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What lies beneath: Rural landholder interpretation of the risks of aquifer exploitation in Australia

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SUMMARY

Risks associated with the management of groundwater in farming landscapes are at the forefront of public discourse in Australia and North America. There has been very little social research examining rural landholder attitudes to groundwater use and management. This is an important gap given the critical role social acceptability plays in resource access decisions, the important role groundwater plays in sustaining livelihoods, and the vital role it plays in maintaining groundwater dependent ecosystems. This paper attempts to address that gap by exploring how rural landholders interpret risks associated with groundwater use for irrigated agriculture. We do that by using a case study from south eastern Australia where farmers' livelihoods are increasingly dependent on groundwater. We draw upon spatially referenced survey data to investigate the general extent and nature of concern about risk associated with pumping groundwater. We also explore the factors influencing risk interpretation, including occupational identity and proximity to the aquifer. Survey results suggest that while there is concern about pumping groundwater for irrigated agriculture in the Wimmera region, there is also considerable confidence that negative outcomes can be avoided. The dimension of risk of most concern to respondents was the possibility that the benefits of pumping groundwater would not be shared equitably. Those reporting lower concern about the risks of groundwater pumping were more likely to own properties located above the aquifer, to exhibit a strong business orientation including prioritising economic values compared to environmental values, and to express attitudes indicating they thought private property rights should be protected. A substantial proportion of survey respondents indicated they were 'Unsure' on all the risk items in the survey. It seems the future social acceptability of groundwater exploitation in the Wimmera region will depend on the extent that those 'Unsure' shift to the 'Agree' or 'Disagree' cohorts. The survey data suggest that focusing on the economic implications of declining water tables would be an effective way of engaging these rural landholders in dialogue about the sustainability of their groundwater resource.

1. Introduction

With the rapid expansion of coal seam gas (CSG) mining, groundwater management is now at the forefront of public discourse in Australia and North America (Braisier et al., 2011). Those concerned about CSG often highlight potential negative impacts on the integrity of aquifers, including the quality of groundwater. The reality is that groundwater is a critical component of contemporary water supplies. In Australia, groundwater constitutes 17% of all water consumed and 33% of water used for agriculture (Marsden Jacob Associates, 2012; National Water Commission, 2012). In the USA, groundwater makes up 20% of all water consumed and 41% of the total water used for irrigation (Barber, 2009). It is estimated that groundwater supplies approximately half of the world's drinking water, and it makes up a major proportion of irrigation supplies (Giordano, 2009).

There is now abundant evidence of the over-exploitation of this important resource, with implications for current and future generations. In many parts of the world, falling groundwater tables are causing draw downs, reductions in river base flows, saline intrusion and land subsidence. Additionally, it is contributing to the drying up of wetlands (Giordano, 2009). In the United States, groundwater depletion has increased markedly since 1950 (Gleeson et al., 2012). Maximum rates of depletion occurred between 2000 and 2008 when the depletion rate averaged almost 25 km^3 per year. Between 1900 and 2008, depletion rates averaged 9.2 km^3 per year (Konikow, 2013). Five major confined groundwater basins in the

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United States have recorded up to an 80% loss of storage space. Two unconfined aquifers have experienced declines in the tens of metres with little likelihood that natural recharge will restore levels in the near future (Narasimhan, 2009). These systems have essentially been mined (Narasimhan, 2009). In the western United States, urban and exurban developments have been partly supported by groundwater use. In some cases, 'exempt wells' have served as a substitute for developing municipal water supplies. This has raised concerns about the sustainability and quality of the resource. It has also created conflict between users, for example traditional users, such as farmers, and new suburban homeowners. These wells are exempt from permitting and monitoring, meaning it is difficult to know how many there are, their location, or how much water they extract (Tracy et al., 2012; Vinett and Jarvis, 2012). At present, the legal status of groundwater is different to surface water (despite scientific knowledge showing they are interconnected).

In 2005, 5% of Australia's 367 groundwater management units (GMU) were over-allocated and a further 23% were highly developed (National Water Commission, 2011). In the Murray-Darling Basin (MDB) (Fig. 1), Australia's food bowl, around 65% of groundwater use is for irrigation (Murray Darling Basin Commission, 2007). State governments have over-allocated groundwater for irrigated agriculture in many parts of the MDB and provided licences to do so at minimal cost. As might be expected, farmers have expanded their areas under irrigation. In 2004/2005, groundwater entitlements in the MDB amounted to 3250 GL/year, compared with an estimated sustainable yield of 2450 GL/year (Nevill, 2009).

In areas where groundwater entitlements are available, the adoption of centre pivot irrigation has aided the expansion of irrigated agriculture based on groundwater extraction. This has occurred in the Wimmera region in the state of Victoria, which is part of the southern MDB. The Wimmera region is the case study for this research. The Wimmera is also an interesting case study because of the large number of ecologically significant small wetlands on farming land that may be affected by changes in groundwater levels and quality.

There has been very little social research examining rural landholder attitudes to groundwater use and management. This is an important gap given the critical role social acceptability plays in resource access decisions, the important role groundwater plays in sustaining livelihoods, and the vital role it plays in maintaining groundwater dependent ecosystems. This paper attempts to address that gap by exploring risk interpretation by rural landholders in relation to groundwater use for irrigated agriculture. In the next sections, we provide an overview of key literature examining the social construction of risk and introduce the research approach. We then report the key findings from our case study. In our discussion, we reflect on the contribution of this research to the wider groundwater literature. We conclude with a discussion of the implications of this research for policy and management.

2. Background

2.1. Water governance

The recent severe drought in south eastern Australia highlighted important water governance issues and led to a number of key reforms, including those intended to address pressures on groundwater resources. Those reforms have included establishing the National Water Initiative (NWI) and the National Water Commission (NWC) to implement the NWI, and the Murray-Darling Basin Authority (MDBA) to replace the Murray-Darling Basin Commission. The MDBA was charged with developing and implementing the Basin Plan. The Basin Plan involved establishing Sustainable Diversion Limits (SDL) for each watershed in the MDB (i.e. the amount of water that can be used by agriculture and urban areas without compromising ecosystem integrity) for both groundwater and surface water. An important change has been the consideration of surface water and groundwater as a single resource. While separate SDLs will be set for groundwater and surface water, they will take into account interactions between surface and

Fig. 1. Location and extent of the Murray-Darling Basin and Wimmera Catchment Management Authority Region, Australia.