Water reallocation is an important means to ensure that water resources are applied to high value uses, within agriculture and across competing uses including municipal and instream flow needs. Water markets can be powerful tools to facilitate this reallocation and increase the productive value of water. While water markets are increasing in number across the western United States, they are currently hindered by multiple information-related constraints and transaction costs that limit market efficacy, and can even exacerbate resource misallocation relative to no market at all. For example, uncertainty over seasonal water availability and consumptive use can affect planting and irrigation decisions, and limit trades. The same types of information problems can limit opportunities for effective water law and regulation as well. We introduce a conceptual framework to mitigate these challenges and improve water use efficiencies by capitalising on three synergistic emerging technologies – improved seasonal water forecasting, automated consumptive use monitoring, and “smart” markets for leasing and trading water. The framework can support water management at both the farm and regulatory levels. Improved seasonal water forecasting can help farmers plan their planting and water use activities earlier and with less uncertainty. Automated consumptive use monitoring can support consumptive-use-based water transactions and minimize negative third-party effects of trade, which encumber regulatory oversight and restrict water trading. Smart markets ease the process of matching multiple sellers and buyers of water rights, and help navigate the highly complex regulatory constraints for a successful trade.

Given that each of these technologies work within institutional constraints, the framework also includes a system-level description of the technology-institutional nexus which is critical for identifying barriers to adoption, how they may be overcome in complex environments, critical system interdependencies, and new opportunities. The framework captures the important interdependencies within and between biophysical and social-economic systems, and facilitates the assessment of the value of technology adoption and institutional changes for improving water use and its economic benefits.