Crop management response to a net recharge quota

David Robinson
Resource Economist, CSIRO Land & Water, Griffith

Mike Ridley
Coleambally Irrigation Co-operative Limited

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- Watertable management could be addressed through instigating a scheme where irrigators could buy and sell recharge credits, under the guidelines of a recharge cap and trade framework
- Three farmers from the Coleambally Irrigation Area participated in a case study and indicated that they would participate in such a market to manage recharge on their own farms

A potential policy solution to control watertables, and therefore minimise the impacts of salinity and waterlogging, is to implement a recharge cap and trade framework.

This report investigates the attitude and crop management response of three farmers to a policy for trading recharge credits, if it was to be implemented in the Coleambally Irrigation Area (CIA). The work is part of a larger study investigating tradeable recharge rights as a tool to manage irrigation-induced salinity in the CIA, which in turn is a part of a pilot project under the National Market Based Instruments Pilot Program.

Trade your way out of high watertables

Prior to irrigation, the watertables in the CIA were around 20 m below the soil surface. However, due to recharge (accessions to the watertable) from inefficient irrigation practices, leaky channels and rainfall in fallow paddocks, an increasing area of the CIA has watertables within 2 m of the soil surface. Shallow watertables induce waterlogging and salinity, both of which have a negative effect on crop production, infrastructure and the environment. Current policies relating to recharge management have been insufficient to reduce or abate net recharge to a sustainable level. Consequently, there is a significant risk that the area and severity of waterlogging and salinity will increase in the CIA if further action is not taken.

A potential policy solution to reduce and maintain watertables at a sustainable level, is to implement a recharge cap and trade framework. The recharge cap is effectively the level of sustainable recharge, ie when regional recharge is less than or equal to groundwater outflow from the region. To implement a recharge cap, each farmer would be allocated a recharge quota (also called recharge credits). The total number of credits allocated within an irrigation region is equal to the recharge cap. Farmers are then required not to exceed the level of recharge credits that they have been allocated, unless they purchase unused credits from another farmer.

Compared with other policy instruments, a trading framework has the main advantage of potentially capturing economic efficiency gains, as trade can take advantage of the different marginal costs of recharge abatement between irrigators and time periods. That is, some farmers can reduce recharge more cheaply than others and with trade, they are able to sell recharge credits to those farmers whose recharge abatement costs are more expensive.

For the 1999–00 to 2001–02 irrigation seasons when allocations averaged 80%, it has been estimated that the level of recharge for the CIA was approximately 55,000 ML per year and the level of sustainable recharge was approximately 30,000 ML. If the sustainable level of recharge becomes the cap, CSIRO Land & Water research has determined approximately 25,000 ML of net recharge needs to be abated per year. On average, each farm in the CIA has to abate approximately 45% of its current recharge, equating to approximately 0.28 ML/ha/year. However, due to the different groundwater conditions throughout the CIA, the recharge abatement required in the northern parts of the CIA is lower than what is required in the central and southern parts.

Farmer response to reducing recharge

The creation of an irrigation recharge cap and trade framework would create a number of costs and benefits to irrigators through changes to agricultural production, and also to the local and wider community through the protection of infrastructure, biodiversity and reduction in potential negative downstream impacts.

A case study analysis was conducted to determine how individual farmers would respond if they had to reduce recharge on their own farms. Recharge can be reduced through land use changes (ie replace recharging crops with discharging or low recharging crops) or by subsurface drainage and disposal options. Preliminary analysis has indicated that subsurface drainage options are much more expensive than land use changes, and therefore have not been considered in these case studies.

The case studies first determined farmer response to reducing recharge in terms of land use change to meet specific recharge abatement targets on individual farms. Using this information the opportunity cost of abatement was calculated and the farmers were asked at what price would the recharge credits have to be for them to either buy or sell credits. This was achieved by a questionnaire and using CSIRO's *SWAGMAN Farm* model to calculate net recharge and farm gross margins for the farmers' specified land use mixes.

A series of steps were conducted for each case study farm to determine farm gross margin, the amount of recharge, the recharge abatement cost and the scenarios when the farmer was most likely to trade recharge credits. The scenarios assumed an 80% allocation, watertable depth at 2 m and average weather conditions. Feedback questions were asked to finalise the analysis in which the farmer was asked to discuss:

- The management issues that were considered when deciding on the crop mix to meet recharge targets (eg marketability of certain crops, expertise in growing certain crops, the ability or desire to have stock etc).
- The farmer's experience in trading water, level of understanding of tradeable recharge credits as a policy tool to manage net recharge for the CIA, the farmer's attitude to the concept of tradeable recharge credits and what they think are the main advantages and disadvantages of such a policy.

Farmers willing to trade

The farmers participating in the case studies had attended a workshop in which participants were given an overview of net recharge management and the concepts of tradeable recharge credits and how they are a flexible tool for net recharge management. All three farmers found that their understanding of net recharge management and tradeable net recharge contracts was increased by attending the workshop, though one farmer stated that the concept of tradeable recharge credits as a net recharge management tool probably raised more questions than it answered.

All farmers have participated in the water market and therefore have practical experience in trading a resource. All had only bought water at that stage but would be prepared to sell water if its price exceeded the marginal benefit of using the water for agricultural production. All have calculated the marginal value of water before it was purchased. Given this experience, all three farmers said they would be comfortable in trading net recharge credits.

A general summary of the case study analyses for the three farms follows.

- Due to variable soil types and different crop mixes and with an assumed 80% water allocation, the net recharge for the case study farms ranged from 60 ML to 235 ML per year.
- The farmers' main recharge abatement strategy was to partially replace recharging summer crops (rice and maize) with discharging crops (lucerne and winter cereals) (see Table 1). All participants agreed that they would be comfortable in making this change if required to meet a recharge cap.

Table 1

Crop management changes with a net recharge quota, and the average cost to reduce (abate) 100% of farm net recharge, under 80% water allocation and average weather conditions, for three farms in the Coleambally Irrigation Area

Farm	Soil type*	Crop	Crop area as % of total farm area		Farm net recharge	Abatement cost
			without quota	*with quota*		
A	50% RBE 45% TRBE 5% SLoam	maize lucerne winter pasture fallow/non-arable	25 17 39 19	20 22 39 19	60 ML	$17/ML
B	13% NSMC 55% RBE 23% TRBE 9% SLoam	rice wheat barley barley after rice lucerne dryland wheat dryland pasture fallow/non-arable	22 25 13 13 3 3 10 13	15 28 13 13 6 3 10 13	85 ML	$153/ML
C	9% RBE 91% TRBE	rice wheat wheat after rice lucerne dryland pasture fallow/non-arable	31 0 16 0 39 14	16 9 16 16 29 14	235 ML	$36/ML

* Soil type legend: RBE - red-brown earth; TRBE - transitional red-brown earth; SLoam - sandy loam; NSMC - non self mulching clay

- All participants recognised that lucerne and cereal crops following rice have the greatest recharge abatement potential.
- The cost to reduce all farm net recharge ranged from $17/ML to $153/ML of abated recharge.
- Given that it was assumed that the market price for recharge credits was $30/ML, only Farmer A would be a seller of credits as the farm's recharge abatement cost was lower than the market price for recharge credits. Farmer B and Farmer C would be purchasers of recharge credits as their abatement cost was higher than the market price for recharge credits.
- All participants recognised that the variability in abatement cost attributed to different crop mixes.
- All participants would consider crop management strategies to create recharge credits if the market value of credits was greater than the cost of abatement.
- All participants identified advantages and disadvantages of tradeable recharge contracts as a policy tool to manage net recharge in an irrigation region.
- The participants suggested that the most appropriate deterrent for non-compliance with a net recharge quota or target would be to impose some type of monetary penalty or to impose an input penalty on water supply the following year, ie an indirect monetary penalty.
- The participants believe that CSIRO's *SWAGMAN Farm* model is a useful educational tool for determining land use options to manage net recharge for the farm.

Although all of the case study farmers opted to substitute rice or maize with lucerne to reduce recharge, this may not be the case on many other farms. Many farmers may be reluctant to grow lucerne because it is labour intensive, lack of farm infrastructure for stock grazing (many farms have removed fencing), the farmer not interested in running stock, hay baling problems due to lack of machinery or contractors and the hay market being volatile due to the seasonality of feed supply for stock within the region. For these reasons, alternative crops other than lucerne would need to be considered to reduce recharge.

Turning potential into reality

Providing that there are enough willing participants to create a market for recharge credits and the cost of implementing the policy is not prohibitive, then a recharge cap and trade scheme could be a viable alternative to existing recharge management policies in irrigation regions. However, for such a policy to work, key issues on policy design need to be considered; in particular:

- what will actually be traded – that is, how to define and measure recharge
- how to allocate the initial ownership of credits
- the process of achieving targets
- management flexibility
- rules for trading in recharge credits
- what monitoring actions are necessary
- penalties for violation of any rules relating to holding, using or trading recharge credits

Examples of where schemes are in place that follow the same principles as the tradeable net recharge credit scheme include the Hunter River Salinity Trading Scheme and the Murray-Darling Basin Salinity Scheme, in which both schemes aim to minimise salt discharge into rivers.

Further information

David Robinson
CSIRO Land and Water, Griffith
T: 02 6960 1579
E: david.robinson@csiro.au