Offsetting with salinity credits: An alternative to irrigation zoning

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Irrigation in the South Australian Riverland

• As is widely known, irrigation induced salinity is a serious problem in SA.
Economics Literature


What are we adding?

• A theoretical model of salinity offsets.

• An empirical study including standalone zoning and offsets in the South Australian Riverland.

• Some interesting policy implications.
How to solve the irrigation induced salinity problem?

- Technical/engineering solutions: salt interception schemes/evaporation ponds, increasing water efficiency of irrigation, dilution flows, etc.

- Still prevalent, but physical and economic limitations are apparent.
Influence the location of irrigation

- Land areas are heterogenous in terms of characteristics relevant for salinity impact.

- Irrigation in one area causes more salinity impact than the same irrigation activity in another area.

- How can we induce a shift of irrigation activities towards “more suitable” areas?
The concept of zoning

- Define “high” and “low” salinity impact areas.
- Typically, orthogonal to the river channel, i.e. low impact zones further away from the river.
- The question is then, how to move irrigation from high to low impact zones.
Related to water trading

• What happens now when water can be traded, but property rights on salinity impacts are not yet established.

• Victorian salinity levies and trade restrictions.

• Incentives to locate in low salinity impact areas.
Newly adopted policy in South Australia

• Irrigation zoning.

• Fairly restrictive.

• Determine the high and low impact zones and only allow new irrigation to locate in low impact zones.
The zoning

High and Low Impact Areas

Legend
Impact
- Orange: High
- Green: Low

[Map showing high and low impact areas with scale and legend]
The effects

• Would decrease salinity impact.

• But, is it least cost?

• Intuitively it is not. Rigid quantity regulation. No incentives. No account for heterogeneous operators.
An alternative: offsets

- Allow new irrigation development in the high salinity impact zone, provided it is offset by reducing salinity impact in another high impact zone.
- This gives rise to salinity credits. The developer will have to buy salinity reduction credits in order to proceed with the project in high impact zone.
- Adds flexibility and likely to be less costly.
Objectives

• Determine the costs of both the standalone irrigation zoning policy and the offset policy and compare them.

• Determine the effect of the salinity offset scheme on the location of new irrigation developments.

• Determine and compare the long term salinity impact of the alternative policies.
Theory

• Maximise profits from irrigation for the whole region under three policies:
  – Unregulated location of new irrigation activities.
  – Irrigation zoning.
  – Offsetting.
Key drivers/assumptions

- Cost of water delivery higher in the low impact zones.

- Salinity impact from upstream irrigation greater than salinity impact from downstream irrigation.

- Salinity credits obtained if ageing crops in high impact zones are not replanted.
Theoretical results

- Offset policy gives as high profit as the standalone irrigation zoning policy in any area.

- Salinity credits tend to be supplied by upstream areas.

- Salinity credits tend to be demanded by downstream areas.
Empirical study

- Divide the whole study area into 16 smaller areas. Each area (except two) has high and low impact zones.
Data

- Five crops: almonds, grapes, oranges, apricots, and potatoes.

- Water delivery costs were calculated based on distances and elevation of various analysis areas, costs of piping and costs of pumping.

- The salt load and salinity impact obtained from CSIRO.
Scenarios

• Programming model set up for three scenarios:
  – Unregulated location: free choice of where to locate;
  – Zoning: can only locate in high impact zones;
  – Offset: can locate in high or low impact zones, provided the impact in high impact zones is offset by reduction in another high impact zone.
## Findings

<table>
<thead>
<tr>
<th></th>
<th>Annual cost ($)</th>
<th>Present value of costs over 100 years ($ mill.)</th>
<th>Net salinity impact (EC projected over 100 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrestricted irrigation</td>
<td>0</td>
<td>0</td>
<td>4263</td>
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<tr>
<td>Standalone zoning</td>
<td>482,118</td>
<td>7.4</td>
<td>338</td>
</tr>
<tr>
<td>Offsets</td>
<td>374,604</td>
<td>5.8</td>
<td>288</td>
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</tbody>
</table>

The offset scheme is both less costly and in fact more effective in reducing salinity impact as compared to the standalone zoning. Equilibrium quantity of permits: 144 EC units. Equilibrium price of permits: $606.
Observed patterns

• Almonds favored under offset.

• Irrigation in downstream areas slightly favored by the offset.

• Main supplier of credits: grapes in Berri-Barmera.
Implications

• Location of irrigation enterprises in the “high” impact zones should be addressed in some way.

• Economics can be instrumental in the way we address it.

• Rather than having a rigid, standalone zoning policy, offsets could be introduced to allow more flexibility and lower cost.

• Maybe we need to shift the attention from the orthogonal approach to irrigation zoning.