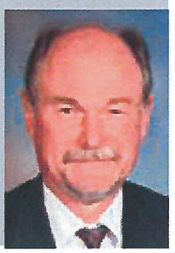
In this series of articles, *Agri* is in discussion with Dr Gerhard Backeberg, executive manager: water utilisation in agriculture of the WRC, in order to obtain information on water use and what the WRC is doing for investment of funds in water research.



Dr Gerhard Backeberg

Water use of bio-fuel crops in South Africa

Many irrigation farmers in South Africa pay an annual research levy to the Water Research Fund in respect of water which is used for irrigation on scheduled land. This Fund is dedicated to financing the activities of the Water Research Commission (WRC) to support and undertake research on the use of water for agricultural, industrial and domestic purposes. The levy on irrigation water is, however, not the only source of income for the Fund: Levies on water use for urban, industrial and domestic purposes makes by far the biggest contribution.

Agri: During 2009 the WRC published a scoping study on the water use of bio-fuel crops, with recommendations for further research. Has this research been completed and what actions can now be taken based on the available knowledge?

Backeberg: The scoping study was followed by a comprehensive research project, undertaken over six years and led by the University of KwaZulu-Natal. After an inaugural workshop, it was decided to give attention to measurement and/or modelling of water use and mapping of bio-fuel feed stocks of sugar cane, sugar beet and grain sorghum (for bio-ethanol production) as well as soybeans and canola (for bio-diesel production). In the concluding summary of the report it is stated that research priorities changed over the project's duration, amongst others due to policy amendments and new developments pertaining to South Africa's bio-fuels industry. Nevertheless, the project contributed to the generation of the following new knowledge:

(1) Monthly crop coefficients were derived for prioritised feedstocks that are deemed representative of local conditions;
(2) These crop coefficients were used to improve estimates of the hydrological impact of feedstock production on downstream water availability;
(3) Land use changes to feedstock cultivation may cause a possible shift in the low flow period, which was highlighted as another potential impact on downstream water users;
(4) The newly generated land suitability maps provide more realistic estimates of the total land area deemed suitable for rain-fed feedstock cultivation; and
(5) The use of a deterministic-type crop modelling to derive estimates of attainable yield and water use efficiency at a national scale represents a major contribution to the existing knowledge base on agricultural production potential.

The mapping and crop yield modelling approaches developed for this project, in particular the suitability maps for different bio-fuel crops, are considered innovative and novel for the bio-fuels industry. Applying a hydrological simulation model, the potential impact on catchment water resources of large scale land use change to feedstock cultivation was assessed.

In addition, a crop water productivity model was used to provide estimates of attainable yield for selected feedstock crops at the national scale. Water use efficiency (WUE = yield per unit of crop water use) was then calculated for each hydrological sub-catchment across the country. It was envisaged that the project outputs will benefit different end-users in the following manner:

- The department of water and sanitation should utilise the large database of monthly and annual runoff simulations to assess the stream flow reduction potential of selected feedstocks in any quinary sub-catchment;
- The bio-fuel manufacturers should utilise the land suitability and crop yield maps to identify and target areas where feedstock should be cultivated;
- Agricultural extension officers will also find the crop yield maps useful for advising emerging farmers on which crop is best suited to their location;
- The department of energy could utilise the information to revise the country's bio-fuel production potential;
- WUE estimates for each biofuel feedstock may assist land use planners in striving towards the most beneficial use of available water resources.

The results from this research highlight the diverse range in feedstocks when ranked according to their bio-fuel yield potential per unit land area (i.e. "land footprint") or per unit water use (i.e. "water footprint").

The output of the project has confirmed that water availability and not land availability, will limit South Africa's bio-fuel production potential. The environmental impact of bio-fuel feedstock production depends on the mix of feedstocks used to meet the volume targets set by the mandatory bio-ethanol and bio-diesel blending rates.

The WRC published research reports (Volume 1 numbered 1874/1/15 and Volume 2 numbered 1874/2/15), with a CD of the atlas of bio-fuel crops in suitable growing areas (Volume 3 numbered TT 652/15), which are obtainable free of charge at the addresses below.

Visit the Water Research Commission's web page www.wrc.org.za for more information and / or ordering of research reports
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