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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

IWRM

Estimating the demand for water in the SA industrial sector

A completed WRC-funded project estimated the marginal value of industrial water use in South Africa, and the associated price elasticity of demand for water.

Background

Sustainable long-term water resources management requires an integrated mix of supply and demand-side strategies. However, the scope for supply-side management strategies in South Africa is decreasing rapidly, with the only remaining options for increasing water supply becoming expensive and infeasible, such as inter-basin transfers and desalination of seawater or acid mine drainage.

The key to strategic water resource management therefore lies in effective demand-side management approaches.

In particular, the economic principle of pricing, which implies that a resource will be allocated efficiently and equitably if it is priced correctly, is an important component of water demand management. Water charges in South Africa tend to focus on recovering the costs associated with water supply, water research, and the construction, operation and maintenance of water schemes. However, the final price paid by water users in South Africa does not generally reflect the opportunity costs of water use or the scarcity value of water.

Water therefore tends to be under-priced and, as such, it is often not allocated or used in an economically efficient and equitable way. The need has therefore been identified for an allocation and pricing system that reflects the economic value of water as a resource (including scarcity value and opportunity costs), so that appropriate incentives are created regarding resource use and conservation.

Methodology

In the marginal productivity approach, water is included along with capital, labour, energy and raw materials as inputs in a production function. As such, application of this approach requires data on water use for a sufficiently large sample of companies to enable statistical estimation of a production function. Thereafter, marginal values and elasticities can be calculated based on the results of the regression model.

The estimated marginal values and elasticities provide useful information regarding the scope for and potential impacts of water demand management strategies based on water pricing. Firstly, the estimated marginal value of industrial water use (which reflect firms' maximum willingness to pay for water) can be compared with prevailing water prices (what firms actually pay); in order to assess the scope for increasing water prices through some form of water pricing strategy. If the marginal value of water use is higher than actual water prices, then there is evidence to suggest that water prices can be increased to better reflect firms' willingness to pay.

Secondly, price elasticity of demand for water is an indicator of the responsiveness of firms to changes in water prices and, therefore, of the expected impact of a change in price on water use and on revenues to the water services provider. More specifically, price elasticity of demand refers to the percentage change in water use resulting from a 1% change in the price of water.

A high negative price elasticity of demand (higher than 1 in absolute value, e.g. -2) implies that firms' water use is highly responsive to changes in price; i.e. that an increase in water prices will result in a significant reduction in water use; and therefore that a demand side management strategy is likely to be effective in reducing water demand.

On the other hand, a price elasticity of demand less than one in absolute value (e.g. -0.5) implies that firms would be

less responsive to changes in price. In this case, although an increase in water prices would lead to a reduction in water use, the percentage reduction in water use would be comparatively lower than the percentage increase in price. As such, in the case of 'inelastic' demand, an increase in water prices would be less effective in reducing water demand as compared to a case of higher elasticity; although it would be effective in terms of increasing revenues to the water services provider.

The WRC-funded study applied and assessed the marginal productivity approach to estimate the marginal value of industrial water use in South Africa, and the associated price elasticity of demand. Primary data was obtained from South African companies in the industrial sector by means of a questionnaire. The primary data was supplemented with secondary data from the annual reports and sustainability reports of a number of companies.

Results and discussion

The production function was estimated statistically by means of an ordinary least squares (OLS) regression in EViews (Quantitative Micro Software (QMS), 2009). On the basis of the estimated coefficients and the sample averages for the different variables; the marginal value of water use, as well as the price elasticity of demand for water, both for all firms in the sample, as well as for each specific industry, were calculated.

The marginal value of water use, for the sample as a whole as well as for specific industries within the sample, was found to be negative, in contrast to theoretical expectations. This counter-intuitive result arises due to the presence of negative coefficients on certain variables in the production function, which in turn seems to arise owing to the presence of multicollinearity in the regression model (i.e. a high degree of correlation between two or more of the explanatory variables).

Indeed, the multicollinearity issue appears to be an inherent problem with this method, given the way in which the variables are constructed, particularly in the presence of a relatively small sample size as was the case in this study.

On the other hand, the price elasticity of demand for water among the sample of industrial water users was estimated in the range of 0.66 to 0.78 (depending on the specification of the model), which is in line with theoretical expectations and comparable with estimates for the industrial sector from other countries, as well as with estimates for other sector in South Africa.

The estimated elasticities suggest that, for every 1% increase in water tariffs, water use in the industrial sector can be expected to decrease by between 0.66% and 0.78%.

Conclusions

This study applied and tested the marginal productivity approach to estimate the marginal value of water to industrial users in South Africa, as well as the associated price elasticity of demand, based on a sample of 58 companies. The results indicate that the method is vulnerable to statistical issues, particularly in the presence of a relatively small sample size, which leads to unexpected results.

On the other hand, the estimated price elasticities of demand are line with theoretical expectations and comparable to estimates for the industrial sector in other countries, as well as for other sectors in South Africa. The estimated elasticities suggest that, as expected, an increase in water prices would lead to a reduction in water use.

Further reading:
To order the report, *Estimating the marginal value and price elasticity of demand for water in the industrial sector in South Africa: An application and assessment of the marginal productivity approach* (**Report No. 2103/1/13)** contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.