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Role of Sectoral Transformation in Evolution of Water Management in Agricultural Catchments: A Socio-hydrologic Analysis

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Sustainable development in society depends on an understanding of how communities interact with the natural system and how they co-evolve in time. Increasingly the livelihood and future viability of agricultural communities are being threatened by competition for water between food production and the environment. This study focused on this water-agriculture-environment nexus as it played out in the Murrumbidgee River Basin, Australia, and how co-evolution of society and water management occurred. Over 100 years of agricultural development the Murrumbidgee Basin has experienced a "pendulum swing" in terms of water allocation entirely to agriculture production at the expense of the environment, and eventually to the reallocation of water back to the environment. This pendulum swing has been attributed to a combination of increased national wealth, reduced share of agriculture in the national GDP, and to increased environment awareness of environmental degradation. Environment awareness depends on the structure of the economy, education, and socio-politic structure. As the basin economy develops accompanied by sectoral transformation, basin production becomes increasingly dependent on the industry sector. A loss of economic dependence on agriculture leads to a lower emphasis on the need to allocate water to agriculture. Society's value and preference turns around and is motivated towards the protection of the ecosystem. We hypothesize that in the competition of water use between economic livelihood and environment well being of society, economic diversification pushed the balance in towards the environment. In order to test this hypothesis, we developed a coupled socio-hydrologic model, which explicitly considers bi-directional feedbacks between human and water systems to explore how the competition for water played out in the Murrumbidgee. We demonstrate this by linking the dynamics of the economy of the whole (agriculture and industry) to community sentiment for the environment and to water allocation. The model captured the changing value and preference, threshold dynamics, changing water management and showed the importance of sectoral transformation in water management. The modeling showed that as agriculture became constrained by water reallocation to restore ecosystem health, the community coped with the transition through the sectoral transformation to the industry sector and out-migration of basin residents. The dynamics observed in the Murrumbidgee River basin highlights how the transformation of the basin economy influenced sustainable development, mitigated adverse economic outcomes and enabled society to transition with the implementation of water management decisions that increasingly favored the environment.