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Sustainable Agriculture in the Lower Murrumbidgee Catchment

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The Murray-Darling Basin in South-eastern Australia is one of the most productive agricultural areas in Australia. The Murrumbidgee River is part of this river system. Irrigated agriculture in Murrumbidgee Irrigation Area (MIA) started around 1910. From 1970 on, the rice growing area increased significantly. Since then, shallow water tables and salinisation have been observed in the region. The human induced salinisation is the result of salt stored in the soil profile and/or groundwater being mobilized by extra water provided by human activities such as irrigation and landclearing. In the 90's, around 50 percent of the MIA had watertables within 2 m below surface. The Land and Water Management Plan for the MIA (July 1998) estimates an area of 20 percent to be affected by salinisation (EC $>$ 2 dS/m). This study investigates the long term behaviour of the groundwater system. Especially the role of the rice growing and the influence of land use changes on the depth to groundwater are modelled.

In order to do so, we implement a quasi-3D finite difference groundwater model. The model extent is larger than the study area itself (MIA) in order to consider the physical boundaries and regional effects. The spatial resolution is 1 km2. Vertically, the model is divided into 4 layers according to the geological units. Because data are scarce, soil properties, e.g. hydraulic conductivity or storage coefficient, are assumed to be homogenous over the entire model region. These values are an average over the available MIA data. Four different classes of land use are distinguished: bare land and non-irrigated land, rice, horticulture and wheat. The recharge is the difference between the input fluxes (precipitation and irrigation) and the plants' transpiration. The direct evaporation from the groundwater is considered in the evaporation package. Time dependent parameters are averaged over the year.

The calculated heads show a good correlation with the observed heads in the MIA, particularly the first layer (average deviation 1.5 m in the first layer, 2.5 m overall). The indication for the salinisation used in this study is the depth to groundwater. If the watertable is within 2 m below surface, there will be a danger of salinity. The calculated final states for different rice areas (15’000 ha - 40’000 ha) are varying between 21’900 ha and 61’200 ha of land with shallow watertables, which corresponds to 17-50% of MIA. The calculation of scenarios shows that lowering the rice growing area will reduce the affected area. It is recommended to lower the extent of the rice growing from 40’000 ha to 20’000 ha as well as to optimise the irrigation management on the rice fields in order to reduce the recharge.