Are Participants In Water Markets More Efficient In The Use Of Water Than Non-Participants?: A Case Study For Limarí Valley (Chile)

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Objective

• Investigate whether there are differences in Global Efficiency (GE), Water Use Efficiency (WUE) and other input use efficiency between farmers who
  • Participate in water markets and
  • Do not participate in them.

• Empirical application focuses on a sample of farmers located in Limarí Valley (Chile)
What do we understand by efficiency?

Technical efficiency (TE): Obtain maximum production with given resources (Output oriented) or minimize input use to reach a given production level.

Allocative Efficiency (AE): Reach a production level at minimum cost or, alternatively, maximize production for a given cost.

\[ \text{Technical efficiency } B = \frac{OB}{OB_1} \]

\[ \text{Unit A's Allocative efficiency } = \frac{OA'}{OA} \]

\[ \text{Efficiency } = 1, \text{ efficient unit} \]

\[ \text{Efficiency } < 1, \text{ inefficient unit} \]
## Water Rights Markets in Chile

Consumptive WR transactions and prices for the period 2005-2008

<table>
<thead>
<tr>
<th>Region</th>
<th>Total Transactions</th>
<th>WR Transactions independent of Land</th>
<th>WR Transaction Values (Only WR Transactions independent of Land)</th>
<th>Average WR Transaction price (US$/WR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Number WR)</td>
<td>(10^6 US$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry Pacific</td>
<td>12,221</td>
<td>11,223</td>
<td>3,623</td>
<td>512,243</td>
</tr>
<tr>
<td>Central Chile</td>
<td>8,835</td>
<td>8,522</td>
<td>1,160</td>
<td>228,737</td>
</tr>
<tr>
<td>Southern Humid Pacific</td>
<td>793</td>
<td>784</td>
<td>31</td>
<td>50,863</td>
</tr>
<tr>
<td>Total</td>
<td>21,849</td>
<td>20,529</td>
<td>4,814</td>
<td>215,623</td>
</tr>
</tbody>
</table>

Source: (World Bank, 2011).
Water Rights Markets in Limarí Chile

• Active Permanent WR and Spot Water Market

• Main participants in the Limarí water rights market are farmers
  • 90% transactions between farmers.

• Consumptive permanent continuous water rights owners trade WR in permanent water market and water allocations in a spot market.

• Previous research shows that water markets in the Limarí basin have been successful in moving water and water rights from low to high-valued uses.
Methodology

- We apply the Russell model (RM) which is a non-radial and non-oriented model
- RM approach enables estimation of
  - Global efficiency (technical + allocative efficiency)
  - Individual input use efficiency (technical efficiency)
- GE and WUE were calculated for
  - All farmers
  - Water sellers
  - Water buyers and
  - Non-traders
- We study factors influencing efficiency scores
  - Based on a non-parametric method
Results

Mean efficiency scores for each input type and global efficiency index for farmers´ category

<table>
<thead>
<tr>
<th></th>
<th>Fertilizers</th>
<th>Pesticides</th>
<th>Energy</th>
<th>Water</th>
<th>Labour</th>
<th>RM</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sample</td>
<td>0.380</td>
<td>0.418</td>
<td>0.431</td>
<td>0.450</td>
<td>0.381</td>
<td>0.412</td>
</tr>
<tr>
<td>Water sellers</td>
<td><strong>0.486</strong></td>
<td><strong>0.538</strong></td>
<td><strong>0.494</strong></td>
<td>0.615</td>
<td>0.452</td>
<td>0.517</td>
</tr>
<tr>
<td>Water buyers</td>
<td>0.344</td>
<td>0.419</td>
<td>0.448</td>
<td>0.469</td>
<td>0.380</td>
<td>0.412</td>
</tr>
<tr>
<td>Non-traders</td>
<td>0.338</td>
<td>0.338</td>
<td>0.377</td>
<td>0.326</td>
<td>0.336</td>
<td>0.343</td>
</tr>
</tbody>
</table>

- Efficiency levels for each input, and therefore the GE for the whole group are low
- Input with the highest efficiency score was water use except for non-traders
- Global and input efficiency differences among the farmers´ groups are statistically significant according to non-parametric test of Kruskal-Wallis
### Results

Summary results of water use efficiency for farmers´ groups

<table>
<thead>
<tr>
<th></th>
<th>Efficient units</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water sellers</td>
<td>21</td>
<td>0.615</td>
<td>0.291</td>
<td>0.115</td>
<td>1.000</td>
</tr>
<tr>
<td>Water buyers</td>
<td>9</td>
<td>0.469</td>
<td>0.215</td>
<td>0.223</td>
<td>1.000</td>
</tr>
<tr>
<td>Non-traders</td>
<td>2</td>
<td>0.326</td>
<td>0.157</td>
<td>0.102</td>
<td>1.000</td>
</tr>
</tbody>
</table>
Closing Remarks

• Farmers participating in water markets are more efficient –from a global and water use point of view
  • Water sellers are the most efficient in the use of water

• Non-parametric tests applied to analyse relationship of external factors with differences in global and water efficiency scores
  • Cultivated area, type of crop, farmers’ experience in agriculture and irrigation technology
  • These factors did not affect GE and WUE
Closing Remarks

• Policy implications

  • Mean WUE is moderate-low.
    • Hence, there are considerable possibilities to reduce agricultural water consumption, maintaining production levels.

  • Promotion of WR markets by water authorities and policy makers would lead to increases water productivity

  • As WUE was estimated at farm level, this information should be transferred to farmers with a benchmark analysis