MARCH 1, 2019

U.S. BEEF INDUSTRY SUSTAINABILITY FRAMEWORK

Cow-Calf Sector

U.S. ROUNDTABLE FOR SUSTAINABLE BEEF

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U.S. BEEF INDUSTRY SUSTAINABILITY FRAMEWORK: INTRODUCTION

The U.S. Roundtable for Sustainable Beef (USRSB) is a non-profit organization formed in 2015. The USRSB's **mission** is to: *Advance, support, and communicate continuous improvement in the sustainability of U.S. beef production by educating and engaging the beef value chain through a collaborative multi-stakeholder effort.*

The mission helps advance the larger **vision** of the organization: *To make the U.S. beef value chain the trusted global leader in environmentally sound, socially responsible, and economically viable beef.*

The USRSB set a **strategic objective** to increase the amount of U.S. beef produced utilizing the U.S. Beef Industry Sustainability Framework to 20% by 2020.

The USRSB's scope centers around the mission, vision, and strategic objective through voluntary adoption of the Framework across the beef value chain, with a focus on continuous improvement. This includes education, training, and outreach.

Out of scope for the USRSB, as an organization, are:

1) Regulatory affairs and legislative lobbying
2) Engagement in business-to-business ventures
3) Mandating of standards and/or verification of individual stakeholder performance

While the USRSB recognizes these are important issues for the industry and the value chain, they are not within the USRSB's purpose and scope. However, to date, the USRSB has supported several pilot projects initiated by USRSB members to showcase the success of the U.S. Beef Industry Sustainability Framework in the value chain. The USRSB will continue to explore the challenges and opportunities for continuous improvement across all aspects of the beef value chain.

WHO IS USRSB?

In total, the USRSB is composed of more than 100 members across the beef community who share in the organization's vision to make the U.S. the trusted global leader in sustainable beef. The diverse set of members includes cow-calf producers, auction markets, feedyards, packers, processors, retail and food service operations, academic institutions, research organizations, conservation organizations, and allied industry organizations.

To date, USRSB members represent 30% of the U.S. cattle herd and more than 20 billion pounds of processed beef, reaching more than 100 million consumers across the U.S.

Since inception, the USRSB has defined an approach for developing a U.S. Beef Industry Sustainability Framework (see Figure 1 below). The USRSB has also developed a full set of resources, all packaged within the U.S. Beef Industry Sustainability Framework. These resources include indicators, metrics, and sustainability assessment guides (SAGs) (see Figure 2 below) that members of the beef value chain can use to assess their individual sustainability efforts.

THE BEEF VALUE CHAIN

The U.S. Beef Industry Sustainability Framework addresses the following sectors of the beef value chain:

1) **Cow-Calf:** The Cow-Calf Sector represents cattle production beginning on the ranch, where calves are born. This includes the time calves spend with their mothers all the way through when calves begin grazing on grass pastures after weaning. The Cow-Calf Sector also represents stocker and backgrounder operations, where cattle are at times sent when they are between six to 12 months of age, to continue growing.
2) **Livestock Auction Markets:** The Auction Market Sector includes companies facilitating the sale of calves, as well as stockers, backgrounders, and feedyard operations.
3) **Feedyard:** The Feedyard Sector represents operations where cattle are fed a carefully balanced diet composed of grains, grasses, and renewable feedstuffs.
4) **Packing and Processing Plants:** The Packing and Processing Plant Sector encompasses facilities where cattle are sent to be harvested and where beef is processed, packaged, and distributed to retail and food service companies either directly or through another processing facility.
5) **Retail and Food Service:** The Retail and Food Service Sector includes businesses providing beef to consumers, such as grocery stores, mass merchandisers, hotels, restaurants, and others.

Figure 1: USRSB's Organizational Scope

APPLYING THE U.S. BEEF INDUSTRY SUSTAINABILITY FRAMEWORK TO THE VALUE CHAIN

The Framework is intended to help continually and voluntarily improve the sustainability of U.S. beef, but the USRSB does not believe this is achieved by checking boxes. By utilizing the Framework, the beef value chain commits to continually seeking opportunities to improve. In turn, the Framework will help connect the consumer to the beef community, answering questions the consumer may have about beef production.

The Framework structure consists of SAGs by sector, each addressing the six high-priority indicators which are backed by sustainability metrics (see Figure 2). The sustainability metrics for improvements within each indicator are identified for each sector of the U.S. beef value chain. The sector-specific SAGs provide further guidelines on the purpose, approach, and methods for meeting the metrics, and ultimately improving the six high-priority indicators. Realizing the diversity in operations across the U.S. (sizes,

regions, environmental factors, etc.), the Framework is intended to be applicable to most situations in the beef value chain.

HOW DID THE FRAMEWORK GET TO THIS POINT?

The USRSB membership first aligned on a singular definition for sustainable beef: a socially responsible, environmentally sound, and economically viable product that prioritizes planet, people, animals, and progress. From there, members focused on two fundamental questions. What factors are most important to producing sustainable beef? How would each sector measure progress?

More than 80 USRSB members worked together to develop indicators around factors most important to beef sustainability, as well as metrics for each of those indicators which are the guidelines for measuring progress. The USRSB members sought guidance and support from a technical facilitator through the University of Arkansas.

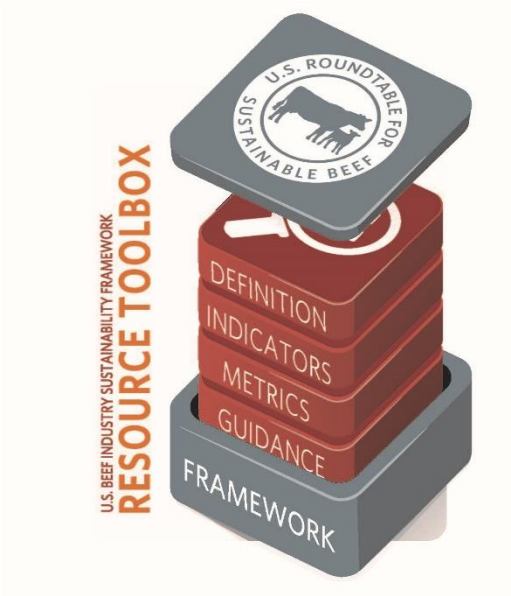


Figure 2: Resources included in, and organization of, the Framework

Early stages of the development process resulted in approximately 160 draft indicators. These draft indicators fostered discussion that helped members identify the final six high-priority indicators:

1) Water Resources
2) Land Resources
3) Air and Greenhouse Gas Emissions
4) Efficiency and Yield
5) Animal Health and Well-being
6) Employee Safety and Well-being

The group agreed unanimously that some draft indicators, including Consumer Perception, Transparency, Food Safety, and Profitability, actually reflected requirements of doing business that crosscut across all sectors and would therefore not be identified as high-priority indicators. For example, Food Safety was not selected as an indicator because it is a precompetitive criterion for the viability of the beef value chain, touching every facet of beef production, processing, distribution, and consumption. Additionally, USRSB members deemed Profitability as foundational across all indicators. Additionally, due to the multi-stakeholder nature of the USRSB, which includes direct competitors, there are legal and ethical concerns regarding discussions around pricing and profit.

Next, the USRSB developed metrics within each high-priority indicator, for each sector. The USRSB agreed that each sector within the beef value chain was responsible for determining the best way to approach and develop metrics for itself. This determination allowed each sector to approach indicators in ways that were most impactful and relevant. While sectors led the development, they actively engaged other stakeholder groups, including civil society and allied industry members.

The metrics then needed a technical guidance document that provided additional tools and resources for the value chain. This led to the development of SAGs. Much like the metric development process, value-chain sectors took the lead in developing these resources.

A draft version of the Framework was first presented internally to USRSB members. In total, members submitted more than 1,250 comments over an 18-month period. These comments assisted in finalizing a draft Framework that was made available for two rounds of public commentary (see Figure 3). During the first round of open public commentary, USRSB received more than 450 comments. During the second round of open public commentary, USRSB received more than 100 comments. The public comments were thoughtfully reviewed and responded to, and when deemed to be an improvement in line with the USRSB vision, mission, and scope, changes were made to the Framework to reflect public feedback. In total, the Framework represents six high-priority indicators which are supported by 51 metrics, across 27 SAGs all developed with input from five official review rounds and over 1,800 total internal and public comments.

Figure 3: Process for sustainability framework development

This process has led the USRSB to where it is today. Much of the work conducted to date around the Framework is related to improving consumer confidence in the beef industry by transparently sharing information and proving the industry is committed to continuous improvement.

BENCHMARKING AND DEMONSTRATING PROGRESS

Sustainability cuts across social, economic, and environmental domains, and it is about continuous improvement of a system. Thus, the USRSB focuses on improving and positively impacting sustainability for the entire beef industry, which the USRSB believes is achievable through robust adoption of the U.S. Beef Industry Sustainability Framework. To show this progress though, measurement over time is required.

Benchmarking is critical to the U.S. beef industry's sustainability efforts. The USRSB has committed to measure and document impacts of the Framework over time and will use surveys and reported information to measure its implementation effectiveness.

Additionally, the USRSB will use the 2013 U.S. Beef Life Cycle Assessment and its subsequent future updates to benchmark and measure industry-wide progress on sustainability outcomes. A **Life Cycle Assessment** (LCA) is an environmental assessment tool that allows for the accounting of environmental impacts across the entire beef value chain, from cradle to grave, or in the case of beef specifically, from feed production to the consumer. The LCA will allow the U.S. beef industry to identify "hot spots" along the value chain that can be targeted for improvement. Additionally, the LCA will help organizations and individuals within the beef value chain understand which impacts are under their direct control and which impacts are upstream/downstream and therefore more difficult to change. The LCA will be a critical component of the beef community's evaluation of its progress on the sustainability journey and the effectiveness of the Framework metrics to impact this journey.

The National Cattlemen's Beef Association, acting as a contractor with the Beef Checkoff[1], made an investment in benchmarking the U.S. beef industry using LCA methodology. A complete cradle-to-grave analysis of U.S. beef was conducted, peer-reviewed, and published in the *International Journal of Life Cycle Assessment*[2].

LCA Results and Connections to the U.S. Beef Industry Sustainability Framework Indicators

The LCA funded by the Beef Checkoff examined several impact categories that overlap with the Framework's high-priority indicators (Table 1).

Table 1. Relationship between the U.S. Beef Industry Sustainability Framework's indicators and LCA Impact Categories

U.S. Beef Industry Sustainability Indicators	LCA Impact Category
Land Resources	Land use
Water Resources, Land Resources	Acidification potential
Water Resources	Assessed and absolute water use
Water Resources	Water emissions
Efficiency and Yield	Resource consumption
Efficiency and Yield	Solid waste
Efficiency and Yield	Cumulative energy demand
Air and GHG Emissions	Photochemical ozone creation
Air and GHG Emissions	Ozone depletion potential
Air and GHG Emissions	Global warming potential
Employee Safety and Well-being	Toxicity potential

The beef industry LCA concluded that beef cattle production in the U.S., including all feed production, electricity use, fertilizer use, and fossil fuel combustion, is 3.3% of total U.S. greenhouse gas emissions. Corn going to feed grain-finished beef cattle in the U.S. represents only 10% of harvested corn grain acres, which is eight million acres and approximately 2% of total U.S. cropland acres. It only takes 308 gallons of water to produce a pound of boneless beef and water use by beef is around 5% of total U.S. water withdrawals. Plus, this water is recycled in the environment. Also, fossil fuel use in beef cattle production represents just 0.7% of total fossil fuel use in the U.S.

Opportunities to further reduce impacts are discussed in detail within the full peer-reviewed beef system LCA article, but some highlighted opportunities include more efficient cattle production (captured in the Efficiency and Yield Metrics of the Cow-Calf and Feedyard Sectors) and reducing refrigerant emissions and waste at retail and restaurants (Air and Greenhouse Gas Emissions, and Efficiency and Yield Metrics for the Retail and Food Service Sector). Each sector of the beef value chain has a role to play in the continuous

[1] The Beef Checkoff Program is a beef producer-funded marketing and research program designed to increase domestic and/or international demand for beef. The Cattlemen's Beef Board and the U.S. Department of Agriculture oversee the collection and spending of checkoff dollars.

[2] A life cycle assessment of the environmental impacts of a beef system in the USA; Asem-Hiablie, S., Battagliese, T., Stackhouse-Lawson, K.R. et al. Int J Life Cycle Assess (2018). https://doi.org/10.1007/s11367-018-1464-6

improvement of U.S. beef sustainability, which is a key reason behind USRSB's approach of each sector developing its own metrics for each indicator.

The USRSB's model for metric development (sector-specific development) aligns with the LCA's findings that support the unique opportunities each sector of the beef value chain has in the continuous improvement of U.S. beef sustainability. Further, alignment of the Framework high-priority indicators with the LCA-identified opportunities for improved sustainability outcomes increase the ability to drive measurable improvement in U.S. beef sustainability in the coming years.

Demonstrating Continuous Progress

As the USRSB works to demonstrate improvement in sustainability of the U.S. beef value chain, several foundational concepts are paramount to success:

1) The goal is to achieve progress for the six high-priority indicators, through voluntary adoption of the Framework across the entire beef value chain.
2) The USRSB will update, as needed, the comprehensive Framework, inclusive of high-priority indicators, metrics for each sector, SAGs, tools, and resources.
3) The metrics developed by the USRSB must be measurable, implementable, and understandable regardless of the scale of the operation. They follow the **SMART** criteria: **s**pecific, **m**easurable, **a**ttainable, **r**elevant, and **t**ime-bound or **t**rackable. They must be embraced by each sector and not dictated by one sector to another; and sectors must explain how metrics will drive change in the high-priority indicators.
4) The USRSB will continue to utilize the U.S. Beef Industry LCA as the guidepost to assess progress and adapt the indicators and metrics to continue the journey of continuous improvement, which is to never stop learning, adapting, and improving.
5) The USRSB will work with stakeholders in the beef value chain to determine how metric data can be used in the future to further improve the quality of assessment through the LCA.
6) It is essential for the USRSB to interface with other sustainability initiatives to avoid duplication of efforts and reporting, such as Field to Market for feed-related inputs and the Innovation Center for U.S. Dairy/Dairy Sustainability Alliance for dairy calves that enter the beef value chain.
7) The USRSB recognizes the necessity of animal identification for the U.S. beef cattle herd to measure success and improvements in sustainability and embraces a nationwide goal of animal identification for purposes of disease traceability, herd security, consumer confidence, quality improvement, international market access, and a means to participate in value-chain programs that offer value-added benefits.

USRSB KEY PARTNERSHIPS AND RELATIONSHIPS

The USRSB recognizes it is essential to interface with other sustainability initiatives to avoid duplication of efforts and reporting. The USRSB continues to seek out partnerships and alliances with other commodities and sustainability initiatives. The following are brief descriptions of relevant key partnerships and relationships:

Field to Market

The USRSB has partnered with Field to Market (FTM): The Alliance for Sustainable Agriculture. The FTM initiative has benchmarked and provided the tools for many of the main grain commodities (including the main grain commodities fed to livestock) to make continuous improvement in their

sustainability footprint. The partnership between FTM and USRSB has resulted in a letter of agreement to find areas in which the two initiatives can work together, identify any knowledge gaps, and specifically look at ways to collaborate on feed sustainability.

Currently, FTM and the USRSB are developing a framework to conduct pilot projects. This process will test the tools, metrics, and communication between the commodity grain and beef markets in order to help identify knowledge gaps. The pilot projects will include grain farmers, grain merchandisers, grain cattle feeders, non-governmental organizations, academic institutions, and retail partners who are working to meet consumer expectations around feed production. While this partnership is in its infancy, the USRSB looks forward to sharing progress toward its goals.

Innovation Center for U.S. Dairy

The USRSB is working with the dairy industry and their sustainability initiative through the Innovation Center for U.S. Dairy. The two industries are connected in many ways and will continue to share learnings and knowledge.

Global Roundtable for Sustainable Beef

The beef sustainability conversation is happening globally. The USRSB is a member of the Global Roundtable for Sustainable Beef (GRSB) and serves on the board of directors. The GRSB aids regional roundtables, such as the USRSB, in communicating on global sustainability challenges including antibiotic stewardship, carbon footprint, and land conversion. Most recently, USRSB participated in the development of the GRSB Statement on Antimicrobial Stewardship. The GRSB recognizes that implementation of such a statement must be in line with member countries' laws, regulations, and producer best practices. In the U.S., the governing body over antibiotics is the U.S. Food and Drug Administration (FDA), and the U.S. Beef Industry Sustainability Framework supports the Beef Quality Assurance (BQA) Program Antibiotic Stewardship Manual and 14 Judicious Use Guidelines, in compliance with all FDA rules and regulations.

The USRSB believes that together, as a beef community, we can make a measurable improvement in the sustainability of the U.S. beef industry, and in beef sustainability around the globe. If you wish to join the USRSB in its journey, please visit www.USRSB.org **to learn more.**

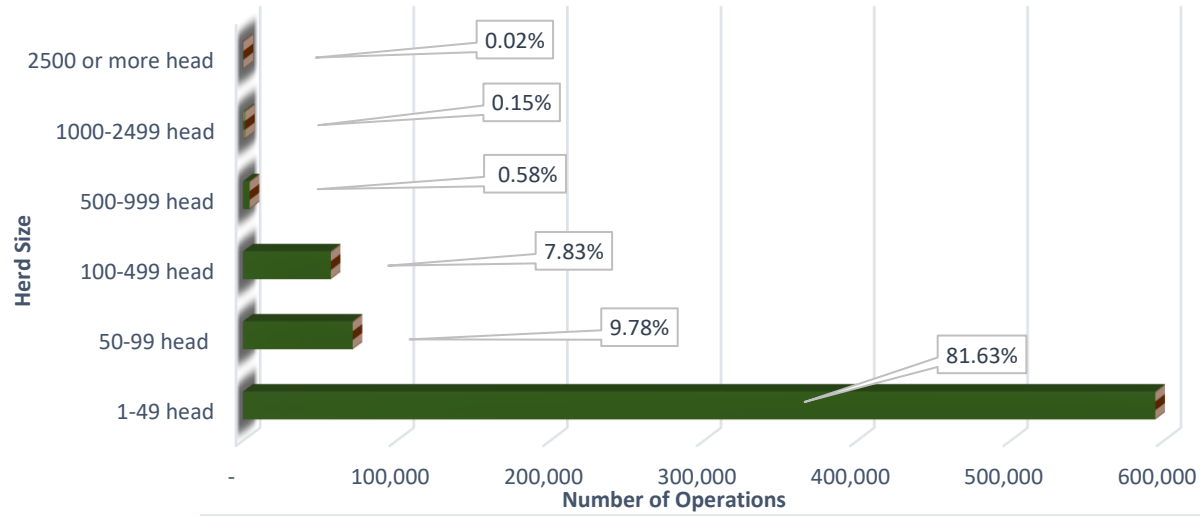
U.S. BEEF INDUSTRY SUSTAINABILITY FRAMEWORK: 1. COW-CALF SECTOR

316

317 # OVERVIEW OF THE COW-CALF SECTOR

318 The Cow-Calf Sector is made up of individuals, organizations and associations of people who are actively
319 engaged in the ownership and management of cattle used to produce beef. For the purpose of this
320 document, the Cow-Calf Sector is inclusive of cow-calf producers (operations that maintain a breeding
321 herd of cows and bulls and produce weaned calves); stockers (operations with grazing or high-roughage
322 diet programs for cattle from the time they are weaned until they are on a finishing ration); and
323 backgrounders (operations with growing programs for cattle from the time they are weaned until they
324 are on a finishing ration).

325 The U.S. is the world's largest producer of beef, and the U.S. beef industry continuously strives to maintain
326 the high quality of its product for consumers in the U.S. and across the globe. The Cow-Calf Sector is the
327 largest and most diverse value-chain sector. Based on the 2012 Census of Agriculture conducted by the
328 U.S. Department of Agriculture (USDA, 2012), there were 727,906 beef farms and ranches in the U.S.
329 (Figure 1). Of these, 91% were family owned or individually operated. The Cow-Calf Sector also plays an
330 important role through grazing cattle. Grazing livestock is the only means of converting human non-edible
331 grass/forage/biomass to human edible protein and fat, and this is important to meet the increasing
332 protein demand from a growing population. Additionally, well-managed livestock production is one of the
333 only current economically viable large-scale land uses that can be compatible with the conservation of
334 open spaces and natural habitats that sustain wildlife and contribute many other critical ecosystem
335 services and quality-of-life benefits to people.



	1-49 head	50-99 head	100-499 head	500-999 head	1000-2499 head	2500 or more head
Cattle Operations by Size	594,222	71,184	56,992	4,215	1,125	168
Percentage	81.63%	9.78%	7.83%	0.58%	0.15%	0.02%

Figure 1: Beef cattle operations by herd size (USDA, 2012)

Just like the landscape, cow-calf operations differ across the country, from less than 50 head on a few dozen acres to thousands of animals spread across hundreds of thousands of acres (Figure 2). Each operation has unique challenges and management styles and must adapt management practices based on current conditions. Variances in resource stewardship practices are precisely what has allowed cow-calf producers to operate in every state in the U.S. and to provide consumers the broadest amount of choice in the marketplace.

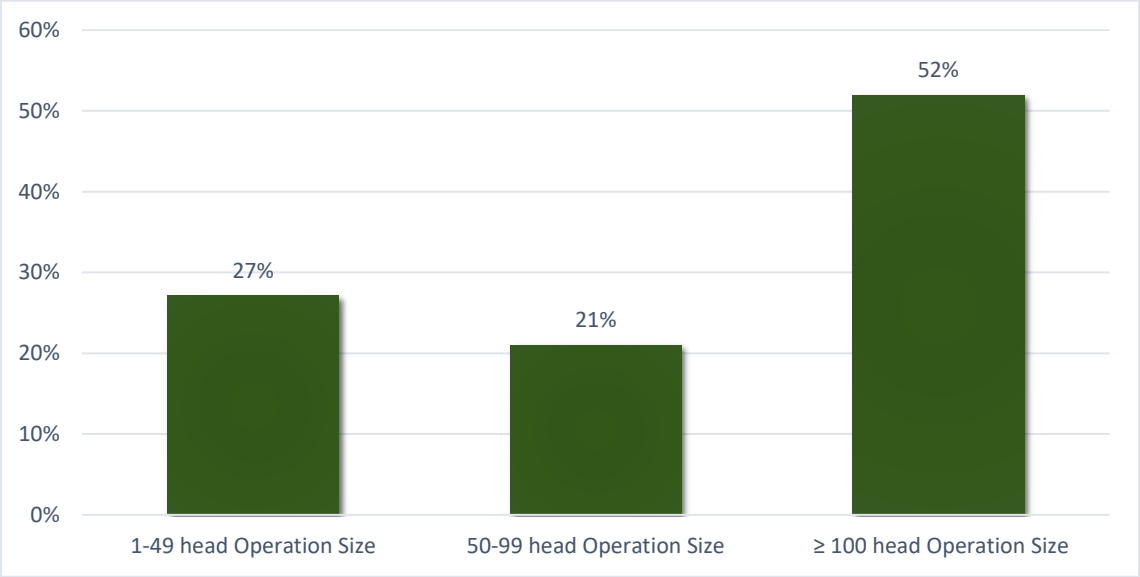


Figure 2: Percentage of calf crop by operation size (USDA, 2012)

The Cow-Calf Sector is a very diverse, complex, and decentralized sector of the beef value chain which makes the sector extremely resilient, and cattle producers tend to be fiercely independent. Change can often be slow, and this sector can have a difficult time quickly adjusting to market demands in the absence of economic incentives. However, change does happen over time. As U.S. beef exports continue to grow, an even greater emphasis will be put on the industry's sustainability and ability to meet future increases in protein demand, with demand primarily coming from growing middle class populations in developing countries. Throughout this growth, it remains critical to balance the protection of natural resources, the well-being of the animals and the needs of the people and communities within and around the beef value chain.

COW-CALF SECTOR SUSTAINABILITY ASSESSMENT GUIDES

The following Sustainability Assessment Guides (SAGs) describe and define the metrics for each of the six high-priority sustainability indicators. The SAGs also include resources and tools which will assist individual operators in assessing their own operations and identifying and implementing opportunities for improvement as it relates to the sustainability indicators. Importantly, adoption and use of the methods and tools described in the SAGs is voluntary. The SAGs are primarily intended to assist operators in improving a wide range of outcomes on their operations over time.

For each of the six high-priority indicators, the SAG will include:

1) A description of the indicator to ensure a clear understanding of its intent
2) A description of the metric selected to measure the indicator
3) Supporting guidelines that elaborate on the context of the metric, including guidelines to address various elements of the metric
    - It is important to note:
        i) Individual operators may or may not be addressing all the items asked in the supporting guidelines for a particular metric
        ii) Knowing what some of these additional elements are creates the opportunity for that operator to consider addressing those items going forward
        iii) Action on the part of the operator to address the listed items, or other items, over time is a means of demonstrating continuous improvement
4) Resources for implementation (not meant to be an exhaustive list), including:
    - Recommended practices for improving a particular metric
    - Summary of existing information for that metric
    - Tools (software, apps, hardware, etc.), for supporting metric assessment
    - Case studies
    - Technical support information
5) Suggested methods to monitor change and/or progress over time

A key tenet of sustainability is managing any operational task to strive toward **continuous improvement.** As this self-assessment is worked through on an operation, the guidelines below should be considered, and implementation planned in accordance with individual operation environments, situations, and needs. Methods to monitor change and/or progress over time also need to be identified. Incorporating guidelines, such as those identified in this SAG, into routine process reviews will potentially improve both the efficiency and sustainability of the operation.

CONTINUOUS IMPROVEMENT PROCESS

INDUSTRY IMPROVEMENT

The farming and ranching industry has made great strides, but further expansion of the number of cow-calf producers in the U.S. who adopt these metrics will improve the sustainability of the beef industry through a cumulative effect. Improvement in industry-wide sustainability outcomes will occur as more producers implement the continuous improvement processes and practices described in this SAG (Figure 3). Producer knowledge and experience will help increase efficiency and effectiveness of implementation. Benchmarking the number of producers across the U.S. who currently implement these metrics will provide the basis for setting goals for expanding adoption rates over the next five years. The U.S. Roundtable for Sustainable Beef (USRSB) will assess the rate of adoption on a regular basis to track needed improvements in these metrics.

Producer knowledge and adoption will also help increase communication of sustainability practices and outcomes with other participants in the value chain. For example, dealing with land tenure issues is a significant challenge for cattle producers who lease pasture from private ranches, state trust lands, or federal public lands. Producers who graze on leased lands often cannot convince the landowner to invest in or allow infrastructure development associated with better management practices. Increased knowledge, adoption, and implementation of these SAGs will eventually provide measurements and benchmarks for producers to more easily communicate the shared benefits of sustainability with landowners.

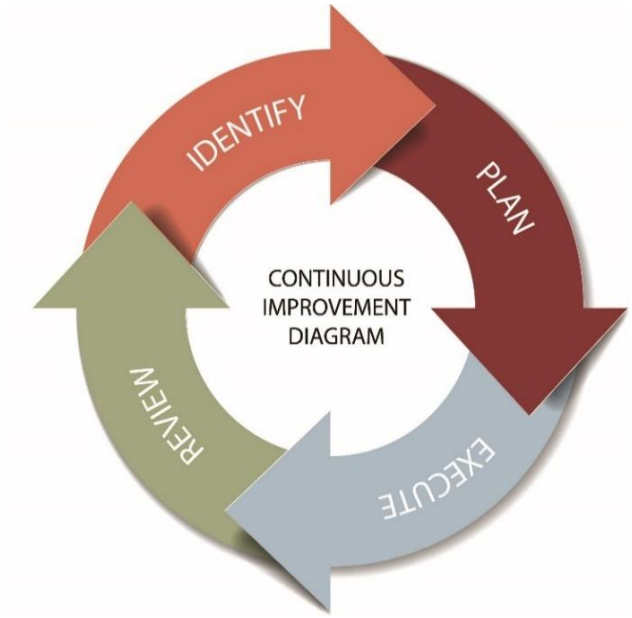


Figure 3: Continuous improvement process

PRODUCER IMPROVEMENT

As individual producers adopt the metrics and implement or enhance the plans and programs described in this SAG, their operations will become more sustainable. Regular reassessments, inherent in the continuous improvement process, allow and encourage producers to improve their operations over time according to the needs and opportunities of the individual operation. Due to the complex interactions with landscape, climate, and market conditions, producers must have the flexibility to adapt to changing conditions. Operation priorities and goals may change as circumstances change, whether through

operational improvements or unplanned setbacks such as drought, fire, unexpected expenses, labor/worker issues, family health issues, or emergencies. Regular self-review and evaluation against the indicators and metrics are important to help managers allocate limited resources appropriately to their operation.

CONTINUOUS IMPROVEMENT IMPLEMENTATION STRATEGY

As producers apply these metrics, and develop and implement the plans and practices described, it may be useful for producers to answer the following questions, as they pertain to their operations, in order to measure the effectiveness of their efforts, document their progress, and ensure continuous improvement:

1) **Indicator Improvement Process:** How will the indicator be improved through implementation of this metric?
   - For example, relating to the Water Resources Indicator, a producer, after identifying the water resources relevant to his/her operation, might ask "How can my grazing management plan help me enhance or protect riparian areas?", or "How can my grazing management plan help me reduce nutrient loads in impaired streams?"
2) **Metric Success Criteria:** What constitutes continuous improvement for the metric as it applies to the operation?
   - For example, relating to the Animal Health and Well-being Indicator, a producer could use a decrease in overall antibiotics needed to maintain heard health, or an increase in the percentage of calves born to calves weaned, to evaluate the success of their heard health program.
3) **Metric Implementation Plan:** What will be measured, when, how, and by whom?
   - For example, relating to the Efficiency and Yield Indicator, a producer could use the number of calves weaned per cow exposed, or pounds of animal gain per acre of pasture, over a specified time period to measure progress. This type of information could be recorded by the producer or record-keeper (if different than producer) in paper-form such as a National Cattlemen's Beef Association (NCBA) Redbook, or an operation's electronic recordkeeping system.
4) **Metric Recording Strategy:** How will the metrics be recorded, benchmarked and analyzed within the operation?
   - For example, relating to the Employee Safety and Well-being Indicator, a producer could record and file when employees receive training, what they were trained on, and who conducted the training. This type of information could be recorded by the producer or record-keeper (if different than producer) in paper files or an operation's electronic recordkeeping system.

COW-CALF SECTOR SUSTAINABILITY ASSESSMENT GUIDE
INDICATOR 1.1: WATER RESOURCES

METRIC 1.1: IS A GRAZING MANAGEMENT PLAN (OR EQUIVALENT) BEING IMPLEMENTED THAT MAINTAINS OR IMPROVES WATER RESOURCES?

DESCRIPTION OF INDICATOR AND METRIC

USRSB defines Water Resources as: The volume of water used by a sector for each process, and any impacts on water quality by a sector for each process.

Cattle producers' management decisions and activities can impact the amount of water required to maintain healthy pastures. The health of pastures affects water retention and quality, soil conditions, forage and plant diversity and health, and many other aspects. Ranchers and farmers can optimize forage production, improve ecological function, and promote healthy riparian areas using a Grazing Management Plan (GMP) as a key tool. Therefore, increasing the number of producers who have and implement effective GMPs in the U.S. can have a significant positive effect on the Water Resources Indicator.

Maintaining grassland has important benefits for water quality and quantity. Grazing refines and maintains this service, both ecologically and economically. Managed grazing can reduce the amount of water required to sprout and grow plants, extend the growing phase of those plants, and increase the diversity of plant species in the pasture. It can also increase water infiltration into the soil, slowing runoff, reducing erosion, and storing water in the ground, which extends the life of springs, creeks, and other riparian areas. Many of the same practices that produce healthier pastures have been shown to protect the quality of the water and integrity of riparian areas (Hubbard et al., 2004; DelCurto et al., 2005; Sollenberger et al., 2012). These practices include, but are not limited to, rotational grazing, providing appropriate recovery time for pastures before re-grazing and preventing cattle from congregating near surface water.

A variety of public and private organizations provide assistance for producers in developing and monitoring a GMP, including appropriate technical service providers and private agricultural educational and consulting institutes. Examples of these organizations can be found below in the Tools and Informational Resources section of the GMP discussion in this document.

Taken holistically, improving one of the Water Resources, Land Resources, or Air and Greenhouse Gas Emissions Indicator outcomes tends to improve the others as well, producing co-benefits across these indicators. The GMP is a means for driving improvement across all indicator outcomes of Water Resources, Land Resources, and Air and Greenhouse Gas Emissions.

Further details can be found in the GMP section, following the Cow-Calf Sector Air and Greenhouse Gas Emissions Indicator 1.3 section.

COW-CALF SECTOR SUSTAINABILITY ASSESSMENT GUIDE INDICATOR 1.2: LAND RESOURCES

METRIC 1.2: IS A GRAZING MANAGEMENT PLAN (OR EQUIVALENT) BEING IMPLEMENTED TO PROTECT AND/OR IMPROVE THE LAND RESOURCES, INCLUDING SUCCESSION/TRANSITION PLANNING?

DESCRIPTION OF INDICATOR AND METRIC

USRSB defines Land Resources as: The stewardship of terrestrial and aquatic habitats in relation to water, soil, and biodiversity. Impacts of land use and land use conversion, both caused by and prevented by ranching and farming activities and other value-chain land use decisions.

Cattle producers' management decisions and activities can directly impact the health of pastures on which the cattle graze. The maintenance, improvement, and protection of land resources in a cow-calf operation is fundamental to all aspects of beef sustainability, from the economic bottom line of optimizing forages, to animal and natural resources health. Optimizing land resources requires the consideration of many factors, including soil type, climate, vegetative cover, wildlife and their habitat, soil ecological function,

cattle health requirements, invasive species (including plants), and many others. Additionally, attention and full consideration of all facets of the business of ranching, including the natural resource health and vitality, is required to allow for the successful transition to future ownership as a cattle operation, thereby preventing land conversion. The most useful tool for cattle producers to manage all these factors to maintain and improve land resources is the implementation of a GMP.

A variety of public and private organizations provide assistance for producers in developing and monitoring a GMP, including appropriate technical service providers and private agricultural educational and consulting institutes. Examples of these organizations can be found below in the Tools and Informational Resources section of the GMP discussion in this document.

The GMP is a means for driving improvement across all indicator outcomes for Water, Land, and Air and Greenhouse Gas Emissions. Taken holistically, improving one of these indicator outcomes tends to improve the others as well, producing co-benefits across indicators.

Further details can be found in the GMP section, following the Cow-Calf Sector Air and Greenhouse Gas Emissions Indicator 1.3 section.

COW-CALF SECTOR SUSTAINABILITY ASSESSMENT GUIDE: INDICATOR 1.3: AIR AND GREENHOUSE GAS EMISSIONS

METRIC 1.3: HAS A GRAZING MANAGEMENT PLAN (OR EQUIVALENT) BEEN IMPLEMENTED THAT PROTECTS OR IMPROVES SOIL AND PLANT COMMUNITY HEALTH, INCLUDING SOIL CARBON SEQUESTRATION?

DESCRIPTION OF INDICATOR AND METRIC

USRSB defines Air and Greenhouse Gas (GHG) Emissions as: The cumulative emissions of pollutants, including particulate matter, GHGs, and other gaseous emissions from a sector for each process.

There are two primary air/GHG emissions sources in the Cow-Calf Sector, and GMPs positively impact both sources. The two sources are 1) natural cattle biological activities that result in enteric and manure GHG emissions and 2) risks to carbon storage and sequestration abilities in grazed land soils.

The Cow-Calf Sector is forage-based, meaning the cows, bulls, heifers, and calves primarily consume a forage-based diet, with potentially minor supplementation of byproduct feeds (e.g., distillers' grains, whole cottonseed or meal), or grains. Beyond improved grazing management and forage quality, the ability to affect enteric methane emissions is minimal and must be weighed against other factors such as costs (feed supplements, labor), and full system effects (e.g., a nutritional intervention to reduce enteric methane may increase emissions elsewhere in the system – consequential analyses of enteric methane mitigation strategies are needed). Therefore, the Cow-Calf Sector selected GMPs as the best opportunity for improvement. The GMPs can help manage and positively influence enteric methane emissions through improved animal efficiency and yield and can help manage GHG emissions from manure by promoting the healthy ecological process that rapidly decomposes manure. In general, improving animal efficiency and yield is the greatest way to reduce GHG emissions, particularly from the Cow-Calf Sector that is primarily extensive and forage-based (Asem-Hiablie et al., 2018). Optimizing animal efficiency and yield generally means fewer inputs and/or outputs per animal (or per pound of beef produced).

The GHG emissions from manure in extensive grazing systems is difficult or logistically impossible to control by people, beyond grazing management. However, in extensive grazing systems, the management of manure is resolved by insects and microbes that consume and break down the manure, returning it back to the soil as fertilizer. Therefore, the area-specific appropriate amount of manure from a volume and time standpoint is important. It provides directly to the life-cycle needs of some species (e.g., dung beetles), and its natural cycle adds nutrients to the soil, which can be beneficial for soil conditions and productivity. Additional research to improve knowledge of animal GHG emissions in extensive production phases is needed to understand how the GHG emissions may be further improved.

Encouraging producers to develop and implement a GMP that incorporates indicators of above- and below-ground ecosystem health is also a key component of this metric, as it positively impacts the ability of grazed land soils to store and sequester carbon. A GMP can drive change in the indicator, not only via improved carbon storage and sequestration, but by potentially lower GHG emissions due to improved pasture and range quality (forage digestibility by the animal; Montes et al., 2013) as well as decreased or prevented erosion and improved dust control through improved groundcover. A GMP can help maintain or improve plant productivity, cover, and diversity (i.e., the above ground ecosystem health), as well as soil health, including carbon storage. Healthy above-ground ecosystems, plus healthy soils, result in healthy root systems (i.e., below-ground ecosystems). This improves water infiltration into and across the soil/roots, along with maintaining appropriate groundcover to help prevent erosion. Implementation of a GMP can also help assure operational succession, in turn helping keep healthy grassland area intact and avoiding significant soil carbon emissions that stem from land conversion. Additional research to improve knowledge of air and GHG emissions in extensive production phases is needed to understand how the air and GHG emissions may be further improved.

The GMP is a key tool used by ranchers and farmers to manage air emissions, improve soil health (which should improve forage production), and therefore promote carbon sequestration and positively influence GHG emissions. Increasing the number of producers who implement effective GMPs in the U.S. can have a significant effect not only on the Air and GHG Emissions Indicator outcomes but also on the Water and Land Resources Indicator outcomes. Assistance for producers in developing a GMP is available through a variety of public and private sources; please see the Tools and Resources section below for a subset of available resources. Further details can be found in the following GMP section.

GRAZING MANAGEMENT PLAN (GMP)

The following GMP discussion is meant to provide added resources and increase understanding and ease of implementation for the metrics across the Water Resources (1.1), Land Resources (1.2), and Air and GHG Emissions (1.3) Indicators.

GMP SUPPORTING DISCUSSION FOR INDICATORS 1.1, 1.2, AND 1.3

The following is not intended as a template, checklist, or instruction for the creation of a GMP; rather, it presents some examples of the components and benefits/goals of a GMP. Many agencies and institutions, both public and private, are available to assist producers in evaluating or developing a GMP (see Tools and Resources section below). Additionally, water resources, land resources, and air and GHG emissions producer situations will vary depending on geographic location. Academic, extension, non-governmental organizations, and private resources used for assistance in development of GMPs need to be regionally relevant.

BENEFITS OF A GMP

A properly implemented and regularly measured GMP that is also aligned with the foundational nature of profitability necessary for a producer's economic sustainability can have significant positive effects on Water Resources, Land Resources, and Air and GHG Emissions Indicators, including:

1) Maintained or improved native ecosystems
   - Proper grazing, including targeted grazing, can promote the health of native ecosystems because it can reduce or eliminate the encroachment of invasive species and promote the growth of native species. Co-benefits of maintaining or improving plant community composition include improved water cycle (e.g., enhanced water infiltration), wildlife habitat, and the production of nutritious or palatable livestock forages.
2) Protected and/or improved riparian areas
   - Proper stocking rates and rotations can address challenges related to cattle congregation in riparian areas, providing plants along stream banks with the opportunity to recover and flourish and avoiding long-term negative impacts. Co-benefits of improved riparian management include enhanced wildlife habitat and a more effective water cycle in terms of both flows and water quality. This will also improve the wildlife habitat and maintain or improve the livestock and wildlife (animal) carrying capacity.
3) Reduced soil erosion and particulate emissions
   - Proper grazing management seeks to ensure that plants retain adequate leaf area after a grazing event for optimal photosynthesis and plant regrowth. This promotes the healthy root systems and associated microbiology in the soil that are key to maintaining and improving productivity over time. A proper GMP also ensures that sufficient groundcover from growing plants and plant litter is present after a grazing event to protect soils from wind and water erosion. Protecting soils from erosion protects soil health, soil carbon, the water cycle, and productivity.
4) Optimized plant cover, relative to fire fuel loads
   - Forage plants are also potential fuels for fires. Such fuels can be of value when they are managed through prescribed burns, but they can also contribute to wildfires, which each year causes tremendous damage to human life and property and can also impact wildlife and ecological systems in many circumstances. In addition, wildfires also emit tremendous amounts of GHGs into the atmosphere each year. Livestock grazing needs to be designed to optimize animal health and well-being and residual cover and plant regrowth, but proper grazing management, which consumes grasses and other fine fuels, can help reduce wildfire risk and its negative impacts on people and nature. Such grazing is also often compatible with prescribed burns, which can enhance forage production and wildlife habitat.
5) Improve access to water for cattle on pastures
   - Grazing management plans seek to distribute grazing animals across pastures and rangeland to balance stocking rates with forage production. The GMPs also inform how and where to provide water to optimize cattle performance by managing the time and distance cattle travel between forage resources and water. Well-designed water systems also protect riparian areas, enhance groundwater infiltration, and promote stream health.
6) Increased forage production and improved utilization
   - The rate of growth of forages in a pasture is directly related to how well the pasture has been managed, not only in recent grazing periods, but also during the previous winter and the prior grazing season. All other factors being equal, the better a pasture is managed, the more forage it

will produce, up to the capability of the soils and the site conditions. A GMP helps ensure proper management of pastures.

7) Increase water infiltration and retention
   - Proper GMPs ensure that growing and dormant plants provide adequate residual groundcover and root systems to slow or stop surface water runoff, which increases water infiltration into soils and aquifers. This improves the overall water cycle and soil health factors that are critical to the growth of plants, including forage species.
8) Improved wildlife habitat
   - The many positive effects that GMPs can have on the ecological processes outlined in this section will often also improve wildlife habitat. Planning for the specific needs of wildlife is still important; however, some species need structural diversity in their home ranges and others may need conditions present at one end or the other of the successional spectrum (e.g., high or low seral state). It is therefore important to incorporate the needs of such species into GMPs to include long grazing deferments and/or severe defoliations in appropriate locations and at appropriate times within an operation. In many cases, such actions can be integrated with drought planning, fire risk mitigation, weed management, and other important ranch goals.

ADAPTATION, IMPLEMENTATION, AND CONSIDERATIONS OF A GMP

Cow-calf operations across the U.S. are diverse and thus the implementation of a GMP will vary from operation to operation. Proper grazing management (the aim of a GMP) means forages are managed so that there is enough leaf left on the plant after being grazed, to maximize photosynthesis and regrowth. However, when developing a new plan or evaluating and measuring a current plan, these key criteria and planning steps cut across the unique geographic regions of the U.S and if implemented, will increase success of the GMP implementation:

1) Assess current resource conditions (e.g., make a ranch inventory), relative to potential optimum conditions
2) Set ranch goals and objectives designed to move conditions toward optimum
3) Select management actions to achieve goals (e.g., stocking rate, timing, duration, rest, intensity, pasture size and number, infrastructure management and/or improvements, business management changes)
4) Make contingency plans for drought and other risks
5) Conduct regular and repeated monitoring of key indicators and compile resulting information
6) Take actions or make operational adjustments based on monitoring results

In addition to the core grazing management components above, the following operational specific conservation considerations may apply to the planning framework. Again, there may be some regional and local variability in considerations, and some listed consideration may not apply in some areas, while others not on the list may be locally relevant:

1) Native plants, animals, and habitats/ecological systems
2) Rare or unique plant or animal populations
3) Soil health and soil erosion risk
4) Water quality and water cycle evaluation
5) Range/pasture condition or health
6) Streamside/riparian areas and wetlands
7) Invasive species/weeds

Adaptability is an important characteristic of GMPs. Cattle operations across the U.S. are extremely diverse, and management of water and land resources and air and GHG emissions varies geographically and is dependent on many variables. The GMPs can be tailored to each ranch or farm, based on the resources, conditions, and ecological characteristics specific to each operation and the goals and objectives of the individual producer. This flexibility provides each producer with valuable, customized information, and provides positive benefits to the operation beyond the current sustainability indicators. A GMP can assist a producer to better plan for different scenarios (precipitation, forage, markets, etc.), to support adaptable decision-making and holistic planning. For example, a GMP appropriately tailored for a given cow-calf operation resource base and executed successfully can enhance ecosystems goods and services, such as carbon storage, nutrient cycling, soil health, and wildlife habitat (Teague et al., 2011; Briske et al., 2011; Franzluebbers et al., 2000). The following additional factors should all be considered when developing, implementing, and managing a GMP.

RANCH AND FARM RESOURCE INVENTORY

A ranch and farm resource inventory serves as an assessment of the resources available for grazing use on a particular property or grazing unit. The inventory provides forage-related information, such as forage amounts and distribution, that enable the land manager to make management decisions within the grazing unit. The inventory further enables the land manager to plan proper forage utilization rates, grazing days per pasture, etc. The inventory additionally outlines and identifies deficiencies in forage resources, such as limited forage availability, presence of toxic plants, invasive weeds, etc. Inventorying and aligning a ranch's forage resources with the rancher's grazing management and business plan goals aids in optimizing operational viability and sustainability (Maczko et al., 2012). The inventory can also include fence, water, and other grazing-related infrastructure, noting its current condition and need for maintenance or replacement.

Lastly, forage inventory data in combination with weather records can assist a rancher in better balancing ranch resource capabilities with the ranch business plan goals and objectives (Hamilton et al., 2011). For this reason, ranchers also may want to correlate temperature, precipitation, and drought condition reports with resource conditions on the ranch. Inventory and monitoring data, as well as grazing management, are useful tools individually, but integrating the two optimizes ranch management sustainability.

PRODUCER/RANCH GOALS AND OBJECTIVES

Producer/ranch goals and objectives are the expected GMP outcomes as outlined by the land manager. The goals provide the specific criteria for measuring the success of the plan. Goals are further defined with objectives that clearly state the management focus. Goals will vary significantly from operation to operation, reflecting the priorities and preferences of the producer, the anthropogenic (human-influenced), and natural environmental conditions, as well as economic and social considerations. Establishing goals and objectives helps clarify priorities, which the producer can use when making management decisions and allocating the ranch or farm resources.

Goals are additionally important because they provide the direction for management actions. Having defined goals also allows adaptive grazing management under shifting environmental and economic conditions to meet management objectives. Adaptive grazing management adds a level of flexibility that often ensures success. Interpretation of selected evaluation criteria is best considered in the context of movement toward a management goal, generally specified in a rancher's GMP. Implementing regular and

repeated GMP monitoring will provide data that a rancher can track to determine if goals are being achieved.

STOCKING RATE

Stocking rate is defined as the relationship between the number of animals and the grazing management unit utilized over a specified time period (SRM, 1998). Stocking rates may be expressed as animal units per unit of land area (i.e., number of animal units/acre), and they will differ geographically based on type of soil, forage, season, annual rainfall, invasive plants, and many other criteria. The stock rate is the single most important decision grazing managers will make because it directly affects animal performance and ecological resources. This will ultimately affect the net profit of an operation, regardless of the type of grazing plan or the breed or class of animal chosen. No grazing management system will be effective without calculating and monitoring stocking rates. Range-science-based technical assistance from range management professionals both private and public is available to assist in calculating appropriate stocking rates for pastures and/or entire ranches.

PASTURE UTILIZATION

A pasture utilization plan identifies periods of grazing, deferment, and rest for each grazing unit. The pasture utilization plan should be site-specific and focused on management goals. The pasture utilization plan should be designed to be adaptive and flexible to fluctuating environmental conditions that have effects on forage availability. The grazing period within a pasture utilization plan should balance the number of grazing animals with the targeted forage residual stubble height or residual forage amount. Adequate plant recovery periods are the key to successful pasture utilization plans. Properly planned recovery periods allow plant communities to fully recover between grazing events. Calendar dates should only be used as a guide in initial grazing planning. Monitoring pasture utilization, regrowth, and resource goals should drive establishment of recovery periods and grazing frequency and intensity.

The geographic region and the associated complexity of managing the natural resources dictate how producers design their individual pasture utilization plans. Soil health, annual precipitation, growing season length, species complexity, environmental issues, marketing, financing, and personal management decisions all factor into customized pasture utilization plans. Cattle producers in every region of the U.S. have supporting information available to guide them in region-specific pasture utilization planning.

CONTINGENCY PLAN

A contingency plan is a tool to assist the land manager in adjusting the grazing prescription to ensure resource management and economic feasibility without resource degradation. Cow-calf producers face a considerable array of risks ranging from financial and market risks to drought, and these risks must be adequately managed to remain a sustainable business operation. As such, every producer needs to have a contingency plan as a component of the GMP. Many cow-calf producers face environmental risks, including drought and fire, that can affect the forage resources available on their operations. While these risks are unavoidable, tools are available to systematically plan for how the operation will continue and recover during such unplanned disruptions (Tolleson 2017; Knutson and Haigh 2013).

The risks faced by cow-calf producers across the U.S. are often dynamic, and thus the correct course of action to continue as a sustainable business operation will be dynamic as well. Consequently, monitoring and evaluating the effectiveness of the plan are key components of a contingency plan.

WILDLIFE RESOURCE INVENTORY AND MANAGEMENT

Each grazing operation offers potential for enhancing and protecting wildlife population, some of which present economic and operational resources for producers. Inventories of these resources and strategies for enhancing them can be an important component of a GMP. Some producers possess the expertise to address wildlife management planning and implementation needs; others can utilize the services of state and/or federal wildlife management experts, qualified consultants, appropriate non-government organizations, or academic experts. The following list represents some components of wildlife resource inventory and management plans.

1) Assessment of potential:
   - Native plant community composition and structure
   - Native fish and wildlife populations (game, nongame, and rare or unique)
   - Current habitat conditions
   - Future habitat conditions
   - Income from wildlife-based recreation, mitigation credit sales, and other marketable ecosystem services
2) Important factors to manage to achieve desired/optimal conditions include:
   - Cattle stocking rates and pasture utilization
   - Prescribed fire and other vegetation management applications
   - Hunting
   - Invasive plants and animals
   - Infrastructure improvements (fencing, water supply, stream crossings, etc.)

PRESCRIBED BURNING

The USDA-NRCS and other relevant sources generally describe prescribed burning as fire intentionally applied to a predetermined area, to achieve identified management outcomes, within a prescribed set of conditions and with appropriate safety precautions. Prescribed burning can be beneficial to grazing operations and ecological health in forest lands, grasslands, pasture lands, wildlife lands, hay lands, and other land types. Prescribed burns serve many purposes in grazing lands settings, including:

1) Controlling fire susceptible undesirable vegetation
2) Managing invasive species
3) Controlling plant disease
4) Reducing wildfire hazards
5) Improving wildlife habitat
6) Improving plant production and forage quantity or quality
7) Removing duff and debris
8) Enhancing seed production
9) Influencing grazing distribution
10) Restoring and maintaining desired ecological conditions
11) Managing native plant diversity, structure, and composition

Depending on geography and management goals, prescribed burning may be a valuable component of GMPs. Several burn planning and preparation considerations are essential to achieving desired outcomes, including:

1) Prescribed fire should be planned with respect to both the broader landscape and entire grazing operation context.
2) Prescribed fire should be carried out according to a thorough burn plan prepared by someone with appropriate experience and expertise and should consider necessary equipment, personnel needs,

weather conditions, fuel loads and conditions, natural and created fire breaks, and other plan elements.

3) Prescribed fire planning should also consider traffic safety, human health, and regulatory implications of smoke produced during and after the burn.
4) Both ecological and grazing productivity outcomes should be considered in selecting the burned and adjacent unburned area size and position.
5) Prescribed fire should be managed with regard for wildlife needs, such as nesting, feeding and cover, including impacts on rare and sensitive plants and animals.
6) Some prescribed fire situations should also consider potential impacts on historical and cultural resources.

EVALUATION

Regular and repeated evaluation (including monitoring and adaptation) of a GMP can further or accelerate improvements, efficiencies, and profitability for operations. Documentation of those improvements can help tell the sustainability story of a ranch or operation.

SUCCESSION/TRANSITION PLANNING

One important aspect of the Cow-Calf Sector is its ability to maintain open spaces, natural habitats, and thriving ecosystems, all while contributing to a financially healthy business. Optimizing the land resources is one aspect of maintaining a healthy business operation that can be sold or passed on to future generations in its best condition. One challenge for many cow-calf producers across the U.S. is how to successfully transfer their business to another entity (whether family or not) and maintain its farming or ranching heritage. The Framework provides the following guidance to assist producers in succession planning, which will aid them in avoiding or overcoming the pressure to sell an operation to an entity for a different and sub-optimal use.

Although retirement plans and estate planning to create detailed wills are both components of an effective transition strategy, there are other critical aspects too. Transfer planning encompasses legal and economic decisions and transactions involved in conveying ownership of the business, ranchland, and associated property and assets to the next generation. Succession planning integrates family social decisions involved in managing goals, objectives, values, and potential role and responsibility conflicts that may arise as families discuss transfer of a farm/ranch business, land, and other property (Goetting et al., 2016).

Key considerations involved in transfer and succession planning may include:

1) **Inventory of operation and family financials**, including assets and debts, and future needs.
2) **Discussion of values, goals, objectives, roles and responsibilities** with family and advisors to identify expectations and define business, personal, and financial plans. This includes daily operation, marketing, and production concerns.
3) **Identification of issues and creation of an advisory team**. Possible participants in addition to family members include an agricultural business consultant, lender, accountant, financial adviser, land-use planner, or conservation planner/land trust representative, lawyer, tax consultant, insurance agent, financial adviser, and a retirement planner or estate planner to help with legal, financial, or asset management questions.
4) **Evaluation of the most effective business structure for the ranching operation.** Basic types of business organization include sole proprietorships, partnerships, corporations, and limited liability companies, with varying degrees of organizational complexity and transfer perspective. A sole

proprietorship is fairly simple. A corporation requires more time and attention to develop and maintain. Partnerships and limited liability companies combine attributes of individual and corporate ownership. Each option offers advantages, depending on family and business needs, tax implications, legal ramifications, financial soundness, etc.

5) **Consideration of a conservation easement**. Conservation easements, or other forms of operational diversification, can enable landowners to retain ownership and management control of their ranches while accessing their property value to acquire business equity from partners or family members, make improvements to the operation, help support retirement resource needs, reduce tax burdens, or create equity for heirs. Each of these values may support succession. Donation or sale of an easement can also lower estate values to make land more affordable during the succession process. Conservation easements also help protect land for agricultural production and conserve wetlands, water resources, open space, soil, and/or wildlife and wildlife habitat, depending on the specific program.
6) **Consideration of a trust.** Assets may be placed in trusts to ensure professional management of financial resources. The trust offers financial security for beneficiaries (such as spouses, children, and grandchildren) and designates who will receive the assets once the trust terminates. Some of the many resources available regarding a trust are listed in the Tools and Informational Resources section below. The Land Trust Alliance provides a more extensive list of resources specific to accredited national land trusts.

Succession and transfer plans guide transition of a ranching operation's ownership, management, and labor to the next generation, while preserving family harmony and business success. Effectively and successfully transferring a complete business, not just assets such as land or equipment, to future generations requires significant time and effort. However, with more than one-third of agricultural operations expected to transition in the next two decades, the importance of planning for these transitions cannot be overstated.

TOOLS AND INFORMATIONAL RESOURCES

The following resources can be helpful to producers seeking to improve their operations; it is not intended to be an exhaustive list. USRSB does not own or manage these resources, but they are provided as potential helpful tools for value chain participants.

Academic and Government Organizations

1) Archbold Biological Station and other private research and education organizations
2) Grassland Productivity Forecast
3) Land grant university extension services
4) National Weather Service: Climate Prediction Center
5) Noble Research Institute and other private research, education, and consulting organizations
6) Ranch management consultants
7) State cattlemen's associations
8) State extension service specialists
9) State and/or federal wildlife and environmental experts
10) USDA Natural Resource Conservation Service (USDA-NRCS)
    - Resource example: National Range and Pasture Handbook

Non-governmental organizations (NGOs)

1) American Farmland Trust

2) Ducks Unlimited
3) Pheasants Forever
4) The Land Trust Alliance
5) The Nature Conservancy
6) World Wildlife Fund

Publications

1) Management transitions: handing over the reins
2) National Climate Assessment 2014: Agriculture
3) Passing it on: an estate planning resource guide for Wyoming's farmers and ranchers
4) Succession planning for ranchers. California Rangeland Trust News, Winter/Spring 2010 edition. p. 4. Business planning – succession planning – estates (Note, may be listed under Spring/Summer 2010 newsletter)
5) Sustainable Rangelands Roundtable
   - Resource example: Sustainable Range Management Assessment Guidebook

State and region-specific grazing resources are regularly updated online at www.beefsustainability.us.

COW-CALF SECTOR SUSTAINABILITY ASSESSMENT GUIDE: INDICATOR 1.4: EFFICIENCY AND YIELD

METRIC 1.4: IS THERE A STRATEGY IMPLEMENTED TO OPTIMIZE ANIMAL PRODUCTIVITY THROUGH IMPROVED NUTRITION, REPRODUCTION, GENETICS, TECHNOLOGIES, AND PRACTICES?

DESCRIPTION OF INDICATOR AND METRIC

USRSB defines Efficiency and Yield as: 1) Efficiency is expressed as the unit of input required to produce a unit of output, and 2) yield is the total product generated per unit of time or space. Both concepts address waste as a negative characteristic and drive toward improved profitability.

Fundamentally, the U.S. beef industry exists to transform lower value inputs (forages, grains) into a high-quality and desirable protein source to nourish people. Improving the efficiency of this transformation and minimizing waste (resources, time, capital) throughout the beef value chain is a major driver of beef's continuous improvement in sustainability. Improved efficiency influences other important aspects of beef sustainability, such as long-term economic viability of individual operations within the chain, the well-being of employees and rural livelihoods, and the preservation and enhancement of important ecosystems. Central to the efficiency of the entire beef value chain is the productivity and efficiency of the cattle in the Cow-Calf Sector.

Within the Cow-Calf Sector, optimizing animal productivity at the individual operation level influences multiple Framework indicators and aspects important to beef sustainability. Optimizing animal productivity directly affects the operator's profitability, which is key to the economic sustainability of the beef industry. Optimizing animal productivity also influences natural resource requirements and environmental emissions produced per unit of beef. Additionally, animal productivity and animal well-being are often positively associated. Thus, the metric for Efficiency and Yield intersects with the

indicators (and their associated metrics) for Water Resources, Land Resources, Air and Greenhouse Gas Emissions, and Animal Health and Well-being.

GUIDANCE TO ACHIEVE THE METRIC

In the Cow-Calf Sector, there are multiple ways to improve animal productivity that relate back to both biological and economic efficiency. For example, determining pounds weaned per exposed female (calculated by dividing the total pounds of weaned calves by the number of exposed females), is a common measure in evaluating productivity. This measure embeds economically relevant biological outcomes, such as pregnancy rate, calf death loss percentage, and the genetic potential of the herd in terms of growth and maternal traits. Genetic selection can also play an important role in efficiency and yield by developing cattle that are most efficient for their given environment. See the Genetics section below for additional conversation on this topic.

Optimizing animal productivity of a given operation by using measures such as pounds weaned per exposed female or genetic selection is contingent upon a multitude of factors; thus, the most appropriate strategy depends upon the location and resources available to a given cow-calf operation.

A cow-calf producer's business goals and objectives, marketing realities, and available resources (capital, forage, labor, time, etc.) are key considerations that dictate the best strategy for optimizing animal productivity.

Measurement is key. As the popular adage states, "You can't manage what you don't measure." Additionally, optimizing animal productivity is a long-term and continuous process that requires recording of data and benchmarking key indicators of animal productivity over time to assess if the operator's goals and objectives are met and if adaption is necessary. A long-term time horizon is important due to year-to-year variations in climate, markets, and the long generation interval of beef cattle. This means observing phenotypic change in the herd can require several years. Consequently, trends are more informative than isolated snapshots in time.

Prior to creating and implementing a strategy to optimize animal productivity, a producer/decision-maker should consider how they will define the strategy(ies) to measure efficiency and yield. The definition may consider the goals and objectives of the operation, a resource inventory, and a marketing strategy.

The following sections provide guidance as to how each key consideration affecting animal productivity relates back to the Efficiency and Yield Indicator, and beef sustainability more broadly, as well as specific examples at the individual cow-calf operation level. Although the considerations are presented in isolation, they are in fact related and intertwined with one another. For example, a cow that has nutrient deficiencies will have poor reproductive performance as well. Therefore, it's important for the producer/decision-maker to evaluate these in the context of the entire operation and its goals.

ECONOMICS

Without a financially robust Cow-Calf Sector, there is no beef industry. Improvements in efficiency and yield can drive economic viability for producers, but without assessment of financial performance, it is unknown whether economic sustainability is being achieved. Economic sustainability in the Cow-Calf Sector also reduces the risk that the lands used for beef production will be converted to other uses, which often cause significant negative impacts on wildlife and other water and land resources, and air and GHG emissions. Assessing financial performance year over year, however, allows producers to ensure they are

meeting their financial goals. This information also helps identify areas for continual improvement and management changes that may need to occur.

Ideally, producers record revenues and expenses throughout the year in an accounting format. From these records, financial statements can be generated. These include but are not limited to the cash flow statement, balance sheet (net worth statement), and income and expense sheet (profit and loss). The information from these financial reports allows key performance indicators (KPIs – typically used in financial analysis across industries) to be calculated. Financial KPIs address five key areas:

1) Liquidity
2) Solvency
3) Profitability
4) Repayment capacity
5) Financial efficiency

Strength in one area does not ensure success. These indicators must be used in a balanced approach. Collectively, achieving a stronger indicator in each area will help ensure that a cow-calf producer is economically sustainable. Further, measuring the KPIs provides for continuous improvement in the Cow-Calf Sector. Combining financial KPIs with production KPIs provides a clearer picture of the long-term viability of the cow-calf operation. This powerful information allows cow-calf producers to continue to drive the efficiency and yield in their operations.

Many resources exist to aid cow-calf producers in not only their recordkeeping but in the preparation of financial documents and assessment of their KPIs. These resources include:

1) Becker K., D. Kauppila, G. Rogers, R. Parson, D. Nordquist, and R. Craven. (2014). Farm Finance Scorecard.
2) Bevers, S. and D. Anderson. (2015). Key Performance Indicator Targets for Beef Cow-Calf Operations.
3) Center for Farm Financial Management
4) Farm Financial Standards Council
5) Purdue University Center for Commercial Agriculture Financial Analysis Resources

REPRODUCTION

Reproduction is fundamental to sustainability of both the operation and the entire beef value chain. At the operation level, reproductive performance influences the pounds of marketed weaned calves produced per year relative to inputs. Additionally, reproductive management and performance influence the length and timing of the calving season, which are important considerations in matching animal nutrient requirements to available resources and marketing strategies for calves to be sold. For the beef value chain as a whole, reproduction can be a key driver in determining the size of the supporting herd (cows, bulls, replacement animals) required to produce beef (if raising own replacement heifers).

Ideally, every cow in a herd will produce a live calf that survives to weaning each year. However, there are multiple factors inside and outside of the cow-calf producer's control that detract from this ideal. For example, a bull used for breeding purposes could be unsound, cows could be in an inadequate energy balance or nutrient status at the time of breeding, or herd health could be lacking (e.g., *Trichomonas* can cause abortion). These factors can influence the creation and maintenance of pregnancies. Additionally, a controlled breeding season can help decrease the variation in weaned calf weights at the time of sale, which is desirable to purchasers. The calf crop percentage and weaned weight of calves are major factors that influence cow-calf producer profitability (Figure 4). A comprehensive analysis of all the aspects of a successful reproduction program are beyond the scope of this SAG. However, several excellent

informational resources that cover reproduction in depth are listed in the Tools and Informational Resources section at the end of this indicator.

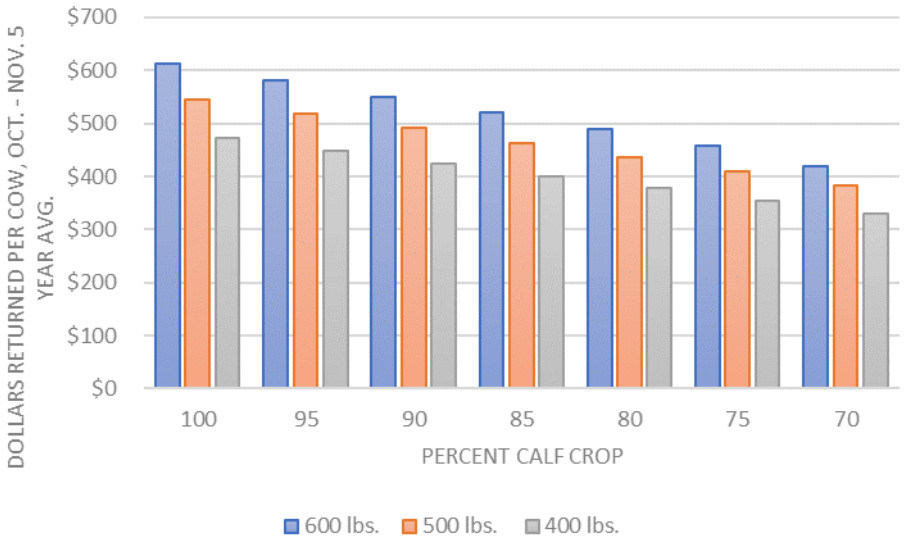


Figure 4: Dollars returned per cow (Oct. – Nov. five-year average) as influenced by calf crop percentage and average calf weaning weight. Data are from Georgia and adapted from Stewart and Dyer, 2017.

GENETICS

The U.S. beef industry is unique among animal proteins, as optimal animal productivity varies between the different operations in the beef value chain, where cattle nutrients are primarily supplied by forages (cow-calf, stocker, backgrounder operations) versus grains and other concentrate feeds (feedyard operations). Consequently, there can be antagonistic relationships between the sectors of the industry when considering desirable animal performance characteristics.

For example, cattle with a higher genetic potential for growth in the Feedyard Sector of the industry tend to have higher maintenance requirements, appetites, and birth weights. While these traits associated with growth are not detrimental in the Feedyard Sector, cows that have higher maintenance requirements and appetites may be less desirable in the Cow-Calf Sector, depending upon the resources available to a given operator. Higher birth-weight calves may increase the risk of calving difficulty. In such situations, where the cow-calf operator has a low input operation, an increase in cow maintenance and feed requirements over several generations may lead to the need to purchase more feed inputs (e.g., hay) or subject the operator to more risk (e.g., more susceptible to forage resources not meeting animal nutrient requirements during drought conditions). Thus, breeding programs should consider a balance of both desirable maternal traits and growth, performance, carcass quality traits, etc. in the offspring that will be marketed for beef.

Despite the complexity, several decades of research have resulted in genetic selection tools to help cow-calf producers make informed decisions based on their goals and objectives. As outlined by Spangler (2015), a good starting place toward making a bull selection decision is to answer the following three questions:

1) What are my breeding/marketing goals?
2) What traits directly impact the profitability of my enterprise?

3) Are there environmental constraints that dictate the level of performance that is acceptable for a given trait in my enterprise?

The answers to these questions can lead producers to the traits that are economically relevant to their businesses, and multiple trait selection indexes can be used to increase the net merit of a given cow-calf operation's cattle. As a caveat, careful consideration should be given to ensure the selection index fits the breeding objectives (e.g., terminal vs. maternal).

Leading beef extension specialists and other land grant university personnel, breed associations, USDA researchers and informational sources, and other technical service providers can be excellent resources in navigating genetic selection decisions to meet a producer's goals and objectives (http://www.ebeef.org/).

NUTRITION

Animal health, well-being, and productivity greatly depends on the nutrient and energy requirements of cattle at their given physiologic state. The efficiency of feed conversion into saleable product (body weight gain in calves) has implications for the economic sustainability of a cow-calf operation, as feed is one of the major costs. Additionally, the efficiency of nutrient and energy retention in the animal has implications for environmental sustainability. For example, improving feed efficiency can minimize the losses of fecal, urinary, and gaseous (methane) nutrients and energy to the environment relative to the product produced. The hierarchy of nutrient and energy partitioning in cattle follows that maintenance requirements should be met before productive function requirements, such as reproduction. Given this, nutritional management is key to a successful reproductive program. Optimizing annual cow costs greatly depends on available feedstuffs and nutritional management, and the nutrition of the cow can also affect the lifetime performance of her offspring. In summary, nutrition is an important consideration to optimize efficiency and yield for a cow-calf operation.

As with other areas outlined in this SAG, more than a century of research is available to help producers make smart nutritional management decisions. Nutrient and energy requirements for cattle have been determined and refined throughout the years, and several hard copy and spreadsheet tools are available for producers that help predict both animal requirements and how feedstuffs are meeting those requirements. Key to this process is having accurate data of animal characteristics (e.g., body weights and condition scores) and the nutrient compositions of feedstuffs. Additionally, there are many technical service providers who can help producers make the best nutritional management decisions that fit each operation's goals and objectives.

TECHNOLOGY AND MANAGEMENT PRACTICES

Technology and management practices are related to all of the considerations outlined above. Technology can refer to tools as varied as ionophores, genomic testing, pesticides, growth implants, estrous synchronization tools, and recordkeeping software. Technology can enhance efficiency and the measurement of outcomes at the cow-calf operation. In turn, best management practices, such as those outlined by Beef Quality Assurance (BQA) guidelines, allow producers to implement the best strategy to optimize their animal productivity.

TOOLS AND INFORMATIONAL RESOURCES

The following resources can be helpful to producers seeking to improve their operations; it is not intended to be an exhaustive list. USRSB does not own or manage these resources, but they are provided as potential helpful tools for value chain participants.

1) Becker K., D. Kauppila, G. Rogers, R. Parson, D. Nordquist, and R. Craven. (2014). Farm Finance Scorecard
2) Beef Cow Efficiency
3) Beef Improvement Federation
4) Bevers, S. and D. Anderson. (2015). Key Performance Indicator Targets for Beef Cow-Calf Operations
5) Brooks, K., J. Parsons, and J. Jansen. (2017). Profit tip: Marketing plans for your cattle operation
6) Center for Farm Financial Management
7) eBeef
   - Leading beef genetic extension specialists and other land grant university personnel, breed associations, USDA researchers and informational sources, and other technical service providers can be excellent resources in navigating genetic selection decisions to meet a producer's goals and objectives.
8) Farm Financial Standards Council
9) Lalman, D. 2017. Vitamin and mineral nutrition of grazing cattle. Oklahoma Cooperative Extension Service.
10) Purdue University Center for Commercial Agriculture Financial Analysis Resources
11) Reproductive Management of Commercial Beef Cows

COW-CALF SECTOR SUSTAINABILITY ASSESSMENT GUIDE: INDICATOR 1.5: ANIMAL HEALTH AND WELL-BEING

METRIC 1.5: HAS THE OPERATION ADOPTED BEEF QUALITY ASSURANCE (BQA) OR SIMILAR PROGRAM PRINCIPLES INTO MANAGEMENT OF THE FARM OR RANCH?

DESCRIPTION OF INDICATOR AND METRIC

USRSB defines Animal Health and Well-being as: the cumulative effects of cattle health, nutrition, care, and comfort.

Cattlemen have long recognized the need to properly care for livestock. Ranchers and producers have a moral and ethical responsibility to ensure, to the best of their ability, the health and well-being of the livestock in their care. Animal abuse is not acceptable under any circumstances. Sound animal husbandry practices, based on decades of practical experience and research (Grandin, 2015), are known to impact the well-being of cattle, individual animal health, and herd productivity, and to result in fewer animal losses. Fewer losses also reduces the chance and/or frequency of attracting predators into proximity of cattle. To continually improve cattle health, nutrition, care, and comfort, the Cow-Calf Sector identified the rate of adoption of BQA program principles and practices as the metric for this indicator.

GUIDANCE TO ACHIEVE THE METRIC

The national BQA program provides educational resources to improve beef safety and quality while improving cattle well-being. The program also raises consumer confidence by offering proper cattle management techniques and a commitment to quality within every sector of the beef industry. The BQA began efforts more than 40 years ago to develop education and training materials for beef quality and safety assurance. The first National Beef Quality Audit was conducted in 1991.

The BQA tools are the result of years of scientific research and practical experience and are continually updated to provide the latest in animal management information and technologies. These tools include guidelines on the proper administration of animal health products, best management practices for animal well-being, and animal handling recommendations. The BQA recommended practices are consistent with the World Organization for Animal Health (OIE) code, which provides global standards for animal well-being and beef cattle production systems (OIE, 2017).

The BQA program provides producers with training and assessment tools they can use on a voluntary basis to improve their operations. As producers incorporate BQA or similar programs, they can assess and identify the strengths and weaknesses of their operation, and once the weaknesses are identified, they can allocate available resources to improve the weak areas. As more producers adopt and participate in these programs, cattle health, nutrition, care, and comfort are better communicated and improved. A voluntary certification program and a national audit that monitors program uptake across the producer participants are both part of BQA.

In the U.S., cattle are produced in very diverse environments and geographic locations. Due to this geographic and environmental diversity, there is not one specific set of production practices that can be recommended to protect the health, nutrition, care, and comfort of cattle for all producers. Personal experience, training, and professional judgment can serve as a valuable resource for providing proper animal care. However, several key considerations are consistent across the unique geographic regions and operations. For optimal animal health and well-being, ranchers and producers can incorporate these considerations in their management decisions and ranch practices. The four key considerations when caring for animals are:

1) Provide adequate feed, water, and care to protect cattle health and well-being
2) Provide disease prevention practices to protect herd health
3) Provide facilities that allow safe and humane movement and/or restraint of livestock
4) Provide personnel with training to properly handle and care for cattle

Implementation of these four criteria, through practices put in place as they relate to the operation, is an important step in ensuring optimal animal health and well-being. The implementation approach at the facility or operation level should focus on the planning process, increase situational awareness, and provide guidance and direction for making decisions and allocating resources.

The following information is to be used as an educational resource; all production practices should be adapted to specific needs of individual operations. The BQA program and other agencies and institutions, both public and private, are available to assist producers in evaluating or developing production practices appropriate for their operations.

PROVIDE ADEQUATE FEED, WATER, AND CARE TO PROTECT CATTLE HEALTH AND WELL-BEING

Making sure basic needs of cattle are met is a fundamental responsibility of livestock producers. Ranchers and producers should plan for and ensure that cattle have adequate supplies of feed and water.

Diets for all classes of beef cattle should meet the recommendations of the National Research Council (NRC, 2016) and/or recommendations of a nutritional consultant. State agricultural extension services are a potential resource for local recommendations and advice.

Body condition scoring of beef cows is a scientifically approved method to assess nutritional status (Gadberry, 2013; Farney et al., 2016). Body condition scores (BCS) range from 1 (emaciated), to 9 (obese). A BCS of 4-6 is most desirable for animal health, well-being, and production. A BCS of 2 or under is not

acceptable, and immediate corrective action must be taken. Maintaining good body condition is not only important for the animal's comfort, it has direct effects on reproductive performance and health. During periods of prolonged drought and widespread shortages of hay and other feedstuffs, the average BCS of cows within a herd may temporarily decline. While this is not desirable, it may be outside the cattle owner's control until drought relief is achieved. During periods of decreasing temperature, feeding plans need to reflect increased energy needs (BQA, 2014).

Good cattle management practices ensure cattle have access to an adequate water supply. Estimated water requirements for all classes of beef cattle in various production settings are described in the National Academy of Sciences, National Research Council's, Nutrient Requirements of Beef Cattle (NRC, 2016).

Euthanasia is a humane death occurring without pain and suffering. It should be utilized when an animal's condition is such that additional treatment options will not be effective. The decision to euthanize an animal should consider the animal's well-being (Dewell et al., 2016; BQA, 2015; AABP, 2013a). Producers should consider all conditions and reasons that indicate distressed animals are candidates for euthanasia and use acceptable methods for conducting euthanasia in cattle, which include gunshot or a penetrating captive bolt with a secondary step to ensure death. People who perform this task should be technically proficient and understand the relevant anatomical landmarks, indications of unconsciousness, and the appropriate methods and protocols used for humane euthanasia of animals. When euthanasia is necessary, an excellent reference is the BQA Euthanasia of Cattle and Calves guidelines (BQA, 2015).

PROVIDE DISEASE PREVENTION PRACTICES TO PROTECT HERD HEALTH

Like other species, cattle are susceptible to infectious diseases, metabolic disorders, toxins, parasites, neoplasia, and injury. Control programs based on risk assessment and efficacy of available products are generally most effective. Economic losses are reduced through health management programs, which include early intervention and preventative practices and lead to increased animal health and well-being.

Healthy herds are more productive. Management programs should be science-based, common-sense driven, and include general animal health products (e.g., vaccines, vitamins, parasite control products, etc.), along with antibiotics when necessary, meeting rules and regulations. Management programs may include practices such as pre-conditioning calves (discussed below). Working with a veterinarian to determine the risk of infectious, metabolic, and toxic diseases and to develop effective management programs when designing a herd health plan can help ensure the appropriate plan is developed for the operation. This relationship will also assist in incorporation of new technologies and products as they become available and make sense for the operation. A Veterinary-Client-Patient Relationship (VCPR) is strongly encouraged (AABP, 2013b); in some states, like California, a VCPR is required to purchase and administer antibiotics.

VETERINARIAN-CLIENT-PATIENT RELATIONSHIP

The VCPR is the basis for interaction among veterinarians, their clients (producers), and their patients (cattle), and it is critical to cattle health and well-being. There is a federal definition for a VCPR, and state definitions for VCPRs exist under the state veterinary practice acts. The FDA has identified the VCPR jurisdiction for the respective state or federal definition in reference to the Veterinary Feed Directive (VFD). The VFD is part of full compliance with FDA Guidance 209 and 213 requiring veterinary oversight of all medically important antibiotics used to improve or maintain animal health and well-being.

The BQA program describes the VCPR as the following:

"In general, a VCPR exists when:

1) The veterinarian has assumed the responsibility for making clinical judgments regarding the health of the animal and the need for medical treatment, and the client has agreed to follow the veterinarian's instructions.
2) The veterinarian has sufficient knowledge of the animal to initiate at least a general or preliminary diagnosis of the medical condition of the animal. This means the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal by virtue of an examination of the animal or the medically appropriate and timely visits to the premises where the animal is kept.
3) The veterinarian is responsible for maintaining and evaluating case and treatment records and is readily available for follow-up evaluation in the event of adverse reactions or failure of the treatment regimen."

Producers and their employees need to have the training and/or experience to recognize common health problems and know how to properly utilize animal health products and other control measures. When prevention or control measures are ineffective, the producer should promptly contact a veterinarian for consultation of a diagnosis and treatment program to reduce animal suffering and animal losses.

PRE-CONDITIONING CATTLE

Pre-conditioning is the process by which calves are weaned and "conditioned" before being moved to grass or a backgrounding yard for growing or sent straight to a feedyard for finishing. The pre-conditioning process improves the likelihood that a calf can deal with future stressors and exposure to pathogens and remain healthy. Pre-conditioning is discussed in the National BQA Manual as an option for cattle producers.

Properly pre-conditioned calves should have fewer health problems after they leave the farm or ranch and will (1) require less medication (including antibiotics), which reduces costs as well as the related potential for injection site lesions or tissue residues; (2) reduce death loss; (3) perform more efficiently; and (4) potentially have higher valued carcasses. Pre-conditioning is a value-added management practice that may positively impact animal health and well-being.

Pre-conditioning may be a key component for certain producers, but producers should focus on the needs specific to their operations according to their priorities and resources.

ANTIBIOTIC STEWARDSHIP

Antibiotic stewardship encompasses common sense practices adopted and committed to by beef producers, including good recordkeeping, an emphasis on herd health to ensure animal health and well-being, responsible treatment of sick animals, and protocols to ensure animals are not marketed with violative antibiotic residues. The producer, packer, and consumer all benefit from healthy cattle in the beef value chain. Positive outcomes of antibiotic stewardship are increased trust and transparency with the end consumer, which can translate into increased demand for beef while ensuring animal health, food safety, and security.

Antibiotics are extremely valuable tools for preventing, treating, and controlling disease in all livestock production. Ability to effectively prevent, treat, and control diseases in cattle directly results in improved animal health and well-being. Additionally, currently available technologies cannot yet replace antibiotics from an effectiveness standpoint. However, the USRSB supports continuing research for antibiotic alternatives. Maintaining the efficacy of antibiotics is a highly complex issue, affecting both human and animal health, and it is a top priority for cattle producers. Antibiotic resistance occurs when bacteria

develop the ability to defeat the drugs designed to kill them (CDC Antibiotic Resistance Questions and Answers). The responsible and judicious use of antibiotics is one key to addressing this concern.

Separately, a violative antibiotic residue is defined as the presence of veterinary drugs in meat. These residues are usually measured in parts per million or parts per billion. Avoiding violative antibiotic residues has been an important BQA principle for cattle production since the creation of the BQA program more than three decades ago. The BQA tools are the result of years of scientific research and practical experience and are continually updated to provide the latest in animal management information and technologies. Avoiding residues remains a top priority for the cattle industry today, and the prevention of violative antibiotic residues is a continuous, coordinated effort between government agencies, veterinarians, and livestock producers beginning before the antibiotic is ever used in animals. The drug approval process, on-farm judicious use of antibiotics, and the U.S. National Residue Program are all specifically designed to prevent animal products with violative drug residues from entering the food supply. The FDA also sets withdrawal times for all veterinary drugs, including antibiotics. Practically, the withdrawal time is the amount of time required for the drug to be reduced to a safe tolerance level. The final step in protecting and preventing violative antibiotic residues from entering the food supply is surveillance testing conducted by the USDA Food Safety Inspection Service (FSIS). The overwhelming majority of meat products contain no residues or residues within the government prescribed tolerance levels. If beef is found with violative antibiotic residues, it is removed from the food chain and discarded.

A complete cattle health program will include the judicious use of antibiotics, documented by on-farm recordkeeping and adhering to the following BQA 14 Judicious Use Guidelines detailed in the BQA Antibiotics Stewardship for Beef Producers guidebook. The guidelines are developed from the American Veterinary Medical Association (AVMA), American Association of Bovine Practitioners (AABP), and Academy of Veterinarian Consultants (AVC) guidance on appropriate Veterinary Antibiotic Use and are updated systematically to stay aligned with current guidance.

1) **Prevent problems:** Emphasize appropriate husbandry and hygiene, routine health examinations, and vaccinations.
2) **Adhere to FDA guidance**: Follow label instructions and FDA guidance for the use of all antibiotics. The use of antibiotics medically important in human medicine should only be used after careful consideration. If medically important feed grade antibiotics are used, they must be under the guidance of a Veterinary Feed Directive (VFD).
3) **Select and use antibiotics carefully:** Consult with your veterinarian on the selection and use of antibiotics under the premise of a valid Veterinarian-Client-Patient-Relationship (VCPR). Have a valid reason to use an antibiotic. Appropriate therapeutic alternatives should be considered prior to using antimicrobial therapy.
4) **Use the laboratory to help you select antibiotics:** Cultures and sensitivity test results should be used to aid in the selection of antibiotics, whenever possible.
5) **Combination antibiotic therapy is discouraged unless there is clear evidence that specific practice is beneficial:** Select and dose an antibiotic to affect a cure.
6) **Avoid inappropriate antibiotic use:** Confine therapeutic antibiotic use to appropriate clinical indications, avoiding inappropriate uses such as for viral infections without bacterial complication.
7) **Treatment programs should reflect Best Use Principles:** Regimens for therapeutic antimicrobial use should be optimized using current pharmacological information and principles.
8) **Treat the fewest number of animals possible:** Limit antibiotic use to sick or at-risk animals.
9) **Treat for the recommended time period:** To minimize the potential for bacteria to become resistant to antimicrobials.

10) **Avoid environmental contamination with antibiotics:** Steps should be taken to minimize antimicrobials reaching the environment through spillage, contaminated ground run off or aerosolization.
11) **Keep records of antibiotic use:** Accurate records of treatment and outcome should be used to evaluate therapeutic regimens and always follow proper meat and milk withdrawal times. Keep records for a minimum of 2 years or longer based on state and local regulations.
12) **Follow label directions:** Follow label instructions and never use antibiotics other than as labeled without a valid veterinary prescription.
13) **Extra-label antibiotic use must follow FDA Regulations:** Prescriptions, including extra label use of medications must meet the Animal Medicinal Drug Use Clarification Act (AMDUCA), amendments to the Food, Drug, and Cosmetic Act and its regulations. This includes having a valid VCPR.
14) ***Medically Important Antibiotic Use Should be Limited to Treat, Prevent or Control Disease*:** Medically important antibiotics should not be used if the principle intent is to improve performance. Antibiotics that are medically important to human medicine may not be used for performance.

Cattle producers have a moral and ethical responsibility to ensure, to the best of their ability, the health and well-being of the livestock in their care. Management programs that provide disease prevention practices, including the judicious use of antibiotics, are extremely important tools that ensure cattle health and well-being in the Cow-Calf Sector.

PROVIDE FACILITIES THAT ALLOW SAFE AND HUMANE MOVEMENT AND/OR RESTRAINT OF LIVESTOCK

All cow-calf producers handle, move, and restrain their livestock as part of the production process. Well-designed and maintained facilities provide a safe, humane, and efficient method to perform these operations. Cattle handling practices should be defined and communicated in compliance with the recommendations of the BQA program (BQA, 2015; Grandin, 2015; OIE, 2017). A conscientious producer should always be considerate of the amount of pressure being applied to cause cattle to move in a desired direction. Too much, or deliberately excessive, stimulation to cause desired movement can result in injury to cattle and/or humans, permanent attitude changes of the cattle toward the facilities and/or humans, and decreased performance such as weight gain or loss of pregnancy.

PROVIDE PERSONNEL WITH TRAINING TO PROPERLY HANDLE AND CARE FOR CATTLE

Management practices should be informally assessed every day to ensure that animal health and well-being are not compromised (BQA, 2015; Grandin, 2015). Regardless, producers are encouraged to implement a system to verify efforts directed at animal care and handling. This can be accomplished by:

1) Establishing a network of resources on cattle care
2) Following the BQA Cattle Care and Handling Guidelines
3) Recording training and educational activities to share as needed
4) Conducting self-assessments or external audits of animal care and handling procedures (self-assessment guides are available online at www.bqa.org)
5) Participating in BQA training and certification programs
6) Periodically conducting informal self-reviews by those involved with cattle feeding and care

Training people who are working with the animals, on BQA principles, is critical to animal health and well-being. Ensuring this training occurs is the responsibility of beef producers. Referencing the Cow-Calf Sector Employee Safety and Well-being Indicator for additional detail and resources on the importance of proper

handling techniques to animal health. Other cattle industry sectors are also encouraged to implement systems to ensure training occurs.

PROVIDE APPROPRIATE TRANSPORTATION FOR THE CATTLE

The national BQA manual details cattle transportation guidelines, including:

1) Cattle sorting and holding pens should allow handling without undue stress, be located near the loading/unloading facility, and be suitable for herd size.
2) Properly designed and maintained loading facilities should be provided for easy and safe animal movement. Proper design of loading chutes, as well as personnel who are knowledgeable of the chutes' proper use, can assure the safety of both cattle and cattle handlers. Ramps and chutes should be strong and solid, provide nonslip footing, and have sides high enough to keep cattle from falling or jumping off. A ramp angle of 25 degrees or less will improve cattle movement.
3) All vehicles used to transport cattle should provide for the safety of personnel and cattle during loading, transporting, and unloading.
4) Strict adherence to safe load levels regarding animal weight and space allocation is critical.
5) Producers hauling cattle in farm and ranch trailers must ensure that adequate space is provided so that cattle have sufficient room to stand with little risk of being forced down because of overcrowding.
6) Cattle that are unable to withstand the rigors of transportation should not be shipped.
7) When a vehicle is not full, cattle should be safely partitioned into smaller areas to provide stability for the cattle and the vehicle.
8) Knowingly inflicting physical injury or unnecessary pain on cattle when loading, unloading, or transporting animals is not acceptable.
9) No gap that would allow injury to an animal should exist between the ramp, its sides, and the vehicle.
10) Vehicle doors and internal gates should be sufficiently wide to permit cattle to pass through easily without bruising or injury.

Additional details can be found in the BQA Transportation Quality Assurance Program. Also, the BQA Transportation (BQAT) online training is available here.

TOOLS AND INFORMATIONAL RESOURCES

The following resources can be helpful to producers seeking to improve their operations; it is not intended to be an exhaustive list. These tools are the result of years of scientific research and practical experience and are continually updated to provide the latest in animal management information and technologies. USRSB does not own or manage these resources, but they are provided as potential helpful tools for value chain participants.

1) American Association of Bovine Practitioners (AABP) Antibiotics Position Statement
2) Antibiotics Resource Center – National Cattlemen's Beef Association, producer resources
3) BQA Manual
4) BQA Antibiotic Stewardship for Beef Producers guidelines
5) BQA transportation online training
6) Framework for Antibiotic Stewardship in Food Animal Production
7) State cattlemen's associations
8) State extension service specialists

COW-CALF SECTOR SUSTAINABILITY ASSESSMENT GUIDE: INDICATOR 1.6: EMPLOYEE SAFETY AND WELL-BEING

METRIC 1.6: ARE ALL INDIVIDUALS WHO ARE INVOLVED IN THE OPERATION TRAINED IN STOCKMANSHIP AND SAFETY, AND ARE THEY IMPLEMENTING THESE PRACTICES ON THE FARM OR RANCH?

DESCRIPTION OF INDICATOR AND METRIC

USRSB defines Employee Safety and Well-being as: The implementation of safety programs and training to provide a safe workplace and help to prevent workplace accidents and injuries associated with production, processing, and distribution of beef and the relative prosperity of workers employed in those activities.

Adopting principles of good stockmanship and safety procedures on the ranch improves the safety and well-being of farm and ranch employees by reducing injury and allowing more confidence and pride to be cultivated in their work. In addition, trained employees using these practices reduce cattle stress and injuries, thereby improving the health and well-being of the animals. Moreover, cattle under low stress conditions and reduced injury risk perform better, improving the Efficiency and Yield Indicator by improving profitability for the cow-calf producer.

Training plays a key role in making sure everyone follows the same procedures for employee safety and well-being, as well as animal health and well-being. To that end, each operation should establish a safety and health program. A written safety and health program helps to mitigate any legal action resulting from an accident or injury. Importantly, on many farms and ranches, family members are the only "employees." Often, these family members have grown up with stockmanship principles as a part of their everyday routine. Nevertheless, stockmanship and safety should always be kept top of mind, with additional training sought whenever possible. Being safe is everyone’s responsibility.

GUIDANCE TO ACHIEVE THE METRIC

Agricultural operations vary across the U.S., and thus, safety and health programs will vary by operation. However, there are elements that apply to any safety and health program. Every program should:

1) Establish safety policies and procedures
2) Identify risks and hazards
3) Eliminate, prevent, or control the hazards and risks
4) Participate in and document trainings
5) Evaluate effectiveness and outcomes of methods

The following is not intended as a template, checklist, or instruction for a safety and health program; rather, it presents some examples of the components of a strong program. Many agencies and institutions, both public and private, are available to assist producers in evaluating or developing a safety and health program (see Tools and Informational Resources section below). USRSB encourages producers to utilize outside expertise/consultants who can develop or aid in the development of a program.

1) Establish safety policies and procedures

- Develop a written safety statement that represents the goals of the program. Safety policies and procedures should be written by an experienced owner/operator on the farm or ranch. Objectives

and goals should be clearly outlined. A culture of safety starts at the top of the organization. All employees (including owners and managers) should be required to follow safety policies and procedures.

2) **Identify risks and hazards**
   - Include controls for reducing or eliminating the hazards and/or adjusting the environmental conditions.
3) **Eliminate, prevent, or control the hazards and risks**
   - Proactively control hazards and reduce occupational injuries and illnesses.
     i) Personal protective equipment (PPE) for each job and instructions on how to properly use appropriate PPE should be described.
4) **Participate in trainings**
   - Provide training to ensure workers feel comfortable performing safe work procedures on the farm or ranch.
     i) Repeat training; frequency of training is needed to master new skills and override unsafe habits.
     ii) Complete training before any new employee starts working, even if they have performed the same job at another place of employment.
     iii) Participate in trainings on a regular basis to keep safe and healthy work practices relevant to workers.
     iv) Consider general bi-annual trainings and monthly safety talks for seasonally relevant issues; for training to be effective it needs to be designed for, and consider these characteristics of, adult learners:
       (1) Self-directed
       (2) Want to use personal experience
       (3) Relevant and practical
       (4) Goal-oriented
       (5) Problem-oriented
       (6) Short on time
       (7) Motivated by intrinsic and extrinsic factor
5) **Evaluate**
   - Perform an evaluation to measure the effectiveness of efforts
   - Determine if changes or additions should be made to enhance the training
6) **Safety Program Guidelines**
   - Outline clearly the responsibilities for each role on the farm or ranch
   - Identify general safety rules
   - Have accountability procedures in place
   - Provide the program in every language that is spoken at the farm or ranch
   - Involve the workers in the development of the safety guidelines
   - Ensure the owners and managers abide by the safety guidelines and set a good example for the employees
   - Monitor and enforce the safety guidelines
   - Include emergency response instructions in the guidelines
   - Require owners and managers to be certified in CPR and first aid
   - Evaluate the training to determine effectiveness
     i) Different methods and tools can be used including:
       (1) Observation – observe employees after the training is completed

(2) Administer pre- and post-tests before and after training to assess workers' comprehension of the covered material

The following are analysis options for employers, that can provide insight to potential hazards associated with the job and control strategies for those hazards to further inform an employee safety and well-being program.

1) Job Safety Analysis

- A job safety analysis (JSA), is a written analysis of potential hazards associated with every step of a job. A JSA includes ways to eliminate, minimize, or control the hazard, and it can be used as a training resource for new employees. A JSA can help improve the efficiency of the jobs on a farm or ranch and encourage teamwork and hazard awareness.
- The first task is selecting the job and listing the individual steps for this job (each step should accomplish a task). The next task is identifying the hazards within the job steps. A good rule of thumb is to ask, "How can I get hurt doing this step of the job?" Next, come up with solutions and recommendations on how to control or eliminate the hazard. Be specific and don't forget to list personal protective equipment.

2) Hierarchy of Hazard Control

- The hierarchy of hazard control is a system used to minimize or eliminate hazards (Figure 5). Hazard control strategies are listed in order of decreasing effectiveness. The most effective options are located on the top of the inverted triangle and the least effective methods are on the bottom. A combination of the approaches can be implemented.

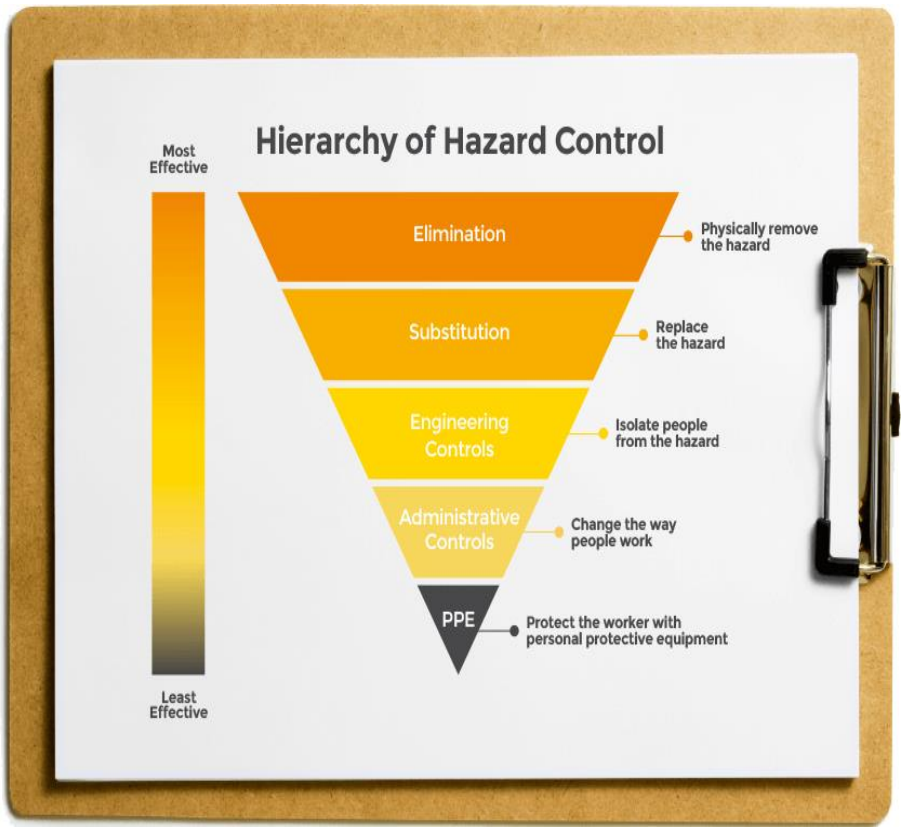


Figure 5: Hierarchy of Hazard Control (LucionServices, 2018)

Expanding the number of cow-calf producers in the U.S. who implement a training program for all individuals involved in the operation and implement practices regarding stockmanship and safety on the farm or ranch will enhance the safety of the workplace and help prevent workplace accidents and injuries associated with production, processing, and distribution of beef.

Further, it will support and protect the relative prosperity of workers employed in those activities. These improvements will be supported by increasing producer knowledge and adoption of the practices described in this SAG. Benchmarking the number of producers across the U.S. who currently have implemented a safety and management plan that addresses worker safety will provide the basis for setting goals for expanding adoption rates in the future.

TOOLS AND INFORMATIONAL RESOURCES

The following resources can be helpful to producers seeking to improve their operations; it is not intended to be an exhaustive list. USRSB does not own or manage these resources, but they are provided as potential helpful tools for value chain participants.

1) Beef Cattle Institute Animal Care Training
2) Beef Quality Assurance
3) Southwest Center for Agricultural Health, Injury Prevention, and Education Agricultural Safety Resources
4) Stockmanship and Stewardship

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CRITICAL KEY TERMS

1) **Accreditation**: Formal recognition that a certification body is competent to carry out certification.
2) **Animal productivity:** This can be in the form of reproductive productivity, weight gain, muscle mass gain, etc., depending on the animal and stage of life.
3) **Animal welfare or care and handling policy:** A statement or statements describing the company's values and principles related to beef cattle management through the supply chain (e.g., antimicrobial stewardship).
4) **Aspirational goal**: Broad and directionally specific goal (e.g., increase or decrease) but without a specific end point or timeline.
5) **Audit**: A systematic, independent, and documented process for obtaining records, statements of fact, or other relevant information and evaluating it objectively to determine the extent to which specific requirements are filled. (ISO 14001:2015)
6) **Balanced diet:** A diet that provides the correct amount of energy and macro and micro nutrients for the given phase of the animal's life.
7) **Beef quality assurance program (BQA):** A national program that provides education in proper management techniques throughout the beef industry. Its focus is to encourage techniques to raise consumer confidence and inspire a commitment to quality. More info at www.bqa.org.
8) **Beef supply/value chain:** The group of participants that make up the value chain, including but not limited to the cow-calf producer, auction market, stocker, feedyard, packer/processor, retailer/food service, and end consumer.
9) **Benchmark**: Level or state of a metric representing performance of an indicator at a specific place or point in time, usually for comparative purposes.
10) **Bulls:** Intact male cattle used for breeding purposes.
11) **Calves:** Young cattle, under one year old.
12) **Calving season:** Time period of the year when cows are calving (birthing).
13) **Carbon sequestration:** A natural or artificial process by which carbon is removed from the atmosphere and held in long-term storage in solid or liquid form; typically referring to the storage of carbon that has the immediate potential of becoming carbon dioxide gas.
14) **Cattle maintenance requirements:** Nutrients required for the animal to keep alive and moving.
15) **Certification (verification) label**: Label or symbol verifying compliance with a specific standard. Use of the label is controlled by the standard setting or certification body. The label is a communication between the seller/buyer and also with the end consumer. For the label to be effective, it must be backed up by a good certification, free of conflict of interest, transparent, and have opportunities for public comment.
16) **Certification bodies/certifiers**: The organization performing the certification is called a certification body or certifier. The certifier might do the actual inspection or contract this out.
17) **Certification**: Procedure that gives written assurance that a product, process, or service conforms to certain standards. Certification can be seen as a form of assurance. The certification decision is the granting of a "certificate" and is based on an inspection and inspection report.
18) **CO2e:** Carbon dioxide equivalent; a metric that expresses the impact of a greenhouse gas in terms of the amount of carbon dioxide (CO2) that has the same global warming potential.
19) **Code of conduct:** A set of rules about how to behave and do business with other people.
20) **Concentrate feeds:** Typically grains (e.g., corn) or byproducts (e.g., distillers dried grains), concentrate feeds are typically higher in energy than forages.
21) **Continual improvement**: Recurring activity to enhance performance. (ISO 14001:2015)
22) **Conversion:** Transformation of land cover from one dominated by natural or semi-natural vegetation to an intensive agricultural, urban, or other human-dominated type. Habitat,

spontaneous natural processes, and ecosystem service values are typically degraded or lost through conversion and may be difficult, costly, or infeasible to fully restore. Includes deforestation, in which tree-dominated ecosystems are converted to lower-stature vegetation, including livestock or row crop agriculture or urban land uses. (SER 2004, FAO 2000, Peet and Roberts 2013)

23) **Cows:** Female cattle that have had one or more calves.

24) **Credence Attributes**: Credence attributes of products are unobservable through search or experience. Some consumers are willing to pay a premium for their provision, and in addition, citizens can apply social pressure on firms to supply credence attributes (such as environmental impact and animal welfare).

25) **Credible:** Ultimately, it is up to each company to determine the level of credibility they are seeking in expertise. Third-party organizations without conflicts of interest or financial investment in the beef industry tend to increase credibility of assessments.

26) **Deforestation risk:** The risk that conversion, including deforestation, could be happening in a company's supply chain. This type of risk should be differentiated from the brand risk associated with not taking clear steps to avoid deforestation or land conversion in one's supply chain.

27) **Deforestation:** Land cover conversion from tree-dominated ecosystems to lower-stature vegetation, including livestock or row crop agriculture or urban land uses. Also see **Conversion**.

28) **Distribute:** The process of supplying beef to stores and other businesses that sell to consumers.

29) **Efficiency Indicators**: Measurements of the parameters of concern with respect to units of production (average daily gain, feed conversion, time).

30) **Efficiency**: The amount of output produced for a unit of input (e.g., kilogram of beef per liter of water).

31) **Enteric methane emissions:** Enteric fermentation is a natural part of the digestive process of ruminants where microbes decompose and ferment food present in the digestive tract or rumen. Enteric methane is one byproduct of this process and is expelled by the animal primarily through eructation (burping).

32) **Enterprise**: Organization or affiliation for a common economic purpose, such as farm, ranch, auction market, stocker operation, feedyard, packer, processor, retail or food service company.

33) **Farming operation**: Discrete enterprise that grows plants and/or animals for economic value for human utilization as food, feed, fuel, fiber, or other social, cultural, or economic purposes.

34) **Fed cattle:** Cattle (typically steers and heifers) that have been fed in a feedyard and are ready to go to the beef packing plant.

35) **Feed additives:** A food supplement for farm animals that supports animal performance and health and can include vitamins, amino acids, fatty acids, and/or minerals.

36) **Feed bunks:** The area in a feedyard pen where the feed is put for the animals to consume.

37) **Feedlot performance measures:** These include measurements such as average daily gain of cattle, feed/gain conversion, death loss, and cost of gain.

38) **Feedstuffs shrink and storage loss:** Between the time that feed is harvested in the field to when it reaches the feed bunk at the feedyard, there is feedstuff loss and shrink for a variety of reasons, including loss during mix and transportation/storage, loss due to wind and weather, and loss due to pests, including birds and rodents.

39) **Feed-to-gain ratios:** The amount (weight) of feed it takes for an animal to gain one pound.

40) **Final carcass weight:** The weight of the carcass of the animal after it has gone through a processing plant and hide, and internal organs have been removed.

41) **Finished product:** This can range from full primal cuts of beef to individually packaged consumer ready cuts of beef, depending on the facility and operation type.

42) **Flush system**: Typically, a system that uses water to flush animal excrement out of the barn/pens/alleyways into a lagoon/collection pit/retention pond.

43) **Food waste targets:** A quantifiable goal to reduce food waste compared to a baseline year (e.g., reduce food waste 20% since 2015; preferred option) or as a proportion of overall food or waste volumes (e.g., divert 50% of food waste from landfill year-on-year). If the waste assessment shows beef is wasted, efforts to reduce beef waste should be included in the target.
44) **Food waste:** Organic waste that can either be prevented, recovered (donated for human consumption), or recycled (repurposed for animal feed, converted to energy, or composted) to improve efficiency of resources.
45) **Forage production:** The farming/production of grass and/or hay.
46) **Forage/pasture utilization rates:** Percentage of forage consumed in a determined area.
47) **Forage:** Bulky food, such as grass or hay, for livestock.
48) **Front-line employees:** Typically, these are employees who are on the processing lines, handling the beef and breaking it down from large cuts to desired cuts, depending on the facility.
49) **Global warming potential (GWP):** Factor describing the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of carbon dioxide over a given period of time.
50) **Grazing unit:** Area of land used for grazing.
51) **Greenfield:** Area that has not been graded, compacted, cleared, or disturbed and that supports (or could support) open space, habitat, or natural hydrology. Areas that have been graded, compacted, cleared, previously developed, or disturbed in any way do not qualify as greenfield. (Source: USGBC https://www.usgbc.org/glossary/)
52) **Greenhouse gas (GHG):** Gases that contribute to the greenhouse effect by absorbing infrared radiation in the atmosphere, e.g., carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), ozone, and chlorofluorocarbons.
53) **Greenhouse gas emissions**: Release to the atmosphere of any gas that creates or contributes to creation of the greenhouse effect in Earth's atmosphere, particularly carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O).
54) **Greenhouse gas sink:** Physical unit or process that removes GHGs from the atmosphere.
55) **Greenhouse gas source:** Physical unit or process that releases a GHG into the atmosphere.
56) **Growth promoting technologies:** Growth promotants are among the tools used by feedlots and other producers to raise more beef, more rapidly, using less feed, while maintaining high standards of animal health, carcass quality, and food safety. Growth promotants include ionophores, growth implants, and beta-agonists.
57) **Heifers:** Young female cattle who have not yet had their first calf.
58) **Herd health:** Overall biological health of the herd (group of cattle).
59) **High conservation value:** Biological, ecological, social, or cultural values considered outstandingly significant at the national, regional, or global level. May be measured by, e.g., degree of species (especially native species) richness or other metric of species, community, or landscape-level diversity, and/or quantity critical ecosystem services or nature-derived cultural values. (UNEP-WCMC 2014). High conservation value land may also include intact or native landscapes.
60) **Holding ponds:** Area built to collect runoff of water and excrement from animal pens when the pens are flushed or during rainy periods.
61) **Impact area**: Broad category of social or environmental results to track.
62) **Impact indicators**: Measurements of outcomes or impacts that result directly or indirectly from activities and processes.
63) **Impact(s)**: Positive and negative outcome(s) wholly or partially resulting from an organization's specific practice or production system. (ISO 14001:2015)
64) **Indicators**: Quantitative or qualitative factor or variable that provides a measurable representation of outcomes of activities to reflect the changes connected to a standards system, or to help assess

the performance of an organization. (ISEAL 2015) Indicators should be specific, measurable, achievable, relevant, and time-bound. Indicators should be outcomes-based, science-driven, technology-neutral, and transparent. The relationship between the indicator and the outcome of concern should be described, and the metrics should represent the outcome as closely as possible.

65) **Intact habitat:** Intact habitat, as defined by the Plowprint analysis, includes those lands that were not in annual crops as of 2008 (in the U.S.) or 2009 (Canada), have not been converted to annual crops between 2008/9 and 2016 (or the most recent year of data), and are also not classified as developed, barren, or open water as of 2011 (the most recent data available for these categories).

66) **Ionophores:** Feed additives used in cattle diets to increase feed efficiency and body weight gain. These are compounds that alter rumen fermentation patterns. Ionophores can be fed to any class of cattle and can be used in any sector of the beef cattle industry. Similar to many other feed additives, ionophores are fed in very small amounts and supplied via another feedstuff as carrier for intake. Ionophores decrease incidence of coccidiosis, bloat, and acidosis in cattle.

67) **Livestock and wildlife carrying capacity:** The number of animal units that can be grazed for a specific period of time.

68) **Marketing:** The sale of a fed animal (typically steer or heifer) from the feedyard to the packer.

69) **Marketplace:** In an economic sense, the marketplace of buyers and sellers of cattle and beef, across the beef value chain.

70) **Metric**: Means of measure; the specific quantification of an indicator; how indicators are defined.

71) **Net deforestation:** The difference between the clearance or conversion of forests in one area and the replanting of forests in another area.

72) **Non-ambulatory animal:** Animals that are unable to rise, stand, or walk without assistance.

73) **North American Meat Institute (NAMI):** A national trade association representing companies that process 95% of red meat and 70% of turkey in the U.S., as well as their suppliers.

74) **Operational goal**: Results to be achieved that define rate and scope of implementation of practices and other activities to achieve tactical goals ("results to be achieved" from ISO 14001:2015).

75) **Outcomes**: Measurable impact or changes in indicators that occur as a result of an action, including a practice, strategy, or policy.

76) **Own operations:** Refers to facilities in direct control (franchised businesses should leverage company-owned facilities at a minimum).

77) **Package:** Steps involved from the large primal cuts of beef down to individually packaged cuts of beef.

78) **Pasture:** Land covered with grass and other low plants suitable for livestock grazing.

79) **Performance:** Tracking and reporting of progress around the set target.

80) **Process standards**: Criteria for the way products are made.

81) **Process:** Steps involved from the animal to the beef meat.

82) **Producer/rancher:** The individual(s) who own and operate the farm and/or ranch.

83) **Product standards**: Specifications and criteria for the characteristics of products.

84) **Publicly available datasets**: Data sets either collected, vetted, or distributed by public agencies, available for nominal to no fee, for public use. Examples include data collected, vetted, and distributed by the U.S. Environmental Protection Agency, U.S. Geologic Survey, U.S. Department of Agriculture (specifically the National Agricultural Statistics Service and Economic Research Service data) and others.

85) **Retention pond**: Area built to collect runoff of water and excrement from the animal pens, which occurs if the pens are flushed or during rainy periods.

86) **Riparian areas:** Interface between land and a river or stream that serves as a natural water treatment facility for the watersheds.

87) **Scope 1:** Direct emissions from onsite combustion and mobile sources.

88) **Scope 2:** Indirect emissions from purchased electricity and steam.
89) **Scope 3:** Sometimes called "optional emissions" that include product transport, employee business travel, and employee commuting.
90) **ServSafe:** Nationally accredited food safety certifications from the National Restaurant Association.
91) **Stakeholder**: Person or organization that can affect or be affected by or perceive him/herself or itself to be affected by a decision or activity. (ISO 14001:2015)
92) **Standard operating procedures (SOPs):** A set of step-by-step instructions to help workers carry out routine operations. SOPs aim to achieve efficiency, quality output, and uniformity of performance, while reducing miscommunication and failure to comply with industry regulations.
93) **Standards**: As defined by ISO, documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions to ensure materials, products, processes, and services are fit for their purpose.
94) **Stewardship:** The job of supervising or taking care of something.
95) **Stockmanship:** The knowledgeable and skillful care, management, and handling of livestock in a safe, efficient, effective, and low-stress manner, which denotes a low-stress, integrated, comprehensive, holistic approach to livestock handling.
96) **Strategic goal**: Numerically specific result to be achieved regarding improvement of a specific outcome. Includes a timeline for achieving the numeric improvement.
97) **Sustainability strategy**: Process for improved decision-making that considers multiple facets of risk and impact across economic, community, and environmental dimensions.
98) **Tactical goal**: Numerically specific result to be achieved within an enterprise for achieving strategic goals. Includes a timeline and range of options for achieving the desired numeric improvement.
99) **Third-party verification**: Assurance activity that is performed by an independent person or body. (ISEAL 2015) Independence can be demonstrated by the freedom from responsibility for the activity being audited or freedom from bias and conflict of interest. (ISO 14001:2015)
100) **Verification**: A confirmation by examination and provision of objective evidence that the requirements have been met (Observation, Interviews, Documented Processes and Procedures, Records). The process by which an entity is evaluated or assessed against a standard or set of criteria. It is also used as a method to "step" systems into a certified method.
101) **Veterinarian Feed Directive (VFD):** Outlines the process for authorizing use of animal drugs intended for use in or on animal feed that require the supervision of a licensed veterinarian and provides veterinarians in all states with a framework for authorizing the use of medically important antimicrobials in feed when needed for specific animal health purposes.
102) **Waste:** Product that must be disposed of that if not otherwise diverted, reused, recycled, etc. would end up in landfill.
103) **Water balance**: An audit that will allow the company to track the input and output of water used throughout the facility.
104) **Water quality:** The condition or state of water relative to the requirements of one or more biotic species and/or to any human need or purpose. (Johnson et al. 1996)
105) **Water risk:** The probability and severity of an entity experiencing a deleterious water-related event. (CEO Water Mandate)
106) **Water use:** Describes the total amount of water withdrawn from its source to be used. Measures of water usage help evaluate the level of demand from industrial, agricultural, and domestic users.
107) **Weaning:** The process of separating a calf from its mother by transitioning it from a diet of the cow's milk to a forage-based diet at about seven to eight months old.