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In the last 20 years, genetic potential of the cowherd and production costs have steadily increased in the United States; however, production outputs (pregnancy rates and weaning weights) have been stagnant or declined. In addition, greenhouse gas emissions and climatic variability and associated effects on annual forage availability and quality are additional challenges facing livestock managers. These challenges threaten long-term sustainability of rangeland-based livestock production and community vitality in rural areas in western U.S. Consequently, future of livestock production is dependent on adoption of precision livestock management tools that allow for economically efficient and environmentally responsive livestock production while maintaining and/or improving rangeland health, meeting other ecosystem service needs. The largest potential in increasing resource efficiency lies in the individual animal monitoring and analysis, and the systematic or integrated way of addressing productivity, forage availability and utilization, and animal welfare complex. Innovative technologies will continue to drive improvements in both production efficiency and sustainability in beef production systems. Digital technologies are already transforming agriculture, particularly with precision cropping/farming. The adoption of technology in beef production systems has been slower to evolve, but opportunities are quickly coming available to increase production efficiency. More precise monitoring sensors that can capture variability in weather, soil water and nutrient cycling, vegetation dynamics, and individual animal grazing behavior can aid in ranch decision making and better linking interactions and potential tradeoffs between livestock production and other ecosystem services. Understanding these systems may provide greater opportunities to enhance management for a greater suite of benefits derived from grazing lands. Embracing individual animal management by utilizing precision feeding technology with animal weighing capacity at a pasture level can decrease cost of labor and optimize individual animal performance. Individual animal performance instead of group performance may allow for greater ability for selection and understanding of variable that contribute to greater efficiency and adaptability to climate change or drought. Overall, emerging solutions and integrated strategies rather than any single technology is likely to deliver the best outcomes given the diversity of beef production systems.