Society faces challenges in the management and use of water resources that are global in nature and yet impact communities and individuals locally. While this presentation focuses on issues common to semi-arid grasslands with applications from the central plains of the U.S.A., the computational framework is extensible to other challenges. A team of researchers at Kansas State University has developed a modeling paradigm to comprehensively study water resources. Individually, computational models will be overviewed that enable studies of groundwater hydrogeology, agro-ecology, and economics. Each model is capable of reproducing historical data (groundwater declines, crop yields, economic decisions), and provides a tool to forecast disciplinary perspectives into the future. Collectively, these models have been integrated using the Open Modeling Interface (OpenMI). This framework enables output from one model to be used as input to others, and provides a tool to integrate perspectives. This framework has been applied to study the impacts of policy change on water resources, land-use choices, and economic productivity. The results of these novel modeling methods will be presented, and the extension to other areas of the world will be discussed.