Sustainability needs good economics

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Economics

With few exceptions ... its practitioners are little known to non-economists, and frequently mocked. Who can forget what Lyndon Johnson once said to John Kenneth Galbraith?

"Did it ever occur to you, Ken, that making a speech on economics is a lot like pissin' down your leg. It seems hot to you, but it never does to anyone else."

Key economics ideas

• Economics - how we make *choices* over scarce items

• People respond to *incentives* in making choices

• *Scarce items* have alternative uses

• If we choose one use of a resource we forgo the benefit from other uses of the resource.

• Benefit foregone = *Opportunity Cost*
Water in New Zealand

- Large amounts of water but not always in the right place at the right time in the right amount
- 1410 m$^3$/capita abstracted, 2$^{nd}$ highest in OECD
  - irrigation 77%, public supply 16%, industry, 7%
- Water quality is degraded in many urban waterways, lowland rivers and streams, lakes.
- Public concern about water availability and quality
- New policies and tools needed.
State of New Zealand environment, Hughey et al. 2006

- 2000 adults also asked to rate quality of 11 aspects of NZ environment (rivers and lakes, groundwater, air, soils...)
- And …”how does NZ natural environment compare to other developed countries”
- Respondents state:
  - NZ rivers and lakes, and groundwater are in ‘good’ or ‘very good’ state,
  - But are lowest, and fourth lowest, rated respectively of 11 aspects of NZ environment
  - NZ environment is in better condition than is environment in other developed countries.
International rating of water availability and quality

- Esty et al., 2005 provide a rating of 146 countries national environmental stewardship.

- Water quality is measured by 4 variables,
  - DO, EC, Phosphorous concentration, suspended solids

- Water quantity
  - freshwater and groundwater per capita

- Overall NZ ranked 14th of 146 countries.
- Water quantity is NZ best score.
- Water quality is NZ 3rd best score
Urban Water and Wastewater Services

• Large, costly network services
  – Capital invested big part of TLA assets
  – Annual costs big part of some TLA budgets
  – Water ~ 6.1% CCC of annual expenditure
  – Wastewater ~ 9.3% CCC of annual expenditure

• Diverse pricing systems used, but metering and volumetric charging is rare
  – Dunedin users: $320/household for water
  – Twizel, $109 + $45/property for water
  – Hurunui all water users: Charge per m³
  – Kaikoura motels, wastewater charge – number of toilets

• Choice of pricing system matters
Seasonal demand

- Seasonal water and wastewater demand, driven by tourism in many smaller centres
- Can have major environmental effects
- Peak demand has high % of discretionary use
- Peak pricing could reduce water demand, and better reflect fiscal and environmental costs
Akaroa Tourism, Water Seasonality

Diagram showing the trend of Guest Nights, Water, and Wastewater from Jul-96 to Jul-02. The graph indicates significant seasonality in guest nights with peaks in winter months, while water and wastewater usage show more consistent patterns throughout the year.
Marginal Social Benefits from water

MSB - Additional benefits from each litre used

Quantity of water used
Funding Water & Wastewater Services

Rates set prices for water and wastewater services
If price/litre = 0, likely that usage $\uparrow$ until MB = 0, and $\uparrow$ demand for capacity, $\uparrow$ operating costs, $\uparrow$ environmental impacts.

Do rating systems for water and wastewater services contribute to sustainability goals?

Could they be improved?
Marginal Social Benefits from water

MSB, Price

$/m^3

0 Q_2 Q_1

Quantity of water used
Do prices reduce water use?

- Price elasticity = \( \frac{\% \Delta \text{quantity}}{\% \Delta \text{price}} \)

- Price elasticity of demand for water is < 1.0
- Water usage falls by 15+% with water charges/m³
- Price elasticity is greatest during peak use periods, as more water use is discretionary
- Water meters & charges assist identification of leakages
- Water meters installed in Akaroa, December 2002
  - Water use over summer peak period 40% less than in 2001/02
## Christchurch water and sewerage rates, 2007-08

<table>
<thead>
<tr>
<th></th>
<th>Water</th>
<th>Sewerage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential (connected)</td>
<td>0.042195c/$CV</td>
<td>0.067728c/$CV</td>
</tr>
<tr>
<td>Non-Residential (connected)</td>
<td>0.042195c/$CV Excess water 45c/m³</td>
<td>0.067728c/$CV</td>
</tr>
</tbody>
</table>

Revenue generation
- Sufficient
- Stable over time
- Complexity and administrative costs

Cost allocation
- Non-arbitrary
- No cross subsidisation
- Include all private and social costs

Provision of incentives
- Statically efficient water use
- Dynamically efficient water use
- Encourage water conservation
- Transparent water charges
### Christchurch water charges evaluated

<table>
<thead>
<tr>
<th>Compliance</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sufficient</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Stable over time</strong></td>
<td>Yes</td>
</tr>
<tr>
<td>Administration costs &amp; complexity</td>
<td>Costs only</td>
</tr>
<tr>
<td>Non-arbitrary</td>
<td>No</td>
</tr>
<tr>
<td><strong>No cross subsidisation</strong></td>
<td>No</td>
</tr>
<tr>
<td>Static efficiency</td>
<td>No</td>
</tr>
<tr>
<td>Dynamic efficiency</td>
<td>No</td>
</tr>
<tr>
<td><strong>Encourage conservation</strong></td>
<td>No</td>
</tr>
<tr>
<td>Correct interpretation</td>
<td>Partially</td>
</tr>
</tbody>
</table>
Christchurch pricing, comment…

- Meters read once per two years residential, once per year non residential.
- No incentive for residential users to reduce water use until reach 1m³ per day, non residential until reach 3m³ per day.
- No recognition of seasonal variation in scarcity.
- No price incentive to reduce volumetric use of wastewater system.
Marginal Cost or Average Cost pricing?

• AC easy to calculate, but could we do better?

  \[ \Delta \text{Total costs} \]

• MC = \[ \frac{\Delta \text{Total costs}}{\Delta \text{quantity of water}} \]

• MC pricing desirable for efficiency but...
  – Difficult to calculate
  – Revenue can be unstable
  – Complicated for customers to understand

• Use combination of tools to get close to Marginal Cost pricing
Sustainability and three goals of rating systems

• TLA are concerned about revenue stability
  ➢ Two part pricing to ensure that revenue does not fluctuate unacceptably with changes in water usage

• Fixed charge plus volumetric charges a solution
  ➢ Sufficient revenue is collected
  ➢ Costs are more accurately allocated
  ➢ Incentives are provided to conserve water and reduce use of wastewater system
Fixed and volumetric charges

- Accounting for fixed and variable costs
- Block increases in price per cubic metre
  - E.g.: $1.80/m³ for first 200m³, $2/m³ for next 500m³, $3/m³ for all subsequent m³
- High first fixed charge and lower but increasing subsequent fixed charges
  - E.g.: $110 for first 200m³, +$40 for next 500m³, +$65 for all subsequent m³
- Wastewater usage can be charged by a proxy - m³ of water used.
- Use seasonal prices to conserve water in summer.
Rating systems and Sustainability

• Reduced water use means
  – less demand for infrastructure
  – lower operating costs
  – less pressure on the water sources

• Achievements are useful contributions towards
  – economic,
  – social and
  – environmental sustainability objectives.
MSB and water allocation

- If we have fixed quantity of water to allocate between uses, economic efficiency is achieved if we allocate water so that MSB\(_d\) = MSB\(_h\) for any d and h
- Allocate O-Q1 water to dairy, Q2 - Q1 to horticulture
- Opportunity cost of using water for horticulture is the foregone MSB of less water for dairy
- If current allocation is at Q2, MSB\(_d\) > MSB\(_h\) and we could increase social welfare by reallocating Q2 - Q1 water
- ABC - the gain in social benefit from water reallocation
MSB and water allocation

Available water per time period

Marginal Social Benefit dairy

Marginal Social Benefit horticulture

MSB\textsubscript{d}

MSB\textsubscript{h}

0 Q

Q\textsubscript{1} Q\textsubscript{2}

a b c
Water allocation in New Zealand

- Water permits allocated on first come first served basis
- Unlikely to result in water going to its highest valued uses if there are competing uses
- Permits for up to 35 years, non transferable, hence water unlikely to move to highest valued uses
- RMA allows water to be allocated at zero price
  - no return to ‘owners’
  - economic rents to permit holders leads to land price ↑
- Zero price likely to result in inefficient use of water
- Allocation process can involve ‘assessment of environmental effects’
- ‘Economic effects’ are considered, but flawed if they do not include an opportunity cost for water
Rural water allocation

Allocation process could aim for several objectives

– Allocation of water to its highest valued uses (economic, social, environmental, cultural)
– Efficient use of water
– Fair return to ‘resource owners or managers’
– Ability for water to be reallocated to highest valued uses as they become known
– Investor certainty
Rural water allocation

• Water allocations at zero price for up to 35 years, little transferability, only meets investor certainty objective.

• Some water uses are public goods, e.g. instream use, and government decision required on its MSB and how much to retain for that purpose.

• Water for private use - pursue the 5 objectives by:
  – Competitive bids for water
  – Royalties for use of water
  – Allow transfer of water rights
  – Well defined property rights for water
Water allocation and water quality

- If one water use has external effects on third parties (e.g. lowers steam quality) we need to subtract the marginal external costs from MSB for that use.

- Measurement of marginal external costs requires careful research, or use of value transfer methods to help identify the efficient allocation.

- [http://ecovalue.uvm.edu/newzealand/](http://ecovalue.uvm.edu/newzealand/)

- If MSB - MEC used to determine allocation of water, → reduced allocation to the use with external effects.

- Reduced allocation to that use → less external effect.
MSB and water allocation

Available water per time period

Marginal Social Benefit dairy

Marginal Social Benefit horticulture

MSBd - MEC

MSBh

Q1 Q2 Q3

0
### External costs of Canterbury dairy farming

Tait and Cullen 2006.

<table>
<thead>
<tr>
<th>Damage estimates</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Canterbury Dairy Economic Surplus ($1780/ha)</strong></td>
<td><strong>$260,000,000</strong></td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Surface water</td>
<td>115,000</td>
</tr>
<tr>
<td>Groundwater</td>
<td>40,000</td>
</tr>
<tr>
<td>Angler values</td>
<td>9,000 - 16,000</td>
</tr>
<tr>
<td>Air</td>
<td></td>
</tr>
<tr>
<td>CO₂ equivalent</td>
<td>24,269,000 - 40,449,000</td>
</tr>
<tr>
<td>Biodiversity</td>
<td></td>
</tr>
<tr>
<td>Shelterbelts</td>
<td>2,947,000</td>
</tr>
<tr>
<td>Sediment</td>
<td>18,000</td>
</tr>
<tr>
<td>Human Health</td>
<td></td>
</tr>
<tr>
<td>Pathogen related illness</td>
<td>39,000 - 152,000</td>
</tr>
<tr>
<td>Bovine TB</td>
<td>1,265,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$28,702,000 - $45,002,000</strong></td>
</tr>
<tr>
<td><strong>External costs/ha/year</strong></td>
<td>~ <strong>$200/ha/year</strong></td>
</tr>
</tbody>
</table>
Recognise water scarcity, reduce use, increase efficiency of use

- Water is scarce, and we need to recognise scarcity.
- We can increase social benefits, reduce demand for water and infrastructure by use of variable charges for urban water and wastewater services.
- Allocation of rights to use water could be modeled on methods to allocate rights to minerals, oil and gas.
- AFO, Competitive bids, royalties will ensure a fair return to owners/managers of water.
- Allowing transfer of water rights will ensure it has scarcity value and use gravitates towards highest valued uses.
- Economic research needed to value marginal external costs to impact water allocation decisions.
References


http://www.aares.info/aares_conference_2006