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The Journey to Sustainable Irrigation

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Introduction

Irrigation in Australia uses around 75% of all the water harvested, and is responsible for agricultural production worth \$7254 million in 1996-7. In fact half of the profit from all Australian agriculture comes from the 0.5% of our land that we irrigate. The Murray-Darling Basin accounts for 1/3 of Australia's agriculture and contributes \$23 billion each year to the economy.

There has been a dramatic increase in irrigation, and water use has increased by 59% between 1983-1996. In the last 25 years we have increased the area of irrigated land in Australia by 26% or 430,000 ha. The competition for water is becoming more intense, just as the community is starting to appreciate that we have degraded the health of our rivers by over extraction. Many countries, including Australia, now face water scarcity and are looking to improved management systems to improve the efficiency of water use in rural and urban sectors (Hamdy, et al, 2003)

These national figures show the importance of irrigation, but don't show the importance of irrigation to sustaining regional communities throughout much of our countryside. If these communities are to have a future, we must ensure that irrigation is sustainable in the long term. This is the challenge for Australia's irrigators, its researchers and its policy makers.

What is Sustainable Irrigation?

A sustainable irrigation system is one that will continue to generate agricultural products at reasonable costs into the future and ensure that environment is itself maintained so that it can sustain the communities that depend upon it. Sustainability requires that future generations have the same opportunities to benefit from our land as we do.

For irrigation to be sustainable irrigation and drainage must be conducted in a way that does not degrade the quality of land, water and other natural resources that contribute to both agricultural production and environmental quality (Oster & Wichelns, 2003).

Sustainable irrigation requires irrigation that uses water efficiently and has effective drainage and salt disposal. Waterlogging and salinisation have historically brought about the destruction of many irrigation systems; over exploitation of rivers and groundwater is now recognized to put at risk the well-being of local communities and those who live downstream. The wider community is now expressing its concerns that mis management and over exploitation of water for irrigation is putting at risk some of the environmental

assets that they value. The health of the Murray system is clearly on the public agenda, and many people blame irrigation for its degradation.

I do not think that much of our irrigation is at present sustainable, and the challenge for all of us is to find ways to move it towards a more sustainable future. I acknowledge the achievements of many Australian irrigators to improve water use efficiency in many of our irrigation industries. The fact that some irrigators and indeed some industries have been able to improve irrigation practice gives us hope that we will be able to bring all irrigators up to something approaching best practice.

A sustainable irrigation system will have the following characteristics:

- Extract only a sustainable amount of water from the river systems that ensures river health is maintained. This almost certainly means taking less than 50% of the median flows of the river. For groundwater systems extraction must not exceed replacement so the resource is maintained in the long term.
- Water is applied to crops as efficiently as possible so that losses in delivery and application are minimized, and that the amount applied meets plant needs. This requires a high level of water control.
- Farm level and regional efforts to minimize, intercept, isolate, reuse and dispose of saline drainage water rather than allowing these to degrade the land or rivers.
- Irrigators understand the capacity of their soils and drainage systems to support various forms of agricultural production, and have the skills and capacity to produce crops that maximize the wealth coming from the water used without damaging our environment.

The Journey to Sustainability

Sustainable extraction from rivers and aquifers

In the last ten years we have developed tools for measuring river health that give us much more information than the concentrations of various chemical substances that we used to measure (Norris & Thoms, 1999). These river health indices are based on the biological outcomes and are based around aquatic invertebrates, fish and sometimes algae, floodplain vegetation and waterbirds.

These tools have shown that many of our rivers are somewhat degraded, and there are real concerns that they may collapse and be replaced by systems that are much less attractive to society (Harris & Gehrke, 1997, Norris et al, 2001, Kearney & Kildea, 2004). The almost permanent algal blooms in weir pools of the Lower Murray are an example of what might be.

There is no doubt there are a range of causes to the observed degradation. Pollution from sewage discharge, loss of riparian vegetation and habitat and blocking of fish migration with weirs are all causing damage, and are being addressed in many of our systems. The remaining element that we are only now starting to understand and address is river flow. The issue here is how much water we can extract from a river and still have a healthy river. It is almost certainly much less than the 80% of median flows we now extract from the Murray, and it may be no more than 50% is sustainable in the long term.

Sustainable levels of extraction from groundwater systems are also hard to assess. Over commitment of a groundwater resource leads to increased pumping costs for irrigators and a drying out and loss of water dependant ecosystems. Finding a sustainable level of extraction requires a significant investment, and this is best done early in the piece since recovering from a situation of over extraction is socially and economically challenging for communities and governments.

A major risk to the future of existing irrigation systems in Australia is the failure of management agencies to understand the connection between surface water and groundwater. Experience in the United States has shown that when groundwater resources are over exploited, the stream flow drops within around 30 years.

It is clear that in a system where the surface water resources are clearly over allocated such as in the Murray-Darling Basin, then no further groundwater licenses should be issued unless it is clearly shown they will not impact on already allocated surface waters. The consequence of State Governments failing in this area is the wasted investment by farmers in bores and pumping systems that may go dry, and the allocation of water that has already been allocated once to either surface irrigators or the environment.

Improving water use efficiency

We know that around 15-25% of water in open channels is lost to seepage and evaporation and that significant savings can be made with lining or piping water in lighter soils, although such investment may not be worthwhile in heavier soils. Other losses in the delivery systems relate to flow measurement and control systems, and the ability to combat theft. The sort of new technologies being developed by firms such as Rubicon have the potential to save significant water that can be returned to the environment in over-allocated systems or used for production in other cases.

On farm losses of some 24% are common with seepage and evaporation, meaning that commonly only 36% of the water that leaves storage finds its way to the plant. These huge losses offer considerable opportunity to reduce the water being used with consequential benefits both to the rivers and to the waterlogging and salinity issues.

Many of our irrigation industries have made considerable investments to improve their water use efficiencies in recent years. An improvement of around 30% in water use efficiency has been achieved in some industries. One area where progress has been slow is in irrigation of pastures for dairy production where some irrigators produce less than 30

Kg milk product/ML of water and others can achieve over 100. The differences relate to soil and farm size, farmer skills and levels of investment in up to date irrigation systems that allow adequate control of water.

I am told there are dairy farms in SA that have used up to 55 ML of water per ha. Modern irrigation practices in vineyards have been able to reduce water use from 8-10 ML/ha down to 5-6 ML/ha. Profligate use of water not only damages the rivers the water is taken from, but the waterlogging, salinity and other pollution that can come from such inept irrigation can be disastrous to the sustainability of those regional communities, who then commonly call for taxpayer funds to bail them out.

Managing drainage to minimize waterlogging and salinisation

Unmeasured and excessive application of water to land leads to waterlogging and the eventual destruction of the irrigation enterprise. As water moves through the soil profile it dissolves salts, and irrigators were once encouraged to apply a leaching fraction to push these salts down below the root zone. Drainage is essential, and the failure to manage drainage and subsequent salinisation of landscapes can destroy the irrigation enterprise. The challenge is disposal of the salty drainage water that can lead to significant degradation if it is returned to rivers. Commonly in Australia we try to intercept this salty water and dispose of it to evaporating basins away from the river, and to salty aquifers. Many farmers are now seeking to use drainage water on their own properties and this creates wealth from this water and reduces downstream impacts.

I don't accept that any irrigation community has the right to dispose of salt in ways that degrade the downstream lands or waterways. We need to treat our irrigation communities as closed systems that must manage their salt within their boundaries rather than accept a subsidy from the rest of us by dumping it to the environment. No industry other than agriculture is allowed to dump its waste on a neighbour's land, and these practices must be addressed in our journey to sustainability.

The Tools to Drive the Journey

Selecting appropriate land to irrigate

In any area we need to select the most appropriate soils to irrigate. These will be the soils that have the least waterlogging risk and salt hazard. New airborne remote sensing lets us identify salt reservoirs and pathways in the landscape and so we can avoid applying water to such areas. New pumped pipe systems to deliver water let us move water to the most appropriate areas rather than just flood areas that are downslope of a distribution channel. To maintain yields as the salinity of soil or water increases, more water is applied to push salt down below the root zone, often exacerbating the regional salinity problem.

Regional Planning

Australia is moving towards establishing regional catchment Boards that invest in projects designed to achieve various end of valley targets for the amount of water, salt, nutrients and other pollutants that should leave a catchment. Setting realistic targets is still a problem and we have yet to devise appropriate monitoring and evaluation strategies, or to develop sanctions for communities that take public funds and do not achieve their contracted obligations. Regional bodies may have to establish markets to let them manage salt within their region, as the States have already done. Further development of incentives and penalties could be used to encourage efficient water use and to ensure reuse of drainage water and minimize the export of salt from farms and local districts to ensure regional targets are met.

Delivery System Design and Management

Many irrigation areas are exploring what is the most appropriate technology to use to deliver and measure water in their region. In sandy and salt prone areas there has been a trend to pipe water rather than transport it in open channels. In other areas sophisticated channel measurement and control systems are being developed to reduce wastage.

At the farm level much greater precision of irrigation is possible with the emerging micro-irrigation systems that allow precise delivery of water to the plant roots in the amounts needed. Soil moisture sensors and computer driven systems can ensure water is only supplied when it is needed. Our understanding of plant physiology is allowing us to influence the sorts of plant growth we seek – be it fruiting or vegetative growth.

The barrier to installing these smart control systems is the capital cost. Obviously as the price of water increases, then investment of this sort becomes economically attractive; alternatively while we underprice water farmers still use the irrigation technologies of the ancient Egyptians – irrigation systems that were not sustainable.

To drive improvements in water use efficiency we need a comprehensive and transparent national irrigation benchmarking system that lets us see the range of water use efficiencies in each commodity and each area.

Water Use Efficiency in Australian Irrigated Agriculture
(National Land and Water Audit)

\$/ML return

Pasture	300
Rice	300
	these two industries use 67% of irrigation water
Cotton	600
Sugar	400
Fruit	1500
Grapes	900
Vegetables	1800

Economic Tools and Water Markets

The CoAG water reforms of 1994 are now being refreshed by the National Water Initiative of 2004. The separation of land and water and allowing water to be traded has already seen some dramatic impacts. There has been a dramatic increase in the price of water, and the water may now be worth much more than the land to which it was once attached. In 1970 a water licence in Moree in Northern NSW sold for under \$30 but now trades for \$1.4 million (Australian Financial Review, 12 December 2001). Financial institutions are concerned about the value of their assets in such a situation, and bankers and irrigators would like to see a formal register of water rights to support trading.

Freeing up a water market has allowed water to be traded out of inappropriate areas and the water used to create significant new wealth in other areas. Clarifying just what rights that farmers have has been difficult for State Governments, and caused much confusion and fear in the farming communities.

Improved Understanding of Environmental Needs

We need to be clear as to what we are trying to protect. Regional plans need to identify the environmental assets – wetlands, reaches of rivers, floodplain communities and estuaries that are to be retained, and we need the best available scientific expertise to estimate the sorts of wetting regimes they need to keep them functioning. We also need an environmental manager with a commitment to using the available environmental water effectively. These institutional arrangements are still being developed.

Research to Improve our Knowledge Base

Knowledge is clearly fundamental to better management of water at the region and at the farm scale. Given the importance of irrigation to Australia, the amount of investment in research is quite pitiful, and we have a limited capacity to undertake the research that is needed. The recently established CRC for Irrigation Futures provides a good platform for investment, but irrigators who are organized in commodity groups have not given it

serious support, preferring their research investment to go to increasing production rather than sustainable irrigation. In my view this is a very shortsighted position.

A Coherent and Connected Industry?

The irrigation industry would be vastly strengthened if it could start to see itself as an industry and start talking to Government and the public with a single coherent voice. Many different organizations claim to speak for irrigators, and most farmers do their lobbying through commodity groups that ensures they are fragmented and often in contradiction to each other. Some make such extravagant claims they are discounted. Loud calls for compensation of farmers are required to stop causing damage to downstream neighbours and environments have hindered the sorting out of equitable approaches to the re-adjustment and reinvestment that the irrigation industries need.

One must ask is there an irrigation industry in this country, or just a series of commodity industries?

Readings

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