The Effect of Climate Change on Health Conditions of American Cattle

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Introduction

Cattle production is the most prevalent and profitable agricultural industry in the United States, contributing to both beef and dairy production. In 2023, the industry is expected to make $88.4 billion in revenue (USDA, 2023). In the context of climate change, cows are negatively viewed as a key producer of methane emissions and other greenhouse gases. The impact of climate change on cows must be explored because of its direct impact on welfare and productivity.

Cows are especially vulnerable to environments with high temperatures and low precipitation. Research shows that prolonged exposure to dry climates leads to heat stress, which is when the body cannot handle any excess external heat; internal temperature and heart rate increase soon after. In 2011, “exposure to high temperature events caused over $1 billion in heat-related losses to agricultural producers” (USDA, 2023). Adverse climates also affect cattle’s nutritional intake by “diminishing pasture conditions and reducing harvested feed supplies” (USDA, 2023). As temperatures continue to rise, and lowering precipitation rates fail to counteract this dryness, the overall health condition of cattle and necessary supporting resources will diminish.

Rises in Temperature

Climate change has had a significant impact on rising temperatures in the United States, contributing to an average increase of 0.45° F per decade (EPA, 2023). In Figure 1, the states with the largest rates of temperature increase, 3° to 4° F, were in the northern and southwestern regions. This continued rise in temperature affects cow health by amplifying the spread of disease, depleting pasture growth, and decreasing animal productivity. The ideal temperature conditions for cattle, both dairy and beef, “range between 41° and 77° F” (USDA).

It is difficult for cows to adapt to hot environments because their sensitivity to high temperatures has increased, a direct side effect of the livestock industry altering environmental conditions and machinery to improve productivity and profit (Bernabucci, 2019). Since cattle are managed mainly in outdoor facilities, they face increased exposure to hot environments. Constant heat exposure causes cows to eat less and stay in the shade for longer periods of time, all of which lowers reproductivity and lactation rates (Stull, 2008).

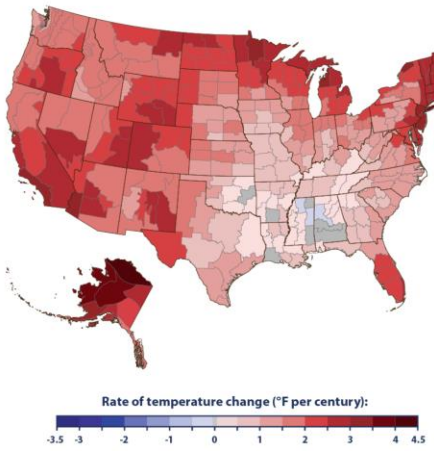

Figure 1: The rate of temperature change varies throughout the country, with large parts of Western and Northern United States facing the highest rates. This coincides with large and highly populated areas of pastures. (Map sourced from https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-temperature#tab-4)

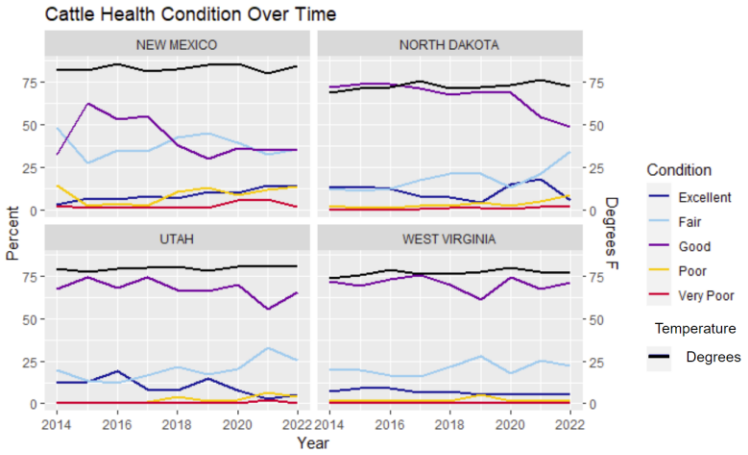

Figure 2: Original plot created by summarizing and grouping USDA health condition data by year and state, and then joining US county temperature data filtered for the existing states. Annual temperature shows a gradual increase over time for each state, as does the “good” condition. While the lower quality conditions decrease in percentage, the “fair” quality increases. Data used to construct the plot is sourced from the USDA-NASS (https://www.nass.usda.gov/Statistics_by_Subject/index.php?sector=ANIMALS%20&%20PRODUCTS).

Fluctuations in Precipitation

Precipitation, often in tandem with high temperatures, amplifies the spread of diseases and causes forage scarcity. It is important for cows to receive stable levels of precipitation, as any of the two extremes can lead to poor nutritional health and eventual death. Variable rainfall affects “feed availability and homeostasis” by “increasing livestock thermal stress, reducing milk and meat production, and lowering animal reproduction rates” (Adhikari et al, 2022). As seen in Figure 4, an increase in temperature corresponds with inconsistent rainfall, which affects cows by “reducing the quality and quantity of forage production, ultimately decreasing animal productivity” (Adhikari et al., 2022). Foraging is crucial to a cow’s diet because the fiber gained is not part of their given feed intake; fiber increases the nutrients that the cow can absorb from their feed (USDA).

High amounts of precipitation commonly cause skin diseases, such as lameness, ringworm, and bovine dermatophilosis (Stull, 2008). Wet and muddy living conditions soften hooves and increase the risk of lameness which, in turn, leads to higher rates of mortality. In combination with high temperatures, high moisture levels can contribute to increases in humidity, which can worsen the effects of heat stress.

Policies and Solutions

The United States Department of Agriculture currently has programs for emergency responses to disease outbreaks and economic reimbursement towards producers who have suffered losses. The Animal Health Surveillance System, part of the Animal and Plant Health Inspection Service, serves to quickly locate where infections have spread and provides adequate resources to combat it. There are multiple ways to combat heat stress, for example, by incorporating more sources of shade into pastures. While physical structures, like barns and portable steel frameworks, are simple to construct and manage, natural structures, like planting large ranges of trees or incorporating trees into pastures are more beneficial for cows as they prefer natural shade (Brantly, 2013).

Silvopasture, the practice of integrating forestry and pastures, addresses many of the negative impacts of heat stress: reduced appetite and weight gain, high body temperature, and heat sensitivity. Evenly distributed trees limit the solar radiation that cattle are exposed to by covering the ground with shade and limiting the sun rays reflected from the ground. In this environment, cattle can see a reduction of internal temperature by 1.5 degrees Fahrenheit and increase in daily weight gain by 1.25 pounds (Brantly, 2013).

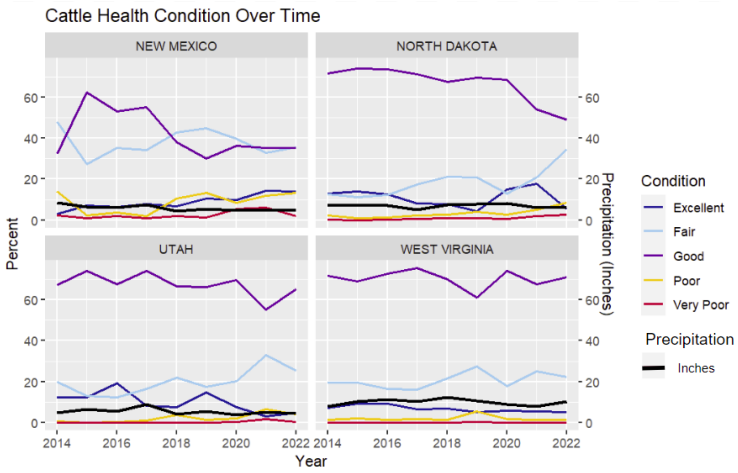

Figure 3: Original plot of annual precipitation over time for each state compared to the yearly health condition percentages. There appears to be a relationship between the health conditions and precipitation, as all health conditions decrease over time while precipitation also decreases. Precipitation does fluctuate over time, whereas temperature generally increased in Figure 2.

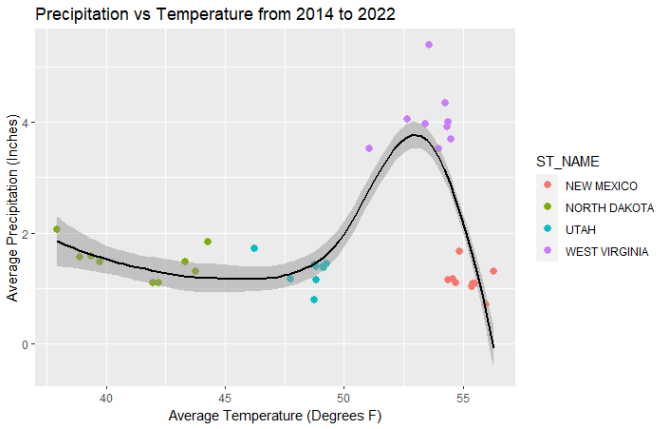

Figure 4: Original plot of average precipitation compared to average temperature. Each state’s set of data is clustered within a unique, constant range. There does not seem to be any relationship between precipitation and temperature. All climate data is sourced from the CRU (https://crudata.uea.ac.uk/cru/data/hrg/).

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