A Vision for Water-Limited Agroecological Systems Research

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Abstract. The Water Management and Systems Research Unit (WMSRU, USDA-ARS, Fort Collins, CO) pursues a broad research agenda with the goal of systems-level advancement of crop production and agroecosystem services in water-limited regions. Building on a century-long history of advances in water, irrigation, and agroecosystem science and management, the WMSRU now proposes a vision for water-limited agroecological systems research, as discussed herein. We believe that major advances in semi-arid/arid agricultural production will require not only advances in genetics, physiology, remote sensing, and modeling but, also, systems-level integration of those advances.

Unit scientists have expertise spanning key processes that drive plant performance and ecosystem services (physiology, genetics, hydrology, meteorology). Data collected by experimental work in the WMSRU and compiled from various sources feed into an analytical framework that integrates plant physiology, growth, precision irrigation management, remote sensing, and watershed hydrology through the development and application of process-based models and artificial intelligence (AI). Primary scientific outputs of the analytical framework are improved understanding of systems function, including interactions of key plant traits and remote sensing metrics that align with crop stress and environmental responses to climate. From these outputs, a better understanding of gene by environment by management (GxExM) interactions is combined with climate projections to predict crop yields and water and nutrient cycling that is implemented in stakeholder-facing decision support tools available as web-based services. Finally, enhanced understanding of process interactions in space and time help us update existing models and refine future methodology.

To meet these goals, WMSRU scientists collaborate extensively with researchers and practitioners globally. We welcome new collaborations in synergistic fields related to systems-level advancement of water-limited crop production and semi-arid/arid agroecosystem services.