Waste water or treasure?

By Lisa Brennan

One man's waste water could be one farmer's treasure according to a recently completed study. A team of researchers from CSIRO Sustainable Ecosystems and CSIRO Land and Water has evaluated the feasibility of using recycled water from sewage treatment plants in Brisbane and surrounding shires to help Darling Downs farmers who are facing critical water shortages.

The study, called An economic and environmental evaluation of the benefits and risks of recycled-water irrigated crop production on the Darling Downs, was commissioned by farming, business and community group Darling Downs Vision 2000.

Access to recycled water offers an opportunity to supplement irrigation water supply on the Darling Downs. The study addressed economic implications at the farm scale — and environmental implications at the farm and regional scale — of introducing recycled-water as a source of irrigation.

Computer modelling of crop production using the Agricultural Production Systems Simulator (APSIM) was teamed with farm-scale economic analysis to compare the production, economic and environmental consequences of using recycled water with those associated with current irrigated and dryland practices on the Darling Downs. The risks associated with climate variability were also assessed by incorporating 45 years of historical climate data into the models.

The study was based on case studies of 10 farms on the Darling Downs, representing the typical mix of crops, existing water sources and locations which could potentially receive recycled water. The participating farmers were asked to describe their current cropping and irrigation activities and nominate how they would incorporate their requested supply of recycled water into their farming system. In addition to the farm-scale analysis, a hydrology study of the Condamine catchment addressed the regional environmental consequences.

Potential to increase production

The results of the study showed that recycled

CSIRO's Peter Carberry (left) and Lisa Brennan (right) discuss the results of the research project with farmer Ray Pengelly.

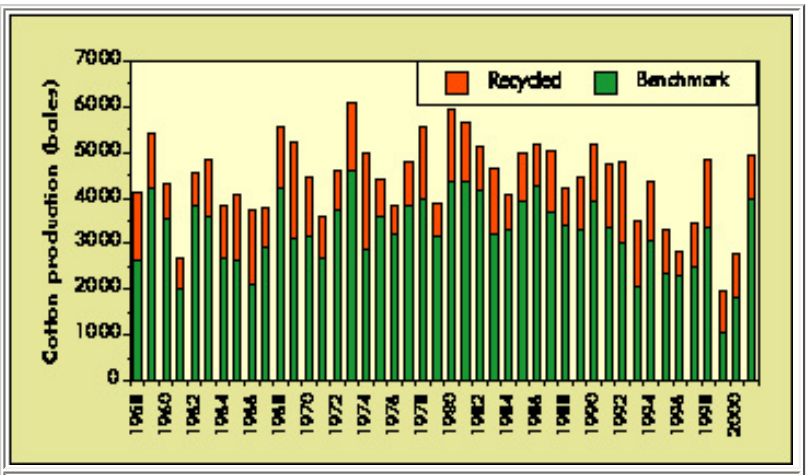

FIGURE 1: Simulated whole farm cotton production over 45 years showing production under the current farm system and subsequent gains attributable to recycled-water irrigation

water has the potential to significantly increase production levels and profits for farmers with cropping enterprises on the Darling Downs — particularly those producing cotton, which showed the greatest returns to irrigation.

This is largely due to increased crop yields and larger areas under irrigation. Farms that benefited most from recycled water generally had potential to expand the area of irrigated production, had limited supplies of other irrigation sources, and sufficient existing on-farm water storage capacity and irrigation infrastructure.

On some farms there is also potential for production variability to decline with access to assured recycled water, although year-to-year variability does not disappear. Furthermore, increased reliability in production can be assumed to generate significant improvements in crop quality and marketing benefits.

Figure 1 illustrates the crop production benefits associated with recycled water use. In this example, the increase in whole-farm cotton production (illustrated in red) is from substituting 162 hectares of dryland cotton production with irrigated cotton.

The average annual additional income attributable to the 1000 megalitres (ML) of recycled water introduced to this farm was $214 per ML or $250 per hectare assuming a $150 per ML price for recycled water. Overall, recycled water delivered an economic benefit to nine out of 10 case study farms. The average annual additional income across all case studies was $203 per ML and $292 per hectare.

This calculation takes into account all changes in costs and benefits from using recycled water on each farm, including any capital infrastructure costs, such as on-farm water storages and reticulation, necessary to supply recycled water to farms.

Recycled water also provides significant opportunities to manage irrigation in a way that achieves environmental benefits. The current water shortage is not only limiting agricultural production, but placing increased pressure on the environment. This is through reduction in surface water flows — as evidenced by the 48 per cent increase in the number of ring tanks on the Darling Downs from 1997–99 — and groundwater extraction rates that exceed the rate of recharge. But the pressure on water resources continues as farm businesses strive for economic viability amidst increasing environmental concerns for local and downstream catchments.

If farmers can use recycled water they will not

Recycled water could make a big contribution on the Downs.

always need to capture as much runoff or take as much water from rivers and bores. Any reduction in capturing surface runoff due to increased recycled water use in the upper parts of the catchment will greatly help improve flows to the streams.

The possible reduced capturing of overland flows and lower seepage losses to groundwater will help improve flows in over a 200 km reach of Condamine River. The improved flows (around 30,000 ML per year as an annual average) in the Condamine River will also result in improved average annual flows of the order of 10,000 ML per year in the Murray River. This will help improve environmental conditions both in the Darling and the Murray rivers.

Reductions in the quantity of water extracted from bores as a result of using recycled water will help reduce pressure on the highly stressed deep groundwater levels. Previous groundwater modelling studies suggest no recovery of aquifer levels in the alluvial aquifers if the present trend of pumping continues.

Recycled water, like other sources of irrigation water, contains salt and so needs to be managed carefully to minimise any negative environmental consequences. Based on the findings for the case study farms, the levels of salt introduced to the soil through recycled water irrigation are, with careful management, unlikely to accumulate in the root zone and be detrimental to crop production.

To protect the quality of aquifers there is a need to restrict the movement of water and solutes from below the root zone to the groundwater. Through deep drainage salt can flow to the groundwater, increasing its salt concentration. So it is important to match the supply of water to the actual needs of the cropping system.

Using the same farm as in Figure 1, the strategy of growing lucerne for hay production in a three-year rotation with irrigated cotton was assessed for its potential to minimise water and solute movement off farms. Assuming the purchase of recycled irrigation water at $150 per ML, annual net cash flow was simulated to increase by 5.5 per cent and accumulated salt leached below the root zone decreased by 50 per cent for a recycled-water irrigated lucerne-cotton rotation compared to a benchmark continuous cotton system. In this simple case study, lucerne was simulated to significantly restrict the loss of recycled water and solutes from the root zone.

Environmental risks can also be managed by using recycled water selectively in the catchment. The basaltic uplands areas of the Condamine catchment are vulnerable to high

rates of recharge of water and salts. But the Condamine alluvial aquifer is less vulnerable and more suitable to irrigate with recycled water.

The risk of leakage of recycled water under storages also suggests there is a need for careful siting and construction of on-farm and large storage facilities according to local hydro-geological conditions to minimise the flow of water and solutes to groundwater.

With proper management, aided by further research, introducing recycled water as a source of additional irrigation water provides the opportunity to address some of the existing urgent production and environmental problems arising through severe lack of water resources.

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