Aquifer recovery during the transition from drought to a wet period: the mechanisms and pathways to recovery

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In semi-arid environments with climate cycles driven by the El Niño-Southern Oscillation (ENSO), groundwater provides a reliable resource for agricultural and portable use. During the drought in early 2000s, abstraction from alluvial aquifers had lowered groundwater levels and thereby affected river at low flow conditions. Recoveries were reported following the wetter climate between 2010 and 2012. This study quantifies the dominating recharge mechanisms, particularly the role of focused recharge during the recovery of depleted aquifers. As a part of a long-term monitoring program funded by the NCRIS Groundwater Infrastructure project, groundwater levels have been recorded at Maules Creek Catchment in the Namoi Valley since 2007. The recent natural climatic transitions from dry to wet have been captured with high spatial and temporal resolution. The climate and hydrology data were analysed to reveal the controlling recharge mechanisms. A general recovery of groundwater levels was observed across the Maules Creek Catchment. Groundwater rise of about 1.5 m was observed Near the Namoi River and 2 to 3.5 m were observed along the mountain front of the Nandewar Range. Along the intermittent section of Maules Creek below the main groundwater abstraction area, water table elevated about 5 m. It appears aquifers along disconnected stream reaches receive substantial recharge even during smaller runoff events. Results also suggested a complete recovery requires at least two consecutive wet years. By contrast, the impact of sporadic floods on groundwater levels near connected reaches (like the Namoi) has been demonstrated to be modest. The results reveal flood recharge is more efficient at ephemeral and intermittent reaches. The mountain front influx is substantial yet needs longer time to reach the alluvial aquifer. Understanding these processes, their distribution and their temporal reoccurrence are essential for using the groundwater resource sustainably as a drought buffer into the future.