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Can recycled factory water be used to grow harvestable hardwoods?

By Mark Podberscek and Jenny Gough
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The Queensland Department of Primary Industries and Fisheries (DPI&F) recently developed a drip-irrigated native hardwood tree plantation at the Nestlé Gympie coffee factory. This innovative approach, designed and managed by the DPI&F, has resulted in the implementation of an environmentally sustainable solution to managing industrial waste.

The Nestlé Gympie Factory, based in Queensland, is the largest coffee factory in Australia, producing nearly 10,000 tonnes of instant and roast & ground coffee per year. One of the by-products of coffee manufacture is coffee wastewater, which is similar in colour and consistency to a cup of very weak black coffee. Since 1987, Nestlé Gympie has been irrigating this coffee wastewater via travelling irrigator onto a 14ha pasture, which is grazed by cattle. This method is a convenient and effective means of wastewater disposal, but Nestlé Gympie Factory was concerned with the long-term sustainability of pasture irrigation.

In 2001, Nestlé Gympie commenced investigations to determine the environmental performance of wastewater irrigation practices. Initially, the investigation focussed on wastewater quality and quantity, soil and groundwater characteristics, hydraulic and nutrient uptake of the crop, and risk management scenarios including wet weather management. The investigation identified improvements which could be made both as part of factory operations, and at the irrigation paddock. A number of trials commenced in 2002, including determining the effectiveness of growing trees and wetland plants with coffee wastewater, various methods of solids removal, and water reuse within the factory.

One of the first improvements made by Nestlé Gympie Factory was the installation of a triple effect wastewater evaporator. This allowed some of the highly coloured wastewater streams to be evaporated, resulting in a clear condensate stream. The removal of solids also contributed to a dramatic reduction in BOD, COD and nitrogen of the wastewater. Reuse initiatives of some clear streams within the factory helped contribute to reducing the total volume irrigated onto the paddock to approximately half of the previous volume.

In 2003, heartened by positive results from the 2002 tree trials and by the luxurious growth of the grasses (mainly Kikuyu and Green Couch) on the irrigated pasture, a full-scale irrigated forest project commenced, managed by the DPI&F. The area chosen for the purpose of growing drip irrigated native hardwood tree species was the vacant 9ha of grassed land next to the irrigated site. Soil in this area consists of a shallow sandy loam with rocky surface horizon and clay subsoil. The climate is sub-tropical where the bulk of the annual rainfall (54 per cent) falls between December and March.

Fourteen native hardwood species were selected because of their capability to withstand conditions that they were likely to receive [ie. frosts and waterlogging (the low-lying area attracts both frosts and the waters of the Mary River during flooding]; the nature of their fast growth rates (which were a commercially economic consideration); and their ability to uptake both high levels of nutrients and water on a sustainable basis.

Measure plots within each species will record annually such things as tree diameter, height, leaf area, crown size and biomass. A key objective of this project is to confirm that irrigation of coffee effluent will not adversely affect tree growth performance. It is expected that thinning will be chipped at age three years and the total tree harvest will be at age 15-20 years.

Gypsum was applied over the undulating terrain followed by ripping and contour mounding at 4 metre intervals. Mounds created were sprayed with a knockdown herbicide just prior to planting in December 3003. Soil samples were collected prior to irrigation to have base data on the physical and chemical characteristics of the soil. Nine bores positioned within and outside the plantation site will be regularly inspected for changing water levels and sampled for chemical composition.

Dripper irrigation was chosen for the project, which allows wastewater to be irrigated over a greater area than the travelling irrigators, and also eliminates the issues associated with spray irrigation, notably odour from aerosols and spray-drift during windy days. Drip irrigation laterals were placed on mounds with emitters positioned every 60cm along the dripper line. The Netafim Uniram heavy-duty drip line selected has pressure-compensating emitters with a nominal flow rate of 2.3L/hr. This system was chosen for its reliability and low clogging hazard and provides significant control of effluent odour.

An Arkal Poly Spin Klin® (four in-line) filtration system with automatic backflush operation fitted with 120-micron discs was installed to effectively remove the biodegradable organics. As a back-up system, three Spin Klin systems with manual filters are positioned in three strategic locations within the plantation.

Continuous soil moisture monitoring to 1m depth is carried out using four permanent EnviroScan® units positioned mid-slope in each of the irrigation management units. Information retrieved from the units will be used on a regular basis to regulate the amount of effluent applied to each irrigation management unit and reduce the potential for percolation into the underlying water table.

An on-site automatic weather station will provide climatic information including wind speed, wind direction, air temperature, relative humidity, tipping bucket rain gauge, data logger, solar radiation for calculation of evaporation (mm/day), solar panel and computer software.

A Motorola IRRInet water distribution computerized control system was installed on site that communicates directly to the Nestle Factory via a two-way low power radio. This system allows the operator to view the status of irrigation schedules for each field unit, equipment performance, flow rates, download record sensor measurements and climatic data and much more.

The major objective of this project is the development of a sustainable wastewater disposal system that is environmentally responsible and addresses not only the concerns of the factory, but also that of the local community, regulators, and Nestlé Worldwide.

In the future, the term "coffee table" may literally come to mean not only the table upon which you rest your cup of coffee, but also that which came about because one of the aspects of its production made it possible … and maybe, a table with, like Camphor Laurel, a distinct aroma that wafts through the air, inviting you to yet another cup of coffee, or a chomp into one of its flavoursome legs!

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