June 2013
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

Non-point source pollution

Modelling agricultural non-point source pollution and economic-environmental trade-offs of pollution control measures

A recently published study funded by the WRC has improved understanding of non-point source pollution from agricultural activities.

Background

Some kinds of pollution are much easier to identify, measure and control than others. When one is dealing with a sewage spill or dumped chemicals the source and effect of pollution is fairly straightforward. The same cannot be said for fertiliser or pesticides leaching slowly from an irrigated field into the soil. This is but one example of the non-point sources of pollution that a recently published multiyear, multidisciplinary WRC study aimed to understand.

Agriculture has been identified as a significant source of non-point source pollution. Non-point source pollution impacts from agricultural activities include salinisation (through irrigation return flows or salt wash off and leaching under dry land cultivation), eutrophication (through fertiliser leaching and nutrient wash-off from human settlements on farms), sediments (as a result of erosion), pathogens (from intensive animal production), pesticides (through the application of insecticides, fungicides and herbicides), and heavy metals.

Leading agricultural non-point source pollution research funding

First order estimates were made of nutrients, sediments and pesticides in South Africa's water resources during an initial scoping study funded by the WRC in 2005. It was recognised that more detailed research was required to measure and model the impact of this type of pollution from field to catchment scale. This led to the latest study being funded by the Commission, the primary objective of which was to develop an integrated modelling approach to predict agricultural non-point source pollution from field- to

Non-point source pollution from agriculture is of growing concern in South Africa.

catchment-scale for selected non-point source pollutants.

A secondary aim was to develop a modelling approach to examine the economic-environmental trade-offs of agricultural pollution control measures.

The project, which ran for close on seven years, brought together the best available experts from different organisations into one research team. Apart from involving specialists in various scientific disciplines, the project also enabled interaction between natural and economic scientists.

Several challenges were identified that hamper the effective management of agricultural non-point pollution, some of which the project aimed to address. These include inadequate understanding of the economic-environmental trade-offs of non-point source control measures; lack of practical demonstration of the water quality improvements brought about by non-point source control measures; fragmented buy-in by organised agricultural and affected farmers; administrative and regulatory disjuncture between relevant government departments and institutions (both national and provincial) as well as disjuncture between political imperatives and environmental management necessities.

The project was structured into four parallel, but overlapping, phases to ensure research effort synergies and interlinked research output:

- Phase 1: Observation and monitoring of non-point source pollution processes at point-, field- and catchment-scales (nutrients, sediments and pesticides);
- Phase 2: Developing field-scale non-point source pollution predictive capability via a bio-physical field-scale model (nutrients and sediments), as well as an expert system (pesticides);
- Phase 3: Developing catchment-scale non-point source pollution predictive capability via catchment- scale bio-physical models (nutrients and sediments); and
- Phase 4: Developing economic-environmental trade-off modelling ability, supported by the above biophysical models.

The project demonstrated that combining economic and applied natural sciences in long-term, multi-scale, multi-disciplinary research is not only operationally feasible, but also yields notable scientific and technological returns. Apart from numerous cross-disciplinary research process learnings various multiscale and multidisciplinary management decision-support and planning analysis modelling tools were established.

New knowledge

Significant new knowledge has been generated on the identification, monitoring and management of non-point source pollution from agricultural sources in South Africa. The project allows differentiation between non-point source and point source contributions to the general loadings in river systems; it facilitates prioritisation of non-point source control measures at both field- and catchment-scales; and it highlights the interface between economic considerations and biophysical considerations in water resource quality management.

With publication of the set of five scientific reports, efforts will now be made to disseminate the results and findings to farmers and officials through information sessions. This will be followed by workshops to determine further actions by various stakeholders.

Project members have also presented their findings at numerous conferences and through 15 journal articles. In addition, the WRC has initiated a follow-up project on the contribution of agricultural activities to pollution of water resources with chemicals contained in pesticides and weedicides in crop cultivation and medicines for livestock husbandry.

Further reading:

To obtain the reports from this research contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.

Reports:

- *Modelling Agricultural NPS Pollution and Economic-Environmental Trade-Offs of Pollution Control Measures. A Project Overview* (**Report No. TT 516/12**)
- *Modelling Nitrogen and Phosphorus Dynamics in Cropping Systems at the Field Scale* (**Report No. 1516/1/12**)
- *Modelling the Fate of Pesticides: Primary Processes, Non-Point Source Data Collection and Guidelines* (**Report No. 1516/2/12**)
- *Modelling Nutrient and Sediment Dynamics at the Catchment Scale* (**Report No. 1516/3/12**)
- *Modelling Economic-Environmental Trade-offs of Agricultural Non-Point Source Pollution Control Measures* (**Report No. 1516/4/12**)