Cow-Calf Reproductive, Genetic, and Nutritional Management to Improve the Sustainability of Whole Beef Production Systems

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Abstract

Optimizing efficiency in the cow-calf sector is an important step toward improving beef sustainability. The objective of the study was to use a model to identify the relative roles of reproductive, genetic, and nutritional management in minimizing beef production systems' environmental impact in an economically viable, socially acceptable manner. An economic and environmental diet optimizer was used to identify ideal nutritional management of beef production systems varying in genetic and reproductive technology use. Eight management scenarios were compared to a least cost baseline: average U.S. production practices (CON), CON with variable nutritional management (NUT), twinning cattle (TWN), early weaning (EW), sire selection by EPD using either on-farm bulls (EPD-B) or AI (EPD-AI), decreasing the calving window (CW), or selecting bulls by EPD and reducing the calving window (EPD-CW). Diets to minimize land use, water use, and/or greenhouse gas (GHG) emissions were optimized under each scenario. Increases in diet cost attributable to reducing environmental impact were constrained to less than stakeholder willingness to pay for improved efficiency and reduced environmental impact. Baseline land use, water use, and GHG emissions were 188 m, 712 L, and 21.9 kg/kg HCW beef. The NUT scenario, which assessed opportunities to improve sustainability by altering nutritional management alone, resulted in a simultaneous 1.5% reduction in land use, water use, and GHG emissions. The CW scenario improved calf uniformity and simultaneously decreased land use, water use, and GHG emissions by 3.2%. Twinning resulted in a 9.2% reduction in the 3 environmental impact metrics. The EW scenario allowed for an 8.5% reduction in the 3 metrics. The EPD-AI scenario resulted in an 11.1% reduction, which was comparable to the 11.3% reduction achieved by EPD-B in the 3 metrics. Improving genetic selection by using AI or by purchasing on-farm bulls based on their superior EPD demonstrated clear opportunity to improve sustainability. When genetic and reproductive technologies were adopted, up to a 12.4% reduction in environmental impact was achievable. Given the modeling assumptions used in this study, optimizing nutritional management while concurrently improving genetic and reproductive efficiency may be promising avenues to improve productivity and sustainability of U.S. beef systems.


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