Sustainability needs good economics

Ross Cullen, Ken Hughey
Lincoln University

NZWWA 49th Annual Conference, Rotorua,
September 2007

LINCOLN UNIVERSITY
Te Whare Wānaka O Aoraki

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."

Kevin R. Kosar , 2007.

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*

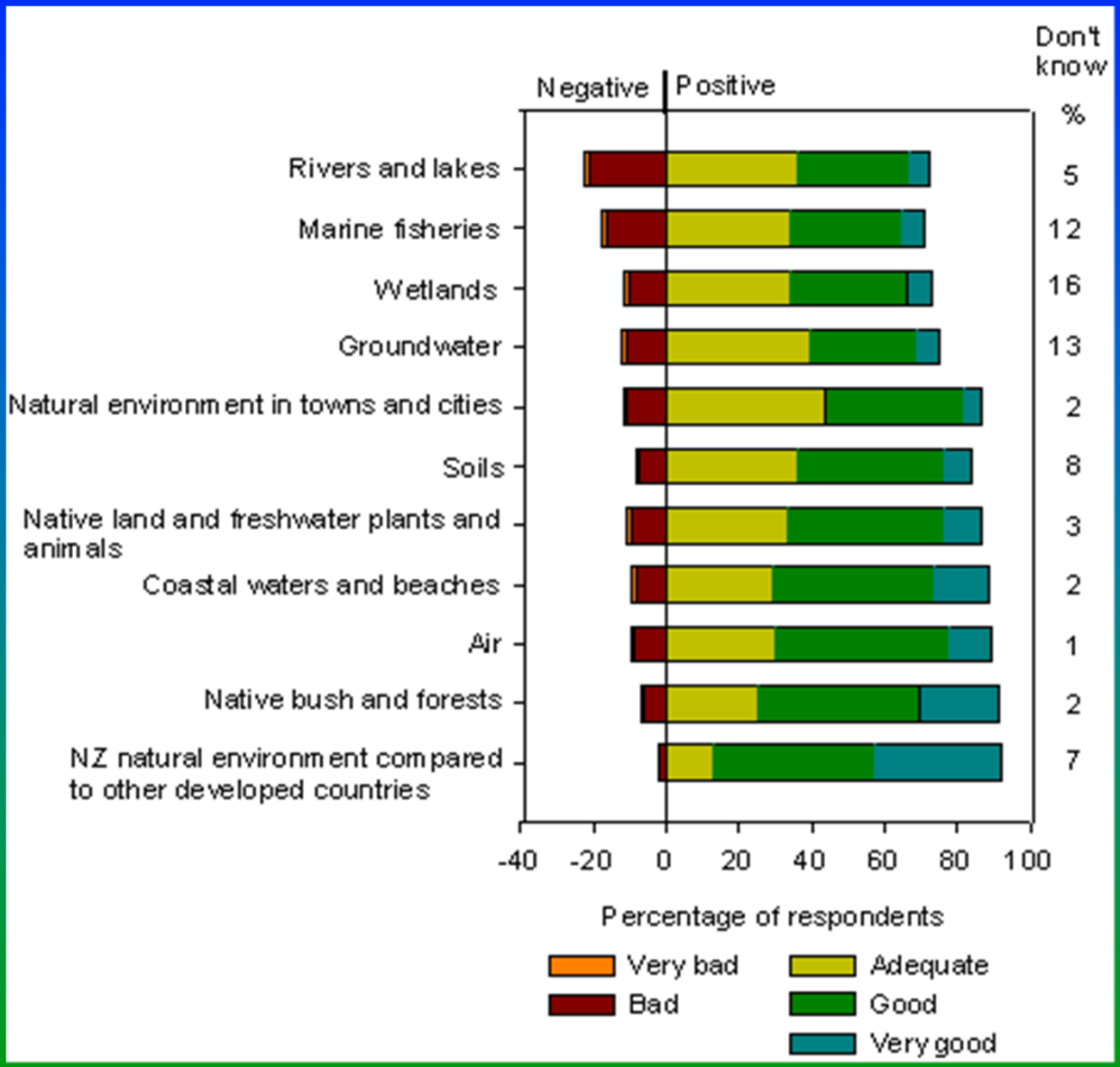
Water in New Zealand

- Large amounts of water but not always in the right place at the right time in the right amount
- 1410 m^3/capita abstracted, 2nd 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.

Perceived state of NZ environment Hughey et al., 2006



International rating of water availability and quality

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

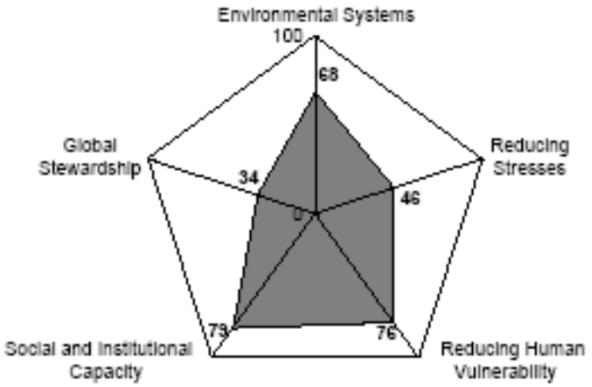
- Water quality is measured by 4 variables,
  - DO, EC, Phosphorous concentration, suspended solids

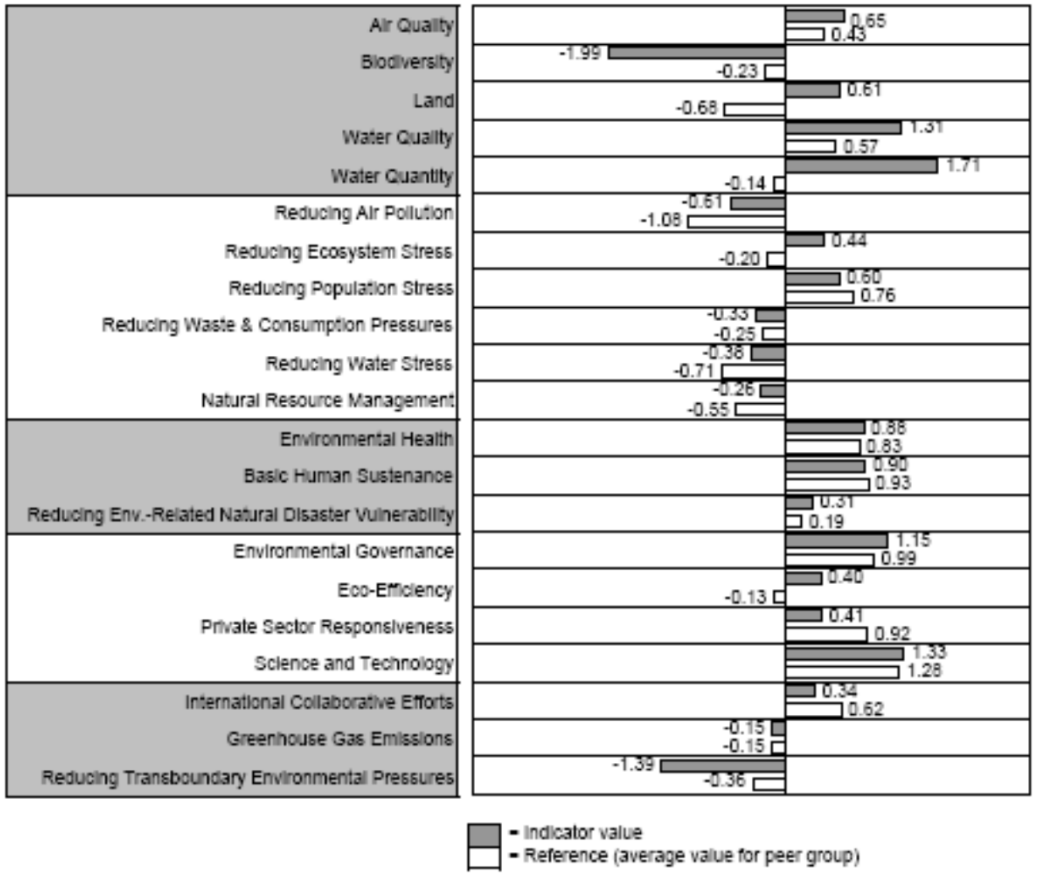
- Water quantity
  - freshwater and groundwater per capita

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

New Zealand

ESI:	61.0
Ranking:	14
GDP/Capita:	$18,416
Peer group ESI:	55.4
Variable coverage:	70
Missing variables imputed:	2





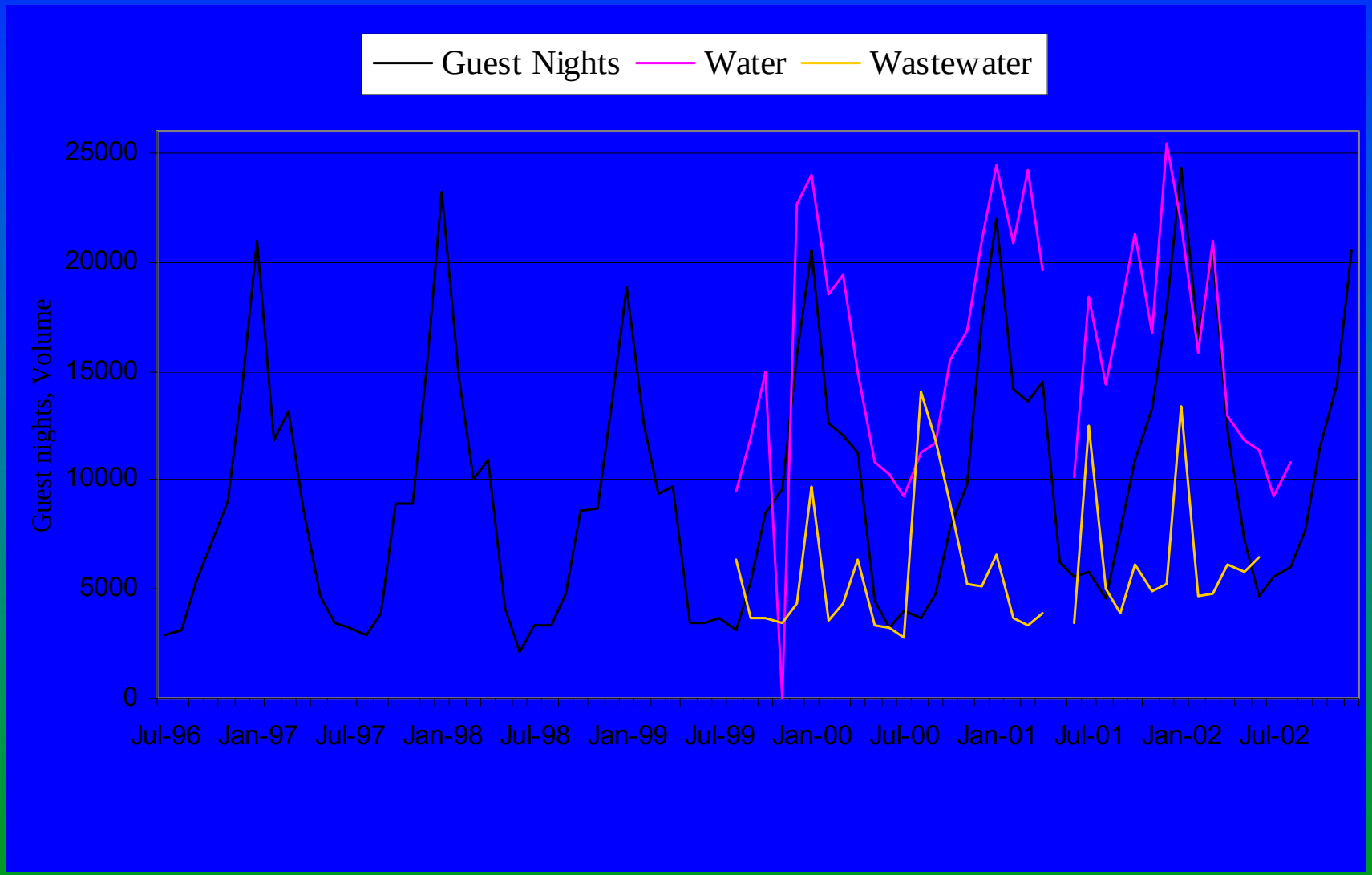
Urban Water and Wastewater Services

- 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 m^3
  - Kaikoura motels, wastewater charge – number of toilets
- Choice of pricing system matters

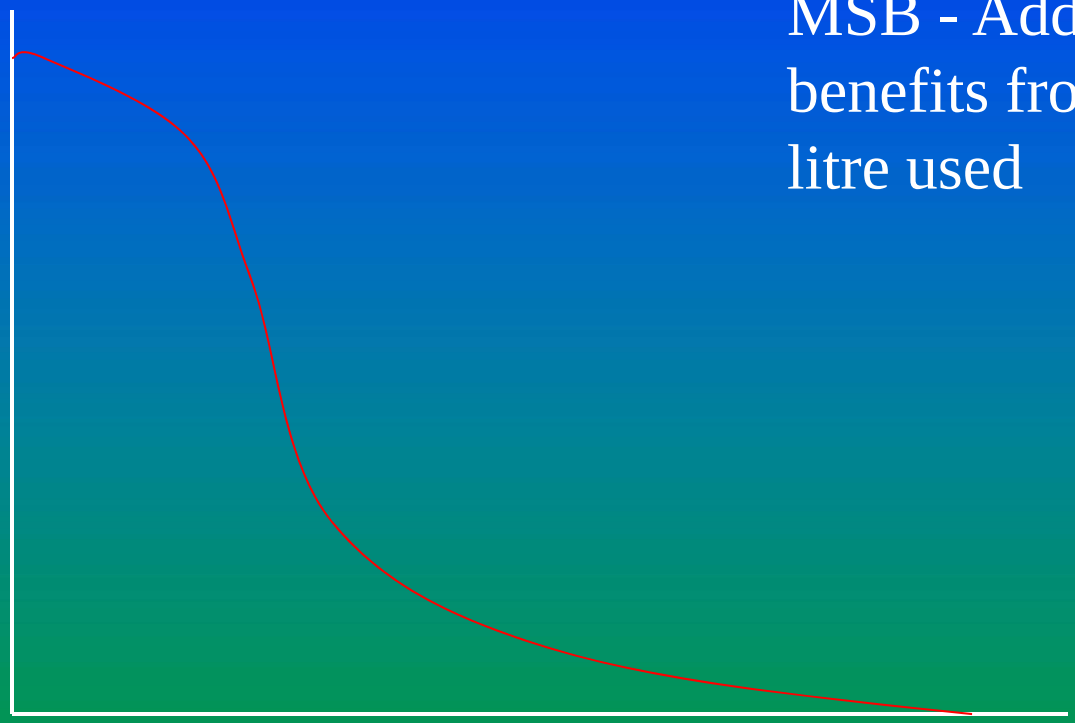
Seasonal demand

- 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



Marginal Social Benefits from water



MSB - Additional benefits from each litre used

Funding Water & Wastewater Services

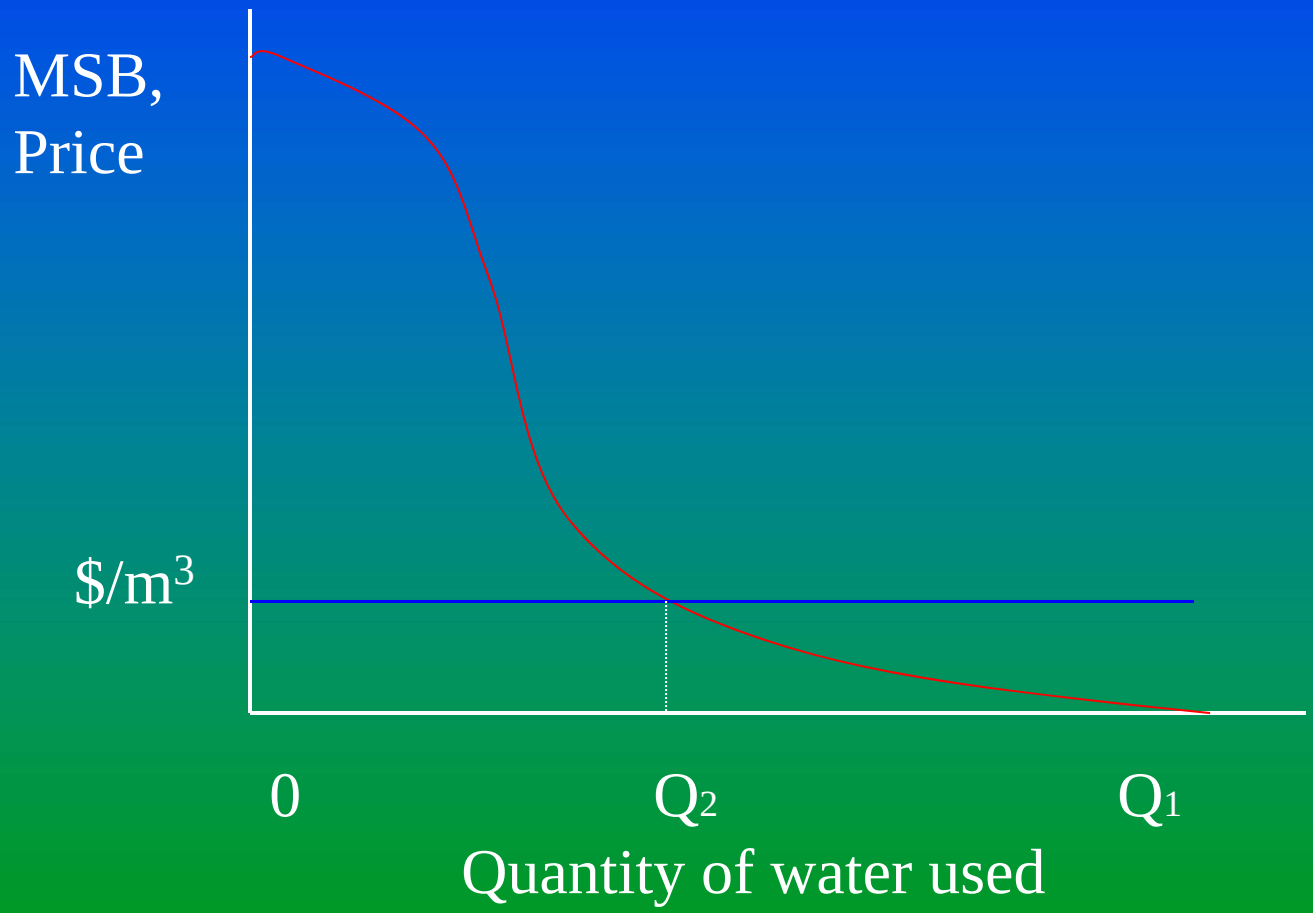
Rates set prices for water and wastewater services

If price/litre = 0, likely that usage ⇑ until MB = 0, and ⇑ demand for capacity, ⇑ operating costs, ⇑ environmental impacts.

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

Could they be improved?

Marginal Social Benefits from water



Do prices reduce water use?

- Price elasticity $= \dfrac{\%\ \Delta \text{ quantity}}{\%\ \Delta \text{ price}}$
- Price elasticity of demand for water is < 1.0
- Water usage falls by 15+% with water charges/m^3
- 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

	Water	Sewerage
Residential (connected)	0.042195c/$CV	0.067728c/$CV
Non-Residential (connected)	0.042195c/$CV Excess water 45c/$m^3$	0.067728c/$CV

Hanemann (1998) Evaluation Criteria

- 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

	Compliance	Justification
Sufficient	**Yes**	The rates collected cover all costs.
Stable over time	**Yes**	Predictable and no significant changes with water use.
Administration costs & complexity	Costs only	Flat rate and little differentiation between users.
Non-arbitrary	No	MC = 0 for residents, 45c/m3 for business after reach allowance
No cross subsidisation	**No**	High water users are subsidised.
Static efficiency	No	Big first block of water, no seasonal peak charges.
Dynamic efficiency	No	High water allowance sets no incentives to change long-run behaviour.
Encourage conservation	**No**	Zero marginal water charge - residents no incentives to engage in water conservation
Correct interpretation	Partially	Transparent system, but no recognition of right incentives.

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 $1m^3$ per day, non residential until reach $3m^3$ 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?
- $MC = \frac{\Delta \text{ Total costs}}{\Delta \text{ quantity of water}}$
- 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** - m^3 of water used.
- Use **seasonal prices** to conserve water in summer.

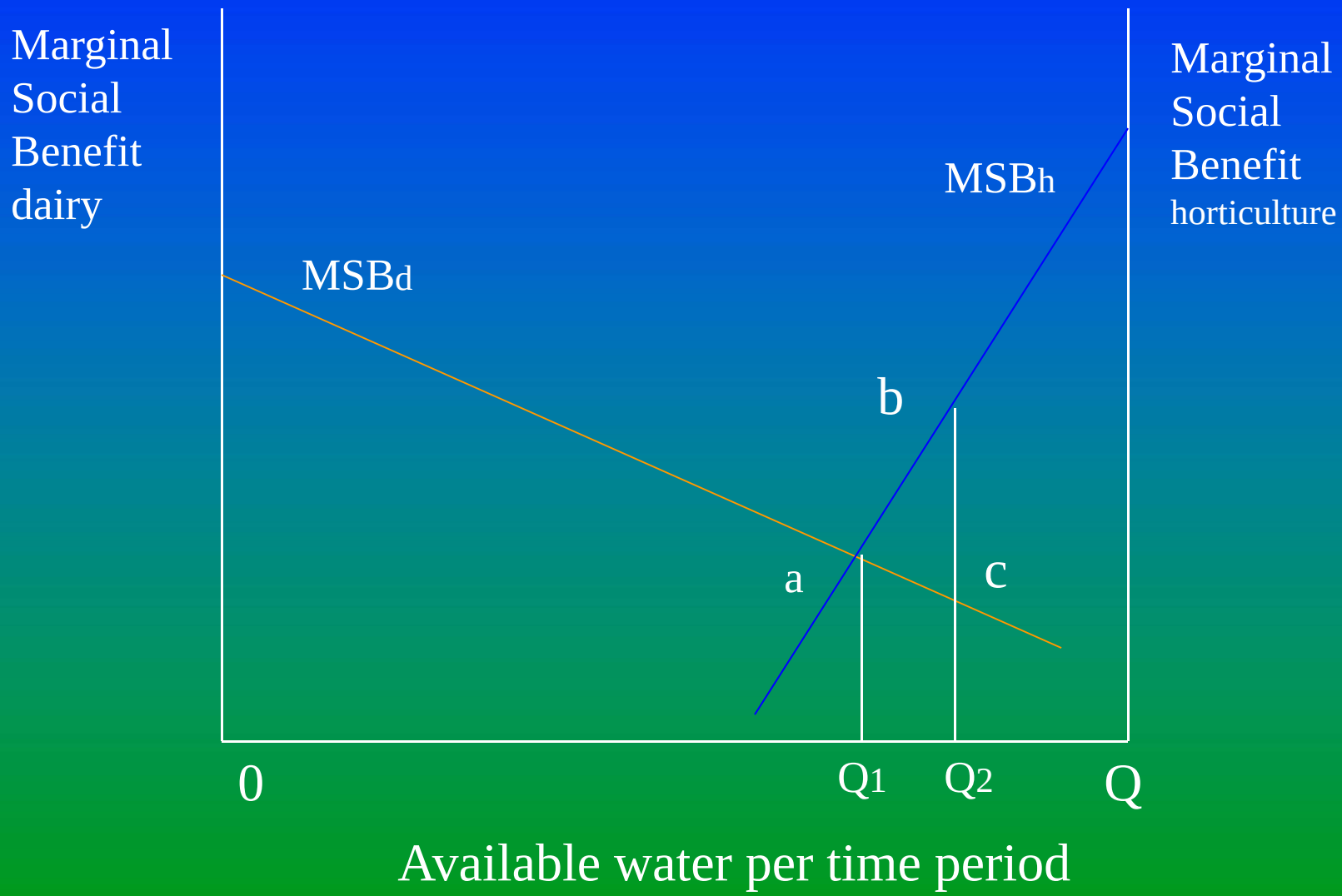
Rating systems and Sustainability

- 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 MSBd = MSBh 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, MSBd>MSBh and we could increase social welfare by reallocating Q2 - Q1 water
- ABC - the gain in social benefit from water reallocation

MSB and water allocation



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

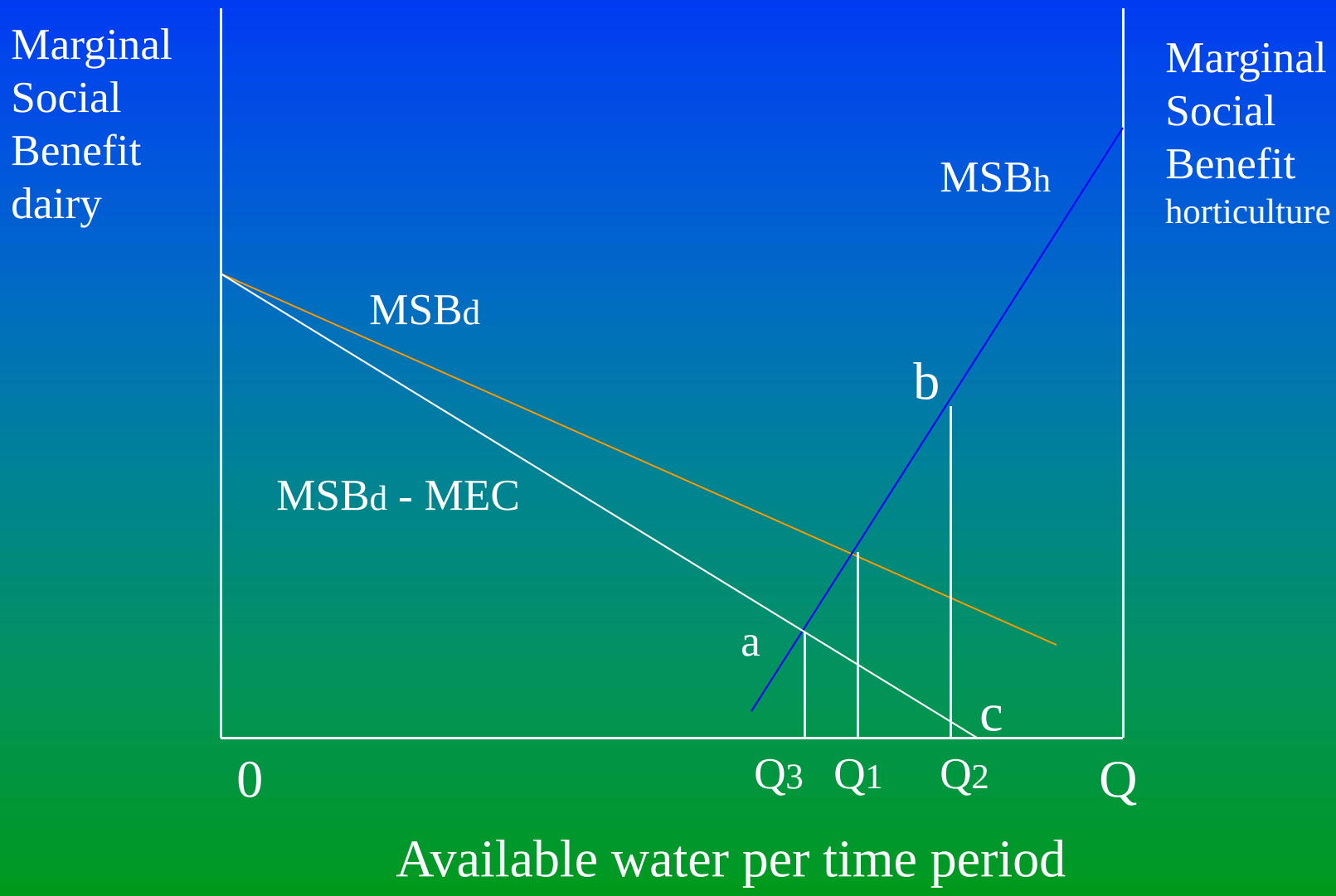
Rural water allocation

- 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/
- 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



External costs of Canterbury dairy farming

Tait and Cullen 2006.

Canterbury Dairy Economic Surplus ($1780/ha)		**$260,000,000**
Damage estimates		$
Water	Surface water	115,000
	Groundwater	40,000
	Angler values	9,000 - 16,000
Air	CO_2 equivalent	24,269,000 - 40,449,000
Biodiversity	Shelterbelts	2,947,000
	Sediment	18,000
Human Health	Pathogen related illness	39,000 - 152,000
	Bovine TB	1,265,000
Total		**$28,702,000 - $45,002,000**
	External costs/	**~ $200/ha/year**

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

Cullen, R., Dakers, A., and Meyer-Hubbert, G. (2005). Tourism demands upon urban infrastructure. In (eds) D.Simmons and J Fairweather, *Understanding the Tourism Host-guest Encounter in New Zealand: Foundations for Adaptive Planning and Management*. EOS Ecology.

Esty, D.C., Levy, M., Srebotnjak, T., de Sherbinin, A. (2005). *2005 Environmental Sustainability Index: Benchmarking national environmental stewardship.* Yale Center for Environmental Law and Policy, New Haven

Freebairn, J. (2003). Principles for the allocation of scarce water. The *Australian Economic Review*, 36(2),203-212

Hanemann, W.M. (1998). Price and rate structures. In Baumann, Boland and Hanemann, *Urban water demand management and planning*. McGraw Hill, New York.

Hughey, K.F.D., Kerr, G.N., Cullen, R., (2006). *Public Perceptions of New Zealand's Environment: 2006*. EOS Ecology, Lincoln.

MFE, 2004. *Sustainable Water Programme of Action. Water allocation and use*. MFE.

OECD, (2007). *Environmental performance reviews. New Zealand*. OECD.

Tait, P. and Cullen, R. (2006). Some external costs of dairy farming in Canterbury. *50th AARES Annual Conference*, Manly, Australia, February http://www.aares.info/aares_conference_2006

LINCOLN UNIVERSITY
Te Whare Wānaka O Aoraki