Modelling of water values in different use sectors of South Africa

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1. Introduction

- Models: OR, Econometric, Input/Output, WTP
- Sectors: Agriculture, Forestry, Environment, Domestic use

2. Economic Principles

(A) Water as Consumption good

Espey surveyed 124 demand studies: Price Elasticity of demand = -0.38 (SR)

(B) As input in production

Derived from demand for product ….

Input/Output & B/C measure Average Product

LP, WTP, Rental Values measure Marginal Product

3 Contribution of water in different sectors

- Input/Output: 1 m^3 of water adds R1.5 in Agriculture and R157 in Industry
- This is an Average Value Product. Water allocation should be based on Value of Marginal Products and these may be similar.

4. Modelling water use in non-agriculture

4.1 Municipal

Conradie (2002) estimates marginal benefit to consumers as R2.4 per m^3 in Nelson Mandela Metropol

City buys water at R0.256 per m^3

Price Elasticity estimated as -0.47 (t=3.1)

4.2 Contingent Value of environmental use (estuary inflows)

40 estuaries (Hosking 2010)

Users: wealthy group (recreation activity), poor group (supply services)

WTP= R0.36 per m^3 (40 estuaries)

WTP = R 0.07 per m^3 (37 estuaries)

Public Good: may need state intervention

Earlier study on reducing alien vegetation: WTP for agriculture R0.125 and recreational use R0.046 per m^3

4.3 Commercial Forestry

- Use water in two forms: evapotranspiration and stream flow reduction
- Residual Value Method estimates water value for eucalyptus at R0.08 and pine R0.017 per m^3 (Tewari)
- Residual Value = Total revenue – all other cost (including capital and management but excluding water)

5.Modelling water in agriculture

5.1 Modelling water in Fish-Sundays River

Conradie used Risk Linear programming (includes variances and co-variances)

Different farm types (some farm types attach zero value to water) , source of cheap water

Marginal value between 0 and R0.21 per m^3

- Citrus producers could bid water away from fodder producers

5.2 Berg River (Louw)

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Positive mathematical programming (avoids inflexible bounds)

- Marginal value =R0.21 per m^3
- Water prices may increase from about R20000 to about R45 000 per ha as land rents move to water

5.3 Crocodile River (East)

Some of the investments in irrigation and development are sunk (fixed)

Per ha cost in cane farming (Van Rooy, 2006)

Cost	Amount
Water	R15000
Bare land	R3000
Development	R10000
Cane	R10000
Irrigation	R20000
Total	R58000

Crocodile River (East)

Irrigation development cost will have no value if water is sold for municipal use; Rents transfer to water if water is sold to non-agriculture . Water prices may increase in real terms from R15000

Per ha to R45000 per ha. Value of farms still the same.

Past policies depressed water price: Non-exercised users sold, no adequate metering, past policies attached scarcity value to land and not water

5.4 Orange River

Buyers of water rights had higher return per m^3 of water than sellers.

Research tools: discriminant analysis, principal components, logit/probit models (Armitage and Gillitt)

5.5 Eastern and Southern Cape

CVM: Benefits from removing water consuming alien vegetation (Port Elizabeth Drift Sands, Albany, Kat River etc). Cost of clearing exceeds benefit of non metropolitan use (Hosking et al. 2002)

6. Reallocation of water

Williams used WTP to study water in Greater Letaba. Showed that if 5 million m^3 of water is transferred from agriculture to municipal use will increase welfare. Municipal use will increase from 25 million m^3 to 30 million m^3 but income will fall from R145million to R113 million.

	Water price per m^3	Costs per m^3	Water value per m^3
Agriculture	0.97	0.109	0.86
Forestry:Pine Gum	0.66 0.27	.0083 .0083	0.65 0.26
Municipal	5.72	3.5	2.22
Ecological	0.19	0	0.19

7. Modelling Risk

- Arrow/Pratt Absolute Risk Aversion
- Farmers in Orange River highly risk averse- downside risk (Possibility of loss)
- Investment model (Ridge Regression) shows that farmers who feel that water licenses are less secure are expected to invest less

8. Assurance of supply

- Water demand elasticity low in industry (water a relatively small share of total output)
- Water demand elasticity low for domestic use.
- Marginal benefit increases sharply with scarcity but falls quickly with increased supply
- Domestic use and Industry require high assurance but no urgency at present to transfer more water from agriculture.

9. Water Quality

- Mines permitted to release effluent in Olifants River during high flow period (ControL Release Program). Still, old disused mines leak pollutant also during low flow
- Proposals: Levy on discharges, markets in pollution rights, bio-diversity off-sets.

10. Further Research

- Farmers want information on many issues (systems analysis approach). Meetings with stakeholders important
- Institutions of water markets
- Water quality

11 Concluding Comments

- Water prices will increase in real terms as rents from land are transferred to water
- Evidence indicates that industry and domestic use place a high value on sufficient water but less value on more that what is currently consumed (price elasticity of demand is low).
- Value of water differs in main sectors and providing institutions for markets will improve efficiency.