

## **Water Quality in the Central and North West Regions of NSW, in relation to the cotton industry.**

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### **Introduction**

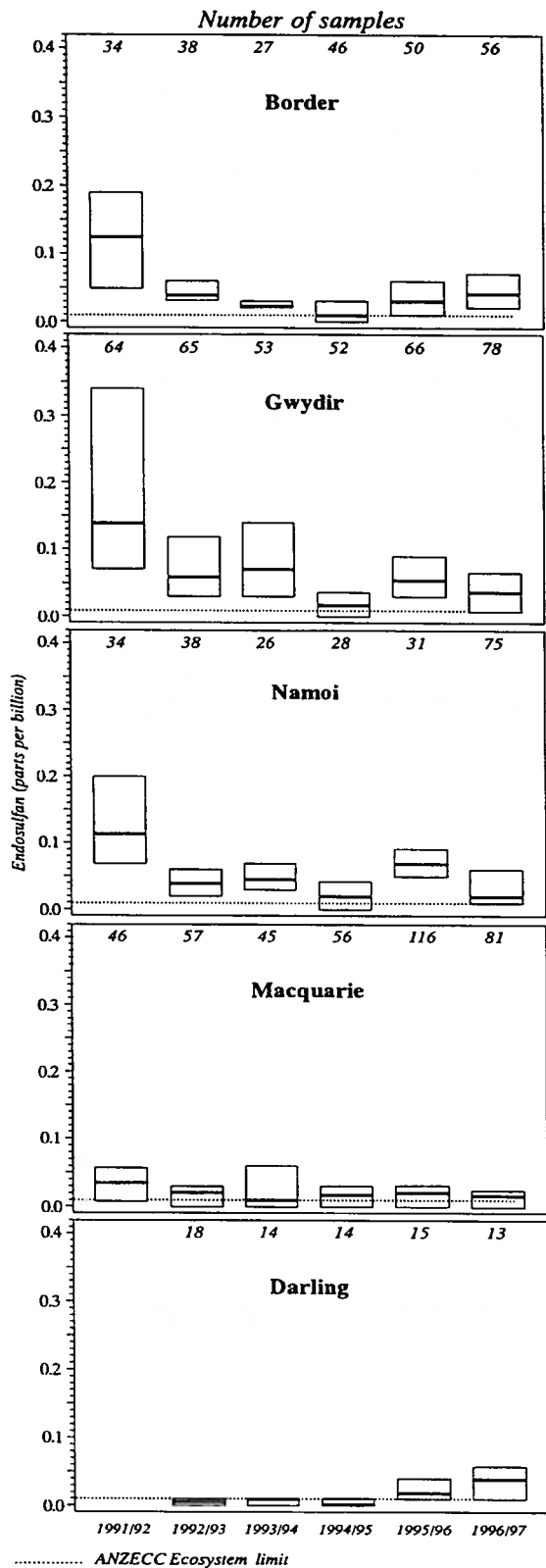
In the late 1980s, growing concern over the impact of irrigated agriculture on the surface and ground waters of NSW, led the Department of Land and Water Conservation (DLWC), to conduct a water quality monitoring program in the Macintyre, Gwydir, Namoi and Macquarie valleys of NSW. This program commenced in 1991/92 and has been jointly funded by the DLWC and the water users of these valleys, whose on going concern, contributions and support are gratefully acknowledged.

Over the last seven years the cotton industry has seen several important developments. Cotton production has expanded geographically into large areas of the central and north west catchments of NSW. The transgenic cotton, Ingard, was introduced into commercial cotton production during the 1996/97 season. A reduction in the number of heliothis sprays which Ingard cotton requires, especially when planted in ecologically sensitive areas such as near waterways, is expected to lead to a reduction in the degree of off farm pesticide contamination. The preparation and formulation of the Australian Cotton Industry's Best Management Practices (BMPs) over the last few years, has prompted the discussion of a range of issues related to cotton farming, the environment and the community. Through the implementation of BMP guidelines, it is expected that the transportation of pesticides off farm would be minimised, and subsequently, pesticide contamination of the riverine environment would also be reduced. During the span of the water quality monitoring program, there have been good rainfall seasons with high cotton production and dry years with low yields of cotton. The amount of cotton planted will affect the volume of pesticides applied during a growing season. Changes which have taken place in the irrigation industry during the 1990s, and the variations in rainfall, have all been monitored as longterm water quality trends through the DLWC's water quality program.

### **Approach**

Physical parameters and nutrient concentrations are routinely monitored through the water quality program. Surface water samples are tested for thirty pesticides and metabolites.





**Figure 2.** Longterm trends of total endosulfan contamination in the Border Rivers, Gwydir, Namoi and Macquarie River catchments and the Darling River at Bourke.

all catchments (triangles). Sites typified by medium ranges of endosulfan and atrazine and low levels of diuron, fluometuron, metolachlor and prometryn were in the middle reaches of each catchment (squares). Irrigated agriculture is common in these areas. Sites that were typified by a high occurrence of pesticides, of which endosulfan sulfate and endosulfan isomers were common, as well as by high detections of atrazine, diuron, fluometuron, metolachlor and prometryn were found at the bottom of each catchment (diamonds). Two sites had relatively high incidences of endosulfan sulfate, alpha and beta endosulfan, atrazine, fluometuron, prometryn and metolachlor (crosses). These results demonstrate the impact of agriculture on surface water quality.

Graphical representation of the data is the simplest way to express longterm water quality trends (Figure 2). In 1991/92, endosulfan contamination of the riverine environment was the worst recorded through this monitoring program. Endosulfan concentrations found in surface waters have since decreased. The low cotton production year of 1994/95 due to drought conditions, was reflected by the lowest levels of endosulfan detected in rivers. Since then, the Border Rivers and Darling River at Bourke have showed an alarming trend of rising endosulfan contamination. The Macquarie River catchment has

maintained low levels of contamination throughout the monitoring program. Endosulfan contamination in the Gwydir and Namoi River catchments rose to pre drought levels in 1995/96, but decreased in the 1996/97 season, despite this season being the highest cotton production year since water quality monitoring commenced. It is hoped that this reflects the beginning of a declining trend of endosulfan contamination in these two catchments brought about by the awareness of BMPs, including the planting of Ingard cotton in sensitive areas. Future monitoring will evaluate whether this trend will hold as BMPs are further implemented, and whether the rising trends in the Border Rivers and Darling River catchments will be reversed. Monitoring at extra sites between Mungindi and Bourke was implemented in 1997/98 to provide a greater insight into these trends.

There is a growing concern that the impact of contaminated river sediments on riverine ecology is not fully understood. Sediments were collected and analysed from sites across the central and north west catchments of NSW during January and February, 1998. Of the 15 sites monitored, 4 were contaminated by endosulfan. Monitoring of sediments will be continued to provide further information regarding the extent and degree of contamination in these catchments.

Apart from routine surface water sampling, a new technique of continuous sampler bags has been used to augment water quality results. The bags are a low density polyethylene membrane, filled with a solvent which attracts and binds pesticides inside the bag. These bags remain in the water for days or weeks at a time, continuously accumulating pesticides which pass down the river. They are able to detect chronic low levels of pesticides which may otherwise be below the concentration level detectable by analytical methods, and therefore go unrecorded by the monitoring program. As the bags are in the water for a longer period of time, they also detect contamination events which may occur outside of the routine weekly, fortnightly or monthly sampling occasions. The bags have been trialed for the last two seasons. They will be incorporated into the future monitoring program in areas which are environmentally sensitive, and where access during high rainfall events is not possible.

Macroinvertebrates are small animals such as insect larvae, shrimps, snails and worms. They are an integral part of the food web of aquatic environments. They are monitored as part of the water quality study as they respond to a variety of environmental impacts that may not be detected by routine water chemistry sampling. Analysis of results to date have found that changes do occur in the biological populations before, during and after the summer spray season, however only weak relationships between these changes and pesticide contamination can be shown. The data is able to assess longterm river health

trends across these catchments. The DLWC is currently investigating the development of an ecological risk assessment model for endosulfan. This is a process for organising and analysing data, information, assumptions and uncertainties to evaluate the likelihood of adverse ecological effects being caused by endosulfan. The assessment will also identify gaps in information which can be targeted through specific data collection studies.

In addition to water quality monitoring and reporting, the DLWC has conducted cotton farm audit and reviews in the Macquarie, Namoi and Gwydir valleys. The purpose of these audits were to record the common farm management practices in each valley to enable comparisons to be made between valleys and with future management practices brought about by the BMP process. Both irrigated and dryland cotton growers, as well as non cotton growers were interviewed about aspects of farm management. Aerial contractors were also interviewed about their application practices. Each report gives an appraisal of how aware cotton growers and non cotton growers are of the environmental problems facing the industry and gives recommendations for future management strategies to reduce off farm contamination by pesticides.

The Land and Water Resources Research and Development Corporation (LWRRDC) has conducted a program entitled "Minimising the impact of pesticides on the riverine environment using the cotton industry as a model". The DLWC has worked closely with LWRRDC on this program allowing the water quality data to be available for use by other agencies for research. In addition the DLWC has investigated the transport of pesticides during storms and has attempted to distinguish the mode of transport of endosulfan from farm to river by analysing chemical and physical data.

## **Conclusions**

Water quality monitoring of the central and north west catchments of NSW will continue to assess longterm trends. This will include the affect of the implementation of BMPs on pesticide contamination of the riverine environment. Areas which are identified as newly developing, or problem areas will be targeted to identify the issues involved and help remediate the situation. Further development of the risk assessment model will continue over several years, along with continued research into the environmental impact of pesticides on river ecology.

## Further Reading

Boydell, P. (1997). Central and North West Regions Water Quality Program. 1996/97 Gwydir Valley Cotton Farm Review and Audit. NSW Department of Land and Water Conservation. CNR97.100.

Cotton Research and Development Corporation. (1997). Australian Cotton Industry Best Management Practices Manual.

Moroney, M. Graice, J. Boey, A. (1997). Central and North West Regions Water Quality Program. 1996/97 Report on Biological Monitoring. NSW Department of Land and Water Conservation. CNR97.113.

Muschal, M. (1997). Central and North West Regions Water Quality Program. 1996/97 Report on Pesticides Monitoring. NSW Department of Land and Water Conservation. CNR97.063.

O'Brien, J.M. (1995). Central and North West Regions Water Quality Program. 1994/95 Macquarie Cotton Industry Benchmarking. NSW Department of Land and Water Conservation. TS95.029.

O'Brien, J.M. (1995). Central and North West Regions Water Quality Program. 1995/96 Namoi Valley Cotton Farm Audit and Review. NSW Department of Land and Water Conservation. TS96.088.

Simpson, J. Norris, R. Barmuta, L. Blackman, P. (1996) AusRivAS - National River Health Program, Users Manual.

Wood, J. (1997). Central and North West Regions Water Quality Program. 1996/97 Report on Nutrients and General Water Quality Monitoring. NSW Department of Land and Water Conservation. CNR97.062.