Developing environmental service policy for salinity & water: Experiments with regulations & markets linking watersheds with downstream water users

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Abstract
Shortfalls in water supplies are perhaps the greatest practical NRM policy concern in Australia today, looming larger in many minds than the great international debates on greenhouse gasses, climate change and biodiversity. Because forest land cover uses more water than any other, wide expansion of upstream tree plantations can significantly reduce water yields upon which downstream urban, agricultural and wetlands depend. We consider the economic efficiency and equity (profitability and distributional) consequences of upstream land use change. The 'environmental services' of concern in our study are the mean annual quantities and qualities (volumes and salt concentrations) of water flowing from upper parts of a catchment to the downstream interests holding entitlements to that water.

We consider the presence or absence of high salinity concentrations (**C**) in a tributary to the water supply of urban and other high-security users; the presence or absence of policy and/or markets giving strong incentives for upstream tree plantations (**P**); and the presence or absence of a policy that water entitlements (**E**) must be purchased from existing entitlement holders before new upstream tree plantations are allowed. A factorial experiment examining all eight 'yes/no' combinations of these conditions is defined to explore the associated distributions of upstream and downstream impacts.

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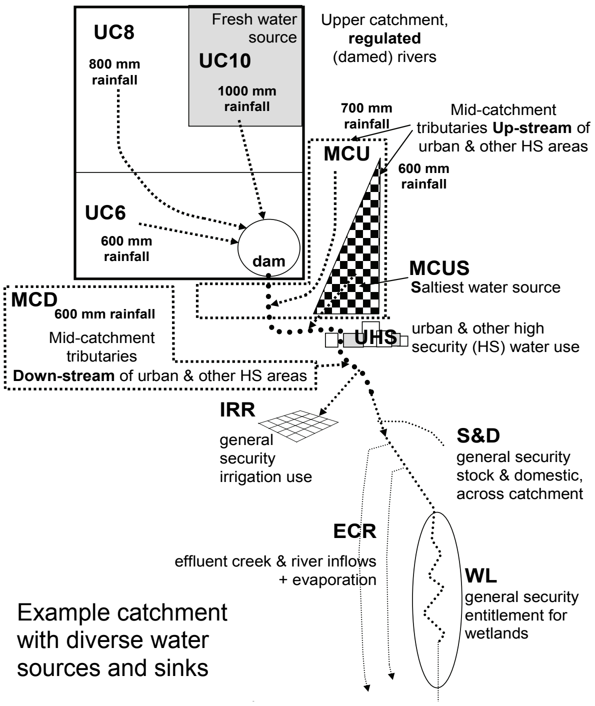
Disclaimer
The authors are responsible for any errors. Opinions expressed are theirs alone and do not necessarily represent the policy of NSW DPI, CSIRO nor or any other institution. Comments and criticism are invited on this 'work in progress'.



Example catchment with diverse water sources and sinks

S.1, in Table 1 below, represents the present case with no shifts in land use expected. **S.2** makes the river too salty for the health of **UHS** who may subsidise tree planting in **MCUS** or consider overland piping of water from fresh up-stream sources; general security users are harmed by lower water yields. **S.3** induces large expansion of forest in the fresh-water upper catchment with maximum negative impact on general security water entitlement holders. **S.4** as with **S.3** but also magnifying the salinity problem faced by **UHS** beyond those of **S.2**. Each of these first four scenarios provides a baseline to which the subsequent four scenarios, under **Policy E**, may be compared.

Table 1 Factorial design for experiments considering contrasting conditions **C** and **P** and effects of a policy requiring that water entitlements (**E**) must be purchased from downstream entitlement holders before new upstream tree plantations are allowed.

Scenario	Condition **C**	Condition **P**	**Policy E**
S. No.	**MCUS** highly saline? **0** = no, **1** = yes	Forest very profitable? **0** = no, **1** = yes	Entitlement for trees? **0** = no, **1** = yes
1	**0**	**0**	**0**
2	**1**	**0**	**0**
3	**0**	**1**	**0**
4	**1**	**1**	**0**
5	**0**	**0**	**1**
6	**1**	**0**	**1**
7	**0**	**1**	**1**
8	**1**	**1**	**1**

Conclusions (anticipated) In **S.5**,with neither salinity problems (**C**) nor high profits for forestry (**P**), **Policy E** will induce few changes except allowing downstream purchases of 'new water' from upstream removals of perennial cover. In **S.6**, **E** makes salinity-mitigation forestry plantings in **MCUS** more expensive and complicated for **UHS** than in **S.2**. In **S.7**, **E** would serve to reduce expansions in forestry and mitigate the accompanying reductions in water-yields, compensating general security entitlement holders by paying those who choose to sell and raising the value of remaining water entitlements for those wishing to keep them. Where salinity-mitigation plantings can be profitable in their own right, as in **S.8**, relief to the plight of **UHS** in **S.6** is seen. Lab experiments explore **Policy E** further.

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