

# **Water use efficiency and influence of management policies, analysis for the small-scale irrigation sector in South Africa**

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With the growing water scarcity, the increasing competition across water-using sectors and the increased concern about environmental sustainability, the need for more efficient water use has worldwide increased in importance. Moreover, cost-recovery is now widely acknowledged as a cornerstone of sustainable water management. These two trends also constitute a major challenge for the small-scale irrigation sector in South Africa. In the light of these challenges, the objective of this research is to contribute to improved water management for small-scale irrigation schemes in South Africa. This study is structured using a conceptual framework identifying two stages in decision support: ex-post analysis of the existing water use situation in the small-scale irrigation sector and ex-ante analysis of the impact of potential water resources management policies. The analyses are based on primary data collected during two phases of data collection in South Africa.

In a first analysis the economic production value of irrigation water at the small-scale irrigation schemes was determined using the residual imputation method. This gives a first indication on how efficiently water is used, but it also sheds light on the potential for cost recovery. Smallholders at this type of schemes mainly produce vegetable crops and the average water values estimated were in line with those from earlier studies for this type of crops. Results however also show that without government subsidies on inputs, the profitability of many smallholders was low. Achieving full cost recovery therefore appears to be problematic if the sector fails to increase productivity.

In the next part the concept of sub-vector efficiencies is introduced as a measure for the efficiency with which water is used. The sub-vector efficiencies are calculated using Data Envelopment Analysis. The low sub-vector efficiencies for water demonstrate that smallholders fail to reach their overall technical efficiency levels when it concerns water use. Therefore, even using the technology currently available there is a potential to reallocate a fraction of the irrigation water to other water demands without threatening the role of small-scale irrigation. The low sub-vector efficiencies furthermore are an example of the fact that without water pricing, farmers have little incentive to limit their water use or to invest in water saving technologies.

In a third empirical chapter an innovative two-steps simulation model was developed to study the impact of introducing a water price. The model uses a representation of the technology and the individual efficiencies of smallholders in a profit maximisation

model. Farmers appear to be quite responsive and adjust their water use, even when a relatively low water price is introduced. Pricing water can thus be used to provide incentives for water use reduction and/or efficiency improvement. However, the introduction of a water price is also shown to significantly decrease farm profit. Smaller farms in terms of output (mainly the poorer farmers) are affected most by this and, at higher water prices, are not profitable anymore; without government support they would even have to quit production.

The last part of the study investigates the potential to improve the water rights system in South Africa. Using a contingent ranking experiment the WTP of smallholders for specific interventions can be estimated. The results show that farmers are prepared to pay considerably higher water prices if this is connected to advancements in the water rights system. This implies that interventions in the water rights system can improve the efficiency of the small-scale irrigation sector. A higher WTP for water is also interesting in the light of the cost recovery objective of the South African government, because it allows the government to increase water charges.

In general, this research confirms that improvement of the water use efficiency and cost recovery are major challenges for the small-scale irrigation sector in South Africa. It was shown how economic analyses can be used to inform policy making to address these challenges.