Economic Impacts of Variable Precipitation on Wyoming Ranchers

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Variation in precipitation is a threat facing the economic stability of the cattle industry. Current national climate change impacts include changes in temperature, precipitation, snowpack, evaporation, and weather variability and increased occurrences of extreme events, most notably drought. These climate changes affect cattle production through the health, well-being, and performance of crops, pastureland, rangeland, and cattle. Quantification of the nature and severity of these effects on cattle production could help producers implement management strategies to reduce potential negative economic impacts.

Objectives

The major objectives of this research include: 1) develop relevant ranch-level economic models of cattle production systems specific to eastern Wyoming, 2) incorporate a range of changes to variation in growing season precipitation on cattle production through both impacts directly on calf performance and indirectly through forage production, and 3) analyze potential ranch-level outcomes of management alternatives using economic models and climate scenarios developed for the first two objectives.

Materials and Methods

A multi-period linear programming (MLP) model is used to quantify the impacts of climate change on cattle production in southeast Wyoming, as well as provide potential benefits and costs of alternative adaptations. The MLP model analyzes these impacts over a suite of climate forecasts to determine the potential impact of changes in growing season precipitation on the viability of cattle producers in the region. Information about the physical effects of climate variables were obtained from long-term research at the U.S. Department of Agriculture, Agricultural Research Service’s (ARS) High Plains Grasslands Research Station near Cheyenne. To use the full climate data used in the ARS research, we utilize a 35-year planning horizon.

Results and Discussion

Results indicate that precipitation variation negatively impacts profitability of cattle enterprises with dry years having larger negative impacts than positive impacts associated with wet years. Models based on static weather tend to overestimate profitability when compared to models that include historical precipitation variation. Further, impacts on forage production have larger negative consequences for producers than the direct impacts on calf performance, suggesting that producers can better prepare for increasing variation in annual precipitation by focusing on better forage management responses than investing in herd genetics. Results suggest that optimal herd numbers will decrease by 9% with a 10% increase in precipitation variation and up to 60% with a 50% increase in pre-
cipitation variation. Also, the negative impacts to discounted net returns when both forage and animal are impacted by weather variation are much larger than either of the individual impacts (Figure 1).

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**Figure 1.** Average discounted net returns from cattle when considering precipitation variation separate and combined impacts on forage production and calf gain.