Finding a Sustainable Balance in the Water-Food-Environment Nexus: Socio-economic Transformation of an Agricultural Basin

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Freshwater security poses one of the major challenges of the 21st century, with future supplies uncertain due to climate change and increasing demands on water as populations grow and ecosystem services become increasingly valued. Increasing water use in agriculture inevitably reduces the share available for ecosystems, leading to its degradation, and in places where ecosystem services are valued by humans, community sentiment turns adverse. Water management decisions made that favour ecosystem sustainability can, however, impact a region's economy, employment, and population, especially in agriculture centred economies. The competition for water threatens the viability of agricultural communities. The potential for conflict is self-evident as different users of water attempt to maximize their benefits at the expense of others. This paper focused on this water-food-environment nexus in the Murrumbidgee River Basin, Australia, and how it contributed to the evolution of the regional economy and changing demographic patterns. In the Murrumbidgee water management policies favouring the environment were implemented in the mid-1990s. Paradoxically, against expectations, unemployment in the region fell and there was an increase in average regional income, despite a decline in agriculture. To understand this, and to explore how the competition for water played out in the Murrumbidgee Basin, we developed and used a socio-hydrologic model that explicitly considers bi-directional feedbacks between human and water systems. The modelling simulated the change in community sentiment in response to widespread ecosystem degradation, and forced water management that favoured ecosystems which led to the inevitable decline in agriculture production. The model translated the impact of this decline to the remainder of the economy. The modelling showed how the basin economy reorganized through sectoral transformation to the manufacturing and service sectors, improved agricultural practices, and out-migration of basin residents. The sectoral transformation was facilitated by capital available for investment in manufacturing and service sectors with knock-on impacts on population dynamics and unemployment. The composite impact of sectoral transformation, out-migration and agriculture diversification cushioned the basin economy which adapted to cope with cuts to agricultural water allocations and collectively these contributed to a sustainable transformation of the basin economy. The dynamics outlined here highlight the adaptive capacity of people and movement of capital in a free economy, supported by appropriate strategies and funding, to cope with water stress. These findings are counter-intuitive and not self-evident without the use of the socio-hydrology analysis present in this paper. This type of modelling can be useful to assist the debate in other agriculture communities and beneficially inform how communities could transform and open up adaptation pathways. In a world where fresh water crisis is imminent it can further the understanding of why water management in some basins fail (Aral Sea, Unina Lake), while other basins like the Murrumbidgee are transforming and can help define the role of economic transformation in water management.

Keywords: ecosystem, economy, sectoral transformation, water allocation

