

Research Projects

Research Project
information from
CSIRO
Land and Water

Sheet No. 18
April 2000



From Saline Drainage to Irrigated Production

Scientists at CSIRO Land and Water have found an answer to one of irrigated agriculture's most vexing problems – secondary salinisation of irrigation areas.

This work is important given that about 30% of the world's food crops and 50% of the two major staples – wheat and rice – are currently supplied by irrigated agriculture.

To feed the world's burgeoning population, total food production from irrigated crops must be boosted 12% in the next decade. But, balanced against this urgent need to increase global food supplies, are the warning signs within irrigation areas that current practices are not environmentally sustainable.

Drainage – an integral aspect of any irrigation scheme – is one of the critical issues facing agriculture today.

There is salt in all water – even rain – and when water is applied to the ground, plants take up pure water and concentrate the salt in the soil. Drainage exports this salt, traditionally 'disposing' of it to deep aquifers or watercourses. This is no longer acceptable.

One common management practice for dealing with drainage water is to use it to irrigate downstream crops – a short-sighted, short-term solution, which merely 'exports' the problem. Another option involves the use of evaporation basins to 'store' drainage runoff. Yet the storage of low salinity water in evaporation



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ponds, without *re-using* that water where possible, is a waste of a valuable resource.

This is where CSIRO Land and Water has come up with an innovative solution - taking the problem of salty drainage water and turning it into a potentially profitable asset. Researchers in Griffith have found a way to repeatedly re-use drainage water to grow crops. In the process the system will concentrate the salt in the water to a manageable level which can then be used or stored in an environmentally friendly manner.

The process, known as Sequential Biological Concentration, is based on a novel system for land-based treatment of secondary treated effluent known as **FILTER** (Filtration and Irrigated cropping for Land Treatment and Effluent Re-use).

SEQUENTIAL BIOLOGICAL CONCENTRATION (SBC)

The SBC system in action can be pictured as a series of three irrigation bays or 'stages' of the FILTER system, each with agricultural pipe buried at a depth of one metre and eight metres apart. This system is followed by two other potentially productive stages.

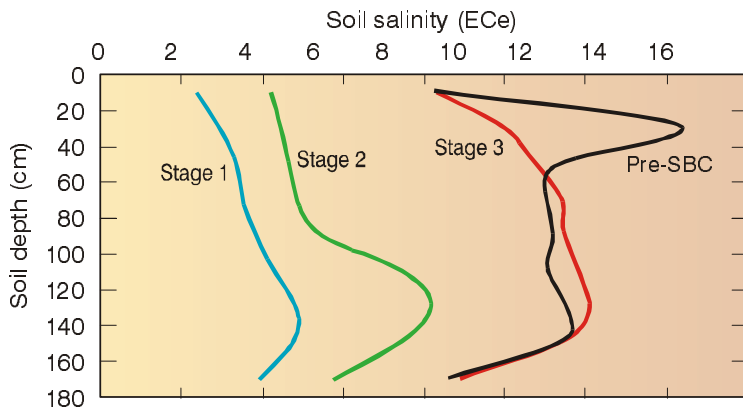


Fig.1 Changes in soil salinity profile in the three stages of SBC

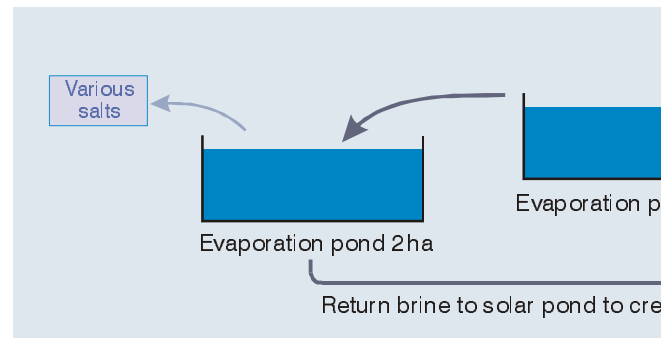
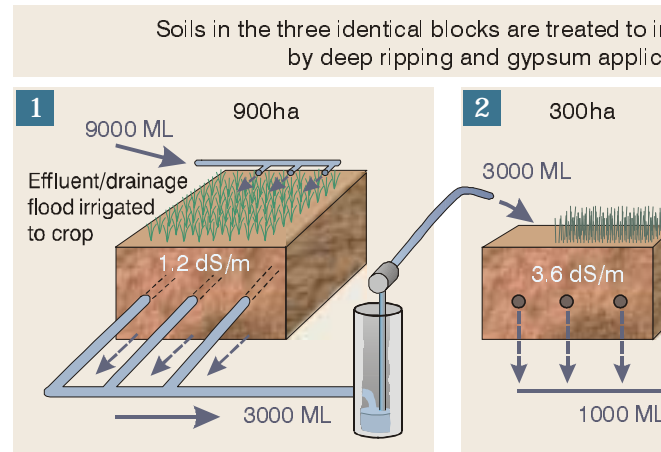
1 In the first stage, saline drainage water enters the SBC system at 1.2 dS/m (which is

FILT

The FILTER system involves the use of irriga nutrient-rich effluent.

The system has already overcome many of the sewage treatment systems. It removes nutrient meets Environment Protection Authority guide while producing an economic crop.

The sequential use of a series of FILTER modul the conversion of dilute drainage waste water (salt) into an economically viable and environm



about 10 times saltier than the original irrigation water and three times saltier than irrigators downstream will accept). This is used to irrigate a range of winter and summer crops. To date, crops of wheat, barley, canola, sorghum, maize, kenaf, sunflowers and pasture have all been produced successfully in this stage.

Scientific understanding tells us this system will only be sustainable if a leaching fraction of 30% is maintained, which means 30% of the water applied must pass through the soil



R

ated cropping with intensive drainage to treat

problems associated with existing land-based

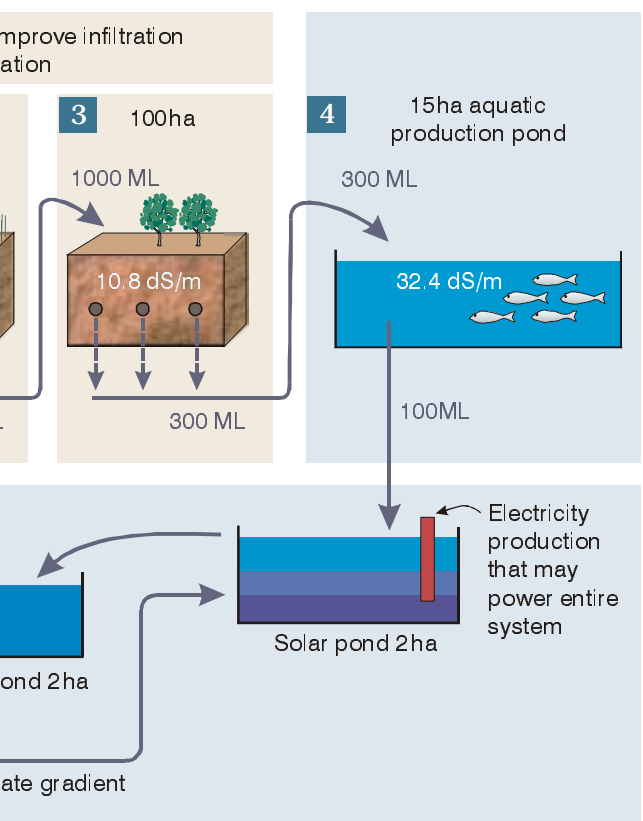
s and other pollutants from the waste stream,

lines and at the same time, concentrates salts

es (as shown in the diagram below) may enable

(containing a cocktail of pollutants including

entally acceptable production system.



profile to the drainage lines
beneath the system. With a 30%
leaching fraction, the salinity of
the rootzone will come into
equilibrium with the salinity of the
applied water (see Fig.1). This
allows the soil to sustain crop
growth even though water of
this salinity would eventually
cause massive yield decline in a
poorly drained soil.



Fig.2 The 10.5 hectare experimental SBC site.

2 The leached water from the
first stage is then re-used. Again,
the same range of crops can be
grown as long as the 30% leach-
ing fraction is maintained, how-
ever the yields are not as high –
the increased salinity of the
applied water (3.6 dS/m at this
second stage) can be expected to
reduce yields by 10-20%. (Drain-
age from this second stage will
be 10.8 dS/m if the 30% leach-
ing fraction is maintained).

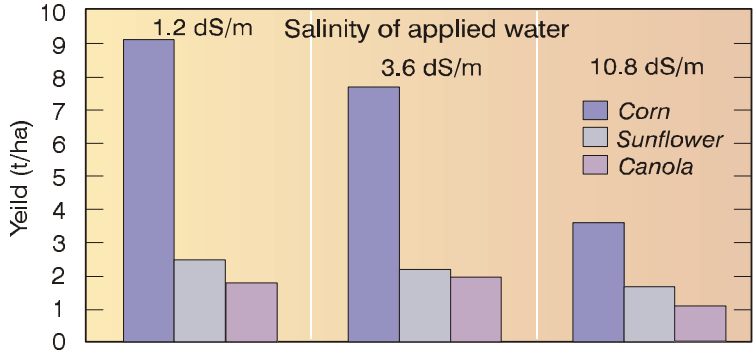


Fig.3 The effect of different water salinities on crop yields.

3 In the third stage, when the
remaining water is once again
used, there is a predictable yield
reduction (see Fig.3) and some of
the crops that can be produced
vially in the first two stages be-
come uneconomic.

Nevertheless, canola grown in the third stage using the highly saline water yielded 0.8 tonnes a hectare. The third stage has also shown itself able to support a stand of saltbush and salt tolerant eucalypts. Other crops have been ruled out, as it is likely they will not be profitable at the equilibrium soil salinity of the profile in this stage (Fig.1).

4 The fourth stage is actually a pond where the water is almost as salty as the sea. Early trials have used this to grow salt-water fish (Australian bass) during winter, although the elevated temperatures in the pond in the summer prove excessive.

To overcome this problem, high temperature-tolerant

species such as prawns are being tested and in the winter, the pond will be re-stocked with 'store' fish which will grow out to market size - a potential fish feedlot.

This fourth stage must also drain – for without drainage, it will become super-saline and be useless for managed aquaculture. A series of lined evaporation basins is being trialed to receive the drainage from the fourth stage. The first of these will be converted into a salt gradient solar pond, which it is hoped could produce enough energy to power the entire site.

The remaining evaporation basins are capable of producing a range of pure salts, some of which may be saleable.

OUTCOME

The project promises to reduce the volume of drainage water exported from the irrigation area. The final outcome – a highly concentrated amount of salt in a much smaller volume of drainage water – can be used or stored in an environmentally acceptable manner. The SBC system tackles a huge problem for irrigation areas - saline irrigation drainage - and turns it into an asset, creating a series of potentially viable farming systems that are able to generate income from cropping, aquaculture and energy.

For further information:

John Blackwell
CSIRO Land and Water
Private Bag 3
GRIFFITH NSW 2680
Phone: 02 6960 1500 Fax: 02 6960 1600
Email: enquiries@grf.clw.csiro.au
Web: www.clw.csiro.au/division/griffith

Funded by the National Heritage Trust through the MIA Sustainable Development Committee



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