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# Can existing practices expected to lead to improved on-farm water use efficiency enable irrigators to effectively respond to reduced water entitlements in the Murray–Darling Basin?

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SUMMARY

Australia is the driest continent and there is increasing competition for scarce fresh water resources between agriculture and the environment. In the Murray–Darling Basin (MDB) that conflict has largely been resolved by reallocating water from agriculture to the environment. As part of the water reform process both governments and industry are focussed on improving on-property water use efficiency (WUE), particularly of irrigated agriculture. This paper examines the potential for WUE to enable MDB irrigators to adapt to cuts in their irrigation entitlements. The paper draws on data from a case study in the Namoi Valley of New South Wales. The distinctive contribution of this paper is that we draw on survey data of the existing and intended adoption of a limited suite of currently available WUE practices. That is, we have not simply assumed that all irrigators, or a specific proportion of irrigators, will adopt each WUE option. Given survey respondents' intended level of adoption, we calculated the potential water savings for each property and then the catchment, without extrapolating beyond the survey respondents. Those calculations suggest that water savings of up to 100.9 GL could be achieved across the Namoi catchment if those interested in doing so were to convert to existing improved WUE practices. Those savings represented 82% of the reduction in irrigator entitlements under the draft MDB Plan, and exceed the 10 GL/yr reductions required under the revised MDB Plan. These results suggest that those adopting existing WUE practices will have additional water for irrigation. To the extent that this is the case, there seems to be less justification for government support for irrigators during the adjustment process.



## 1. Introduction

Water governance is "the most important topic in the international water community in the 21st Century" (Lautze et al., 2011). In the USA there are concerns that pumping groundwater for agriculture is depleting aquifers to the extent that urban development will be constrained and future water security compromised (Thomas, 2001). In China there are disputes between upstream and downstream users along the Yellow River (*Huanghe*) (Yahua, 2002). In India, separating land and water rights has been a contentious step in the reform of groundwater management (Moench, 1998). In Israel there have been concerns that The Water Commissioner has over-allocated aquifers to support agriculture (Feitelson, 2005).

In this paper our focus is on Australia's Murray–Darling Basin (MDB) where there is competition between agriculture and the environment for fresh water. The MDB occupies 1/7 of the continent and is Australia's food bowl. The gross value of irrigated agriculture in Australia for the 2010–2011 financial year was $AUD 13.5 billion, with 49% of that value produced in the MDB (Australian Bureau of Statistics, 2013). For that year, cotton was the most important crop by value of production at $AUD 2 billion (Australian Bureau of Statistics, 2013). Irrigated cotton production as it is currently undertaken involves the application of large volumes of water. Indeed, 1.9 million of the 5900 GL (there is 1000 ML in a giga litre) of water applied for irrigation in the MDB was applied to cotton crops. However, the extraction of water

*Abbreviations:* CSIRO, Commonwealth Scientific and Industrial Research Organisation; MDB, Murray–Darling Basin; NSW, New South Wales; WUE, water use efficiency.

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for irrigated agriculture has had a significant impact upon ecosystem function and biodiversity (Nevill, 2009).

Increased concern about the ecological impacts of irrigated agriculture led to a series of policy initiatives that began around 1994. Those initiatives employed a range of policy instruments (reviewed in Rawluk et al., 2012) including: markets established or freed-up to enable water to move to higher value uses; upgraded infrastructure to reduce transmission losses; improved governance arrangements so that water pricing better reflects the cost of supplying that water, including the cost of infrastructure (maintenance and replacement); new institutional arrangements that link surface and groundwater resources, as well as government purchases of water for environmental watering; research, development and extension to identify and encourage farmers to adopt improved crops and practices to increase WUE; and public support for farmers to upgrade their farming systems in return for a share of water saved (i.e. a proportion goes to the environment). These efforts are ongoing. For example, the prices farmers are charged for irrigation water still do not include the full cost of operating that infrastructure.

Despite substantial government investments to improve the efficiency of irrigation systems and support farmers to increase their WUE, farmers and their communities have been very concerned about the economic and social impacts of reduced irrigation entitlements and water being purchased for the environment. In this paper we explore the extent that adoption of existing on-farm WUE practices by farmers would enable them to adapt without substantial negative economic or social impacts for them and their communities. The Namoi catchment, located in the MDB, has a long history of irrigated cropping, being one of the most important cotton growing regions in Australia. Water reform in the Namoi also had a turbulent history with considerable social backlash to the large cuts in irrigation entitlements over more than a decade. Using the Namoi catchment as a case study, we draw on data provided by farmers about their adoption of a suite of WUE practices to calculate the extent of possible water savings. The novel contribution of the paper is that we focus on existing practices and only include in our calculations those farmers who indicated in a landholder survey that they were likely to adopt any of the WUE practices included in this study. Our view is that this approach provides a realistic assessment of the opportunities for existing WUE measures to offset the potentially negative economic and social impacts of reduced irrigation entitlements. With the results, we then discuss what role the government should play in assisting in this type of adaptation.

## 2. Case study

The Namoi catchment is located in the MDB, in northern New South Wales, Australia (Fig. 1). Australia's pre-eminent science organisation, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), estimated that surface water flow in the Namoi was 965 GL/yr, and that 37% of this was diverted for agriculture (CSIRO, 2007). Groundwater extraction also underpins irrigated agriculture in the catchment and it is estimated to contribute an additional 251.5 GL/yr (Murray Darling Basin Authority, 2011). The significance of the Namoi is illustrated by the statistic that the region accounts for 40% of the total use of groundwater in New South Wales (Murray Darling Basin Authority, 2010). Groundwater use in the catchment rapidly increased in the late 1970's (Turral and Fullagar, 2007) to the extent that by 2001 the licensed allocations exceeded the estimated recharge (Pigram, 2006). Cotton is the main irrigated crop in the Namoi, accounting for 60% of irrigated area and 76% of water used in the catchment (Australian Bureau of Statistics, Australian Bureau of Agricultural and Resource Economics and Sciences, Bureau of Rural Sciences, 2010). The 2010–11 irrigation season resulted in a $2.5 billion cotton crop (Schliebs, 2011).

As explained above, farmers in the Namoi have been affected by almost two decades of water reform in Australia. Responding to evidence of over-extraction of groundwater in the Namoi, the New South Wales (NSW) Government cut groundwater entitlements in the Namoi by almost 80% over 10 years (CSIRO, 2007). Water reform in the MDB culminated in the Murray Darling Basin Authority's Basin Plan which identified Sustainable Diversion Limits for each catchment in the Basin. The draft plan stipulated Sustainable Diversion Limits in the Namoi that required a 72–94 GL/yr reduction in surface water use, and a further 40.1 GL/yr reduction in groundwater extraction (Murray Darling Basin Authority, 2011).The combined reduction in entitlements was 112.1–134.1 GL/yr. Namoi farmer and irrigation community concerns about the economic and social impacts of the planned reductions in entitlements were repeated across the Basin and formed part of a coordinated critique of the Plan. The response to this backlash included a revised MDB Plan with substantially reduced cuts to entitlements. In the Namoi, the revised Plan only required a reduction in entitlements of 10 GL/yr and, that cut only applied to surface water (Murray Darling Basin Authority, 2012). More recently, the Australian Government purchased around 6 GL from irrigators in the Namoi to underpin environmental values (Commonwealth Environmental Water Office, 2014). Consequently, Namoi irrigators still need to reduce their water use by 4 GL/yr in order to meet the revised MDB plan requirements.

Efforts to improve WUE have been part of the response by irrigators to water reform. Namoi cotton growers have been at the cutting-edge of these on-farm innovations. For example, it has been estimated that water-use efficiency on irrigated cotton properties in the Namoi has been increased by three to four percent per year or 20% over 10 years (Roth, 2010). Governments have supported these efforts through funding for a cooperative research centre and more recently, by providing $AUD 83 million to subsidise assessments of on-farm WUE and the costs of implementing recommendations, through their "Sustaining the Basin: Irrigated Farm Modernisation" Program (NSW Department of Primary Industry, 2014). Nevertheless, the landholder survey data presented in this paper suggests that there is much scope for further adoption of existing WUE practices, including modifying flood irrigation practices, changing from flood irrigation to spray irrigation and deepening dams.

There are other pressures on farmers to innovate, including their reduced terms of trade as the cost of agriculture inputs rises faster over time than the prices they receive for their products. It is also possible that irrigators in the Namoi will have their irrigation entitlements (or annual allocations) reduced further as a result of feedback from monitoring of the environmental outcomes of existing cuts; or changes in community values as the wider public makes judgements about the social acceptability of agriculture, particularly irrigated cotton. There are recent examples where social acceptability has affected market or resource access by primary industries in Australia, including animal welfare groups boycotting wool in response to the practice of mulesing of sheep, a social media campaign against the "super-trawler "leading the Australian Government to ban the trawler from fishing in Tasmanian waters, and a moratorium placed on coal seam gas mining in NSW and Victoria, as a result of public concerns about potential impacts of "fracking" on groundwater.

The Namoi therefore represents an important case study for the assessment of the potential for existing on-farm WUE practices to offset reduced entitlements as part of the water reform process. In the next section we explain the source of our data, introduce the