IMPROVING WATER QUALITY IN NSW CANE DRAINS BY MONITORING AND GROWER PARTICIPATION

By

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Abstract

AFTER a 3 year study of surface water quality adjacent to canelands in north-east coastal New South Wales, Australia, the sugar industry has emerged from having little direct awareness of physiochemical, nutrient and pesticide water quality in major cane drains to a position of knowledge. Monitoring occurred in six of the many natural and constructed drains in the region. Automated water quality 'stations' were installed and maintained at the discharge end of each main drain to continuously measure pH, electrical conductivity (EC), dissolved oxygen (DO), temperature, stream height and velocity. In addition, monthly water samples were collected and analysed for DO, suspended solids, pH, EC, chloride, nutrients and pesticides. Canegrowers with farms adjacent to the drains operated as focus groups to discuss and respond progressively to the results from their respective drains, while several strategies were used during the study to inform other canegrowers and the wider community of the findings. The interactive nature of the study helped to raise awareness and change practices, which subsequently led to measurable improvements in water quality, particularly for pesticide residues.

Introduction

Around 35 000 ha of good agricultural land are used for sugarcane production by 600 growers in Australia’s most southerly cane growing region, located at downstream ends of the Tweed, Brunswick, Richmond and Clarence River Catchments in New South Wales (NSW). The area growing sugarcane in the four catchments is highly visible yet minor, comprising a little over one percent of the combined area of the four catchments.

To participate from a position of strength in environmental debates, the NSW sugar industry needed to be aware of its impacts on water quality. Farming lands in the sugarcane growing areas of NSW contain acid sulfate soils (ASS) that can release acid into river systems. Approximately 50% of the 600 NSW cane farms are underlain by acid sulfate soils. The industry needed to know the quality of drainage waters and how changes to on-farm management might impact on water quality in adjacent drainage canals, which are essential for efficient drainage and production in the NSW sugar industry.

On a local basis, it was recognised that a water quality monitoring program needed to involve growers on a similar basis to the way in which the acid sulfate soil problem was addressed via an interactive farm-scale survey in which every grower participated (Beattie et al., 2001). The wide network of natural and constructed waterways in the region provided an opportunity to undertake water quality monitoring in micro-catchments surrounded almost exclusively by cane farms.

How we did it

The study commenced in July 1999 with the major objectives being to create awareness among NSW cane growers of relationships between canegrowing practices and water quality; to progressively enhance water quality by modifying any practices identified by monitoring to be unsustainable; to inform growers on other drainage systems in NSW of management practices that have improved water quality; and
to inform the regional community of findings and actions by cane growers to enhance water quality. Monitoring commenced in November 1999 and continued through to September 2002.

**Drains and instrumentation**

Six of the many natural and constructed drains in the region were targeted, two in each of three mill areas (Condong Sugar Mill: Tweed/Brunswick River Catchments; Broadwater Sugar Mill: Richmond River Catchment; Harwood Sugar Mill: Clarence River Catchment).

A region and site location map is shown in Figure 1. All drains (shown in Figure 1) were under tidal influence and all except one drain were 'gated' to restrict the ingress of estuarine water, except that part-way through the study, the floodgates of Drains 5 and 6 were regularly opened to encourage tidal water exchange.

Automated water quality monitoring equipment was installed and maintained at the discharge end of the six main drains to continuously measure pH, EC, DO, temperature, stream height and velocity. In addition, monthly water samples were collected close by and analysed on-site for DO and, in a quality accredited laboratory, for suspended solids, pH, EC, Cl, nutrients (nitrogen and phosphorus) and pesticides (atrazine, diuron, 2,4-D, glyphosate, chlorpyrifos).
Key findings

Drain physiochemical properties

\textit{pH}

Most drains monitored were in good shape, without persistent acidity. One drain had periodic acid discharges. The average monthly-monitored pH was $7.03 \pm 0.86$. The maximum pH recorded was 8.6, the minimum 3.74, and the median 7.2.

\textit{EC and chloride}

These provided assessments on the ‘saltiness’ of the drainwaters. There were no surprises, given the proximity of the drains to estuarine water.

\textit{Dissolved oxygen}

Waterways provide critical habitat in the life cycles of many fish and other important aquatic species. All need DO in the water to remain healthy and productive. Our monitoring showed DO levels mostly between 6–8 mg/L, which rates as a satisfactory level of DO to support aquatic life.

\textit{Turbidity}

All sites that were monitored had turbidity levels below Australian guideline levels except in flood events.

\textit{Nutrients}

\textit{Nitrogen (N) and phosphorus (P)}

There was seasonal elevation of N and P levels. The components of N and P that attract close attention due to the connection with fertiliser and land management practices made up less than 10% of the total N and P measured at all sites.

\textit{Pesticides}

Five key points to emerge from the monitoring of pesticides in the drain waters were:

- No detectable residues during 15 months of monthly monitoring of the herbicide glyphosate and the insecticide chlorpyrifos.
- Median concentrations of atrazine, diuron and 2,4-D were mostly low or non-detectable and, with the exception of diuron on 6.6% of sampling occasions, were always within Australian water quality guideline values for moderately disturbed systems.
- The levels of residues in Drain 6 declined to inconsequential levels following initiatives of the local agricultural advisor and growers to replace problem formulations with alternative products.
- At no time did any pesticide residue exceed Australian Drinking Water Guidelines or recreational use guidelines.
- The pattern of detections of pesticide residues varied from drain to drain despite their relatively close proximity and similar farm management practices.

A co-operative approach

The success of this study relied on good communication. The NSW sugar industry recognised that, for the project to be a success, canegrowers whose farms surrounded the drains being monitored needed to be involved and have the opportunity to respond to the water quality indicators.

Prior to the commencement of monitoring, growers on each drain system were contacted, the aims of the project explained, and all growers agreed to participate.

Following these meetings, the water quality monitoring equipment was installed and, over the life of the study, growers received regular updates of findings. These were discussed in relation to current management practices and how management practices could be altered. Regular contact with the growers on the drains also occurred when collecting water samples and when maintaining equipment at the sites.

An obvious improvement in controlling unwanted pesticide residues resulted from this participation. Specifically, the occurrence of elevated levels of atrazine were brought to the attention of growers at Drains 1, 5 and 6 during shed meetings during the first 14 months of monitoring. This information generated considerable discussion and a concerted effort to investigate and use alternatives to

atrazine. The efficacy of these changes was seen in the marked reduction in atrazine concentrations in subsequent monitoring.

What has changed?

Pre-project attitudinal surveys revealed cane growers adjacent to the selected main drainage systems were interested in water quality and its links to land use practices. A follow-up attitudinal survey revealed new insights. All of the growers responded they had become more aware of the impact pesticides and fertilisers can have on water quality.

Similarly, 90% of respondents indicated they had gained a better understanding and knowledge of water quality within their drainage system over the past 3 years due to their association with the study.

Other cane growers were kept informed as was the local community and scientists within the Australian sugar industry. The initiative and some of the findings were also presented and discussed at national and international conferences on sugar and natural resource management.

Conclusion

This study has shown that monitoring of drain waters combined with a high level of interaction and communication with cane growers can result in improvements in water quality and uptake of farm practices that improve water quality and sugar industry sustainability. The NSW sugar industry is committed to continue with water quality monitoring, using the equipment already in place and by equipping and training growers on other drains.

The study has served as a model that others might adopt.

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REFERENCE

AMÉLIORATION DE LA QUALITÉ DE L’EAU DANS LE RÉSEAU D’ASSAINISSEMENT DE LA CANNE À LA NOUVELLE-GALLES DU SUD À TRAVERS LE SUIVI ET LA PARTICIPATION DES PLANTEURS

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Résumé

GRACE à une étude de trois ans sur la qualité de l’eau de surface s’écoulant dans la zone limitrophe des champs de canne dans la région côtière du nord-est de la Nouvelle-Galles du Sud, en Australie, l’industrie sucrière a acquis des connaissances quant à la qualité physico-chimique et nutritive et la teneur en pesticides des eaux provenant des drains principaux de la canne. Un suivi a été effectué sur six des nombreux drains naturels et artificiels de la région. Des stations automatiques ont été installées et entretenues à la sortie de chaque drain principal pour mesurer continuellement le pH, la conductivité électrique (CE), l’oxygène dissous (OD), la température, ainsi que la hauteur et la vitesse d’écoulement des eaux. De plus, des échantillons d’eau ont été prélevés mensuellement et analysés pour déterminer leurs teneurs en OD, solides en suspension, pH, CE, chlorure, substances nutritives et pesticides. Des planteurs de canne possédant des champs adjacentes aux drains ont été ciblés pour discuter et réagir au fur et à mesure que les résultats étaient obtenus de leurs drains respectifs, alors que plusieurs stratégies étaient utilisées durant l’étude pour informer les autres planteurs et le grand public des résultats. La nature interactive de l’étude a suscité à une prise de conscience et des changements dans la pratique, avec pour résultat une amélioration marquée de la qualité de l’eau, surtout en ce qui concerne les résidus de pesticides.

MEJORANDO LA CALIDAD DEL AGUA EN LOS DRENAJES DE CAÑA EN NEW SOUTH WALES CON MONITOREOS Y PARTICIPACIÓN DE LOS PRODUCTORES

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Resumen

LUEGO de un estudio de 3 años de calidad de aguas superficiales cercanas a cañaverales en la costa noreste de New South Wales, Australia, la industria azucarera ha pasado de tener poca conciencia directa del efecto de agentes fisicoquímicos, nutrientes y pesticidas en la calidad del agua a una posición de conocimiento. Los monitoreos se hicieron en seis de los muchos drenajes naturales y construidos de la región. Estaciones automáticas de calidad del agua fueron instaladas y mantenidas en las salidas de descarga de cada drenaje principal para medir continuamente el pH, conductividad eléctrica (CE), oxígeno disuelto (OD), temperatura, altura del caudal y velocidad. Adicionalmente se recolectaron y analizaron muestras mensuales para la OD, sólidos en suspensión, pH, CE, cloro nutrientes y pesticidas. Los productores de caña con fincas adyacentes a los drenajes funcionaban como grupos focales para discutir y responder progresivamente a los resultados de sus respectivos drenajes, mientras que varias estrategias eran usadas durante el estudio para informar a otros productores de caña y a las comunidades sobre los hallazgos. La naturaleza interactiva del estudio ayudó a aumentar la conciencia y a cambiar algunas prácticas, lo que condujeron subsecuentemente a mejoras cuantificables en calidad del agua, particularmente en cuanto a residuos de pesticidas.