Abstract citation ID: skae019.045

6 Identifying research gaps and opportunities to enhance sustainable beef production.

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Abstract: Sustainability has evolved and extended its influence across diverse sectors of the economy, including those in the beef supply chain. Public-facing companies predominantly emphasize environmental sustainability, especially climate-associated features, while beef producers continue to prioritize economic sustainability, hoping to to ensure their operation thrives into the next generation. Diversifying revenue and improving productivity are pivotal for safeguarding economic sustainability and fostering resilient production systems. Diversification is not new to beef producers; many have integrated ecosystem services into their operations to generate non-production revenue. The most valuable asset of a beef producer is the productivity of the land. Decision support tools need to be enhanced to allow producers to either capitalize on above average forage production to generate additional income, or to plan for alternative strategies when forage supply is forecast to be reduced. Because downstream beef supply chain participants prioritize environmental sustainability or reduction of scope 3 emissions, an emerging diversification opportunity for beef producers is to address this opportunity. While soil carbon initiatives have received attention, companies with substantial scope 3 emissions from beef production may value greenhouse gas (GHG) emissions from cattle more highly. Incentives for practices that reduce GHG emission from cattle can simultaneously reduce environmental impact associated with beef production and generate an additional revenue stream adjacent to beef production. Current opportunities to participate in these incentive programs are limited. Research can address the creation of functional protocols, and their intrinsic value. Clear targets, for gross emissions or emissions intensity, must be set but are not equivalent. In particular, research on effective/acceptable monitoring, reporting, and verification of emissions claims is imperative to functional markets. Innovation in emissions management and productivity gains can be integrated, so that goals of economic and environmental sustainability among value chain participants can be achieved. Maintaining a comprehensive perspective on sustainability solutions is essential to meeting the needs of humanity.