Climate Change and Animal Agriculture: Federal Actions Protect the Biggest Contributors from the Disasters They Cause

By
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Animal agriculture is a major contributor of greenhouse gases involved in climate change.¹ Current changes in the climate are driving a shift in weather patterns that will cause an increase in frequency and intensity of extreme weather events including heat waves, drought, heavy downpours, floods, hurricanes, wildfires, and winter storms.² Consequences of the increased extreme weather events are far-reaching and are expected to substantially impact economic growth,³ human quality of life, and farmed animals themselves.⁴ This paper discusses the connection between animal agriculture emissions and climate change. It examines climate change in several regions of the United States the Southeast, the Midwest, and the West because while each of these three regions will experience drastic changes, these changes will differ greatly. This paper also talks about the federal protections and incentives in place for animal agriculture operations to operate regardless of their environmental impact and how the federal protections further insulate animal agriculture operations from the environmental damage they cause. It then explores options for how these protections can be altered to lessen the environmental impact of animal agriculture operations.

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Introduction

Animal agriculture produces the same amount of greenhouse gas emissions as all the world’s modes of transportation combined.5 Animal agriculture operations release large amounts of carbon dioxide (CO₂), methane, and nitrous oxide. Per pound, nitrous oxide has 296 times the warming potential of CO₂ and methane has 25 times the potential of CO₂. Animal agriculture also contributes to ocean acidification, which accelerates climate change. Additionally, animal agriculture causes pollution, biodiversity loss, and antibiotic resistance which are also linked to climate change.

What is done now to reduce emissions will determine whether the global rise in Earth’s temperature is kept under the 2 degrees Celsius target set in the Paris climate agreement. Because animal agriculture is such a large contributor of greenhouse gas emissions, the sector’s inclusion in the climate discussion can make a large impact on overall emissions. Changes in agriculture alone can determine whether or not we keep warming under 2 degrees Celsius.

United States Department of Agriculture disaster relief programs authorized by the Farm Bill that bail animal agriculture operations out of the natural disasters that they, in part, cause should be ended. Protecting animal agriculture from disasters linked to climate change, and therefore to their very practices, removes any responsibility for the externalities that the industry imposes on both a societal and ecological level. Instead, in the next Farm Bill, Congress should either allocate less money to disaster relief programs or spend the funds solely on non-animal related agriculture operations impacted by natural disasters. Animal agriculture operations are often large industrial operations that are in the best decision to make determinations on

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profitability. If these operations are forced to bear some of the cost of the externalities they impose on the environment, they will need to factor this in to their profitability and take actions

This paper explores the sources of animal agriculture emissions that contribute to climate change as well as the impacts of climate change caused by these emissions. It then examines three of the regions in the United States that will be impacted by climate change. It looks at increasing hurricane intensity in the Southeast, worsening floods in the Midwest, and increasingly destructive wildfires in the West. Each area will experience climate change differently and the natural disasters that result are also different. Each type of natural disaster both impacts animal agriculture and is worsened by the impacts of animal agriculture. The paper then discusses natural disaster relief programs from the USDA that alleviate the impact of natural disasters on animal agriculture operations. It next talks about changes that should be made to the programs to force animal agriculture to pay for the environmental externalities of its operations.

Congress should discontinue the appropriation of disaster funds for animal agriculture in the 2023 Farm Bill and beyond. Additionally, we can each take action to reduce the impact agriculture has on climate change by adopting a plant-based diet, which has a much smaller carbon footprint than a diet that includes animal products. Changing what we eat can alone mean the difference between keeping Earth’s temperature under 2 degrees Celsius and the cascade of positive feedback loops that will accelerate warming if the temperature rises over 2 degrees Celsius. We need both government action to stop bailing out animal agriculture, an industry that contributes significantly to climate change, and individual action to change our diets in a way that reduces emissions that cause climate change.
I. Climate Change Basics, Biggest Contributors, and General Impacts

Climate change is arguably the most pressing issue of our time. Our actions now will determine the landscape for future generations of both human and nonhuman species. With climate change comes disruptions in harvests, an increased prevalence of infectious diseases, drought, environmental degradation, and extreme weather. As demographic trends, migration, and urbanization occur in concert with climate change, the most vulnerable populations will face even greater threats to their livelihood and survival.

Changes in climate have already begun to occur. Earth’s average temperature has increased by 2°F during the 20th century. Accompanying this change in temperature, glaciers have shrunk, sea ice has been lost, plant and animal ranges have shifted in latitude and elevation, plants have started to flower sooner, sea level has begun to rise, and more intense heat waves have been recorded. These changes are just the tip of the iceberg. The Intergovernmental Panel on Climate Change (IPCC) predicts that the net damage costs of climate change, financial and otherwise, will be significant and will continue to increase for decades to come. IPCC projects an overall temperature rise of 2.5 to 10°F over the next century.

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7 Id.
11 Id.
12 Id.
Climate change is predominantly driven by greenhouse gas production as a result of human activities. The primary greenhouse gases contributing to climate change are: carbon dioxide (CO$_2$), methane, nitrous oxide, and fluorinated gases. CO$_2$ production is predominantly a result of fossil fuel use but is also emitted through deforestation, land clearing for agriculture, and soil degradation. Methane is mainly produced through agricultural activities, energy use, and biomass burning. In the United States, methane emissions from livestock and those from natural gas are about equal. Nitrous oxide is released through agricultural activities like fertilizer use and fossil fuel combustion. Fluorinated gases in the atmosphere have no natural sources and are entirely a result of human activities such as industrial aluminum manufacturing and through their use as a substitute for ozone-depleting substances like refrigerants.

Although CO$_2$ represents a higher percentage of overall emissions than methane, methane is more efficient at trapping radiation in the atmosphere than CO$_2$. Per pound, methane has 25 times the impact of CO$_2$ over a 100-year time period. Methane’s efficiency at trapping radiation in the atmosphere makes its role in climate change particularly impactful. While methane is emitted from energy, industry, and agricultural activities, the largest contributor of methane in the United States is the agricultural sector. Nitrous oxide is another greenhouse gas

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13 Id.
15 Id.
16 Id.
21 Id.
22 Id.
more efficient than CO₂.²³ Nitrous oxide has 296 times the warming potential of CO₂ and can stay present in the atmosphere for 150 years.²⁴ Livestock contributes 65% of all human-caused emissions of nitrous oxide.²⁵ A 2013 report by the United Nations Food and Agriculture Organization found that 14.5% of all global greenhouse gas emissions are from livestock.²⁶ This is the same amount as emissions from all the world’s cars, trucks, trains, and airplanes combined.²⁷

A. Carbon Dioxide

Animal agriculture releases CO₂ through high-energy feed crop production, factory farm energy requirements, processing and packaging the animals, desertification, and deforestation.²⁸ Emissions released from the production, processing, and transport of feed make up 45% of emissions from animal agriculture.²⁹ Beef cattle, followed closely by dairy cattle, contribute the largest

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²⁴ Id.
²⁵ Id.
²⁷ Id.
amount of CO2 of all farmed animals.\textsuperscript{30} Approximately 62\% of the sector’s overall CO2 emissions are from both beef and dairy cattle alone.\textsuperscript{31} Just under 10\% of total animal agriculture emissions (including CO2 and other emissions) are a result of CO2 released through land use change to expand the area in use for feed crop production and for pasture expansion for grazing.\textsuperscript{32} Of land use change emissions, a major portion is due to the conversion of forests to pasture.\textsuperscript{33} Another 25\% of CO2 emissions are due to feed crops produced for animal feed.\textsuperscript{34}

\textbf{B. Deforestation}

Animal agriculture is the leading cause of deforestation and is responsible for up to 91\% of deforestation in the Amazon.\textsuperscript{35,36} Beef, soy, palm oil, and wood production drive the majority of tropical deforestation.\textsuperscript{37} In all, deforestation accounts for three billion tons of CO2 released into the atmosphere each year.\textsuperscript{38} Much of the soy produced through deforestation is destined to become animal feed; eighty percent of soy cultivated in the Amazon is grown for animal feed.\textsuperscript{39}
Deforestation contributes to climate change by releasing carbon back into the atmosphere. After trees are cut down for agriculture, they are often left to rot and decompose or are burned—either way releasing carbon back into the atmosphere. Soils in tropical forests are very nutrient poor and contain only a thin layer of topsoil. Because of this, forest land cleared for agriculture is not conducive to agricultural use in the long-term. When forests are cut, the soil-plant cycle is disturbed and the soils are vulnerable to soil erosion and chemical changes to soil that result in the formation of rocklike laterite. Once the nutrients have been depleted from the soil, the next patch of forest is razed and the cycle continues.

C. Methane

Methane is another significant source of greenhouse gas emissions from animal agriculture and makes up around 44% of the sector’s total emissions. In the United States, animal agriculture is the largest source of methane emissions. Ruminant animals—such as

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41 Id.
cattle, sheep, and goats—produce methane as a byproduct of enteric fermentation. This occurs as their rumens break down carbohydrates into simple sugars.\textsuperscript{49} Methane is also produced from animal manure as it decomposes.\textsuperscript{50} From 1990 to 2017 methane emissions decreased overall in the United States; however, this was due to a decrease in emissions from landfills, coal mining, natural gas and petroleum.\textsuperscript{51} Over the same time period, methane emissions from animal agriculture increased.\textsuperscript{52}

**D. Nitrous Oxide**

Nitrous oxide is emitted by animal agriculture operations through the application of nitrogen-based fertilizer to fields used to grow feed crops for farmed animals.\textsuperscript{53} The increased fertilizer use over the past 50 years is responsible for the rise in atmospheric nitrous oxide concentrations.\textsuperscript{54} A study by researchers at the University of California, Berkeley, using data from the Cape Grim Baseline Air Pollution Station in Tasmania, shows empirically that the nitrogen isotope ratio in the atmosphere and how it has changed over the past 50 years is a direct consequence of fertilizer usage.\textsuperscript{55} Since 1750, nitrous oxide levels in the atmosphere have risen 20\% from under 270 parts per billion (ppb) to over 320 ppb in 2012 when the study was reported.\textsuperscript{56} As of February 2019, atmospheric nitrous oxide levels were at 331.86 ppb.\textsuperscript{57}

\textsuperscript{51} Id.
\textsuperscript{52} Id.
\textsuperscript{54} Id.
\textsuperscript{55} Id.
\textsuperscript{56} Id.
\textsuperscript{57} *Global N\textsubscript{2}O Levels*, THE 2\degree INSTITUTE, https://www.n2olevels.org/ (last visited July 16, 2019).
Further, climate change will increase the amount of nitrogen making its way into United States waterways. With changes in precipitation patterns and increased total rainfall, as well as warmer temperatures due to climate change, an average of 19% more nitrogen will enter our waterways by the end of the century\(^58\)—and this isn’t including the likely increase in nitrogen application for more intensive agriculture.\(^59\) The increased nitrogen runoff will contribute to more widespread toxic blue-green algae blooms and increase the size of the dead zone in the Gulf of Mexico.\(^60\)

E. Ocean Acidification

Carbon dioxide released as a byproduct from animal agriculture will also contribute to ocean acidification. As the concentration of CO\(_2\) in the atmosphere increases, CO\(_2\) absorbed by the ocean also increases.\(^61\) Around 30% of human-generated CO\(_2\) production is absorbed by the oceans.\(^62\) Worldwide, ocean pH is decreasing and the seas are becoming more acidic due to their absorption of CO\(_2\) from the atmosphere.\(^63\) Since the industrial revolution, the average surface water pH of the world’s oceans has decreased from 8.2 to 8.1 which represents a 30% increase in acidity.\(^64,65\) A rate of change this rapid has never before been recorded in the geologic record of

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59 Id.
60 Sarah Gibbens, Massive 8,000-mile 'dead zone' could be one of the gulf's largest, NATIONAL GEOGRAPHIC (June 10, 2019), https://www.nationalgeographic.com/environment/2019/06/massive-dead-zone-predicted-to-be-one-of-largest-gulf-of-mexico/ (last visited July 16, 2019).
63 Id.
64 Id.
Earth’s history. If CO₂ emissions continue through the end of this century, ocean surface waters could be twice as acidic as they were at the end of the last century.

Scientists have demonstrated several impacts that ocean acidification has on sea creatures, such as disrupted predator-prey responses, but many potential changes in inter-species interactions remain uncertain. Ocean acidification is especially harmful to species that build their shells and skeletons from calcium carbonate like clams, mussels, crabs, and corals. When CO₂ enters the water, it reacts with water molecules to form carbonic acid which then dissociates into bicarbonate and hydrogen ions. The presence of hydrogen ions is what causes the acidification. Because less carbonate ions are available in the water for sea life to build shells and skeletons, the likelihood of their successful reproduction decreases. This disruption in reproduction to species that need carbonate causes a disturbance throughout the food chain because these species constitute those at the lowest trophic levels.

It is also unknown what the implications will be for species that depend on habitat-forming carbonate-dependent species, like mussels, which form shell aggregations that create habitat on which hundreds of other organisms depend. Additionally, when other climate

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70 Id.
71 The Chemistry of Ocean Acidification, CLIMATE INTERPRETER (December 20, 2018), https://climateinterpreter.org/content/chemistry-ocean-acidification (last visited July 16, 2019).
72 Id.
73 Id.
stressors are present, ocean acidification makes it more difficult for species to recover.75 For example, coral bleaching can occur when water temperatures get too high, as a result of runoff containing pollutants, from overexposure to sunlight, or from low tides.76 When bleaching occurs, corals expel the algae living in their tissue with which they have a mutualistic relationship.77 With the algae expelled, corals are more vulnerable to disease and are less able to build their carbonate skeletal structure.78 As animal agriculture operations continue to release large amounts of CO2 into the atmosphere, they will remain a contributor to the increasing acidity of the world’s oceans and the harm that results from the increase in acidity.

F. Pollution, Biodiversity, Antibiotic Resistance, and Emissions Projections

Animal agriculture’s impacts on planetary health are far-reaching and include more than climate change. It is also the leading cause of water and air pollution and biodiversity loss.79 Animal agriculture also uses a large proportion of Earth’s land, water, and energy resources to raise the 70 billion land animals slaughtered annually for human consumption.80,81 Raising these animals uses a third of the planet’s ice-free land surface and sixteen percent of global

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78 Id.
80 Id.
freshwater. Additionally, a third of worldwide grain production is used to feed livestock. Animal agriculture also causes 55% of erosion and 60% of nitrogen pollution.

Farming animals for human consumption also contributes to antibiotic resistance. Approximately 80% of all antibiotics sold in the United States are for use in animal agriculture, 70% of which are medically important to human medicine. They are implemented in animal agriculture through animal feed to increase growth and prevent infections from spreading in closely confined conditions. This practice is expected to spread worldwide over the next fifteen years.

Evidence has shown that widespread antibiotic use for nontherapeutic purposes in animals promotes antibiotic resistance in humans. Antimicrobial resistance causes a significant number of human deaths worldwide; estimates show that the number of these deaths due to resistance could reach up to ten million per year by 2050 and cost a total of 100 trillion in economic output. The World Bank has also found that antimicrobial resistance could cause the same amount of damage to the world economy as the 2008 financial crisis. According to the World Health Organization, we are moving toward a “post-antibiotic era in which common

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83 Id.
84 Id.
85 Id.
87 Id.
88 Id.
89 Id.
infections will once again kill.”92 Currently, less than five percent of venture capital in pharmaceutical research and development is invested in antibiotic resistance.93 If trends continue, organ transplantation, joint replacements, and cancer chemotherapy may become too difficult to undertake without effective antibiotics.94

As temperatures increase, certain bacteria become increasingly present in healthcare systems and societies.95 Several very recent studies have shown an association between climate change and antimicrobial resistance.96 A 2019 study found a significant link between E. coli and MRSA and warmer temperatures.97 The first study published on the link was in 2018 and found that as temperature and population density increase, so does antibiotic resistance in common pathogens.98 It also found that the associations between temperature and antibiotic resistance is consistent across most classes of antibiotics and pathogens.99 As the human population grows and the planet warms, the impact of antibiotic resistance is likely to be more significant than initially expected.100

92 Id.
99 Id.
100 Id.
Additionally, permafrost worldwide is beginning to melt due to rising global temperatures.\textsuperscript{101} Permafrost is ground that remains frozen year-round and is made up of soil, rocks and sand held together by ice; it covers large regions of the earth, including a quarter of the land area in the northern hemisphere.\textsuperscript{102} Most permafrost has remained frozen since the last ice age around 10,000 years ago.\textsuperscript{103} Permafrost, which traps carbon in its frozen soil, can be up to a mile thick.\textsuperscript{104} As the vast amounts of carbon trapped in permafrost are released as the ground thaws, carbon and methane will be released into the atmosphere, creating a positive feedback loop of accelerated warming.\textsuperscript{105}

In addition to carbon and methane, permafrost contains bacteria and viruses.\textsuperscript{106} Some of these have been dormant for thousands of years and some of which were the cause of past human pandemics such as the Spanish flu and smallpox.\textsuperscript{107} As climate change melts permafrost soils, there is a strong possibility that ancient viruses and bacteria will be released.\textsuperscript{108} Only a few years ago, in 2016, in the Yamal Peninsula of the Arctic Circle, a 12-year-old boy died after being infected with anthrax he contracted from a reindeer infected with the disease that had been dead for seventy five years.\textsuperscript{109} Scientists theorize that the reindeer’s frozen carcass was trapped in

\textsuperscript{104} Id.
\textsuperscript{106} Jasmin Fox-Skelly, There are diseases hidden in ice, and they are waking up, BBC (May 4, 2017), http://www.bbc.com/earth/story/20170504-there-are-diseases-hidden-in-ice-and-they-are-waking-up (last visited July 16, 2019).
\textsuperscript{107} Id.
\textsuperscript{108} Id.
\textsuperscript{109} Id.
permafrost that melted in a 2016 heatwave which then released the bacteria to over 2,000 reindeer grazing nearby.\textsuperscript{110} The grazing reindeer then passed the disease on to humans.\textsuperscript{111} While not all bacteria can come back to life after being frozen, some can, and it is still unknown which diseases we may see resurface as permafrost melts.\textsuperscript{112} As global temperatures rise, northern countries will also become more susceptible to outbreaks of diseases usually found in warmer climates where the pathogens that cause the diseases thrive.\textsuperscript{113} With the rise of antibiotic resistance and the unearthing of disease-causing bacteria, climate change will only increase the detrimental impacts of antimicrobial resistance.

Animal agriculture operations also contribute to phosphorous pollution, soil erosion, and air pollution.\textsuperscript{114} Operations release around 400 different harmful gases into the atmosphere including particulate matter, ammonia, and hydrogen sulfide.\textsuperscript{115,116} In addition to environmental contamination, the industry is rife with environmental justice concerns.\textsuperscript{117} While air and water pollution can have a broad impact, communities of color and low-income communities contain a disproportionate number of factory farm and slaughterhouse facilities.\textsuperscript{118} In these communities,

\begin{footnotesize}
\begin{enumerate}
\item Id. 
\item Id. 
\item Id. 
\item Id. 
\item Environmental Racism, FOOD EMPOWERMENT PROJECT, https://foodispower.org/environmental-racism/ (last visited July 16, 2019).
\item Id. 
\end{enumerate}
\end{footnotesize}
people are forced to breathe toxic air pollutants from these facilities and because of this suffer from higher rates of respiratory diseases such as asthma.\textsuperscript{119,120}

Emissions from animal agriculture have increased by 51\% from 1961 to 2010, much of this from methane and nitrous oxide from livestock manure.\textsuperscript{121} The impacts of animal agriculture are expected to continue to increase. By 2050, meat consumption is expected to rise by 76\% and dairy products by 64\%.\textsuperscript{122} If the trend toward diets more heavily laden in animal products proceeds unchanged, these diets will be a major contributor to the estimated 80\% increase in global agriculture greenhouse gas emissions from food production and land clearing by 2050.\textsuperscript{123} Changes made now to the management of animal agriculture, as well as the foods we choose to consume will, in large part, determine how much the planet warms.

II. Natural Disasters, Farmed Animal Impacts, and the Future of Climate Change in Each Region

The impacts of climate change will differ both globally and by region throughout the United States. On average, the Midwest will receive warmer and wetter weather, the Southeast coast will see more intense hurricane activity, and the West will face hotter and drier conditions.\textsuperscript{124} The Southeastern United States will also experience more summer thunderstorms and hot, humid weather, including up to 100 additional warm nights per year by the end of the

\textsuperscript{119} Id.
\textsuperscript{122} Id.
\textsuperscript{124} We broke down what climate change will do, region by region, GRIST (Nov. 29, 2018), https://grist.org/article/we-broke-down-what-climate-change-will-do-region-by-region/ (last visited July 16, 2019).
In the Midwest, crop diseases and pest populations will increase as corn yields decline by 5 to 25% by midcentury. Additionally, the Ogallala Aquifer which stretches from South Dakota to Texas, on which agricultural irrigation depends, may run dry within 25 years. The Southwest is already experiencing heat waves, drought, and wildfires and is running out of water. Megadroughts lasting 10 years are expected to become commonplace and hits to agricultural production will cause food insecurity. Although each region will experience climate change differently, all will face new challenges as they are forced to determine ways to mitigate its impacts.

A. Hurricanes in the Southeast

One major consequence of climate change in the Eastern United States is an increase in intense hurricane activity, which began in the 1970s. Since the mid-1970s, the number of hurricanes that reach category four and five has doubled. Although there will not be an increase in the number of hurricanes (around 90 hurricanes will continue to occur globally every year) scientists predict that hurricanes will continue to become more intense with higher wind
speeds and more precipitation.\textsuperscript{133,134} The increased intensity paired with a rise in sea level and a growing coastal population will further exacerbate the consequences of increasingly intense hurricane activity.\textsuperscript{135}

Sea levels are rising primarily due to glacier and ice sheets melting as a result of warmer air and water temperatures and because water itself expands as it warms.\textsuperscript{136} In the past forty years, sea levels have risen an average of four inches globally and although this small increase in sea level height has not added much to the destruction of hurricanes, by the end of the century levels are projected to rise around one foot and this will lead to increased destruction.\textsuperscript{137} Higher sea levels will contribute to hurricane intensity by giving the coastal storm surge a higher starting point as the storm approaches the shore.\textsuperscript{138} This will lead to a surge that reaches further inland, particularly in low elevation areas.\textsuperscript{139} Growing population density also presents an aggravating factor to intensity because large amounts of coastal development mean a higher financial impact when storms hit.\textsuperscript{140}

Warmer air temperatures will also contribute to intensity of hurricanes because warmer air has a greater capacity than cooler air to hold water vapor.\textsuperscript{141} This increased capacity will add

\begin{flushleft}
\textsuperscript{134} Id.
\textsuperscript{135} Id.
\textsuperscript{137} Id.
\textsuperscript{138} Id.
\textsuperscript{139} Id.
\textsuperscript{140} Id.
\textsuperscript{141} Id.
\end{flushleft}
fuel to hurricanes and lead to a higher average precipitation rate. Additionally, as ocean temperatures rise along with air temperatures, less cold, subsurface ocean water will be available to weaken hurricanes as they approach shore. As climate change continues to increase hurricane intensity, scientists project a doubling of category four and five storms by the end of the century, with the western North Atlantic facing the largest increase in intensity of storms.

Some models project a 45-87% increase in the frequency of category four and five hurricanes for the continental United States, although there may be a slight decrease in the total frequency of hurricanes overall.

The increasingly intense hurricanes have an impact on farmed animals as well. In September of 2018, Hurricane Florence hit North Carolina and killed millions of farmed animals. The North Carolina Department of Agriculture and Consumer Services Counted 3.4 million chickens and turkeys as well as 5,500 pigs. Thirty of the independent farms owned by one of the largest poultry producers in the state were isolated by flood waters, each containing 211,000 chickens. Farmed animal deaths as a result of Hurricane Florence were greater than those from Hurricane Matthew in 2016 and those from Hurricane Floyd in 1999. About half as many animals were killed in Hurricane Matthew as in Hurricane Florence.

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142 Id.
143 Id.
144 Id.
145 Hurricanes and Climate Change, CENTER FOR CLIMATE AND ENERGY SOLUTIONS https://www.c2es.org/content/hurricanes-and-climate-change/ (last visited July 16, 2019).
147 Id.
148 Id.
149 Id.
North Carolina is the second largest pork producer in the United States, with Iowa as the first.\textsuperscript{151} The state is also the fourth largest chicken producer in the United States and houses a total of 9.3 million hogs, 819 million chickens, and 33.5 million turkeys.\textsuperscript{152} As both demand for animal products and the intensity of hurricanes hitting the east coast rise, impact to farmed animals in North Carolina will also increase.

**B. Flooding in the Midwest**

Climate change impacts to the Midwest will result in increases in temperature and precipitation.\textsuperscript{153} This shift has already begun. From 1900 to 2010, the average air temperature increased by over 1.5° Fahrenheit (.8 degrees Celsius).\textsuperscript{154} From 1950 to 2010, this average increased twice as quickly and from 1980 to 2010 it increased three times as quickly as the overall average from 1900 to 2010.\textsuperscript{155} While the amount of future warming is uncertain because it depends on changes in the concentration of atmospheric greenhouse gases, projections for temperature increases in the Midwest put the average temperature at 3.8 degrees Fahrenheit (2.1 degrees Celsius) higher for a scenario with substantial emissions reductions and at 4.9 degrees Fahrenheit (2.7 degrees Celsius) higher for a scenario with continued growth in global emissions by the middle of the century.\textsuperscript{156} Projections for the first scenario with a substantial reduction in emissions put the increase in temperature by the end of the century at 5.6 degrees Fahrenheit (3.1

\textsuperscript{152} Id.
\textsuperscript{154} Id.
\textsuperscript{155} Id.
\textsuperscript{156} Id.
degrees Celsius) and project an increase by 8.5 degrees Fahrenheit (4.7 degrees Celsius) for a scenario with no reductions.\textsuperscript{157}

In addition to temperature increases, the amount of precipitation in the Midwest is also increasing.\textsuperscript{158} As temperatures rise, air can hold more moisture, with an average of 7% more water for every degree Celsius.\textsuperscript{159} Since 1900, average annual precipitation in the United States has increased around 5\%.\textsuperscript{160} In the Midwest, precipitation has increased by 9\%, the highest of all regions.\textsuperscript{161} In addition to an overall increase in precipitation, the number of heavy downpours is also on the rise.\textsuperscript{162} Since 1991, the amount of rain in heavy precipitation events has increased, with the Midwest and upper Great Plains receiving 30\% more than the 1901-1960 average.\textsuperscript{163} This has contributed to a greater number and intensity of flooding events in the Midwest.\textsuperscript{164}

With wetter weather and more rapidly warming spring seasons, flooding is projected to increase in future years, with events such as the extensive flooding this spring becoming more of

\textsuperscript{157} \textit{Id.}


\textsuperscript{161} \textit{Id.}


\textsuperscript{163} \textit{Id.}

a norm than record-breaking. Additionally, if reductions in emissions do not occur, the agricultural sector could lose billions of dollars a year by the middle of the century.

The spring 2019 flooding in the Midwestern United States is an example of weather pattern changes attributable to climate change. As air temperature rises due to climate change, the warmer air will have an increased capacity to store water and this increased capacity will cause an increase in the number and intensity of future flooding events as large amounts of water are released.

In March of 2019, a “bomb cyclone” hit the central United States, bringing blizzard conditions, severe flooding, and 80 mph winds consistent with those seen in a Category 1 hurricane. Flooding in Nebraska, Iowa, and Missouri was caused by the “bomb cyclone” which carried moisture from the Pacific up to 1,000 miles away. This “bomb cyclone” was triggered by a sudden drop in pressure, which caused the storm to intensify and spin counterclockwise. The drop in pressure occurred when a warm subtropical air mass from the south met a cold Arctic air mass to the north. The resulting “bomb cyclone” caused snow to

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171 Id.
melt and new rainstorms to bring additional precipitation to the Midwest.\textsuperscript{172} The extensive flooding is expected to continue through May.

Damage from the flooding has been extensive.\textsuperscript{173} Nebraska Governor Pete Ricketts called the flooding the “most widespread disaster we have had in our state’s history.”\textsuperscript{174} A spokeswoman for the Nebraska Department of Agriculture said that she expects their initial farm damage estimates of $400 million in crop damages and $400 million in lost livestock to increase.\textsuperscript{175} Iowa Governor Kim Reynolds, who flew over flooded fields in a helicopter, compared the flooded fields to an ocean where all that could be seen was the tops of grain bins.\textsuperscript{176} The U.S. Secretary of Agriculture Sonny Perdue has claimed that the governors of Nebraska and Iowa informed him that up to one million calves may have been killed.\textsuperscript{177}

Nebraska, Iowa, and Wisconsin have all declared states of emergency in response to the extensive flooding.\textsuperscript{178} While most of the high water levels causing flooding in Iowa and Nebraska are beginning to recede, snow cover in North and South Dakota remains and flooding is likely to occur there as well. Water levels in the Missouri and Mississippi Rivers along Kansas, Missouri, and Illinois are also expected to rise and potentially worsen the moderate

\textsuperscript{173} \textit{Midwest Flooding has Killed Livestock, Ruined Harvests and has Farmers Worried for Their Future}, CNN 13 WHO TV (March 22, 2019), https://whotv.com/2019/03/22/midwest-flooding-has-killed-livestock-ruined-harvests-and-has-farmers-worried-for-their-future/ (last visited July 16, 2019).
\textsuperscript{174} Id.
\textsuperscript{175} Id.
flooding occurring there.\textsuperscript{179} Although flooding is ongoing and the full extent of the damage is yet to be determined, estimates are in the millions.\textsuperscript{180}

Thousands of animals have been killed as a result of the 2019 flooding. In one instance, a creek in Illinois overflowed its banks and drowned 2,500 hogs trapped in a barn.\textsuperscript{181} On another farm just outside of Omaha, a farmer reported that about 700 of his hogs drowned, many of whom were confined in a barn.\textsuperscript{182} The fate of some animals is unknown, such as in the case of one Iowa farmer who knew of six facilities holding 3,000 pigs each, where no one has been able to access the flooded buildings to check on the animals.\textsuperscript{183}

\textbf{C. Wildfires in the West}

In the western United States, wildfires are expected to continue to become hotter and more intense as a result of climate change.\textsuperscript{184} From 1984 to 2015, double the amount of western forest area burned than would have in a world without climate change.\textsuperscript{185} Seven of California’s most destructive wildfires occurred in the past few years.\textsuperscript{186} While wildfires primarily affect wildlife, they also have an impact on farmed animals both directly and indirectly through the

destruction of grazing lands. Rangelands are burned and cattle are caught in fires and killed. The United States Department of Agriculture counts animal deaths due to wildfire in its “adverse weather” category which includes lightning strikes, floods, tornados, hurricanes, and blizzards as well, and does not report the number of deaths by disaster type.

Because of climate change, modern megafires such as those seen in California in 2018 are nearly impossible for firefighters to extinguish. These fires are able to create their own weather systems, which make winds erratic and conditions dangerous for firefighters to attempt to put out the fires. As the fires continue to be fueled by drought, low humidity, and high temperatures resulting from climate change, fires are only predicted to worsen in upcoming years.

In addition to changes in climate, forest management practices over the past century emphasizing suppression of naturally occurring wildfires have led to an unnatural buildup of fuel for fires. Fire suppression was historically favored to protect timber assets; however, it is currently employed to safeguard homes and property. While fire suppression may benefit human interests, many ecosystems in California evolved to be fire-dependent, meaning that they require natural fire cycles as an abiotic factor in maintaining overall ecosystem health. For example, some seeds of plants found in western fire-dependent ecosystems require a fire for

188 Id.
191 Id.
192 Id.
193 Id.
194 Id.
195 Id.
germination. Others require long intervals between fires to grow. Fires also clear underbrush from a forest which allows sunlight to penetrate the forest floor, facilitating the growth of grasses, herbs, and shrubs that provide food for wildlife species. Soil nutrients are also released back into the soil as a result of fires. Frequent fires prevent large buildups of underbrush by cycling through fuel, which leads to less intense and destructive future fires. As humans tried to remove essential fire cycles from the landscape, this has led to larger and more intense fires that will only be made more intense and destructive as a result of climate change.

Additionally, in the past couple of decades, there has been an increase in development located in high-fire-risk forests and wildlands. According to Headwaters Economics, there are currently 2 million homes at direct risk of wildfires, with this figure continuing to rise even in the face of climate change. Climate scientists and fire ecologists predict that damages from fires are only going to increase.

III. USDA’s Role in Managing Agriculture and its Products and the Department’s Potential to Fight Climate Change

The United States Department of Agriculture (USDA) is the primary authority that regulates the agricultural industry in the United States. It is made up of smaller Services

196 Id.
197 Id.
198 Id.
199 Id.
200 Id.
202 Id.
203 Id.
204 Id.
Agencies which administer categories of programs within the USDA. The most recent Farm Bill, passed on December 21, 2018, authorizes the USDA’s food and agricultural programs through September 30, 2023. The Farm Service Agency within the USDA manages the disaster assistance programs authorized in the Farm Bill.

A. USDA Aid Programs for Animal Agriculture Following Disasters and Changes to the Programs to Fight Climate Change

The USDA, guided by the Agricultural Improvement Act, more commonly known as the Farm Bill, is primarily in charge of regulating both plant and animal agriculture. The most recent Farm Bill was passed in December 2018 and reauthorized numerous protections for animal agriculture designed to help lessen the financial impact of natural disasters. The Farm Service Agency within the USDA manages the disaster assistance programs authorized in the Farm Bill.

One of these programs is the Livestock Forage Program (LFP), which provides compensation to livestock producers who have suffered losses because of impaired grazing due to drought or fire on land that is native or improved pastureland or land where vegetation has been planted specifically for grazing. Another of the disaster aid programs is the Livestock Indemnity Program (LIP). This program provides payments to livestock producers for

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207 The Farm Bill, NATIONAL INSTITUTE OF FOOD AND AGRICULTURE UNITED STATES DEPT OF AGRICULTURE https://nifa.usda.gov/farm-bill (last visited July 16, 2019).
212 Id.
213 Id.
livestock deaths caused by extreme weather that directly results in loss of livestock.\textsuperscript{214} A third program available to livestock producers is ELAP or Emergency Assistance for Livestock, Honeybees, and Farm-Raised Fish.\textsuperscript{215} It provides assistance after extreme weather events and wildfires not covered under the first two programs.\textsuperscript{216} Another emergency program that USDA administers is the Emergency Conservation Program.\textsuperscript{217} This program provides payments to farmers and ranchers to repair damage to farmlands caused by natural disasters and in particular to implement emergency water conservation measures during drought.\textsuperscript{218} USDA also manages the Noninsured Disaster Assistance Program or NAP, which allocates funds to producers of noninsurable crops when planting is prevented due to natural disasters.\textsuperscript{219} This includes crops planted and grown for livestock.\textsuperscript{220}

One of USDA’s disaster relief programs focuses on events that took place solely in 2017 because it was such a historic year for natural disasters.\textsuperscript{221} The 2017 Wildfires and Hurricanes Indemnity Program provides disaster payments to farmers and ranchers to offset losses from hurricanes and wildfires that occurred in 2017.\textsuperscript{222} The program was passed in 2018 in the Bipartisan Budget Act of 2018.\textsuperscript{223} This new program may be the first of its kind. Natural disaster

\textsuperscript{214} Id.\textsuperscript{215} Id.\textsuperscript{216} Id.\textsuperscript{217} Emergency Conservation Program, \textit{United States Department of Agriculture Farm Service Agency}, \url{https://www.fsa.usda.gov/programs-and-services/conservation-programs/emergency-conservation/index} (last visited July 16, 2019).\textsuperscript{218} Id.\textsuperscript{219} Noninsured Crop Disaster Assistance Program (NAP), \textit{United States Department of Agriculture Farm Service Agency} \url{https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/noninsured-crop-disaster-assistance/index} (last visited July 16, 2019).\textsuperscript{220} Id.\textsuperscript{221} 2017 Wildfires and Hurricanes Indemnity Program (WHIP), \textit{United States Department of Agriculture Farm Service Agency}, \url{https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/wildfires-and-hurricanes-indemnity-program/index} (last visited July 16, 2019).\textsuperscript{222} Id.\textsuperscript{223} Id.
frequency is on the rise; disasters occur nearly five times as often as they did in the 1970s.\textsuperscript{224} As natural disaster frequency and intensity continue to increase, Congress may want to allocate funds to offset losses by farmers and livestock producers from natural disasters.

USDA also has an Emergency Loan Program that it administers to farmers and ranchers to help farmers rebuild following natural disasters once the Secretary of Agriculture or the President of the United States declares the weather event a natural disaster.\textsuperscript{225} Just this year, in spring of 2019, the President approved a major disaster declaration following the Midwest flooding which made federal relief loans available under the Emergency Loan Program.\textsuperscript{226}

In order to keep climate change below a 2 degree C increase above pre-industrial levels, as members of the Paris climate agreement have committed to do,\textsuperscript{227} animal agriculture should be directly targeted. Given that it contributes the same amount of greenhouse gas emissions as all the world’s transportation combined,\textsuperscript{228} changes in agricultural practices will have a profound impact on overall warming potential. One way for the US to help with this is to end USDA aid programs for animal agriculture following disasters. Protecting animal agriculture operations from disasters linked to climate change, and therefore to their very practices, removes any responsibility for the externalities that the industry imposes on both a societal and ecological


level. Not all of USDA’s disaster relief programs are for the benefit of animal agriculture, although nearly all are. Some are for the benefit of both animal and plant agriculture and those would not need to be ended, only altered. Congress could either allocate less money to the programs or spend the funds solely on non-animal related agriculture affected by disasters.

Without USDA disaster aid programs, animal agriculture operations will need to consider environmental factors in determining their profitability. For example, hog farms in North Carolina may need to move further inland in order to avoid being submerged as more powerful hurricanes strike the coast in the future. Similarly, hog farms in the Midwest may need to relocate out of flood plains or rebuild farm facilities more suited to higher water levels as the region becomes warmer and wetter as a result of climate change. If the industry is forced to make these changes, many facilities may not remain profitable. Iowa is presently the number one state for hog operations with 22.7 million pigs in 2018. North Carolina is number two with 8.9 million pigs. The Iowa Pork Producers Association claims that 94% of Iowa’s hog farms are family owned; however, USDA’s definition of family farm includes “any farm organized as a sole proprietorship, partnership, or family corporation.” In this definition, size of the farm is also not a factor. Of all farms in Iowa, less than 7% are small or medium-sized farms that are owned by one family. Given that the majority of Iowa’s hog farms are owned by larger operations and not independently by families, they are in the best position to afford the expensive

230 Id.
233 Id.
234 Id.
changes needed to operate sans taxpayer subsidy in the face of climate change disasters. The operations that produce the negative externalities that contribute to climate change will be forced to shoulder the burden of protecting their own industry from the consequences of those negative externalities.

If animal agriculture operations are not given USDA disaster aid, the price for animal products will very likely increase and consumption of these products will drop due to this price increase. This drop should not be viewed negatively from an environmental perspective. In the *New York Times* article *The True Cost of a Burger*, Mark Bittman writes that, “Cheeseburgers are the coal of the food world, with externalities in spades.” With a higher cost for animal products following the reduction in subsidies, all of these externalities would be reduced, including those linked to climate change such as carbon dioxide, methane, and nitrous oxide emissions. Overall, a decreased demand for meat will mean less greenhouse gas-producing animal agricultural operations operating at full steam contributing to climate change.

In addition to the environmental benefits, a reduction in the consumption of animal products can lead directly to better overall human health which has an additional impact on reducing emissions that lead to climate change. Consumption of animal-based foods have a large impact on human health. High rates of meat consumption increase the risk of diabetes, heart disease, and stroke. According to the Centers for Disease Control and Prevention, heart


disease is the leading cause of death in the United States.238 Strokes are number five.239 In 2018, the USDA predicted that Americans would consume a record amount of meat, over 222.2 pounds on average per person.240 This is over twice the daily amount of meat that nutritionists recommend per day.241

The high demand for healthcare to treat chronic disease is related to diet. The United States healthcare system has a gross domestic product of 3.3 trillion dollars and if our healthcare system was an individual country, it would have the fifth largest economy in the world.242 This enormous sector of the United States economy is also the seventh-largest producer of CO2.243 In 2011, the sector emitted 655 million tons of CO2, which is 10% of all CO2 generated by the United States that year.244 Decreasing the amount of animal products in our diets can reduce the number of doctors’ visits for chronic diseases like heart disease and diabetes and in turn, the demand for healthcare.245 If everyone in the United States adopted a plant-based diet and removed animal products from their diet, the U.S. would save 250 billion dollars a year in healthcare services.246 If there is less demand for healthcare to treat chronic disease because fewer people have chronic diseases, the carbon emissions from healthcare will also decrease as there will be less of a need for these services. Preventative healthcare is the cheapest, and a diet

239 Id.
241 Id.
243 Id.
244 Id.
246 Id.
that protects against both poor health and climate change is a win-win for both the environment and human health.

B. What We Can All do to Encourage a Food System that Fights Climate Change

The bad news is that without immediate and drastic action, climate change is likely to surpass the 2 degrees Celsius warming goal set forth in the Paris climate agreement.\textsuperscript{247} A 2017 study found that there is only a five percent chance that Earth will warm by only 2 degrees Celsius by the end of the century.\textsuperscript{248} Scientists predict that any warming above the 2 degree planetary threshold will increase risks dramatically by setting in motion a cascade of positive feedback loops that will continue to cause Earth temperature to rise even if emissions are curtailed.\textsuperscript{249}

In order to avoid catastrophic climate change, we need to act now.\textsuperscript{250} The good news is that we can each take immediate action to mitigate the impacts of climate change by altering the way we eat. According to a study in Lancet, a revolutionary change in food systems is needed to meet the environmental goals of the Paris climate agreement.\textsuperscript{251} The study found that staying within a 2 degrees Celsius increase in global temperature could be done by switching to plant-based diets and that this switch is more effective than altering production practices.\textsuperscript{252} While changes in food production practices could reduce agricultural greenhouse gas emission by 10%...
by 2050, changing to more plant-based diets could reduce emissions by 80%.\textsuperscript{253} If we adopt completely plant-based diets, this number could be even greater. Vegan diets produce the least amount of greenhouse gases.\textsuperscript{254} On average, a 2,000 kcal high meat diet has over two and a half times the greenhouse gas emissions of the average 2,000 kcal vegan diet.\textsuperscript{255} Switching from a high-meat diet to a vegan diet can reduce a person’s carbon footprint by 1,560 kilograms of CO\textsubscript{2} per year.\textsuperscript{256} If we all make the switch now, we just may be able to make that 5% chance of staying under 2 degrees Celsius.

\textsuperscript{253} Id.
\textsuperscript{255} Id.
\textsuperscript{256} Id.