadacre and Dairy and Northern MDB Broadacre

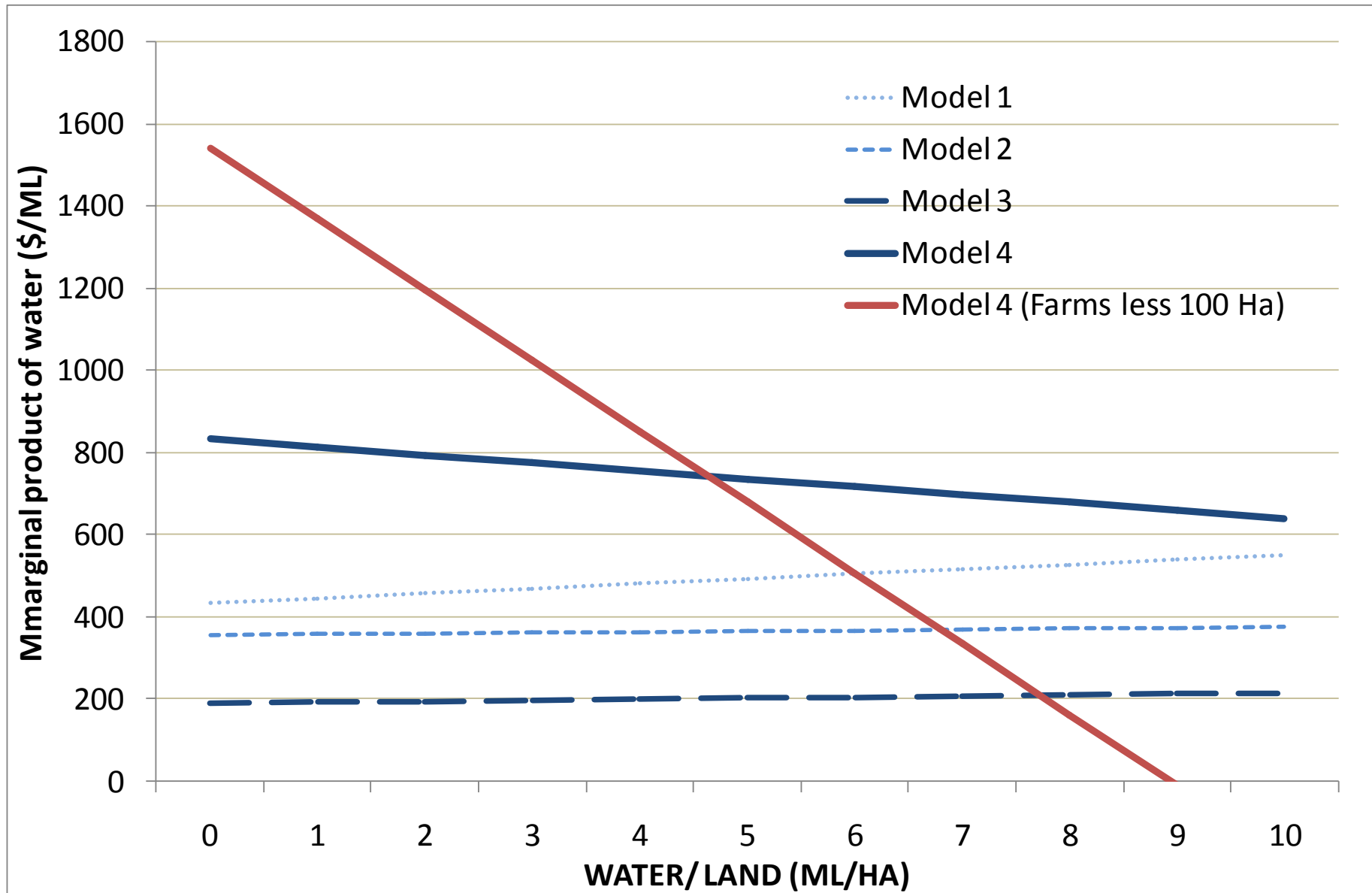
# Farm level production functions

- Are *MAT* and *LABOUR* endogenous?
- **Four models**
  - Model 1: OLS with *MAT* and *LABOUR* excluded
  - Model 2: OLS with *MAT* and *LABOUR* included
  - Model 3: Instrumental variables for *MAT* and *LABOUR*
  - Model 4: Fixed effects estimator
- Quadratic functional form
  - Linear short run marginal revenue product of water

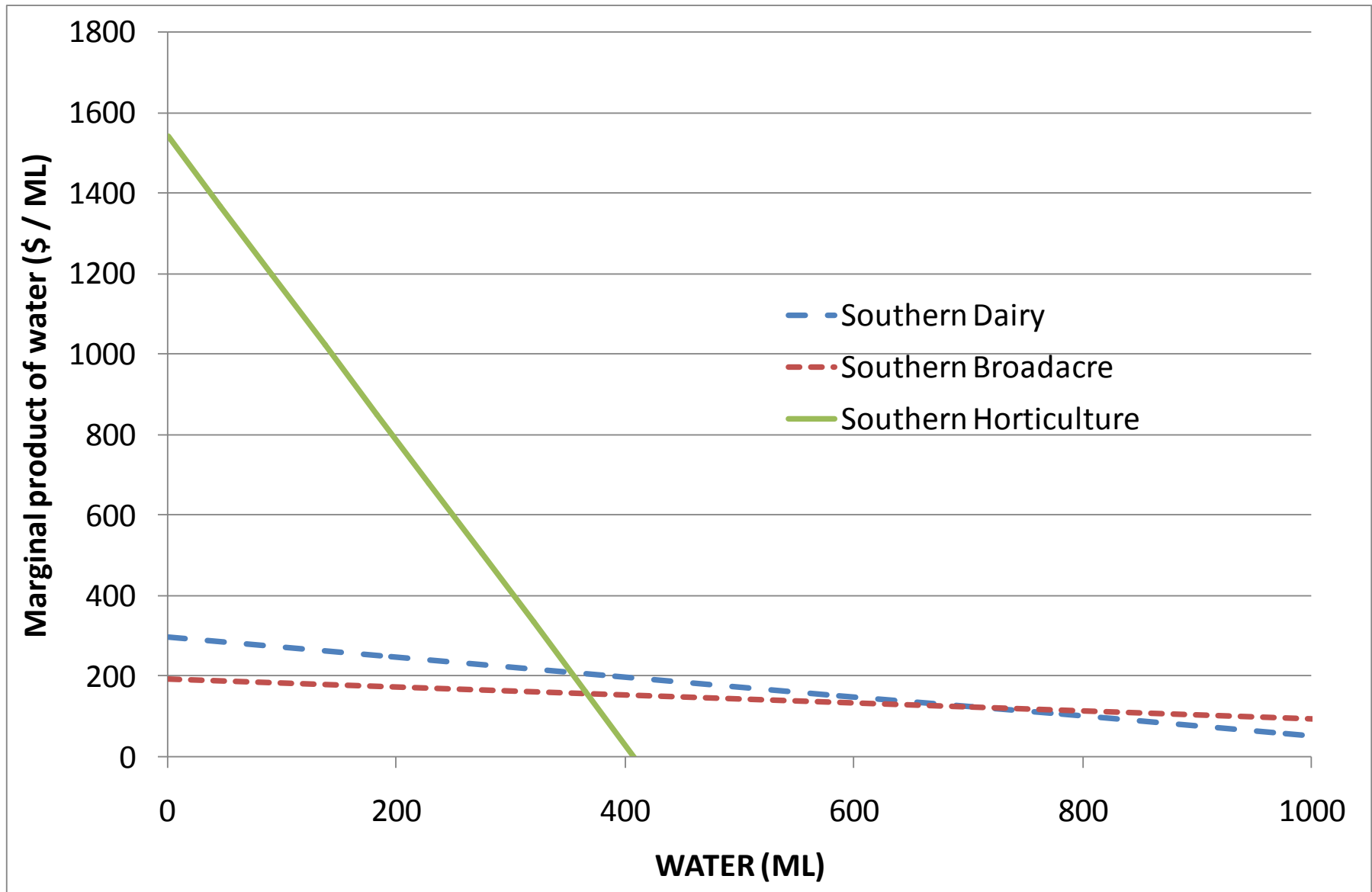
# Southern Dairy



# Southern Horticulture



# Comparing the industries



# Conclusions

- Limited drought effected time series
- Despite this the results are encouraging
  - Demonstrate expected relationships between water use and output at the farm and enterprise level
- Results display a lack of robustness
- Precision and generality of results will improve significantly with longer time series

**Thank you**

*Science and economics for decision-makers*