Chapter 9. Livestock and Rangeland in California

Tina L. Saitone

Abstract

U.S. farm sales in 2017 are projected to be $365 billion, including $190 billion (52%) from crops and $175 billion (48%) from livestock and animal products. Unlike many other states, where animal products generate more farm sales than crops, in California crops are about three-fourths of farm sales.

Saitone notes that California's $12 billion in livestock sales are about 6 percent of U.S. livestock sales. Cattle and calves had farm sales of $3.4 billion in 2015, almost 30 percent of animal agriculture's $12 billion in sales; poultry and eggs were worth $1.7 billion and were 14 percent of the state's animal agriculture sales.

The beef cattle industry has distinct subsectors, with some ranches breeding cows to produce calves and others fattening cattle before slaughter. The major expense involved in fattening cattle, as well as in producing broiler chickens and eggs, is feed, which is often over half of production costs.

California had 2 percent of the 31 million beef cows in 2017. Three very different counties, Kern, San Luis Obispo, and Siskiyou, have large beef cow herds. Saitone emphasizes several distinct attributes of California livestock: extensive reliance on public lands for forage for cattle, moving cattle to access different pasture-based forage resources, limited in-state meat processing facilities, and regulations on antibiotics and transportation that will increase the costs for California ranchers.

Cow-calf operations are the first stage in the beef supply chain, raising calves until they are about 7 months old and weigh 600 pounds. Calves are sold to stocker operations that feed them on pasture until they are 1-year old and weigh about 900 pounds. Yearling cattle are sold to feed lots, often in the Midwest, and fattened with grain before slaughter at 1,300 pounds. Almost three-fourths of "cattle on feed" in the U.S. were in Nebraska, Texas, Kansas, Iowa, and Colorado, meaning that many yearling cattle leave the state in trucks and return as beef.

California has about 10 percent of the 5.5 million sheep in the U.S., ranking second to Texas in sheep inventory but first in wool production. Like cattle, lambs are raised on grass until they are moved to feed lots for fattening and slaughter.

Cattle and sheep ranchers need low-cost forage, which is disappearing with increased regulation of grazing on federal lands. Ranchers believe that the big four meatpackers who process over 85 percent of cattle are able to depress prices, although research has failed to find convincing proof. The use of antibiotics to prevent disease is being restricted in order to slow antibiotic resistance, and new rest requirements for truck drivers may make it more expensive to ship cattle to Midwest feedlots.

Author's Bio

Tina L. Saitone is a Cooperative Extension specialist in the Department of Agricultural and Resource Economics at the University of California, Davis, and a member of the Giannini Foundation of Agricultural Economics. She can be contacted at saitone@primal.ucdavis.edu.

Table of Contents

Beef Cattle

The United States is the largest producer of beef in the world, facilitated, in large part, by the nation's ample grasslands and substantial feed-grain production. Cattle production in the U.S. accounted for $78.2 billion in cash receipts in 2015, 21 percent of the total receipts for agricultural commodities. In 2015, California cash receipts associated with livestock and livestock products were $12 billion, 25 percent of the state's total $47 billion (CDFA, 2016), including dairy products ($6.3 billion),[1] cattle and calves ($3.4 billion), poultry and eggs ($1.7 billion), hogs and pigs ($29 million), and miscellaneous livestock ($554 million).[2] Ranching is a part-time business for many operators. According to the 2012 Census of Agriculture (USDA, 2012), 87 percent of beef cattle operators made less than half of their income from farming.

The U.S. beef supply chain is generally characterized by four relatively distinct segments of the supply chain: 1) cow-calf operations, 2) stocker operations, 3) feeding operations, and 4) slaughter and packing.

Cow-Calf and Stocker Operations

A typical cow-calf operation manages a commercial herd of beef cows that are bred to produce calves. Calves are raised at their mother's side on rangelands until they are weaned at roughly 6–8 months of age, weighing between 500 and 650 lbs. Given the reliance of cow-calf operations on pasture-based forage resources, these operations characterizing this initial stage in the supply chain are geographically diffuse and are present in nearly all states throughout the United States. Figure 1 is a dot density plot of calf inventories in the U.S. on January 1, 2017, where each dot represents 1,500 head. In 2012, 727,906 farms in the U.S. had beef cows, with an average herd size of 40 cows per operation (USDA, 2012). Cow-calf operations are especially important in the western and southeastern United States (Blank, Saitone, and Sexton, 2016).

The size of the beef cow herd in the U.S. has been declining since its peak in 1975. Despite reductions in reproductive capacity, beef production has increased as the industry has become more efficient. Figure 2 overlays U.S. beef cow inventories and annual commercial beef production from 1940 to 2017. In 1975, the U.S. produced 23.7 billion pounds of beef with a beef cow herd of 45.7 million head. By 2017, a beef-cow herd of less than 30.2 million produced 25.2 billion pounds of beef. The size of the dairy-cow herd affects total commercial beef production, as dairy-bred steers and culled cows enter the beef supply chain.

As of January 1, 2017, California was home to 2.1 percent of the nation's 31.2 million beef cows. California's beef cow herd has been declining monotonically since its peak in 1982 (nearly 1.2 million head) until 2015 (590,000 head). In very recent years, the state's herd has begun rebuilding following substantial herd reductions due to severe drought conditions that persisted from 2013–2015.

Small operations (less than 100 head of beef cows) manage one-quarter of the state's beef-cow herd, while medium-sized operations (100–499 head) manage 35 percent and large operations (500 head) account for the remaining 40 percent (USDA, 2012). These operations are distributed across the state, with Kern, San Luis Obispo, and Siskiyou counties having the largest county-level herds. Figure 3 is a dot density plot that shows how beef-cow inventories are distributed across counties in California with each dot representing 500 head.[3]

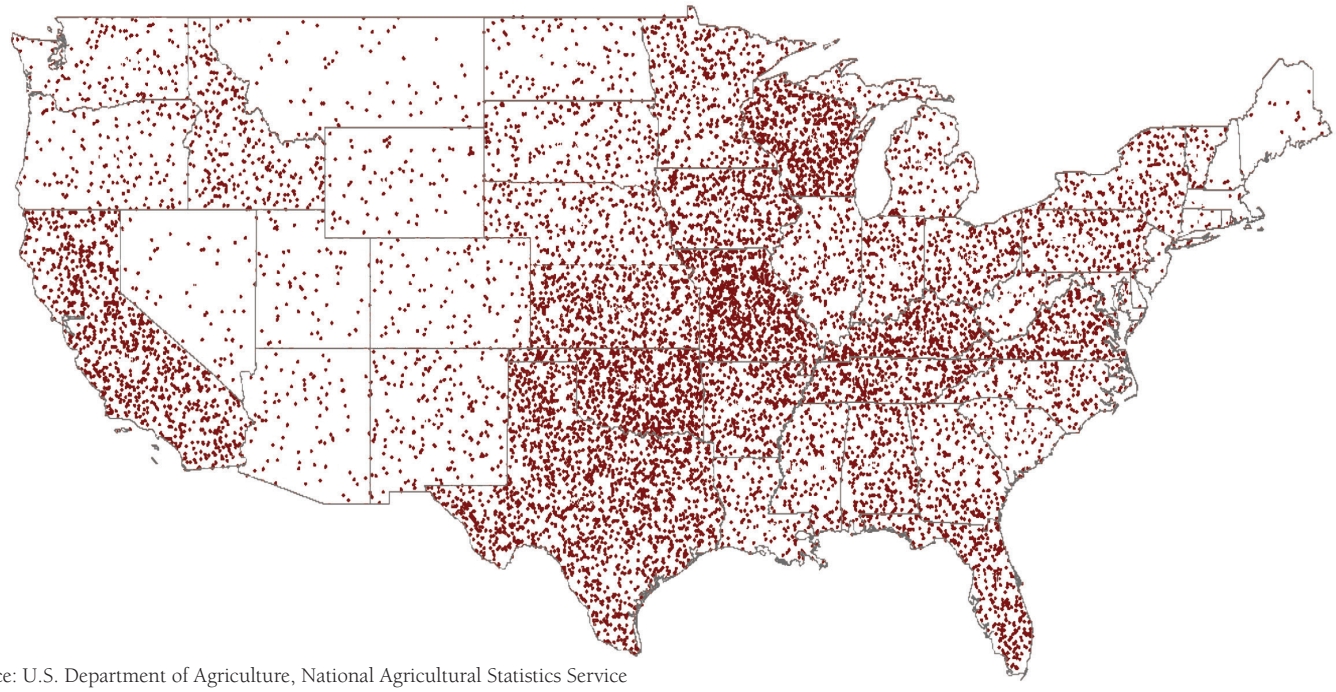
After weaning, calves are typically sold to stocker operations through local sales yards or satellite video

1 Although dairy cattle are considered part of the state's livestock industry, the prominence and regulatory specifics associated with the industry warrant more detailed consideration than can be provided here. For more information on the California dairy industry, please consult Chapter 6.

2 Miscellaneous livestock includes sheep and lambs and goats used for milking and meat production.

3 Dots are not location specific and are simply used to show within-county density. County-level beef cow inventories are not available for Alameda, Alpine, Amador, Imperial, Los Angeles, Mariposa, Mendocino, Modoc, Mono, Monterey, Napa, Placer, Plumas, San Benito, Santa Barbara, Sierra, and Yolo counties. In total, these counties account for 161,700 (25 percent) beef cows in 2017.

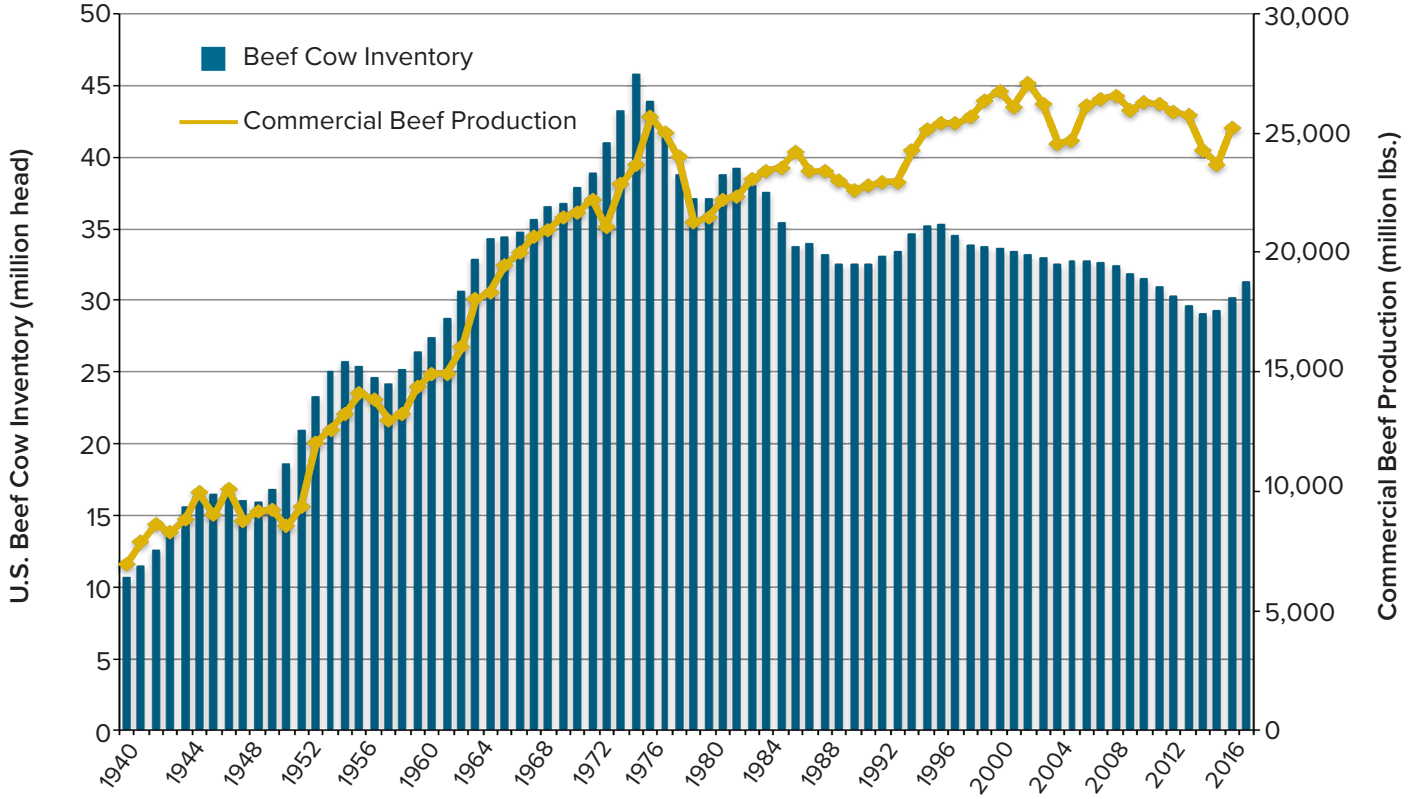
Figure 1. Dot Density Plot of Calf Inventories, January 1, 2017



Source: U.S. Department of Agriculture, National Agricultural Statistics Service

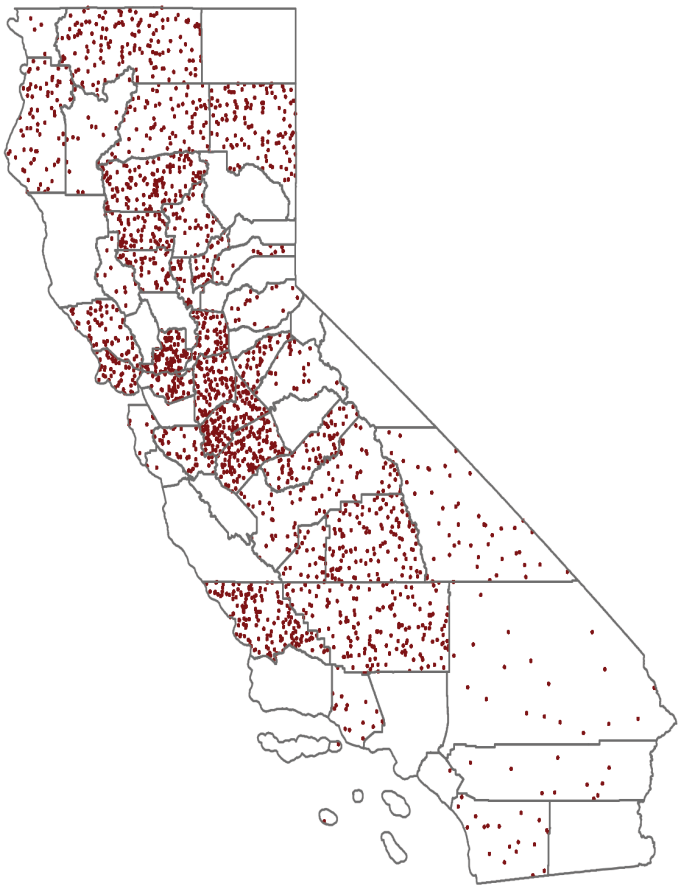
Note: Each dot represents 1,500 head.

Figure 2. U.S. Beef Cow Inventories and Commercial Beef Production, 1940–2017



Source: U.S. Department of Agriculture, National Agricultural Statistics Service

Figure 3. Dot Density Plot of California Beef Cow Inventories by County, January 1, 2017



Source: California Department of Food and Agriculture
Note: Each dot represents 500 head.

auctions, although some cow-calf operations retain calves through the stocker phase. The standard stocker operation feeds animals on pasture for roughly six months, until the animals weigh between 800 and 950 lbs. These "yearling" cattle are then typically sold to feeding operations to add weight before slaughter.

Available statistics specific to the stocker phase of the supply chain in California are limited. However, much like cow-calf operations, stocker operations typically market cattle via sales yards or satellite video auctions to feeding operations, most of which are in the Midwest. The lack of feeding and processing capacity in California and the Western U.S. is an important consideration, and causes cattle born in California to be sold at discounted prices, relative to comparable stock raised in close proximity to feedlots, to compensate for the costs of transportation. For example, Blank, Saitone, and Sexton (2016) found from 2009–2013, calves were discounted $0.82/cwt. for every 100 miles they were from the concentration of feeding and processing capacity in Nebraska. This was a $14.63/cwt. discount for calves raised roughly 1,600 miles from Nebraska (e.g., in Northern California).

Rangeland and Pasture-Based Forage

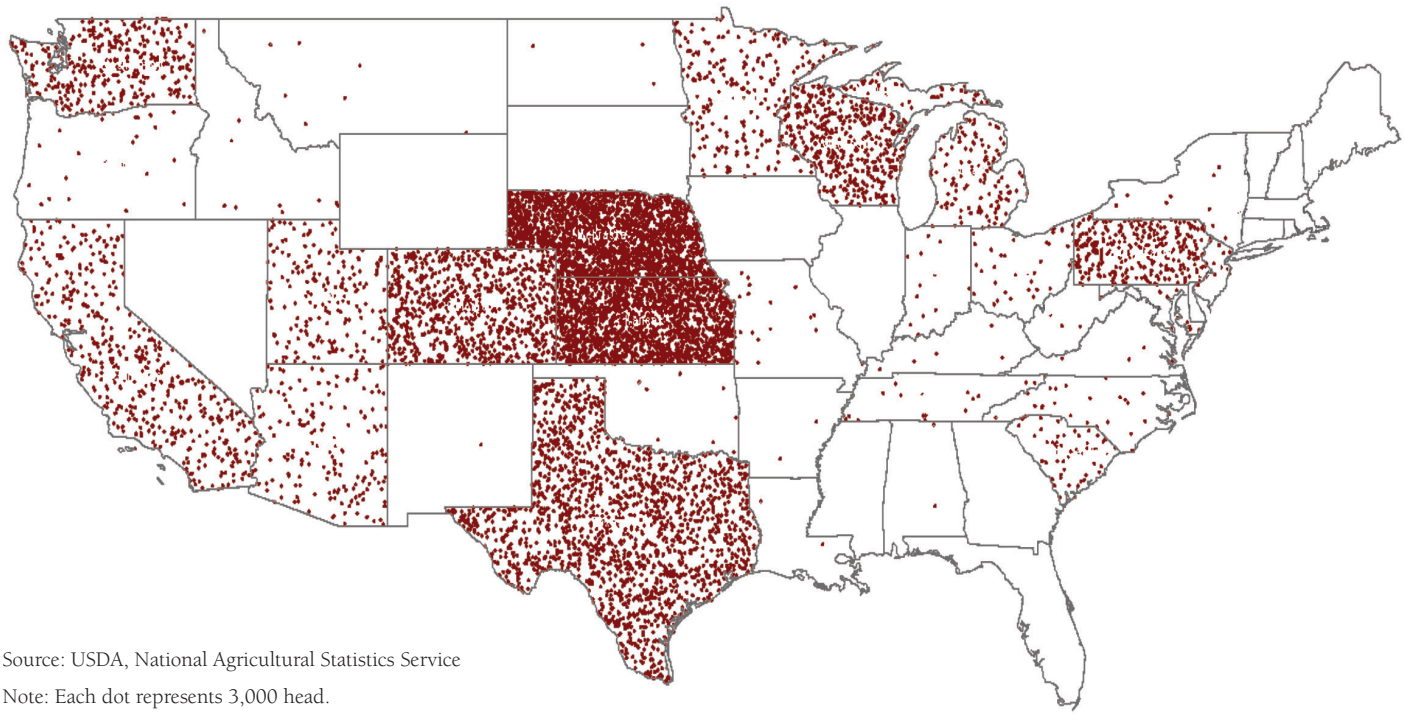
Livestock grazing is California's most extensive land use. California's total land area consists of nearly 101 million acres, of which 25.4 million acres are farmland. Approximately 63 million acres (62 percent) of the state's land area is considered to be rangeland. Ninety percent of the state's grazed forage is supplied by approximately 41 million acres (CDFF, 1988). Annual grasslands in the state, roughly 10 million of the 41 million grazed acres, produce the majority (70 percent) of the forage consumed by livestock.[4] Cattle and other livestock typically are grazed on marginal lands that are not suitable for other agricultural or productive uses. Mottet et al. (2017) estimate that on a global scale, 57 percent of the land used for livestock forage is not suitable for food production.

A unique feature of California and the western United States is the presence of publicly owned land that is managed by state and federal agencies. More than 45 percent of California's acreage is federally owned and managed, which makes many livestock producers in California reliant upon on the availability of federal grazing permits.

Livestock grazing on public lands began during the last half of the 19th century and increased to unsustainable levels around World War I. In response to the damage caused by unregulated grazing pressure, grazing allotments were established and allocated to individual producers beginning in the mid-1920s and culminating in the mid-1950s. During the 1990s, a regulatory paradigm shift changed the management of federal lands to include grazing utilization standards and integrated riparian management conservation policies, which reduced livestock grazing on federal lands by 15 percent across

4 Annual grasslands are characterized as open grasslands or woodlands dominated by an understory of annual plants and are primarily in the state's valleys and low-elevation mountains and foothills.

Figure 4. Dot Density Plot of Commercial Slaughter Total, 2016.



Source: USDA, National Agricultural Statistics Service

Note: Each dot represents 3,000 head.

the 11 western states from 2000 to 2015, and by 36 percent in California (Oles et al., 2017). Despite these reductions, ranchers in the western U.S. continue to get roughly 17 percent of their annual forage needs from public lands (Rimbey, Tanaka, and Torell, 2015).

Cattle Feeding and Processing

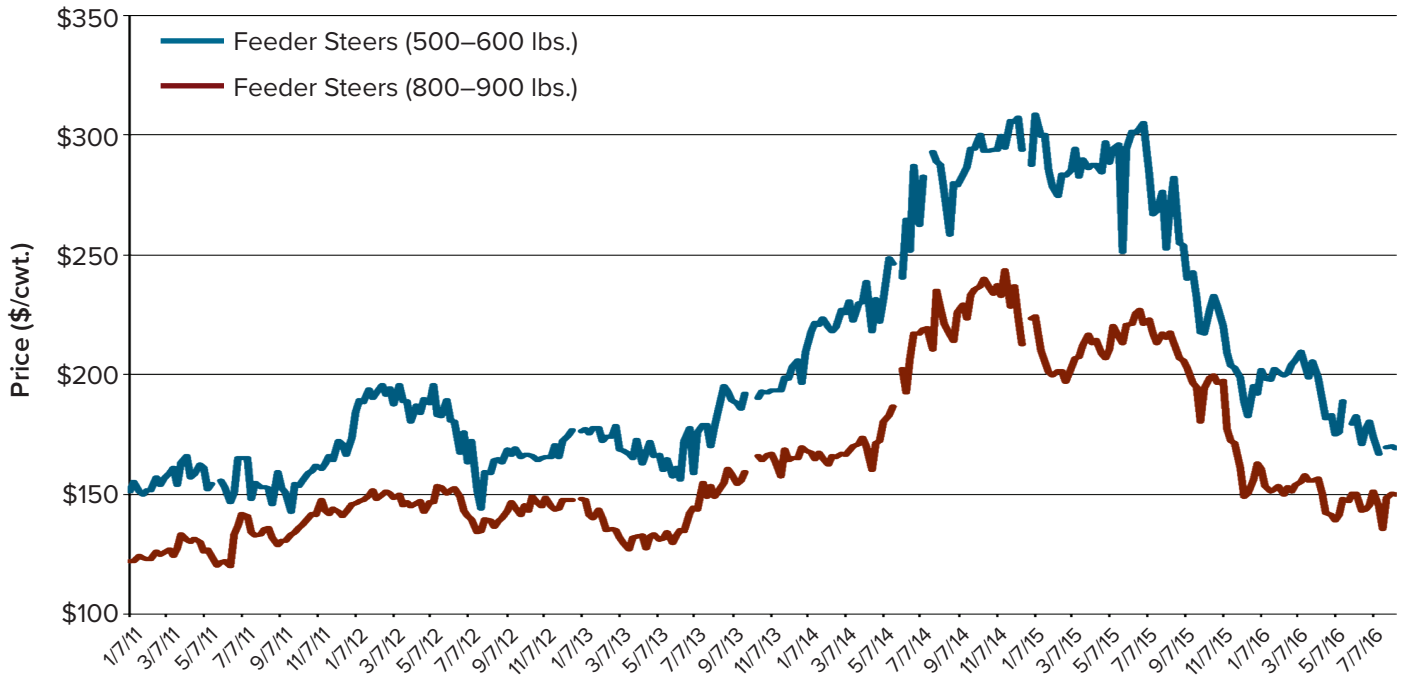
The majority of cattle in the U.S. are fed the last 4–6 months before slaughter on concentrated, grain-based rations (i.e., "grain-fed").[5] The U.S. Department of Agriculture's National Agriculture Statistics Service defines "cattle on feed" as cattle receiving a ration of grain, silage, hay, and/or protein supplements for the slaughter market, and expected to produce a carcass that will grade as select or better. At this stage in the beef supply chain, most yearlings have been shipped out of California to the Great Plains to feedlots located in close proximity to processing facilities.

Seventy-one percent of the cattle on feed in 2017 were being fed in just five states (Nebraska, Texas, Kansas, Iowa, and Colorado). Only 3 percent (430,000 head) of cattle received feed in California in 2017.

Cattle-processing operations are specialized to handle either steers and heifers or culled cows (including dairy) and bulls. Cow and bull plants are scattered across the country, reflecting the location of dairy operations. In 2016, dairy cows accounted for 9.6 percent of cattle slaughtered. Steer and heifer plants provide most of the high-valued muscle cuts of beef, such as steaks and roasts. The Midwest has the greatest concentration of processing operations for steers and heifers, with Nebraska, Texas, Kansas, and Colorado accounting for 70 percent of all commercial slaughtering in 2016. Nearly 55 percent of cattle slaughtered in 2016 were steers, and roughly 26 percent were heifers. California accounted for only 4 percent (1,218,800 head) of total commercial slaughter, with an estimated 50 percent comprised of culled dairy cows and bulls. Figure 4 is a dot density plot of commercial slaughter totals for 2016, with each dot representing 3,000 head slaughtered, and highlights the concentration of plants in the Midwestern states and major dairy states including California, Wisconsin, and Pennsylvania.

5 Alternatively, some feeding operations choose not to use grain-based rations and instead use pasture and hay to add weight prior to slaughter. Finishing cattle on grass takes longer, and these operations are highly dependent on sufficient grass supplies. Thus, grass-fed cattle are typically older at time of slaughter (22–26 months) and somewhat lighter (1,000–1,200 lbs.), relative to their grain-fed counterparts.

Figure 5. Weekly Feeder Steer Prices, 2011–2016



Source: U.S. Department of Agriculture, Economic Research Service

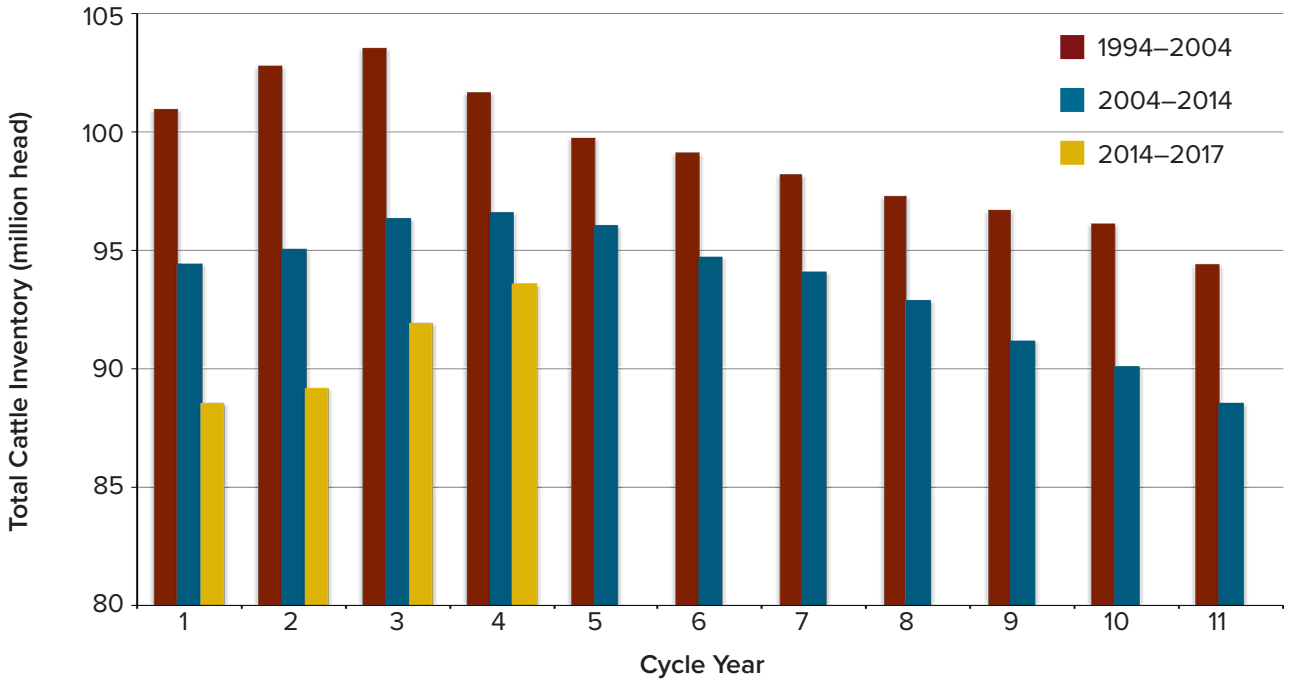
Four firms dominate meatpacking (JBS, Cargill, Tyson, and National Beef), slaughtering 85 percent of the steers and heifers in the United States. At time of slaughter, cattle are between 14–22 months of age and weigh between 1,200–1,400 lbs. Geographic concentration continues to intensify when moving downstream from the feeding to the processing stage. A number of factors account for this geographic concentration. They include minimization of labor costs, avoidance of unionized labor, and improved technology in fabrication (i.e., boxed beef). (See Wohlgnant, 2013 for a comprehensive summary.)

Marketing

Cow-calf and stocker operations typically use either local sales yards or satellite video auctions to market their calves and yearlings. Research suggests that satellite video auctions attract higher-quality cattle and offer producers access to a larger pool of potential buyers. In addition, satellite video auctions allow producers to differentiate their product, which is increasingly important as consumer tastes and preferences evolve. With food purchases accounting for less than 10 percent of the budget for a typical American household, consumers can afford to pay premium prices for quality characteristics that they want, including how the foods they eat were produced. For livestock products, many consumers want to know, for example, if the animal received antibiotics or hormones, and whether it was raised in a humane manner.

Ranchers are using different management practices (e.g., non-hormone treated, natural, Global Animal Partnership certified) to increase the value of their cattle. Studies have shown that these value-added management practices often command price premiums at video auctions (Blank, Saitone, and Sexton 2016; Zimmerman et al., 2012). For example, calves raised as "natural" (i.e., without the use of antibiotics, ionophores, synthetic hormones, or given supplements containing animal by-products) sold for $1.20/cwt. more than cattle not participating in this program (Blank, Saitone, and Sexton, 2016). Further, non-trivial premiums for respiratory vaccines and weaning are confirmed by many studies, as these practices have been shown to improve performance at the feeding stage. Of course, ranchers earn premiums at the expense of higher costs of production, so they must weigh carefully what quality characteristics they seek to provide in their cattle.

Figure 6. Total U.S. Cattle Inventories Across 11-Year Cattle Cycles, 1994–2017



Source: U.S. Department of Agriculture, National Agricultural Statistics Service

Even when ignoring these opportunities for differentiation, the market for live cattle is inherently volatile, characterized by large fluctuations in price. Figure 5 shows weekly average prices for calves (feeder steers 500–600 lbs.) and yearlings (feeder steers 800–900 lbs.) from January 2011 to August 2016. During this roughly five-year period, prices ranged from $1.43/lb. to a maximum of $3.09/lb. for feeder steers in the 500–600 lb. range. Similar volatility is present in the market for yearlings, although these larger cattle sell at a lower price per pound.

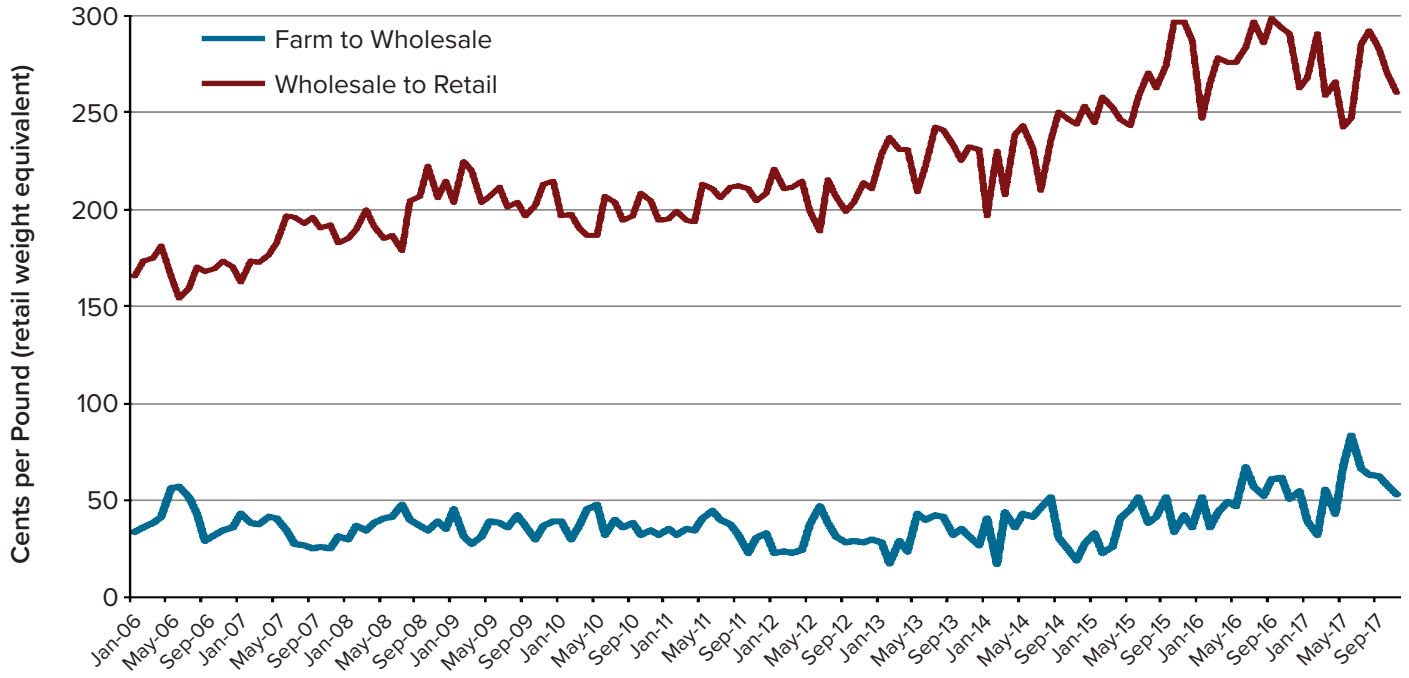
Some of the underlying price volatility is due to a periodic "cattle cycle," wherein cattle inventories vary in a somewhat predictable cyclical fashion. Figure 6 depicts total U.S. cattle inventories and shows how the cattle cycle ebbs and flows over 11-year periods, with each cattle cycle characterized by progressively lower total U.S. cattle numbers. Prices, not surprisingly, are lower during periods of higher inventories, which translate into increased supplies of cattle to the market.

Many ranchers seek to offset the risks of cattle ranching by diversifying their operations and also raising crops or other types of livestock or, alternatively, engaging in off-farm work. Ranchers can also attempt to hedge against adverse price movements in live cattle markets by buying and selling on organized futures markets.

Ultimately, the price that ranchers receive for their cattle is derived from the prices that consumers pay in grocery stores and restaurants for beef products. The farm-to-retail price spread measures the difference, on a per-lb. basis, between the value of the animal at the farm and its value at the grocery store, after adjusting for the fact that a pound of beef on the hoof produces less than a pound at retail due to inedible parts of the live animal.

The price spread includes two components: farm to wholesale and wholesale to retail. Figure 7 shows that the farm-to-wholesale price spread has been relatively stable; fluctuating a maximum of 66.2 cents over a more than 11-year period. At the same time, the wholesale-to-retail price spread has generally been trending upward from a minimum of $1.54 per lb. in June 2006 to a maximum of $2.99 in September 2016, a difference of more than $1.44/ lb.

Figure 7. Farm-to-Wholesale and Wholesale-to-Retail Beef Price Spreads, 2006–2017



Source: U.S. Department of Agriculture, Economic Research Service

Cattle and Beef Trade

The United States is a net importer of live cattle, importing from Canada or Mexico. In 2017, the U.S. imported more than 1.7 million head of cattle—55 percent coming from Canada and 44 percent from Mexico. Over the most recent three years for which data are available (2014–2016), on average, the U.S. imported 40 percent of cattle for feeding (i.e., between 400–700 lbs.) and another 30 percent for slaughter. In 2016, the U.S. exported nearly 70,000 head of cattle, mostly to Canada and Mexico.

The majority of the beef exported from the U.S. is high-value, grain-finished muscle cuts. At the same time, the U.S. imports predominantly lower-valued, grass-fed beef to combine with fat to produce ground beef. While still a net importer of beef and veal, the U.S. earned the distinction of being the world's largest beef exporter measured by value in 2016—$6.343 billion (U.S. Meat Export Federation, 2016). In total, the U.S. exported more than 2.55 billion lbs. of beef in 2016 to Japan (655.4 million lbs.), South Korea (459.2 million lbs.), and Mexico (395.0 million lbs.), among others, while importing more than 3.0 billion lbs. of beef from Australia (767.2 million lbs.), Canada (717.8 million lbs.), and New Zealand (612.5 million lbs.), among others.

U.S. beef exports are expected to continue to increase over time despite sanitary, phytosanitary, and traceability requirements (Pendell et al., 2013). For example, in 2017, China lifted its 13-year ban on fresh beef imports from the United States. O'Donoghue and Hansen (2017) predict that imports of beef to China will increase by 42 percent over the next decade. Yet, the U.S. may be slow to respond to this opportunity, as there are limited volumes of cattle in the U.S. to meet the export requirements (e.g., only 0.27 percent of the cattle slaughtered by Tyson each week currently meet the specifications [*Bloomberg News*, 2017]). As demand in specific export markets rises, processors have begun to search for cattle that meet the characteristics required or desired in these markets (e.g., age- and source-verified, and hormone-free).

Sheep

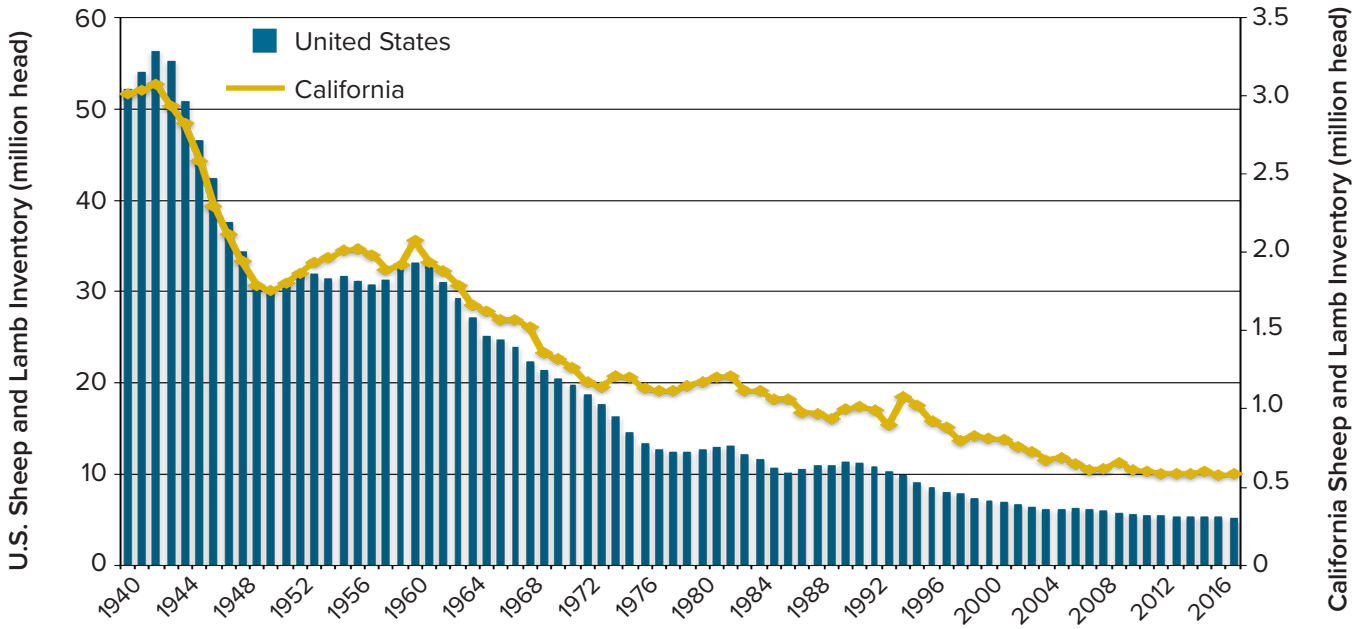
Although the U.S. at one time was home to more than 56.2 million sheep, inventories have been declining since their peak in 1942. Figure 8 shows sheep and lamb inventories in the United States and California from 1940 through 2017. Following precipitous declines in the 1940s and 1960s, the U.S. flock has stabilized at roughly 5.5 million head. The decrease is due to declining domestic per capita consumption of lamb; increased foreign competition in the markets for lamb, mutton, and wool; available synthetic textile substitutes for wool; predator pressures resulting in substantial death losses; and price volatility with persistent periods where prices were below costs for many producers. According to the most recent Census of Agriculture, more than 88,000 farms in the U.S. had sheep and lamb inventories in 2012. Many of these farms are relatively small, with 92 percent of farms having less than 100 head on their operations. Larger operations with 1,000 head or more account for less than 1 percent of farms but have nearly 44 percent of total inventories. The sheep and lamb inventories in California have followed the same general trend as the United States, stabilizing at roughly 600,000 head. The top five sheep- and lamb-producing states in the U.S., in order of total inventories in 2017, were Texas, California, Colorado, Wyoming, and Utah.

The majority of sheep in the U.S. are raised for both meat and wool production. Total wool production in the United States has been declining due to sheep inventory reductions, as well as reduced demand for wool for use in textiles. Although Texas has larger sheep and lamb inventories, California has more sheep shorn and the largest wool production numbers of any state in the nation. In 2016, 410,000 sheep were shorn in California, producing 2.7 million pounds of wool.

In 2017 California produced 20 percent (250,000 head) of the market lambs and 13 percent (10,000 head) of the market sheep in the United States. During 2016, there were 16 federally inspected processing plants in the state for sheep and lamb processing.[6] In the same year, California

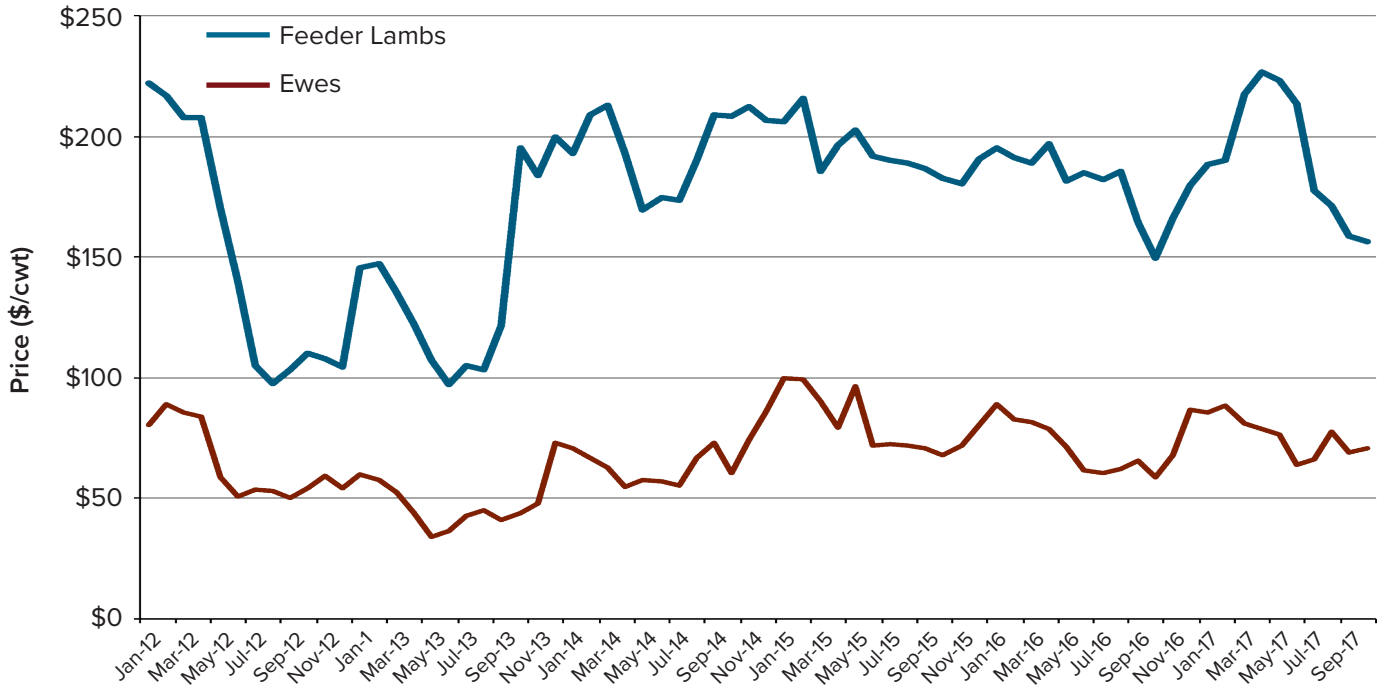
6 In 2016, 94 percent of commercial slaughter in California was at federally inspected plants. State-inspected facilities processed the remaining animals.

Figure 8. United States and California Sheep and Lamb Inventories, 1940–2017



Source: U.S. Department of Agriculture, National Agricultural Statistics Service

Figure 9. Ewe and Feeder Lamb Prices, San Antonio, Texas, 2012–2017



Source: U.S. Department of Agriculture, Economic Research Service

had the second largest commercial sheep and lamb slaughter total (314,600 head), 14 percent of the national total.

Marketing and Trade

In general, the lamb supply chain today is much like the beef supply chain. Lambs destined for slaughter are fed in feedlots and then marketed to processors. Over time, processors have substantially reduced the amount of purchases that they make via "formula," from roughly 70 percent of purchases in 2007 to approximately 40 percent in 2016. At the same time, the portion of lambs owned and fed by processors has increased from less than 20 percent in 2007 to nearly 40 percent in 2016. Much like cattle, the market for ewes and feeder lambs is quite volatile. Figure 9 shows average monthly ewe and feeder-lamb prices for the past six years.

The United States is a net exporter of live sheep. Exports of live sheep in the same year, totaling 51,638 head, were destined for more than 20 countries around the world. The vast majority of sheep exported went to the United Arab Emirates (60 percent) and Mexico (26 percent).[7] In 2016, all live sheep imports, totaling 14,272 head, originated from Canada.

The U.S. is a net importer of lamb and mutton, which primarily comes from Australia or New Zealand. Over 50 percent of U.S. lamb exports were destined for Mexico. Mexico is the primary export market for the U.S. (38 percent of the mutton exports in 2016), with the remaining volume shipping to more than 50 export destinations. In 2016, all live sheep imports, totalling 14,272 head, originated from Canada.

7 The United Arab Emirates was a new export destination for U.S. sheep beginning in 2016. In prior years, the majority of sheep exported went to Canada and Mexico.

Issues, Challenges, and Opportunities

As livestock producers continue to struggle to manage their operations profitably, they are confronted with new and unprecedented challenges. While the gamut of challenges facing the livestock industry is too vast to cover fully in this chapter, the subsequent sections discuss a few key issues especially relevant to California.

Forage Resources

A persistent and ongoing challenge for cow-calf and stocker operations, the segments of the supply chain most prevalent in California, is sufficient forage. One of the strongest predictors of profitability on an operational scale is non-pasture feed costs, with producers who are able to minimize the need and amount of supplement feed remaining the most solvent. Given this dependence on rangeland and pasture-based forage supplies, climate, environmental, and regulatory changes that restrict access, availability, and efficient use of these resources are of paramount concern to California livestock producers.

Climate change is expected to result in more variable weather patterns, with longer and more severe droughts being one likely outcome. California's ranching community, which is reliant on rain-fed (i.e., climate-sensitive), pasture-based forage systems, is likely one of the most vulnerable to climate variability and drought (Roche, 2016). Simultaneously, there is growing societal pressure for sustainable food production and expanding expectations for land conservation, making the management of both private and public rangelands increasingly complex (Roche et al., 2015). These challenges have often resulted in conservation strategies that reduce livestock stocking rates or remove livestock altogether on public lands, despite evidence that grazing pressure is currently at a level that balances livestock production and conservation goals (Oles et al., 2017).

Beyond supporting agricultural production, California's rangelands simultaneously provide a wide array of benefits, often referred to as ecosystem services, that include recreation, wildlife habitat, open space, nutrient cycling, carbon sequestration, water, and timber. Yet, the quality and quantity of these ecosystem services are at risk. In the 14 years between 1990 and 2004, urbanization contributed to the loss of 100,000 acres of grazing land. Forecasts are that by 2040, an additional 750,000 acres will be urbanized (CDFF, 2010; Kroeger et al., 2009). Beyond reductions in land available for grazing, urbanization, as well as exurban parcelization, creates ecosystem fragmentation. This fragmentation is a major threat to ecosystem services and biodiversity that is dependent upon large, contiguous areas of land (Hobbs et al., 2008). Attempts to curb these trends include conservation strategies to reduce property taxes for agricultural lands (i.e., the Williamson Act), conserve grasslands through voluntary, publicly funded restoration incentives, and create mitigation banks (e.g., habitat, water, etc.) (Cameron and Holland, 2014).

Concentration, Vertical Integration, and Vertical Coordination

The concentration of processors in the beef industry has been a focal point for researchers, policymakers, and those involved in the supply chain dating back to the early 1900s. Yet, despite investigations by the U.S. Federal Trade Commission and the U.S. Department of Justice (DOJ), private antitrust lawsuits, and regulatory attempts through the development and enforcement of the Packers and Stockyards Act, the concentration in processing has continued to increase apace from the mid-1970s to present. From 1976 to 1998, the four-firm concentration ratio in steer and heifer slaughter increased from 25 percent to 80 percent (Ward, 2002), and by 2015, was 85 percent (USDA, 2016).[8] Although the preponderance of empirical evidence in the academic literature fails to find processors exercising their buying power (monopsony power) in order to depress cattle prices, concerns among industry participants

8 The four-firm concentration ratio (CR4) is one measure used to quantify concentration. It is calculated by summing the market shares of the largest four firms in the industry.

persist to this day.[9] One recent example is a cattle-producer group's (R-CALF USA) petitioning the U.S. Senate Judiciary Committee to investigate the U.S. beef processor industry's role in the precipitous decline in cattle prices in and around 2015.

National concentration metrics likely understate concentration in the local or regional areas where individual livestock producers operate. Ranchers, particularly those operating feedlots, say they have only one, or at most a few, perspective buyers. This was a recurring theme at the joint USDA-DOJ listening sessions conducted across the country in 2010. The following comment from a cattle producer is representative:

> "While potentially there are four market participants, what we see typically region by region is that there are really one to two meaningful participants, rarely three, and four meaningful participants is very much an oddity." (U.S. Dept. of Justice 2010a, p. 211).

Inextricably related to processor concentration is the use of vertical integration and contracting to procure cattle. Large cattle processors are dependent upon a steady supply of cattle to process in order to operate their facilities at efficient capacity and remain profitable. As a consequence, packers have increasingly relied upon vertical integration into cattle feeding and/or vertical coordination through contracts in order to assure their supply.

In the 1970s, the share of cattle marketed under vertical coordination mechanisms was similar to the shares observed in other agricultural product industries (around 10 percent by 1980), but this share for cattle roughly doubled in the subsequent 20 years. By 2007, the share of fed cattle purchased using spot-type mechanisms (e.g., auctions, private sales, etc.) was 60 percent, but by 2016, it had declined to just 30 percent (USDA, 2016). The rate of increase in vertical coordination through contracts in the United States has been most pronounced in the livestock sector—representing about 60 percent of all contracts in U.S. agriculture (Crespi, Saitone, and Sexton, 2012).

9 The literature on the exercise of market power (e.g., Azzam and Schroeter 1995; Morrison-Paul, 2001) has found modest departures from competition but overall, has concluded that the efficiency advantages of consolidation outweighed any negative potential impacts from the exercise of market power.

While the cattle feeding and processing segments of the supply chain remain the most concentrated and coordinated, these trends, coupled with the potential for increased efficiency, have caused speculation surrounding whether or not the upstream portions of the beef supply chain will follow hog and broiler production.

It is imperative that the beef supply chain evolves in order to satisfy consumer preferences, while simultaneously complying with sanitary, phytosanitary, and traceability requirements imposed by trading partners in order to increase demand. Concurrently, processors must employ procurement strategies that facilitate the sourcing of animals with very specific suites of characteristics. This is a monumental task considering the geographically diverse and often small-scale and autonomous set of producers that characterize the cow-calf and stocker segments of the supply chain.

Upstream livestock producers may use this situation to create opportunities to reduce uncertainty and increase profitability by either increasing the specificity (i.e., production of specific quality characteristics) of their marketed animals to attract or target particular buyers, or coordinating with buyers via contracts to guarantee a market for their animals, thereby reducing risk and price volatility.

Regulations and Restrictions

Like other businesses operating in California, ranchers face a number of state-specific regulations and geographically based challenges. While state-specific regulations often penalize in-state production relative to production in other locales (Sumner, 2017), some of the challenges are simply an artifact of the geographic location of California's livestock operations. A key example of a California-specific regulation is that beginning in 2018, livestock producers face more restrictions in the use of antibiotics on their operations. New commercial transportation laws that will likely increase costs associated with livestock hauling are a key case of a national regulation that may affect California ranchers disproportionately. Further, an increasing number of Northern California producers must deal with increased predator pressure from the wolf.

Veterinary Feed Directive and California SB 27

Antibiotic resistance is one of the most pressing public health challenges. While concerns about resistance are paramount in both the human- and animal-health arenas, the food-producing animal segment (e.g., beef cattle, dairy cattle, poultry) of the supply chain has been widely criticized for using antibiotics for growth promotion and enhanced feed efficiency (i.e., subtherapeutic uses), as when antibiotics are administered for an extended period of time. According to the Center for Disease Control, this type of long-term, low-level exposure contributes to the survival and growth of resistant bacteria. In response to these concerns, regulations have been put into place to limit the use of antibiotics in food-producing animals for growth promotion and to increase feed efficiency.

The Department of Heath and Human's Service's Food and Drug Administration (FDA) amended the Animal Drug Availability Act of 1996 to create a new avenue to distribute antibiotics used in or on animal feed or administered through water. This change was implemented on January 1, 2017, and barred the use of "medically important" antibiotics for subtherapeutic treatments i.e., an antibiotic used in both humans and animals. Moreover, this class of drugs can only be used to treat, prevent, or control disease in animals under the supervision of a licensed veterinarian. A veterinary feed directive (VFD), which closely resembles a prescription for feed- or water-based antibiotic treatment, provides this supervision.

At roughly the same time as that VFD rule went into effect, California Governor Jerry Brown signed Senate Bill 27 ("Livestock: Use of Antimicrobial Drugs"). This bill, which became effective on January 1, 2018, implements regulations in California that are similar to, and more stringent than, the federal rules. Beyond expanding the regulatory oversight and use restrictions in the state, SB 27 also mandates that the California Department of Food and Agriculture develop and distribute stewardship guidelines for judicious use of antibiotics, put in place requirements for data collection on the use of antibiotics, conduct surveillance for antimicrobial resistance, and survey management practices and associated health outcomes.

Restricting the use of antibiotics through regulations are likely to have economic ramifications, with farm-level production costs expected to increase as a result. The costs associated with veterinary consults to facilitate the use of feed- or water-based antibiotic treatments will be borne by producers, with small operations likely experiencing higher costs on a per-unit basis. Further, the cost of feed-based antibiotic treatment is likely to rise as feed mills and feed distributors are required to mix and sell medicated feeds in compliance with regulations while engaging in more stringent record-keeping obligations. Finally, as producers substitute away from medically important antibiotics to unregulated alternatives, prices for these alternative treatments may increase. And, given that the California regulations are more stringent, these anticipated cost increases and production challenges are likely to be more severe here relative to other parts of the country.

Electronic Logging Device Regulations

The lack of cattle feeding and processing capacity in California and the western U.S. causes ranchers to receive lower prices for cattle, compared to their counterparts in the Midwest, in order to compensate buyers for the costs associated with transportation (Blank, Saitone, and Sexton, 2016; Saitone et al., 2016). This price differential is anticipated to become larger due to new transportation regulations governing commercial cattle haulers. In December 2017, the Federal Motor Carrier Safety Administration (FMCSA) implemented Electronic Logging Device (ELD) regulations that will monitor and limit both driving and on-duty time for commercial transportation services.[10] While regulations limiting drive and on-duty time are needed for safety, there are potentially significant cost and animal-welfare implications associated with the implementation of these regulations for live-animal commercial haulers.

Cattle hauled from California to the center of feeding and processing capacity in the Midwest travel between 1,500 and 1,700 miles. Under EDL regulations, this will

10 At the time that this chapter went to press, commercial haulers of agricultural products, including cattle, have been given a 90-day extension to ELD implementation.

require a mandated 8-hour rest period for a single driver or require the use of a second driver. Further, the auctions through which cattle are purchased and shipped can create inefficiencies and delays that require haulers to spend limited on-duty time in trucks waiting for lots to be aggregated and loaded. The stress of shipment on cattle will only be exacerbated if haulers are required to unload and re-load cattle in order to comply with these regulations, especially given the few locations where this would be possible.

Western ranchers, particularly those in California, are at substantial locational disadvantage and, as a consequence, are estimated to have received $0.82/cwt. less for every mile that they are from Omaha, NE, controlling for quality and value-added characteristics (Blank, Saitone, and Sexton, 2016). The EDL rule and associated cost increases will put Western ranchers at further disadvantage due to their location.

Predator Pressures

While livestock producers in other states (e.g., Montana, Idaho, and Oregon) have been forced to deal with predation pressure from wolves for some time, California ranchers have not faced this challenge until relatively recently. Wolves were removed from the California landscape at the beginning of the 20th century.

The first grey wolf confirmed to have re-entered California (named OR-7) did so in late 2011. OR-7 originated in Oregon, frequently crossed the Oregon-California border from 2011–2013, and, while he eventually remained in Oregon, his presence marked the beginning of concern and anticipation of the return of wolves to California's landscape. Since this time, trail cameras in remote areas of Northern California have confirmed the presence of other wolves and wolf pups in the state. By July 2017, there were a minimum of two wolf packs in the state—the Shasta Pack and the Lassen Pack—and the state's first confirmed wolf kill of livestock occurred in October 13, 2017, in Lassen County.

Grey wolves are listed under both the state and federal endangered species acts. Due to the protections afforded by the act, it is prohibited by law to "harass, harm, pursue, hunt, shoot, wound, trap, capture, or collect, or to attempt to engage in any such conduct." Given these protections, ranchers with herds in areas with wolves are constrained to using non-lethal depredation strategies to attempt to protect their animals from harm. These strategies, including carcass removal, guardian animals, and range riders, have limited effectiveness in deterring wolf predation while increasing production costs. Potential losses due to predation could have substantial negative consequences for cattle and sheep operations in the state. Yet, the indirect production impacts associated with predator pressures (e.g., lower conception rates, reduced weight gain, increased stress, etc.) have been shown to have more substantial economic consequences for producers than direct (i.e., death) losses (Ramler et al., 2014).

A number of government- and nonprofit-funded initiatives have attempted to provide compensation for direct losses incurred by livestock producers due to wolves, while other proposals have created cost-share funding for producers who wish to adopt non-lethal predator protection techniques. Historically, these programs have not been successful, as the losses sustained by producers have often outpaced government-based funding and/or donations. Consequently, livestock producers, particularly those in Northern California, will have to reassess their operational procedures (e.g., timing and location of calving, location and timing of pasture, etc.) in order to maximize profits under a new risk paradigm and subject to a dynamic set of constraints from predator pressures.

Conclusion

California's livestock sector accounts for nearly one-quarter ($12 billion in 2015) of the state's total cash receipts. Cattle and sheep in California transform forage into protein and fiber using predominately marginal lands that would otherwise not facilitate agricultural production. California's livestock producers face persistent disadvantages associated with their geographic location that cause them to receive lower prices for their animals. Further, additional factors are looming on the horizon that may exacerbate the challenges associated with engaging in livestock production in California. Yet, California ranchers are resilient and resourceful. Opportunities exist for producers to earn premiums in a modern food market environment and access to California's niche markets may be an untapped prospect. Finally, policymakers need to recognize the importance of this key agricultural industry and the challenges it faces as they contemplate rules and regulations that impact this sector of our economy.

References

Azzam, A. and J.R. Schroeter. 1995. "The Tradeoff between Oligopsony Power and Cost Efficiency in Horizontal Consolidation: An Example from Beef Packing." *American Journal of Agricultural Economics* 77(4): 825-836.

Blank, S.C., T.L. Saitone, and R.J. Sexton. 2016. "Calf and Yearling Prices in the Western United States: Spatial, Quality, and Temporal Factors in Satellite Video Auctions." *Journal of Agricultural and Resource Economics* 41(3): 458-480.

Bloomberg News. 2017. "U.S. Beef is Back on China's Shelves -- But China Doesn't Care." Accessed 28 December 2017: https://www.bloomberg.com/news/articles/2017-08-03/trump-s-vaunted-return-of-u-s-beef-to-china-risks-turning-a-dud.

California Department of Food and Agriculture (CDFA). 2016. *California Agricultural Statistics Review, 2015*. Sacramento CA. Accessed 25 November 2017: https://www.cdfa.ca.gov/Statistics/PDFs/2016Report.pdf.

California Department of Forestry and Fire (CDFF). 1988. *California's Forests and Rangelands: Growing Conflict Over Changing Uses*. Sacramento CA: Forest and Rangeland Resources Assessment. Accessed 25 November, 2017: http://www.bof.fire.ca.gov/regulations/regulations_file_library/regulation_files_201-250/238_4%20of%208.pdf.

California Department of Forestry and Fire (CDFF). 2010. *California's Forests and Rangelands: 2010 Assessment*. Sacramento CA: Fire and Rsource Assessment Program. Accessed 25 November 2017: http://frap.fire.ca.gov/data/assessment2010/pdfs/california_forest_assessment_nov22.pdf.

Cameron, D.R. and M.J. Holland. 2014. "Whither the Rangeland? Protection and Conversion in California's Rangeland Ecosystems." *PLoS ONE* 9(8): e103468.

Crespi, J.M., T.L. Saitone, and R.J. Sexton. 2012. "Competition in U.S. Farm Product Markets: Do Long-Run Incentives Trump Short Run Market Power?" *Applied Economic Perspectives and Policy* 34(4): 669-695.

Food and Agricultural Organization of the United Nations. 2006. *World Agriculture Towards 2030/2050 Interim Report: Prospects for Food, Nutrition, Agriculture and Major Commodity Groups*. Rome IT: Global Perspective Studies Unit.

Hobbs, N.T., K.A. Galvin, C.J. Stokes, J.M. Lackett, A.J. Ash, R.B. Boone, R.S. Reid, and P.K. Thronton. 2008. "Fragmentation of Rangelands: Implications for Humans, Animals, and Landscapes." *Global Environmental Change* 18(4): 776-785.

Kroeger, T., F. Casey, P. Alvarez, M. Cheatum and L. Tavassoli. 2009. "An Economic Analysis of the Benefits of Habitat Conservation on California Rangelands." Conservation Economics White Paper, Conservation Economics Program. Washington DC: Defenders of Wildlife.

Morrison-Paul, C.J. 2001. "Cost Economies and Market Power: The Case of the U.S. Meat Packing Industry." *Review of Economics and Statistics* 83: 531-40.

O'Donoghue, E. and J. Hansen. 2017. "USDA Agricultural Projections to 2026." *Agricultural Projections No. OCE-2017-1*. Washington DC: U.S. Department of Agriculture. Retrieved from: https://www.ers.usda.gov/publications/pub-details/?pubid=82538.

Oles, K.M., D.A. Weixelman, D.F. Lile, K.W. Tate, L.K. Snell, and L.M. Roche. 2017. "Riparian Meadow Response to Modern Conservation Grazing Management." *Environmental Management* 60: 383-395.

Pendell, D.L., G.T. Tonsor, K.C. Dhuyvetter, G.W. Brester, and T.C. Schroeder. 2013. "Evolving Beef Export Market Access Requirements for Age and Source Verification." *Food Policy* 43: 332-240.

Ramler, J.P., M. Hebblewhite, D. Kellenberg, and C. Sime. 2014. "Crying Wolf? A Spatial Analysis of Wolf Locations and Depredations on Calf Weight." *American Journal of Agricultural Economics* 96(30): 631-656.

Rimbey, N. R., J. A. Tanaka, and L. A. Torell. 2015. "Economic Considerations of Livestock Grazing on Public Lands in the United States of America." *Animal Frontiers* 5: 32-35.

Roche, L.M. 2016. "Adaptive Rangeland Decision-Making and Coping with Drought." *Sustainability* 8(12): 13 p.

Roche, L.M., T.K. Schohr, J.D. Derner, M.N. Lubell, B.B. Cutts, E. Kachergis, V.T. Eviner, and K.W. Tate. 2015. "Sustaining Working Rangelands: Insights from Rancher Decision Making." *Rangeland and Ecology Management* 68(5): 383-389.

Saitone, T.L., L.C. Forero, G.A. Nader, and L.E. Forero. 2016. "Calf and Yearling Prices in California and the Western United States." *California Agriculture* 70(4): 179-186.

U.S. Department of Agriculture (USDA). 2016. *Packers and Stockyards Program: 2016 Annual Report*. Washington DC: Grain Inspection, Packers, and Stockyards Administration. Retrieved from: https://www.gipsa.usda.gov/psp/publication/ar/2016_PSP_Annual_Report.pdf.

U.S. Meat Export Federation. 2016. "Global Beef Exports Held Steady in 2016." Accessed 28 December 2017: https://www.usmef.org/global-beef-exports-held-steady-in-2016/.

Ward, C.E. 2002. "A Review of Causes for and Consequences of Economic Concentration in the U.S. Meatpacking Industry." *Current Agriculture, Food & Resource Issues* 3: 1–28.

Wohlgenant, M.K. 2013. "Competition in the U.S. Meatpacking Industry." *Annual Review of Resource Economics* 5: 1-12.

Zimmerman, L.C., T.C. Schroeder, K.C. Dhuyvetter, K.C. Olson, G.L. Stokka, J.T. Seeger, and D.M. Grotelueschen. 2012. "The Effect of Value-Added Management on Calf Prices at Superior Livestock Auction Video Markets." *Journal of Agricultural and Resource Economics* 37(1): 128-143.