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SUSTAINABLE DEVELOPMENT

BRIEFING NOTE

Does Pricing Water Reduce Agricultural Demand?

An Example from British Columbia

Highlights

- The pricing program established in 2000 in the South East Kelowna Irrigation District (SEKID) has had a significant impact on the demand for water per hectare.
- The metering and education programs established in the same area in 1994 (six years before the pricing program) did not have a strong impact on water use.
- There was a long-term decline in irrigation water use per ha in SEKID prior to the metering and pricing programs, possibly due to the gradual replacement of older technology, a shift toward crops that are less water-demanding, or gradually heightened awareness over time.

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Background

Agriculture is the largest consumer of water in Canada, as in most countries. With expansion of irrigation agriculture in many regions, and possible increases in drought and reductions in supply due to global warming,[1] finding ways to encourage agricultural water use efficiency without impairing productivity is urgently needed.

Volume-based pricing of water has long been promoted as a tool for managing demand, though in Canada, there are few rigorous studies of its effectiveness. Those studies that are available are restricted to largely urban domestic water use.[2] In addition, as volumetric pricing requires metering (which is itself an educational tool), it has been difficult to separate the effects of metering and education from those of pricing.

The South East Kelowna Irrigation District (SEKID) in interior British Columbia, presents a rare opportunity to disentangle the effects of metering and education from the effects of pricing. A preliminary analysis, comparing water use in drought years before and after the implementation of metering and pricing, suggested a minor reduction in water use due to metering and education, and a larger effect from pricing (Pike, 2005).

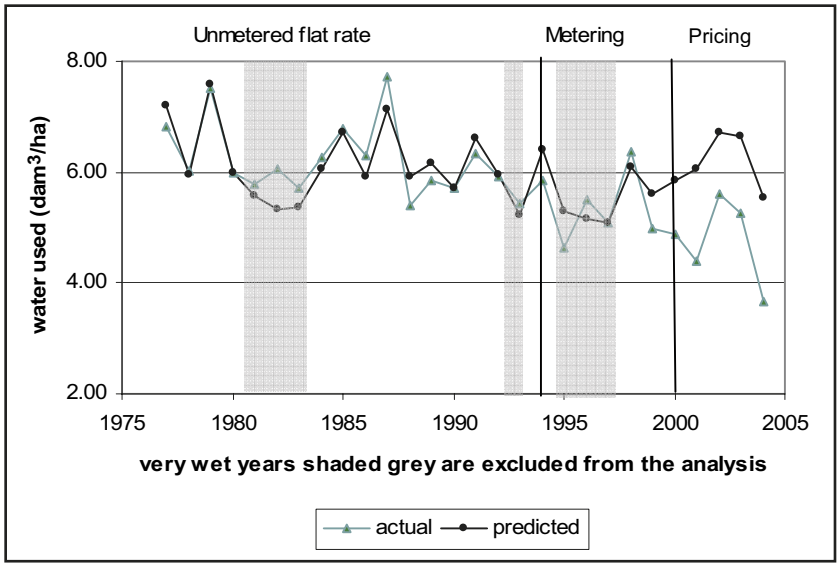
This Briefing Note, the fifth in a series on economic instruments for water demand management,[3] explores the SEKID example in greater detail. Presenting the first rigorous analysis of the effect of water pricing in Canada that takes weather into account, we find no strong evidence of an effect from metering and education. Pricing, however, seems to have significantly reduced water use.

The South East Kelowna Irrigation District

The SEKID serves 2,282 ha of mainly orchard land in the semi-arid Okanagan Valley of southern British Columbia. It currently has 2,300 water connections, including 400 irrigation connections. Approximately 85 percent of the water used in the SEKID is for agricultural irrigation. The SEKID draws its water from reservoirs that are primarily replenished by spring melt of the snow pack in the 65 km^2 watershed. It is considered highly vulnerable to climate change, which is expected to both reduce the snow pack and increase irrigation water demand.

Canada

Figure 1: Actual and Predicted Water Used: Multiple Regression



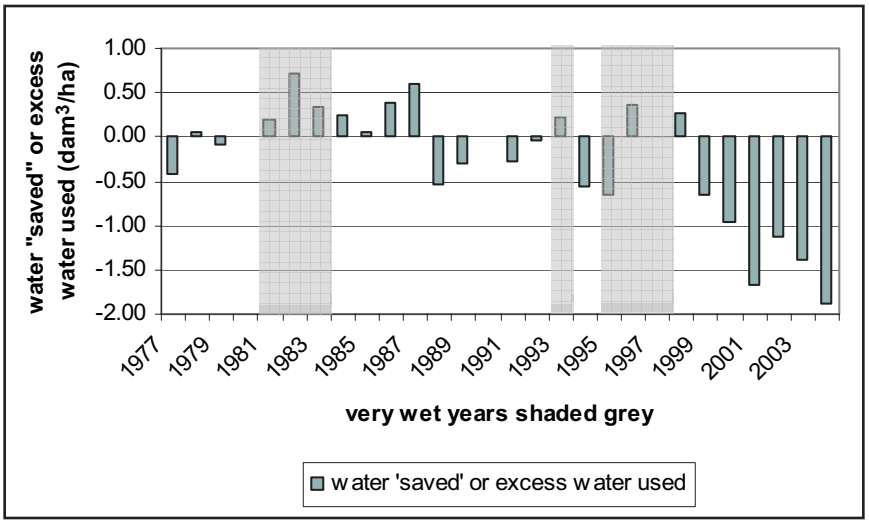
Water use per ha from 1977 to 1993 is predicted with 75% accuracy by a multiple regression of water use against seasonal moisture deficit and year. Projecting this relationship from 1994 to 2004 adequately predicts water use during this period, and suggests no impact from the metering and education program from 1994-1999, but a net impact from the pricing program, from 2000-2004. Wet years (those with moisture deficits more than one standard deviation below the mean) were excluded from the analysis, but are shown on the graph.

In the late 1960s, the estimated requirement for irrigation water in a drought year was 7.62 dam^3 ha^{-1}. This drought-year requirement became the basis for issuing irrigation permits. In 1994, in response to a series of droughts and continuing expansion of the irrigated area, the SEKID began installing water meters and providing irrigators with tensiometers (soil moisture meters), primarily as an educational tool, so irrigators would have a better sense of their own water usage and when irrigation was actually needed. This was followed in 2000 with a program of charging a flat rate for a basic water allotment and a volumetric rate for water use beyond that allotment. In 2003, this became a punitive increasing block rate for excess users. The charge in 2003 for exceeding the allotment by up to 10 percent was on average $40; two users who exceeded their allotments by more than 70 percent paid nearly $1400 each. The number of large abusers — those who used more than 130 percent of their allotments — was reduced to zero in 2004 after averaging about 5 percent of all users in the previous three years.

Pricing Impacts and Long-term Trends in Water Use

A multiple regression analysis[4] shows that when annual weather conditions are taken into account, water use declined by about 40 percent with the pricing program. The metering and education program alone (from 1994 to 1999) does not appear to have had a strong impact, though three of those six years were abnormally wet and cannot be taken as indicative of the program's effectiveness.

Figure 2: Water "savings"
Negative Values are Water Saved, Positive Values are Excess Water Used



Water "savings" — the difference between predicted and actual water used, based solely on annual weather and trends from before the metering and pricing programs. Negative values are "savings," positive values are excess use. 2001 to 2005, when punitive prices where introduced, are the only years where the savings are more than one standard deviation better than average.

The difference between the water use predicted by the pre-metering trends and the actual use provides a picture of water "savings" due to the metering and pricing programs. The "savings" of the year 1995 or of the year 1999 — after the metering program was introduced and before the pricing program — are strong, but not noticeably stronger than the "savings" of the year 1988 — before the metering program. In the year 2000, when prices where introduced, the water savings became significantly larger, and from 2001 to 2005, when punitive prices were introduced, water savings were very strong, exceeding one standard deviation. Therefore, the impact of the metering and education programs is not evident in the analysis, while the impact of the pricing program on water use is quite strong.

However, the volumetric pricing program is obviously dependant on metering. Further, the progressive phases of first metering and education followed by volumetric pricing only after five years might have helped irrigators to accept the pricing program and prepare for it.

There is also a long-term trend to declining per ha water use prior to the metering program. While the cause of this long-term trend is not known, it has also been observed anecdotally from other irrigation districts in interior British Columbia. Most water managers believe it is related to irrigators gradually adopting newer, more water efficient irrigation technology as their old equipment needs to be replaced, and the use of newer technology on land newly commissioned for irrigation agriculture. While it may also be that new, more drought-tolerant crops are being adopted in some areas, anecdotal evidence suggests that in fact farmers in the region are increasingly turning to more water-demanding crops with higher market values, such as cherries.

The per-hectare water savings realized through the volumetric pricing program in the SEKID will allow the District to either expand the area under irrigation without increasing water storage, or will provide supply security in the face of climate change. With the meters in place and users already comfortable with the volumetric pricing program, the SEKID is also well placed to manage demand, if necessary, through rate increases or other volume-based measures should there be a severe multi-year drought.

Conclusions

The SEKID example clearly shows the expected impact of pricing strategies. Hence, policies promoting metering and pricing might prove useful at least in the short term for reducing irrigation water demand. It also shows a long-term trend in water use reduction. If this trend is due to the adoption of newer irrigation technologies as old equipment fails, then policies encouraging the adoption of new technologies — for example, regulations limiting the sale of inefficient technology, or subsidies for upgrading before the end of the useful life of older less efficient technology — may be effective in continuing and perhaps even accelerating this trend.

It is not possible from the available data to distinguish how much water use reduction was achieved through replacement of old and less efficient equipment, how much through changes in practices, and how much through changes in crops or decommissioning of previously irrigation-intensive lands. The British Columbia ministry of Agriculture and Lands and Agriculture and Agri-Food Canada have initiated a detailed land use study that will help determine the contribution of land taken out of agricultural production to changes in water demand. Reduced extreme excess use on the part of a small number of producers in the last few years, however, suggests that at least part of the savings achieved were directly attributable to changes in behaviour on the part of some irrigators.

Further research is needed on metering, education and water pricing and their relative impact on agricultural water use. Research on the effect of flat rate versus increasing block rate is also needed. Moreover, the long-term decline in water use in the SEKID shows there are other means of reducing agricultural water consumption in Canada that should not be ignored.

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Notes

1 See for example Environment Canada, 2004. *Threats to Water Availability in Canada*. National Water Research Institute, Burlington, Ontario. NWRI Scientific Assessment Report Series No. 3 and ACSD Science Assessment Report Series No. 1. p128.

2 For a review, see *Economic Instruments for Water Demand Management in an Integrated Water Resources Management Framework*, available at <www.policyresearch.gc.ca>.

3 For other Briefing Notes in this series, please visit <www.policyresearch.gc.ca>.

4 See On-line Appendix: Statistical Analysis, available at <www.policyresearch.gc.ca>.