

COMMUNITY SECURITY IN BEEF PRODUCTION SUSTAINABILITY

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Final Technical Report

National Cattlemen's Beef Association

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INTRODUCTION

Beef producers traditionally face a multitude of challenges. As business owners, their livelihoods depend on keeping herd animals well fed and healthy. As land stewards and people running a business, they navigate compliance with regulatory constraints along with multiple generations of knowledge passed along to protect the soil, water, and vegetation. As family members, they carry emotional weight about teaching children ethics related to the health of raising animals and making responsible resource stewardship decisions while also turning a profit into the future. And, as community members, they contribute civic engagement – sometimes fire protection, charitable donations, and routine levels of support to neighbors – exemplary of what often resonates as *good community* in our culture.

In rural communities tied to beef production, many miles often stand between operations, but social ties remain because mutual support is a need. Those social bonds add up to key ingredients of individual and collective sustainability. Considering social sustainability in beef production has become an even greater need for the industry. At the same time, beef producers' grand challenges continue to multiply: increasing integration of the global economy, climate variability, and an age profile that continues to go up rather than down. Together, these challenges do not guarantee continued beef production, but instead put succession, family livelihood, and viabilities of entire operations at risk.

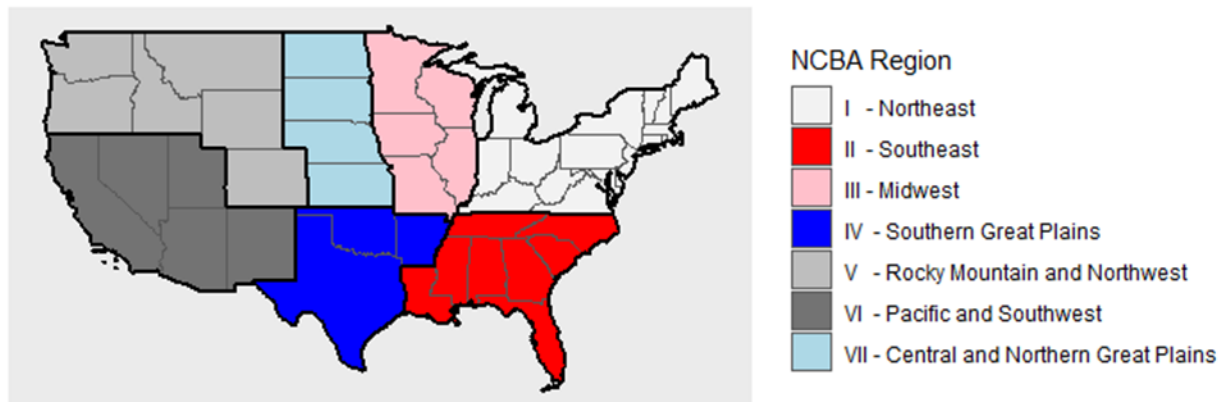
The U.S. beef industry – experiencing volatility in both domestic and global demand and supply, increasing climatic concerns, industry pledges towards net zero carbon commitments, and increasing efficiencies of production – faces a challenge of social sustainability. Part of this challenge is related to the variation in operational types and sizes. For example, there are many more small ranches in the industry, yet the majority of livestock are held on larger operations. Further, each region is evolving in different ways in response to current trends in the beef industry. These challenges do not manifest the same across the landscape. In fact, one of the most defining features of the industry is the diversity that keeps operations going and enables the industry to thrive amidst the challenges.

This study documents the current relationship and history of trends about the number of cattle *and* the number of producers because that combination is the single most important story that will affect the trajectory, viability, and security of the industry. Some of the topics within the report are sensitive because they touch on issues of public health, they can conjure emotional responses, and often get politicized via the media. Like everyone, producers lead lives in local places, raise families, and work to get the bills paid that provide both a major source of protein for the world and stewardship of a large portion of the land base across the U.S. They need and rely on their rural communities for long-term infrastructure and social support. That is community security for the U.S. beef industry.

METHODOLOGY

The overall methodology for the study included two core data collection approaches: 1) sociological data, and 2) economic industry-related data. The study coupled *primary* data (sociological data from interviews collected during the study) with *secondary* data (economic data sources compilation, aggregated, and analyzed as a part of this study). Originally, the study proposed a focus on NCBA regions II, IV, V, VI, and VII within the time and budget constraints of the proposal; however, due to the pandemic-modified methodology, all NCBA regions were included (Figure 1) in data collection and analyses.

National Cattlemen's Beef Association (NCBA) Regions



Source: <https://www.ncba.org/about/leadership/executive-committee>

Figure 1. National Cattlemen's Beef Association (NCBA) Regions. (Source: NCBA 2022a)

Sociological data collection and analysis

Following a phase of university-related travel restrictions due to the global COVID-19 pandemic, the research team conducted a series of data collection trips between April 28, 2021 and May 28, 2022 across the seven NCBA regions. These data support the need for expanding qualitative datasets among producers in agricultural settings (Prokopy 2011). A total of 22 field trips occurred with distributed coverage across 28 states (including 60% of the states and approximately 75% of the total geography within the lower continental United States) across all seven NCBA regions (see Appendix A for a listing of field trip details).

A total of 63 semi-structured personal interviews were conducted with producers, industry experts, and community leaders. Interviews ranged in length from 30 minutes to 3.5 hours, and averaged 65 minutes. Interviewee recruitment used snowball sampling approaches where initial contacts existed, and through primary industry (often state-level) associations and organizations to seek recommendations to connect with relevant participants for the study. Other interviewees were suggested by colleagues within academic and government agency organizations. Interviewees were also recruited via industry meetings, trade shows, and field events.

The majority of interviews were conducted in-person, but in six cases, interview formats required either Zoom or telephone connections. When possible, and always with informed consent, interviews were audio-recorded using the Otter.ai iPhone app in order to expedite transcription and accuracy of reporting. Per University of Idaho protocol, interviewers were either masked, or offered to be, in order to protect all participants from possible health risks related to COVID-19.

Data were redacted to remove key identifiers and personal information. Interviewees were advised all data would remain anonymous per the University of Idaho-approved Institutional Review Board protocol to provide research assurances to human subjects (#20-211; see Appendix B). Interview questions generally focused on characterizing trends and challenges producers face in operations, and how those factors relate to connectivity for their local, regional, and industry-related communities; a copy of the full interview protocol is found in Appendix C. Interviews were coded and analyzed for key thematic patterns within MAXQDA (VERBI Software 2022).

Economic industry-related data

Due to pandemic related travel restrictions, plans for regional producer panels and focus groups to examine current trends in economic sustainability of beef production in select areas were replaced with historical data collection nationwide. Sources for secondary economic and industry-related data include National Agricultural Statistics Service (NASS) surveys and agricultural census, Livestock Marketing Information Center (LMIC) (NASS 2022; LMIC 2022).

Specific spatial data describing public grazing lands were collected from the Bureau of Land Management (BLM), US Forest Service (USFS), some of which were compiled from Freedom of Information Act requests by Public Employees for Environmental Responsibility PEER (BLM 2022; USFS 2022; PEER 2020).

Specific Agricultural Census data, including the 2002, 2007, 2012, and 2017 Summary by North American Industry Classification System, was requested via a special tabulation request by the University of Wyoming and compiled by the NASS Economic, Environmental and Demographic Section, Statistics Division.

This report provides NASS Agricultural Census and Agricultural Survey data at the regional aggregate level. Therefore the analysis reports a collection of data based on state-level reported values. For data that are reported as totals (i.e., total number of ranches per region) we simply summed the values across states within a given region. For data reported as an average, we used weighted averages based on the number operations in a given state in each region. Finally, all financial data were converted to 2021 dollars using the producer price index (PPI) to account for inflation over the study period, with 1982 as the base year.

In working with US Agricultural Census and Agricultural Survey data, some inconsistencies occur due to variation in collection approaches of data across time and space.¹ The most consistent publicly available data for livestock inventory are data from the Agricultural Survey compiled by the Livestock Marketing Information Center (LMIC), now collected in real-time and updated continuously. Cattle inventory numbers were analyzed from 1980 to 2021, based on available data sets from the LMIC. The LMIC provided a clear, consistent and reliable dataset documenting 'beef cows', 'steers over 500 pounds', and 'cattle on feed' inventories. For other cattle industry factors including: 'number of operations', 'size of operations', 'net cash farm income', and 'producer age', we used U.S. Agricultural Census data from 2002 to 2017. The cattle industry data we collected represent a twenty-year time frame (2002 - 2017) versus the forty-year (1980 - 2021) timeframe available for the livestock inventory data.

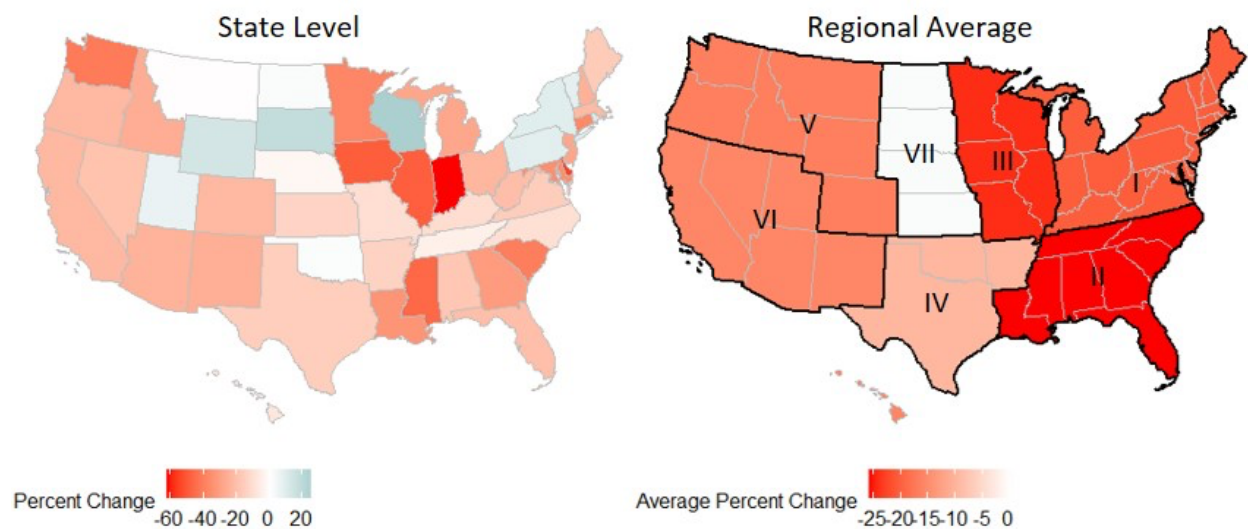
The primary reason for the differing time period is limitations in the data available from the National Agricultural Statistics Service (NASS). Unfortunately, Ag Census results of the Summary by North American Industry Classification System (NAICS) prior to 2002 are not available for all fifty states in a standardized and accessible format. Another data challenge in working with Agricultural Census data, is that census questions and/or methods of reporting may change from year to year. To ensure accurate comparisons, only 2012 and 2017 census data could be analyzed for 'net cash farm income'. Prior to 2012, 'net cash farm income' was not specifically reported. Equally true, the definitions of 'farm-related income' and 'farm-related expenses' have also evolved between 2002 and 2017; as such, 'farm-related income' and 'farm-related expenses' were not analyzed within this report.

RESULTS

Beef Cattle Inventory Trends

Since peaking in 1975 at over 132 million head, the national beef herd ('all cattle and calves') number has consistently decreased apart from minor increases during cattle cycles, to just under 92 million head in 2022. Despite the national decline in 'all cattle and calves', the industry continues to meet consumer demand for beef through gains in efficiency and production by way of improved genetics, better breeding/weaning practices, increased feedlot performance, and better utilization of other (e.g. dairy) animals. The cumulative result manifested as a 15% increase in the amount of beef produced per cow during the last 20 years (LMIC 2022). As inventory has declined and production has increased, the effects over time and space to the overall industry do not manifest equally. Socially and economically, the inventory trends matter and are easier to understand at aggregated scales like regions and states (see Figure 2).

¹ The U.S. Agricultural Census conducted by NASS is more thorough, but occurs only every five years; to supplement that interval, we also used USDA Agricultural Survey data which occurs annually, but routinely contains fewer responses and inconsistent data collected.



Sources: National Agricultural Statistics Service, Beef Cattle Inventory; NCBA regions

Figure 2. Change in US Beef Cow Inventory, State-level percent change and NCBA region average percent change, 1980-2021. (Sources: National Agricultural Statistics Service, Beef Cattle Inventory; NCBA 2022a)

For instance, Region VII has seen the cattle and calves inventory increase by 4% from 1980 to 2021 (see Figure 3). While Region IV and Region VII hold similar inventory totals, over the last four decades these regions have experienced different trajectories in inventory, with Region IV experiencing a much larger decline in the mid 2010's due mainly to climatic factors. Further, breaking down the cattle classes into production sectors demonstrates this type of regional deviation from national trends. In order to understand the scale of trends and the differences between sectors and regions, our analysis has differentiated between 'beef cows', 'steers over 500 pounds', and 'cattle on feed' inventory classes. For example, since 1980, the national 'beef cow' herd has decreased by 16% while the national 'cattle on feed' inventory has increased by 20%². Inventory data provide evidence about how the nation has become more efficient regarding the number of animals that make it to the final production stage.

² The 'Cattle on Feed' category includes all animals on feed. The increase in this category, coupled with the decrease in number of 'beef cows', suggests a combination of increased production efficiency at the breeding stage (increases calving and weaning percentages), increased utilization of dairy animals (both calves and cull cows), and perhaps increased imports of feeder animals in finishing operations.

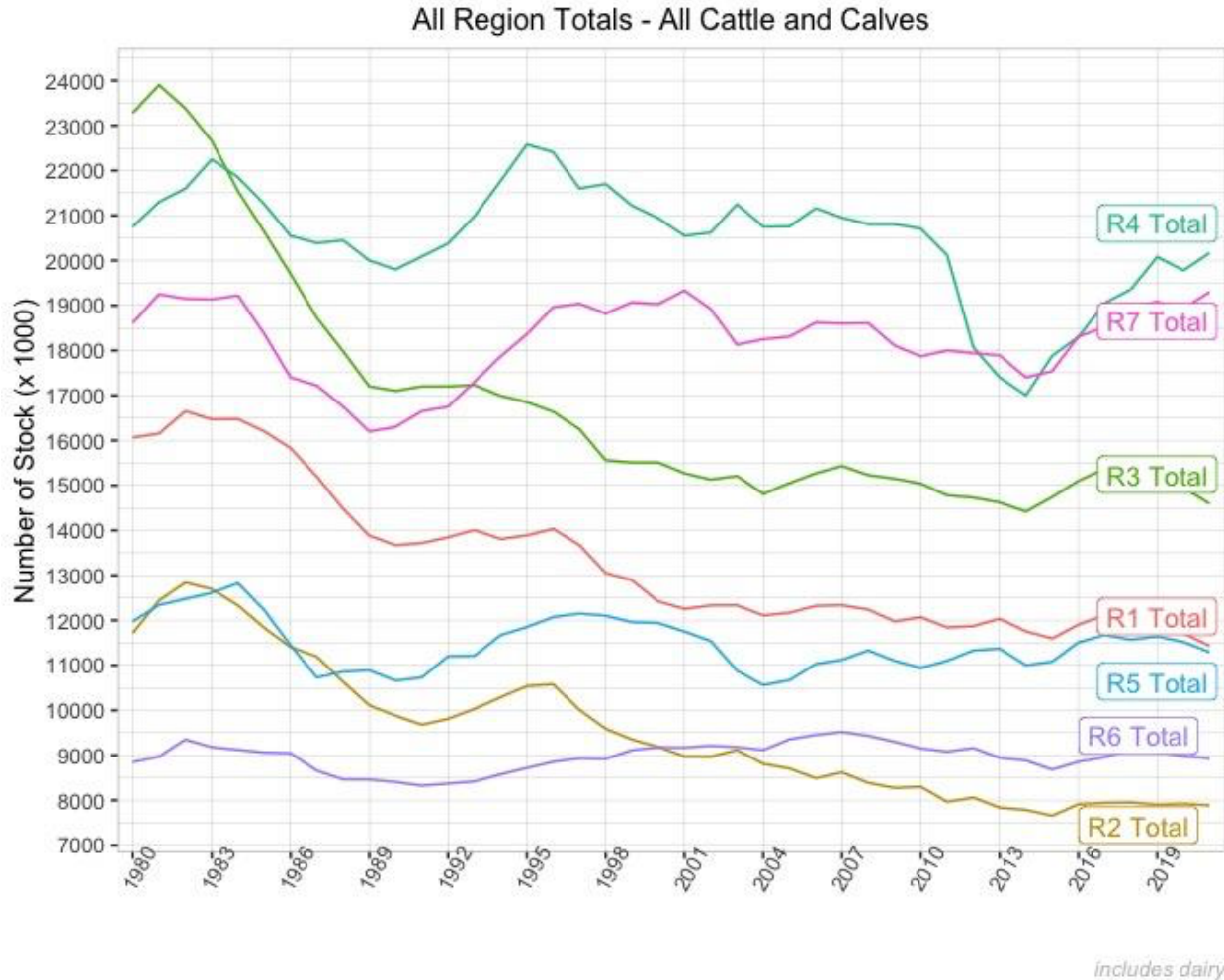


Figure 3. All Cattle and Calves, Total Inventory (including dairy), by NBCA Region, 1980 - 2020. (Source: LMIC Annual January 1 Cattle Inventory by State)

This report further breaks down inventory trends by region and by cattle class. Considering inventory data by region boundaries and inventory class allows a more nuanced understanding of how regions differ from national trends. The Appendix provides a complete set of tables and figures to further detail of industry sectors and animal inventory types.

Beef Cow Inventory Trends

From 1980 to 2021, the total national ‘beef cow’ inventory is down by almost 6 million head. The largest total decrease (1.6 million head) and percent decline (29%) occurred in Region III, while Regions I, II, III, and VI all realized larger percentage decreases than the national average. Region VII has seen the smallest decline with roughly a 4,000 head decrease over the same time period. The slight decline in Region VII is driven primarily by contractions in Kansas and Nebraska, despite inventory increases in both North and South Dakota. Therefore, it is important to note regional *and* state level trends (not just national) when designing policy and or management recommendations to better understand differences across scales and possible implications of proposed changes (Figure 4).

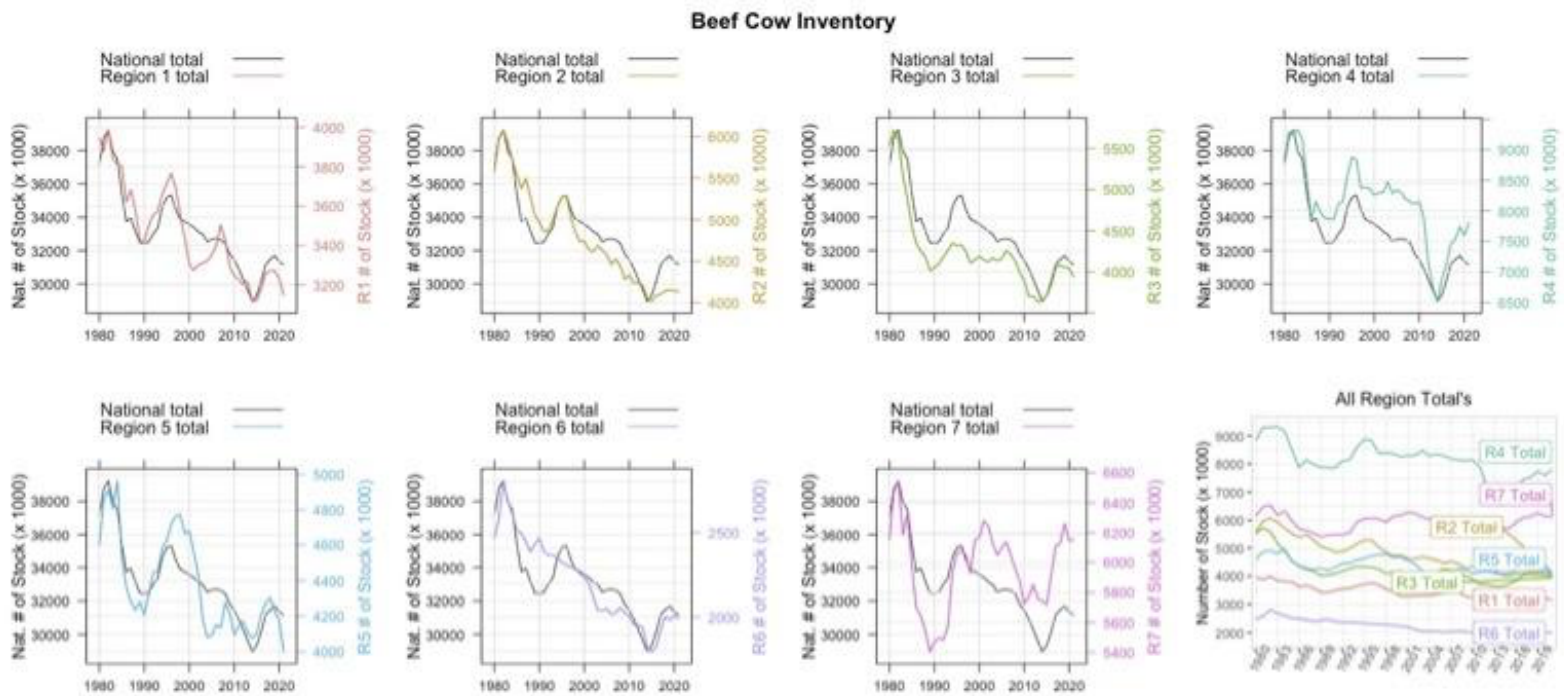


Figure 4. Beef Cow Inventory, State and NCBA Regional and National Totals, 1980 - 2020. (Source: LMIC Annual January 1 Cattle Inventory by State)

Within the project, we interviewed an array of producers who characterized their operations as standard 'cow-calf', but of varying sizes – ranging from a few head to herds of hundreds. When discussing the dynamics of herd size, producers often reflected on issues of conservation, resilience, and effects to their operation related to inventory shifts. One cow-calf producer elaborated these complexities with the following:

The most resilient part of our ground is the tall-grass prairie where those roots go yards into the soil. We've had years of drought here, but you can't see the effects as bad in those native vegetation areas. Given that, here we manage about 200 head well. If you scale that up, it all affects the resiliency of our food supply – our national food security. You know, ranching in the right way can be such a benefit not only for conservation, climate, and carbon, but also good security.

Feeder Steer Inventory Trends

The 'steers over 500 pounds' census inventory category is defined as any beef steer over 500 pounds - this includes backgrounded, stocker, *and* feedlot steers³. Therefore this category has overlap with the 'cattle on feed' inventory below. Unlike beef cow numbers, 'steers over 500 pounds' have seen a 12 percent increase since 1980. However, similar regional level trends in the beef cow inventories are occurring in regional level steer trends. The largest nominal (971,000 head) and percent (32%) decreases were observed in Region III, with Regions I, II, III and VI all experiencing declines over this time period. Region VII experienced the greatest total (1.8 million) and percentage (49%) growth, followed by Region IV (804,000 head, and 27% growth) and Region V (113,000 head and 6% growth). The decrease in cow numbers with a simultaneous increase in steer numbers suggest improvements in management related to better conception/calving/weaning rates as well as increases in imports. Further, a shift in some production practices likely occurred over this time period, with producers dedicating more of their forage resources to livestock other than breeding stock. More producers may be grazing steers (with less cows) in order to increase weight prior to sale, better match marketing dates to cyclical price variations, or increase flexibility to forage variability due to climatic factors such as drought and wildfire (Bastian et al. 2018; Torell et al. 2010).

Cattle on Feed Inventory Trends

'Cattle on feed' as defined by NASS is as follows: "Steers and heifers being fed a ration of grain, silage, hay and/or protein supplement for slaughter market that are expected to produce a carcass that will grade select or better. It excludes cattle being 'backgrounded only' for later sale as feeders or later placement in another feedlot" (Averill, 2022). As with steer inventories, the nation has seen a 20 percent increase in 'cattle on feed' inventory over the last 30 years. Again, the largest nominal (2.5 million) and percent (76%) increase occurred in Region VII, with Regions IV and V also experiencing increases. 'Cattle on feed' includes steers, heifers, culls, and culled dairy animals; the inclusion of dairy animals and non-replacement heifers is likely part of what has led to the large nominal and percent increases in Regions IV, V, and VII (Figure 5).

³ These numbers also include dairy and imported steers, regardless of whether they are grazing or in feedlots.

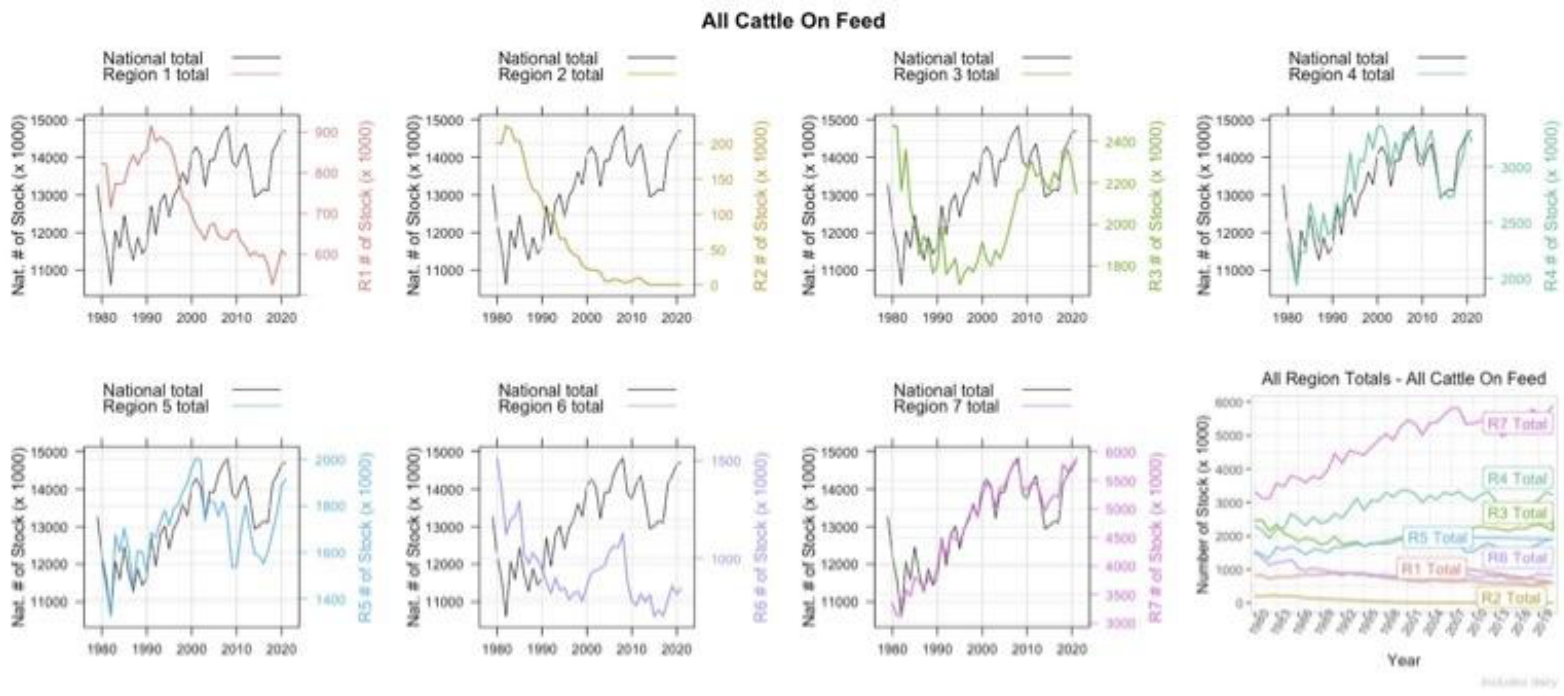


Figure 5. All Cattle on Feed Inventory, NCBA Regional and National Totals, 1980 - 2020 (Source: LMIC Annual January 1 Cattle Inventory by State)

Beef Cattle Operations – Trends, Labor, and Succession

This project emphasized social dimensions of sustainability more than most prior research within the NCBA sustainability program. Thus, one concentration is on the human elements of beef production – measured here through trends in operations as well as issues of labor and succession.

The operators and their decision-making patterns make or break the success of meeting beef demand as the start of the supply chain. Because operations often intertwine family, business, and a base of land/resource assets that can transfer generations, ranch succession occurs as a function of financial success, cooperation, resource management and a combination of planning/attention/intentionality to effectively extend legacies. Not all operations have the chemistry and conditions to enable succession. Overall trends in beef operations are central to this aspect of community security for beef production sustainability.

Ranch Number and Size

In total, there was a 3% decrease in the number of ranches nationally between 2002 and 2017, and the average ranch size (in terms of acreage) also decreased by 11% over that time period (Table 1). However, Region V and VI saw an increase in the number of ranches (13% and 37% increases, respectively), while these same regions saw a decrease in ranch size (21% and 48% decreases, respectively) at greater rates than the national average. This suggests the entry of many small producers in the area or, potentially, the dissolution of some larger ranches as succession occurred. Regions II and III also saw a larger percent reduction in acreage as compared to the national average, coupled with an overall reduction in the number of operations from 2002 to 2017.

It is important to note that animals are not dispersed equally across ranching operations either nationally or regionally. Nationally over 70% of ranches have less than 50 total head, and animals on these operations account for less than 50% of the total inventory. This relationship is even more pronounced when comparing regions. Regions V, VI and VII are the only regions where at least 10% of all ranches have at least 200 animals, Figure 6.

The dichotomy between the number of operations and the number of cattle / operation also intersects with labor in significant ways. One large ranch/feedlot manager contended the challenges and instabilities with labor never go away, but have gotten noticeably more difficult:

There are tremendous challenges in hiring anywhere – from basic to skilled labor – in production agriculture. The feedlots, dairies, and packing industry have struggled the most. We often wonder inside the operation: what is a job like that DOESN'T take 365 days/yr? I wish my employees could have Christmas Day off, but cows don't have Christmas. I hypothesize – and I could be wrong – but with this younger generation, time is almost as valuable to them as money. Their days off are REALLY important to them. That means you've got to hire more people so you can provide more days off, and that in turn puts pressure on the wage rates you can pay because you've hired MORE people.

Table 1. Number, Size (acres), Percent Change of Ranches, and Percent Change Ranch Size. (Sources: US Agricultural Census 2002, US Agricultural Census 2017)

Number of Ranches and Average Acreage					
Region	Year	Number of Ranches	% Change Number of Ranches	Ranch Average Acres (weighted*)	% Change Ranch Average Acres
Region 1 Northeast	2002	101043		154	
Region 1 Northeast	2017	102093	1%	140	-9%
Region 2 Southeast	2002	137198		178	
Region 2 Southeast	2017	112137	-18%	107	-40%
Region 3 Midwest	2002	83453		219	
Region 3 Midwest	2017	78166	-6%	159	-27%
Region 4 Southern Great Plains	2002	200905		563	
Region 4 Southern Great Plains	2017	202710	1%	552	-2%
Region 5 Rocky Mountains & Northwest	2002	49650		1894	
Region 5 Rocky Mountains & Northwest	2017	55977	13%	1497	-21%
Region 6 Pacific & Southwest	2002	24542		3362	
Region 6 Pacific & Southwest	2017	33571	37%	1737	-48%
Region 7 Central & Northern Great Plains	2002	50879		1358	
Region 7 Central & Northern Great Plains	2017	43259	-15%	1300	-4%
US total	2002	664431		632	
US total	2017	641496	-3%	565	-11%
(weighted *) these are weighted averages; the regional average was calculated by taking the average of individual state values (within the region) and the values were weighted by the number of ranches in each state (within the region)					
Source: US Agricultural Census 2002, US Agricultural Census 2017					

Feedlot Number and Size

According to the US Ag Census, the number of feedlots declined by over 75% from 2002 to 2017, while the average size (acres) of feedlots grew by over 125%. The largest declines in numbers occurred in Regions IV (-95%), I (-83%), V (-80%) II (-78%) and VI (-73%). However, as four of these Regions have more than doubled in size (Region IV experienced 420% growth, Region V 291%, Region VI 160%, and Region I 101% growth), this is likely due to increased consolidation in the feeding industry (Table 2). From 2012 to 2017, Region IV saw a 70% decline in the number of feedlots, while NCFI per operation increased substantively. This regional consolidation disproportionately impacts the national trend, as feedlot numbers decreased 2.6% from 2012 to 2017, while Regions II, III, V, VI, and VII have actually seen increases in the number of feedlots reported over the same time frame. The average NCFI per feedlot increased by over 96% from the period from 2012 to 2017, with all Regions other than Region II (-54%) experiencing positive growth in NCFI per operation over this time frame.

As with ranches, animals are not dispersed equally across feedlots, nationally or regionally. However, there is a more equal distribution of numbers of feedlots of various sizes nationally, while the majority of animals are located in feedlots of at least 2,500 head (Figure 6). There is a wide disparity, however, when comparing Regions I, II and III with regions IV, V, VI, and VII. Eastern regions have animals more equally dispersed across all sizes of feedlots (with Region III being slightly skewed toward larger feedlots), while the vast majority of feedlot inventory in western regions (Regions IV-VII) is in feedlots with 2,500 or more head (Appendix D, Figure D6).

Table 2. Number, Size, and Percent Change of Feedlots, by NCBA Region, 2002-2017. (Source: US Agricultural Census 2002, US Agricultural Census 2017).

Number of Feedlots and Average Acreage					
Region	Year	Number of Feedlots	% Change Number of Feedlots	Feedlot Average Acres (weighted*)	% Change Feedlot Average Acres
Region 1 Northeast	2002	18069		147	
Region 1 Northeast	2017	3004	-83%	295	101%
Region 2 Southeast	2002	927		115	
Region 2 Southeast	2017	204	-78%	148	28%
Region 3 Midwest	2002	16544		297	
Region 3 Midwest	2017	5778	-65%	436	47%
Region 4 Southern Great Plains	2002	7615		386	
Region 4 Southern Great Plains	2017	375	-95%	2008	420%
Region 5 Rocky Mountains & Northwest	2002	4996		726	
Region 5 Rocky Mountains & Northwest	2017	977	-80%	2837	291%
Region 6 Pacific & Southwest	2002	1450		1802	
Region 6 Pacific & Southwest	2017	386	-73%	4678	160%
Region 7 Central & Northern Great Plains	2002	5858		1538	
Region 7 Central & Northern Great Plains	2017	2637	-55%	2039	33%
US total	2002	55472		468	
US total	2017	13379	-76%	1058	126%
(weighted *) these are weighted averages; the regional average was calculated by taking the average of individual state values (within the region) and the values were weighted by the number of ranches in each state (within the region)					
Source: US Agricultural Census 2002, US Agricultural Census 2017					

Net Cash Farm Income

Net Cash Farm Income (NCFI)⁴, a core measure of financial health for operations, was consistently collected over the last two NASS Agricultural Census collection points (2012 and 2017). Nationally, in the five year period from 2012 to 2017, both ranches and feedlots nearly doubled in NCFI. However, despite a doubling in NCFI it is important to keep in mind the real value of NCFI for each sector; in 2017, the national ranching NCFI was \$4,586 per operation while, the 2017 the national feedlot NCFI was \$442,675 per operation. This is, in part, due to the fact that, at least nationally, feedlots tend to be larger (in terms of animals per operation) than ranches (see Appendix D, Table D5 for more detailed information).

⁴ Definition for 'Net Cash Farm Income': Net cash farm income of the operation is derived by subtracting total farm expenses from total sales, government payments, and other farm-related income. Depreciation is not used in the calculation of net cash farm income. Net cash farm income of the operation includes the value of commodities produced under production contract by the contract growers.

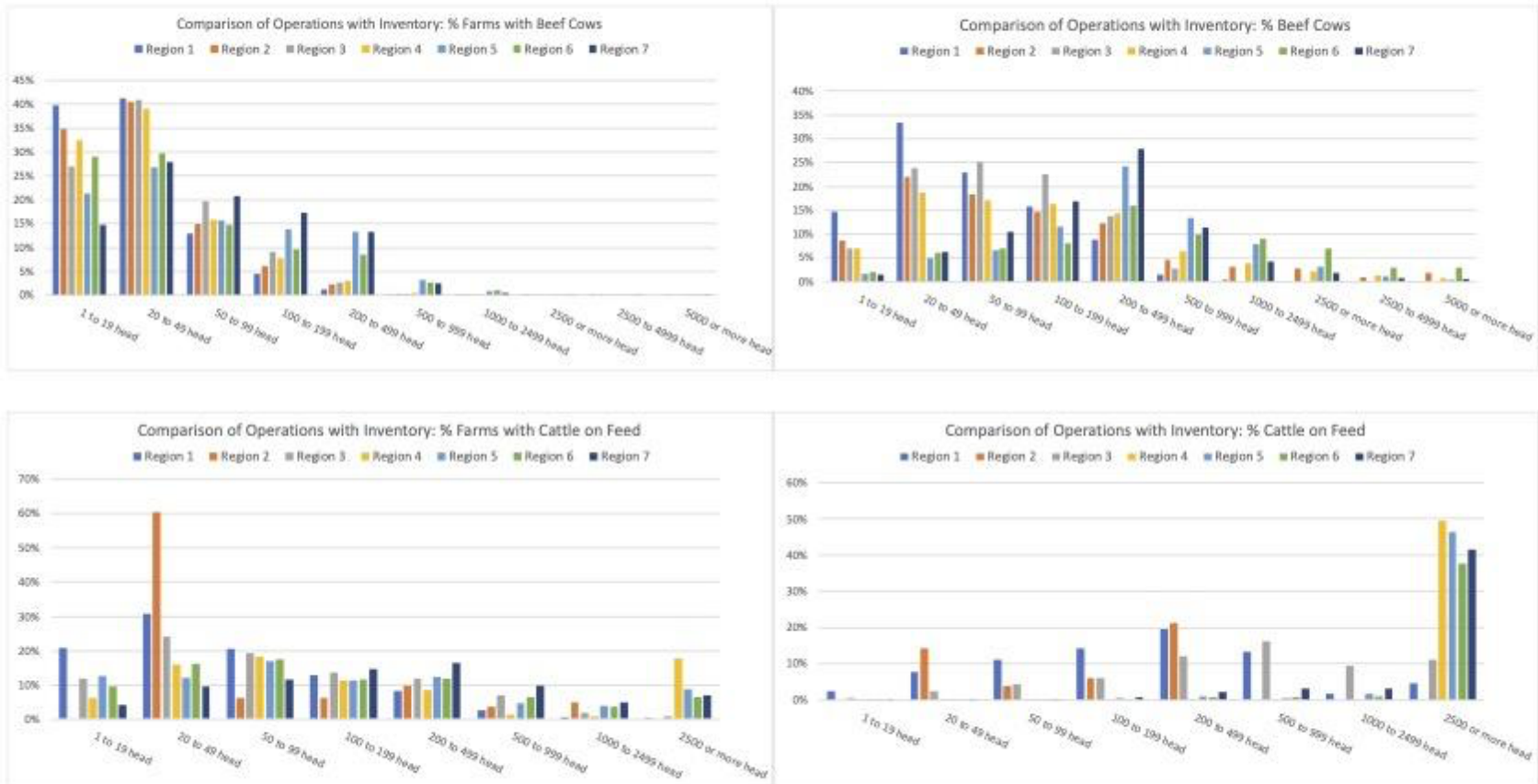


Figure 6. Comparison of Operations with Inventory, by NCBA Region, 2017.

(Source: USDA Agricultural Census 2017: Table 12. Cattle and Calves - Inventory: 2017 and 2012)

As with inventory trends the regional landscape of NCFI is considerably different than the national trend. The most profitable (per operation) region for ranching as of 2017 is Region VII, which is in part due to having larger average ranches in general than the other Regions. Region VII also saw over a 5% increase in NCFI from 2012 to 2017. Region V is the next most profitable Region, but saw an almost 3% decrease in NCFI over the same period. Regions I, II, and IV also all reported negative NCFI in 2017. Region I was reported as being the least profitable, which is likely related to the fact that this Region has more ranches with <50 head than any other Region. Region I also reported a slight decrease in NCFI from 2012 to 2017, while both Regions II and IV reported an increase of over 30% over this time period. However, it is important to note that both Regions II and IV still report negative NCFI on average in 2017, and while the percentage increase in profitability is large, nominally the increase is only \$2,080 and \$639 per operation in Regions II and IV respectively (see Appendix D, Table D7). For example, in Texas (Region IV) despite a nominal increase in average ranching NCFI of \$1,148 between 2012 and 2017, the aggregated state and the regional NCFI levels were still negative.

Producer Age

According to the US Agricultural Census, NAICS Summaries from 2002 to 2017, the average age of the principal producer in both ranching and feedlot sectors is indeed continuing to increase slightly. In 2017, the average age of principal operators in ranching is 57yrs, and 55yrs for the feedlot sector. It is important to note, that these averages reflect only the individuals who have completed the Ag Census, *and*, it is not necessarily reflective of family, children, or employees who may be in the process of transitioning into a manager position. This is especially true for family-operated ranching operations. Appendix D, Table D6 provides a regional look at operator average age and change in average age over the 15 year period between 2002 and 2017. Note that the percent change of ranch operator's age is under 3% (less than two years) for all regions, which suggests that 1) age is somewhat stable and 2) succession or transitions also occur.

The feedlot sector also shows a slight increase in operator age from 2002 to 2017, but at nominal levels, suggesting some transition is occurring in the principle operators of feedlots. The larger nominal increase in feedlot operator age occurred in Regions II and Region III with an increase of four years, raising the feedlot operator age to 60yrs (Region II) and 59yrs (Region III). Finally, the regional aggregation of producer age data masks the fact that there are some states that are experiencing a slight decrease in the average age of ranchers, such as Iowa and Illinois in Region III which have seen a -3% and -2% decrease in rancher age.

Succession and the Labor Challenge

In light of these fluctuations of number of operations and average size, couple with NCFI and producer demographics, many producers interviewed for the project reflected on ranch succession challenges as a mix of factors, including: economic constraints, social dynamics, legal/policy parameters, and planning. When they described the challenges of accomplishing succession, they often allude to this mix as this operator from Idaho did:

We're not exceptional, but we've planned more detail than most of the ranches I know; most of them are reacting. Sometimes, the kids want to come back. They have lots of challenges to pay for the land, or even have enough to run a full operation. Even when the younger generation is interested, if the family didn't plan for it, it doesn't always work between siblings who may want to cash out. And, the inheritance taxes can be prohibitive. If they're not, sometimes a young rancher can't find enough help. It's not just simple to transfer a ranching operation.

Long-term effects to the community, from multiple ranches experiencing unstable succession, ripple into the education system as loss of pupils in the school, into the economy as changes in annual expenditures for inputs and equipment to run the operations, and declines in willing citizens to volunteer, be civically engaged, and help neighbors in need. Yet, the industry is also experiencing labor changes such that even when labor is available, community effects can still occur as this producer in Montana explained:

The number of US citizens working on these ranches here has dropped in half, not counting the operator families. It's happening all over the state. The result is that most of their salary dollars are leaving for Mexico. Now, not all of it because they buy groceries, but most of the money is sent back home. Now, these guys have a serious work ethic which is harder and harder to find in locals. The migrants really work hard. I understand why ranchers like them. Some of them have been here 10 years and are very capable. They know how to fence, fix tractors, move cattle – they've learned the ranch. They are more than valuable given the industry labor issues.

Producers also commonly discussed labor shortages in the context of family ethics and values that are inseparable in their experience of raising a family, running a business, tending to animals, and keeping the natural resource they rely on secure. A ranch couple we interviewed in Region II who run a smaller, but normal-sized operation (60 head) continue to grow, but incrementally, and as a function of figuring out dynamics of their three children (ages 8, 14, and 16). The couple described the following:

Well, it goes back and forth. We want <the children> to be involved, but each kid is different. Sometimes, it's not always a good fit for them, and they have different likes and skills. At the end of the day though, knowing they are safe, knowing they are connected to something that is both family and productive for our livelihood, and figuring out if it's a good option for them is priceless for a young person in society today. They learn the value of hard work and to be innovative with what you have rather than thinking Amazon fixes everything w/ a new order. The experience they are getting here isn't perfect every day, but we wouldn't trade it for anything.

Social Impacts, Threats to Community Security, and US Beef Production

To provide more detail about the multitude and diversity of challenges germane to community security in beef production, this section highlights a variety of results that illustrate the breadth of factors on the ground. For instance, beef production communities suffer from problems associated with conflict over multiple-use issues on public lands, drought, public health epidemics, immigration policy, and shifts in consumer trends, to note a few. This section is *not* meant to be a comprehensive listing or detailed description of all possible challenges; further, all those reported are not universally true across the entire geography of production. Thus, addressing the industry-related challenges in many ways defies one-size-fits all policies or remedies.

Unique context of public rangelands and US Beef Production

Especially in the western US, leased public rangelands remain integral to beef production and ranch assets, with substantial economic benefits for rural western communities. Through the 1890s, settlers established valuable landholdings in western regions with home and winter ranches located near water and hay meadows adjacent to summer grazing on government-owned rangelands. This land holding pattern has persisted, and healthy, productive public rangelands remain essential to western cattle production. Further, healthy rangelands are the root of strong ranching communities, supported by local direct and secondary spending with economic benefits for the community as a whole.

Two federal agencies – the Bureau of Land Management (BLM) and US Forest Service (USFS) – manage the majority of public US grazing lands. State-, county-, and municipal-owned lands also manage public grazing areas leased to producers. In Wyoming as an example, producers lease 34,544 acres of state-owned lands for grazing, primarily for beef cattle production (WOSLI 2022). BLM grazing allotments in 14 western states cover 282 million acres of leased public lands; USFS allotments are located in 26 states, covering 99 million acres (BLM 2022, USFS 2022) (see Appendix E, Figure E1).

Rangeland productivity varies across the landscape, along with the number and timing of cattle permitted to graze. In 2020, active BLM grazing allotments were permitted to graze 21 million Animal Unit Months (AUMs) (BLM 2022); 2020 National Forest System (National Forest and National Grasslands) authorized AUMs for cattle totaled 6 million AUMs (USFS 2020).⁵

Economic effects for beef producers occur at direct and indirect levels in association with public rangelands allotments. Multiplying AUMs leased on public BLM and USFS lands by rent per animal unit reported by NASS returns a rough direct valuation of public rangeland productivity

⁵ Potential forage in terms of livestock use is measured in a standardized way by Animal Unit Months, or AUMs. One AUM is the forage required by a 1,000 lb animal for one month; equivalent to 780 lb. of dried forage (UNL 2013).

in 2020 of \$5.6 billion for 27 states with federal grazing lands (see AppendixE, Table E1).⁶ More indirectly, each new dollar spent locally by beef producers also generates additional economic activity as it is re-spent by local businesses. This secondary or “indirect” economic activity takes into account supply chain purchases and hiring by local businesses and labor income spent in the local economy. Strong ranching communities supported by local direct and secondary spending have economic benefits for the local economy as a whole.

Given the magnitude of impact associated with public rangelands allotments for a major proportion of the industry’s geography, a contemporary aspect of ranching on public lands has relevance from western producers’ interview responses. Because select interest groups created a pattern of litigious environmentalism (Baier 2016; Martin 2021) perversely enabled by the 1980 Equal Access to Justice Act (EAJA), many producers have experienced a period of collective stress associated with longstanding permitting and assessment processes to establish access with public allotments in the western U.S. A cow-calf producer interviewed for the project reflected:

Once that starts, you never escape the worry from uncertainty for your livelihood. We used to have trust relationships with the range cons <conservationists>, but they are too scared to manage the resource for fear of a lawsuit. It hamstring everything. It has cut the legs out from several operations in a four-County area here because they lost their permits in EAJA litigation.

Environment-based effects

Producers cited a variety of environment-based effects pertinent to long-term security of their operations and often inseparable from various social and economic phenomena often in need of response. For instance, a breeder we interviewed registered hoof and mouth disease (*aphtae epizooticae*) as the concern he ranked highest among all the challenges he considers threats. In an earlier era, risk of the spread of the disease led their family to purchase land in another region to protect breeding genetics which resulted in both opportunity and cost to their operational security.

In the case of Florida, a major beef production state in Region II, producers face an accelerating mix of socio-environment effects ranging from rapid population growth, related ongoing urbanization, conservation pressure for wildlife preservation, and impacts to both water quality systems in the region as well as the hydrologic structure of the physical environment. Although agricultural producers in the region have often experienced blame for the water quality challenges or impacts to wildlife, beef producers have innovated to support and facilitate conservation partnerships that not only create environmental benefit, but also forge new alliances and collaborative potential within local/regional community settings. While Florida’s

⁶ A direct economic valuation of public grazing AUMs on USFS RMUs and BLM allotments has been estimated at \$16 to \$27 per AUM (Maher et al. 2021). Private pastureland cash rent in counties with BLM allotments or USFS RMUs provides an additional measure to estimate the production value of public grazing lands. Reported state pasture rent per AUM for states with public grazing averages for Mean 2021 cash rent over 469 counties that contain BLM or USFS grazing leases is \$20.46 per AUM, and varies considerably depending on pasture productivity, from \$10/AUM in Arizona to \$49/AUM in Nebraska (NASS 2020) (see Appendix Table E1).

combined impacts may be more extreme, many beef production communities across the country have similar environment-based factors they cope with and manage.

And, cattle production in a heavily populated, but geographically diverse eastern state has an emergent challenge for long-term community security and production. Industry partners there explained a unique dilemma emerging for the landscape as they manage for a sustainable future:

We have always worked in coalition with other cow-calf producers. We all need to work together. A big thing we had to address last year had to do with solar projects and the green energy quota our Governor set for the state. It puts us as cattle producers in an interesting spot. We're generally all for private property rights; at the same time, some producers are in a position to let some of their land go for solar development. It raises the land prices for all of us and that's prime production land going out.

Community & population dynamics

During the sociological interviews, we prompted producers to respond open-endedly to what they perceived as the primary threats to beef production. In some cases, producers also highlighted phenomena that not everyone may associate with challenges to security in beef production, but relate to human dimensions impacts through what happens in the population. Several examples of these challenges are summarized broadly here as 'community change', 'public health trends,' 'consumer preferences,' and 'immigration effects'.

One of the most prominent social impacts producers noted across the country manifested as accelerated change within their local communities. In many cases, as this breeder explained, this occurs as change in the very demographic profile of the sub-sector they consider peers within the agricultural community:

It's different than it was 50 years ago. Today, we've got a lot of people in the cattle business that are not cow people. They're doctors, bankers, and lawyers. They've gone and bought a ranch, but they don't know much about cattle. So they rely on managers to really stick it out....that changes the community from what we had 50-75 years ago. It adds to the fact that most people in the general population have no idea what it takes to produce their food.

As both NCBA and the US Department of Agriculture have recently recognized through publications (NCBA 2022b) and webinar opportunities (USDA 2022), many in rural agricultural communities continue to experience lasting impacts of an accelerated mental health crisis. Although our analyses did not focus on this difficult and sensitive trend within beef production communities, the problems associated with opioid and fentanyl addictions/overdoses as well as the prevalence of suicide among agricultural families and communities hits home for many in the industry and were raised by producers within the interviews. Nason et al. (2021) in a project report addressing this epidemic, cite recent research revealing the suicide rate is higher among agricultural workers than any other profession, and 50% higher than during the 1980s. Compassion for those motivated and able to address these challenges in the industry should be honored and supported as they cut to the heart of human elements within community security.

Pertinent to a different category of social relations and emotions, some producers have one-on-one contact with consumers of the beef products through cases of direct product marketing and sales. However, many do not, and even when that connection does occur, the majority of consumers do not have direct relations to producers. Yet, some sources of consumer trends show an expanding movement about attitudes and political activism related to cases of animal welfare concern as well as development of non-meat/laboratory-based and plant-based protein alternatives (Kindle, 2021; Manning, 2019; World Economic Forum 2019). Most producers do not consider these trends imminent threats, but rather as additional concerns if they need to also attend them. Issues that can compound family and business operation stressors in everyday routines, lead to additional costs in time, energy, and anxiety, as well as result in market uncertainties with the general population of consumers. At the least, these trends – no matter whether they are based on a mix of misinformation and reliable sources – affect the morale of producers who take substantive pride in animal welfare as a standard in production and a measure of quality. As one producer noted,

Well, you know PETA (People for the Ethical Treatment of Animals) is becoming more of a social norm now. Animal welfare is a thing, and rightfully so. The perception is growing – right or wrong about the degree to which problems occur. So much information and misinformation just floats around on media and social media sites, often unchecked, we have to ask how much of this affects people's actual decisions to still order a hamburger vs a fake one. It just seems crazy to me that we would draw political lines in the sand about food options. That it seems that has become more prevalent, rather than recognizing how we're taking care of animals and providing protein, is what worries me.

As another example, producers interviewed in the region adjacent to the Mexican border referenced a unique population challenge. In addition to the routine of invasive weeds, wildfire risk, drought, and wildlife interactions, it has become increasingly common for producers along the border to have humans crossing their private rangelands and public allotments simply as a function of location, developed water sources, and remote levels of access. Producers documented cases of immigrants on the run, human trafficking, and drug trafficking based on observing different groups and behaviors. One southwestern cow-calf family described the following, a story and trend also corroborated via other producers (Burke 2021) as well as media sources (del Bosque 2014; Hod 2021):

When we first saw them, we didn't know, but quickly learned not to interact except to pat our chest as an indicator that 'we're also carrying'. We've suffered what I would call good-intentioned vandalism because we are a prime water source. Water we develop for our cattle gets used for drinking water, bathing, and washing clothes. Some days it's still hard to process that this kind of thing is a part of our ranch. Now the hardware store has developed some special connectors for our water lines that help limit the damage. As if the endangered species issue isn't enough of a threat, we are faced with the dilemma of whether to help another human in need. It's extreme circumstances, but common for us. Illegal or not, it's reality.

In addition to noting the challenges of immigrants crossing grazinglands, producers across the country in many cases also noted that reliable labor has shifted demographically, including the

hiring of foreign-born labor across at least Regions II, IV, V, VI, and VII. See Watson et al. (2012) for analysis of increased pressure for foreign-born labor in rural and agricultural communities due to lack of viable substitutability among the domestic population.

IMPLICATIONS

A recent economic analysis reports: “The beef cattle industry is one of the most — if not the most — complicated markets in agriculture, and stakeholders throughout the supply chain have a number of varied viewpoints” (Fischer, Outlaw, and Anderson 2021, pg. x). This report documents that many of the industry’s producers, whom we take to be an obvious category of stakeholders, experience substantive impacts from the diversity of challenges affecting their operations. In this final section, we outline a series of key implications drawn from the results highlighted above.

Trends in Efficiency and Consolidation

Both ‘steers over 500lbs’ and ‘cattle on feed’ have increased over the last 40 years while beef cow numbers have dropped; the industry appears to be more efficient in terms of reproductive efficiency, generating more saleable calves per cow, while also potentially utilizing more dairy calves (and imported animals) directly in the beef industry. There also appears to be more consolidation of all beef cattle into the central and northern Great Plains region, with more increases occurring in the northern plains (see Appendix Figures D7 and D8). In fact, Region VII has the largest inventories of both ‘steers over 500lbs’ and ‘cattle on feed’. Over recent decades, increased globalization, climate variability, and mixed results of family succession within operations have intersected to result in macro trends affecting the cattle inventory location and profile. At the highest levels, the trends of cattle moving north and to the central part of the country as well as to more concentrated operations are key to the dynamic profile of the industry as well as the more localized scales of community security or insecurity. One first-generation family operation described these effects, especially as they relate to the land and ranch succession:

Yes, there’s family legacies wrapped up in all this, but also, what’s gonna happen to the resource? We’ve been through a lot, renting or buying from other operators who didn’t have a next generation coming. It’s a tough thing for that family and that whole transition to let it go. And it’s tradeoffs in the community because if we consolidate five ranches to make ours, those folks all had civic roles in the community to volunteer, help at church, or keep a side business that helped all of us. Now, it’s fewer of us keeping up with the same amount of ground. And, even though it’s opportunity for us, it’s a lot of risk we manage because of that consolidation.

Land Management and Public policy

As ‘steers over 500lbs’ and ‘cattle on feed’ inventories continue to grow, managing rangeland for livestock production and conservation goals will be challenging. In Region VII, considering the 49% growth in ‘steers over 500lbs’ since 1980, the 15% decrease in ranches, and the 4%

decrease in the average size since 2002, a key question arises: can the central and northern Great Plains support larger stocking rates? Also in Region VII, the number of 'cattle on feed' has increased by 76%, while the number of feedlots has decreased by 55%, and the size has increased by 33% (measured in acres). There are several potential impacts and questions that arise from this consolidation of feedlot animals. The source and methods of farming needed to feed these animals will be a critical piece of feedlot economics, as well as conservation goals for the area. What impact will the concentration of feedlot animals to this region have on cattle feed costs? What impact will the concentration of feedlot animals to Region VII have on grassland conversion? How will the region, and feedlots specifically, adapt to changing climatic variables such as temperature and precipitation?

Risk Management

The concentration of livestock in the central and northern plains (primarily Region VII) presents opportunities and challenges for risk management. As Derner et al. (2018) and Briske et al. (2021) have described, regional vulnerabilities will be determined by ecological changes due to climate change as well as producer adaptability. Figures 2, 3, 4, 5 (see also Appendix D, Tables D1 - D3) show the general trend of 'beef cows' and 'cattle on feed' continuing to shift into Region VII and vary, if not decline in/out of all other regions. These movement patterns present an opportunity for targeted- and regionally-based policy. However, these patterns also contribute to regional-scale production vulnerability if this concentration becomes too great and resulting in the lack of dispersion of operations across the country. Thinking ahead, for instance, if the central and northern Great Plains were to experience drought or other extreme climate conditions, this would significantly impact a large portion of the industry.

Diversity of operational scale: Farms versus Inventory

The disparity of size and number of operations of a specific size can have pronounced effects on the impacts of any policy or management recommendations. If the goal of a proposed policy is to impact producers, the largest impacts will be seen if smaller operations (specifically ranches) are targeted. However, if the industry aims to impact the most animals, that will likely be more efficiently achieved by targeting larger operations (and especially feedlots).

One common concern is that because there are relatively fewer, yet larger, feedlots as compared to ranching operations, feedlots are able to capitalize on market power which impacts prices received by ranches. Recent literature speaks to price discovery and price risks for sellers in fed cattle markets, specifically the importance of a broad shift away from auctions towards more privately negotiated contracts (Bastian et al. 2021). In fact, key findings from the Agricultural and Food Policy Center evaluation of cattle markets state, "While not necessarily a popular position, most economic research confirms that the benefits to cattle producers due to economies of size in packing largely offset the costs associated with any market power exerted by packers. Research indicates that there is market power, but its effect has been small" (Fischer, Outlaw, and Anderson 2021, page x).

While interactions between industry consolidation, market power, and cattle prices are beyond the scope of this analysis, it is a very commonly held social perspective among many producers that market forces *do* have negative effects on cattle prices and, therefore, their livelihoods. In fact, this impact occurred as the most prevalent trend among the sociological interviews. As this producer noted, some operators tie together multiple complex parts of the overall system trying to manage what to do about uncertainty with prices:

Just like Amazon or Wal-Mart knows everything you click on, every cut of meat gets tracked so it could be recalled if something happened. They know exactly where it is. You can't tell me they don't have pricing figured out. And just recently, we've gotten the news that some of the packer owners were convicted of fixing prices. This doesn't mean every deal and every person is corrupt, but it's part of the equation. The rising costs of inputs is different now. You'll hear these guys talk about the (economic) cycle of the beef industry. This time it's different. We didn't have this level of consolidation in those cycles. The cows are moving. Just my truck alone is costing me \$200+/week now. Put this in your equation – I've got a great operation I've sustained for decades; every acre is optimized and neighbors marvel at the grass here; I'm connected to NCBA; and I can't get fair prices for my cattle. That doesn't last long.

Sustainability – Dichotomy, Choices, & Tradeoffs

As noted in the “Diversity of Operational Scale” section above, there is a disparity in that there are a majority of small operations, yet larger operations control most of the cattle inventory. As an example, the table in Figure 7 (see also Appendix D, Table D10) shows that over 70% of the nation’s ranches have 49 or fewer head. Across all regions, there tends to be more smaller ranches (<50 head), although western regions do have greater proportions of larger ranches than eastern regions (for additional detail on these differences, see Appendix D, Figure D6).

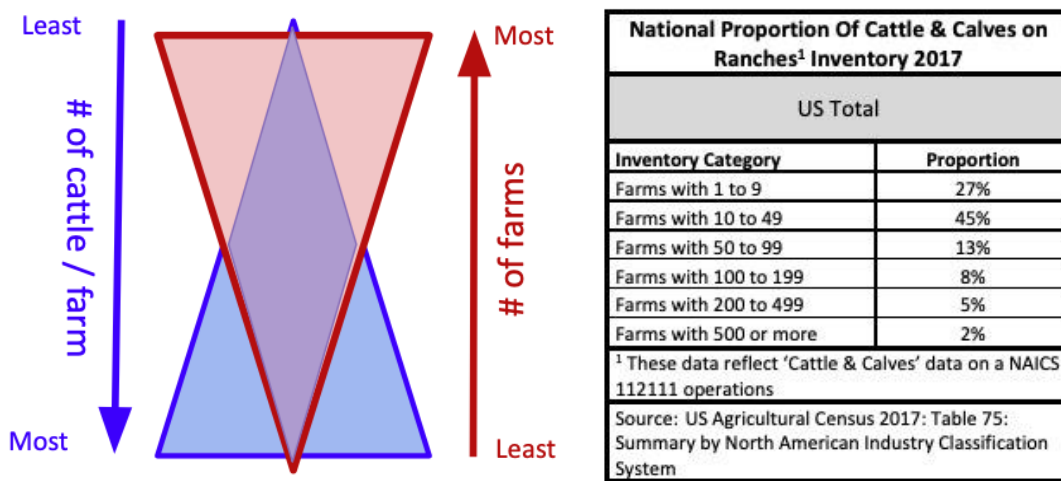


Figure 7: Representation of the industry dichotomy between # of cattle / operation and # of operations. (Source: US Agricultural Census, 2017, Table 75)

However, the distribution of inventory skews toward larger operations. For example, in Texas, 84% of the operations have less than 100 animals, and these operations only hold 30% of the state's total inventory, meaning the remaining 16% of operations control 70% of the state's animals. In Regions I, II, and III, this trend is less obvious within the feedlot sector, where inventory remains more equally dispersed across feedlot sizes. In contrast, feedlots within Regions IV - VII show consistent numbers of operations of each size, yet the majority of inventory is held in feedlots with >2,500 head. This difference correlates heavily to macro-level variation in the eastern vs western geographies of the country and industry. That variation also has important implications for policy makers as management or policy recommendations aimed at impacting the largest numbers of animals may not benefit the largest number of producers, which then also likely have cascading effects to community security.

There are also important implications for whether policy is aimed at new or existing producers. Average ranch sizes decreased 11% nationwide from 2002 to 2017, even as the number of ranches increased in Regions IV, V and VI over this period, implying there are more smaller producers entering the industry in recent years. That alone could be a sign of community security for the industry through ranch succession, but may also represent a trend of smaller 'hobby' ranchers that do not always have the same social ties to community as noted above.

Further, the fact there are so many small ranchers can create issues when smaller ranchers sell to larger feedlots (beyond concerns of market power - see discussion above) as the industry should attend to a gradient of operational sizes with respect to marketing and transportation. In other words, trying to optimize for both efficient production economics *and* community security can mean ensuring smaller lot sizes of calves can be handled efficiently and with viable pricing to ensure the continued flow of feeder animals for finishing.

One benefit of having more, smaller operations may be viewed as increased capacity for risk management in the industry. Diversification of inventory across numerous operations and locations may result in less catastrophic industry-wide impacts if large-scale risks within the environment and/or society occur with threats to individual businesses as well as the overall supply chain. However, a major benefit of larger operations is tied to economies of scale, with larger operations tending to be more efficient and able to produce at lower costs. If that trend of concentration shifts too far, our overall results indicate the likelihood of ongoing detrimental impacts to local communities if these operations require less total labor and/or supplies purchased locally as compared to many smaller (and likely less efficient) ranches and/or feedlots. Akin to the major theme behind Gladwell's (2000) "tipping point" concept, the industry should recognize the need to balance this dichotomy, in order to provide community security for the bulk of its producers, not just animals.

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