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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.

POLICY BRIEF

# Water and the economy

## Exploring the economic value of water

A recent WRC-funded study explored the value of water as an economic resource in the Greater Letaba River catchment.

## Value of water as a basis for water management

It has been suggested that as water scarcity in South Africa increases, the need to manage water as a national asset and for overall social benefit becomes imperative. A further contention is that such management would require knowledge of the economic value of water in different sectors of the economy and in different parts of the country. This contention rests on the hypothesis that water allocation according to the principle of maximising social welfare is best done by optimising the consumer surpluses that arise from all uses of water.

It is further postulated that these consumer surpluses are linked to the economic value of water through the water demand schedules for each of the various uses. The economic value encompasses the complete value of water to the economy, not just the infrastructural costs associated with making water available to end users.

To test these hypotheses and provide a basis for sound water management, the value of water as an economic resource in the Groot, Middle and Klein Letaba river catchments has been explored. The Groot Letaba area forms part of the Lowveld region of the Limpopo and represents the heart of the provincial economy, while the Klein and Middle Letaba can be classified as rural with a strong bias towards agriculture and retail. The area is largely arid, mainly low income, but has opportunities for commercial farming and forestry. The demand for water is an important issue in every part of the area and thus the need for effective water management is great. The ability to obtain economic values for water, and to use these for management decision support, is clearly a matter of great importance for this area.

## Approaches to valuing water

The value of an economic good can be approximated by users' willingness to pay for the good rather than go without it. This value can be expressed in terms of the money that would be exchanged for the commodity, provided that an explicit market for the commodity exists. Hence, if it is possible to estimate a market demand curve, the value of a good may be approximated as willingness-to-pay, by measuring consumer surplus.

Water demand curves for different goods are simulated through the use of various modelling techniques. The approach employed here was to use contingent valuation methods where water demand is direct (eg, municipal water), and to use either enterprise budgets and linear programming, or enterprise budgets with crop water production functions in the case of derived demand (eg, forestry and agricultural water). For the purpose of integrating these curves and evaluating different scenarios, a model which allocates water according to the principle of maximisation of social welfare was used. Model outputs are water demand schedules for different water user groups, from which consumers surpluses and water value are imputed. This scenario evaluation model reallocates water and sets appropriate prices, as well as providing a benchmark which indicates the extent to which the welfare-maximising objective of the exercise is met.

## Water supply, demand and value in the Greater Letaba catchment

### Water balance

The total water use in the study area was estimated to be 316.5 $Mm^3$ in the year 2002. In terms of annual runoff, this

would equate to a surplus of 183 $Mm^3$. However, in terms of the secure available annual yield (192 $Mm^3$) and an estimated annual use of 223 $Mm^3$ (after excluding the ecological reserve of 92 $Mm^3$) there was in fact already no available surplus. The position can only deteriorate in future (with the demand possibly rising to 228 $Mm^3$ in 2023) if no provision is made for increasing the future catchment yield.

## Water demand schedules and the value of water

Water demand schedules and values of water were obtained for the following sectors: agricultural water use; forestry water use; municipal water use; and ecological water use. For agriculture and municipal use, water was valued once it had been abstracted from the river and put to specific use. In the case of ecological water, the value of the water remaining in the river (not abstracted) was determined. This was done by considering the services which the river provides and the products, used by neighbouring communities, which it nurtures. Whilst not of direct concern in valuing ecological water in the Letaba catchment, it is important to have some appreciation of the value of Letaba River water to the Kruger National Park (KNP) downstream of the catchment. The value of Letaba water in the KNP was therefore estimated on the basis of the tourism potential of the river.

Using these approaches, the characteristics of the current water use, which include total use, economic water price, costs and economic water value, were deduced for each of the sectors. The economic price was revealed by the water demand schedules at the current level of supply, i.e., the price which would be current if there were a market for water. The water value was taken as the difference between the water price and its associated costs.

## Water allocation scenarios

Three different water allocation scenarios were postulated to test the strength of the Net Social Profit (NSP) model as an allocating mechanism. The first scenario relates to the current water allocations, for which values of allocated quantities, together with prices, values and an allocation benchmark were obtained. The benchmark gives a measure of the total consumer surplus associated with this scenario.

This second scenario relates to the reallocation of 5 $Mm^3$ water from agricultural to municipal water use. This resulted in a larger overall consumer surplus and consequently a more effective allocation from the point of view of increasing social welfare.

The third scenario relates to the allocation and use of new and currently unused water. Such a situation could arise as a result of savings due to more effective demand management, better water loss control or development of new water resources. An increased water availability of 5% in each sector is allowed for, resulting in this scenario having the largest benchmark of the three considered.

From the consideration of the three different scenarios, it has emerged that the NSP model can indeed be used to indicate broad trends, guide policy formulation and indicate the direction which water markets might take if they could be implemented. The hypotheses which underpin the application of the model have been proved sound.

However, caution is needed against unwarranted extrapolation to either the present or future of the quantities that have resulted from this particular study. These quantities (based on 2002 data) may lack general validity because of subsequent changes in critical model inputs and assumptions.

While this comment need not detract from the value of the study, it does, nevertheless, emphasise the need for understanding the underlying principles, strengths and weaknesses of the models when using their results.

## Recommendations

Having explored the various models, confirmed their promise and verified their operation, further research should be encouraged to remedy certain shortcomings, refine the models and facilitate their use as tools in the formulation of policy.

The following issues require attention:

- Delinearisation of the linear programming models (including the agricultural and Net Social Profit models) by using non-linear objective functions.
- Identification and assembling of more accurate and appropriate data to support further research on, and implementation of, models.
- More focused and appropriate use of the models in order to maximise their effectiveness.

**Further reading**:
To obtain the report, *The Value of Water as an Economic Resource in the Greater Letaba River Catchment* (**Report No: 989/1/08**) contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; E-mail: orders@wrc.org.za; or Visit: www.wrc.org.za to download a free copy.