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Socio-hydrology: understanding the dynamics of agricultural communities under water stress

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At present, over 4 billion people globally face a form of water scarcity. Over the coming decades this number is expected to rise due to a combination of factors, including population growth, changing (dietary) habits and changes in climate. As agriculture is a major water user, water scarcity is of particular significance in this respect. The concept being relative and dynamic, a community can experience water scarcity at any level of demand and supply. Moreover, different communities may have followed different paths to arrive at their present situation as a consequence of the continuous, specific interactions between the hydrological and the social system present. Models studying the socio-hydrological system have traditionally started at the water cycle dynamics thereby considering human interactions as external forces to the system. Also, these models have run under the assumption of stationarity. Aim of this study is to identify the major feedbacks between the hydrological and the social system and identify the main drivers that result in these different pathways and outcomes. This is done through the development of a stylized model consisting of 3 (4) ordinary differential equations intended at capturing only those interactions between the social and the hydrological system that give rise to the long-term dynamics of a hypothetical agricultural community. The model is, through its simplicity and its emphasis on feedbacks, complementary to existing social theories and more complex, spatial explicit and often data intensive model frameworks. Having insight in the dynamics and the qualitative behavior of the state variables in this hypothetical setting is the first step in characterizing the similarities and differences between real world human-water systems and in so doing follows the path of comparative socio-hydrology.