



Food Safety and Inspection Service  
U.S. DEPARTMENT OF AGRICULTURE

# Climate Change Adaptation Plan

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## 1.0 Executive Summary

The Food Safety and Inspection Service (FSIS) is the public health regulatory agency of the U.S. Department of Agriculture (USDA) responsible for ensuring that domestic and imported meat, poultry, and egg products are safe, wholesome, and properly labeled. This includes addressing impacts of climate change which may impact employee health, food safety and animal welfare. Strategies to address potential impacts are outlined in this report.

FSIS established a team of scientists, health professionals, veterinarians, risk assessors, an emergency response specialist, policy experts and communicators to develop this climate adaptation plan (Appendix 1). The team considered the impacts of climate change through the lens of an increase in extreme weather events, such as an increase in heat waves/severe cold and increased precipitation/flooding/snow. The United States is seeing an increase in days where the ambient temperature is greater than 90 °F, which may create conditions that affect employee health, welfare of animals presented for slaughter, and the safety of meat, poultry, and egg products. Increased drought severity may reduce water availability for drinking, sanitation, and meat processing. In addition, an increase in extreme weather events may lead to power outages, flooding, or more severe winter weather, including increased snowfall, which can harm FSIS employees and livestock/ birds.

The team identified the potential impacts (vulnerabilities) on FSIS employee health, animal welfare/ humane handling and food safety. Ten key vulnerabilities, in order of likelihood and potential impact, were identified:

- More frequent natural disasters/extreme weather events, e.g., wildfires, drought, floods, heat waves, extreme cold, which impact human health, animal welfare, and food safety.
- Changes in the geographical distribution of animal pests and diseases due to warmer temperatures, which can impact animal welfare and food safety.
- Heat stress on FSIS employees.
- Decreased animal welfare.
- Heat stress to animals during transport.
- Less water or contaminated water at processing plants.
- Less water availability in pre-slaughter/ante-mortem.
- Increased inspector workload due to greater numbers of sick or disabled animals.
- Increased processing, storage, and transport costs.
- Slower laboratory sample transportation and storage issues.

FSIS has strategies in place to address these impacts and will continue to monitor these to protect FSIS employee health, animal welfare and the food supply.

## 2.0 Introduction

FSIS is the public health regulatory agency of the USDA responsible for ensuring that domestic and imported meat, poultry, and egg products are safe, wholesome, and properly labeled. FSIS ensures food safety through the authorities of the Federal Meat Inspection Act (FMIA), the Poultry Products Inspection Act (PPIA), and the Egg Products Inspection Act, as well as humane animal handling



through the Humane Methods of Slaughter Act (HMSA). To carry out these congressional mandates, FSIS employs approximately 8,700 full-time employees, including a frontline workforce comprised of public health veterinarians, consumer safety inspectors, and food inspectors.

On January 27, 2021, the President issued Executive Order (EO) 14008 to help the United States prepare for a changing climate, which is resulting in an increase in extreme weather events, such as heatwaves and heavy precipitation. This EO laid out a vision to address the risks and opportunities posed by climate change and requires each federal agency to develop an action plan describing steps the agency can take to bolster adaptation and increase resilience to the impacts of climate change.

USDA's [Departmental Regulation \(DR\) 1070-001: Policy Statement on Climate Change Adaptation](#) reflects the high priority that the Administration has placed on addressing climate change and affirms the necessity of integrating climate adaptation into USDA's work. [USDA's Action Plan for Climate Adaptation and Resilience](#) provides information, tools, and resources to increase resilience to climate impacts.

Our changing climate may create conditions that affect FSIS employees, the welfare of animals presented for slaughter, and the safety of meat, poultry, and egg products. FSIS considered the potential impacts of more frequent extreme weather events, such as heat waves and floods, as well as risks associated with a warming climate and drought. Climate change is also resulting in more severe winter weather, including increased snowfall, and very cold weather in locations where extreme cold does not typically occur. This is due to changes in the Arctic Polar Vortex, which allows extremely cold air to dip south, instead of staying in place over the North Pole. Extremely cold weather can result in harm to FSIS employees and livestock/ birds. This report outlines the policies, procedures, and programs that FSIS leverages to increase our resilience and reduce the impact of climate-driven conditions on human health, animal welfare, and food safety.

The FSIS Climate Change Adaptation Plan has been developed in accordance with [DR 1070-001](#), with guidance from USDA's Office of Energy and Environmental Policy within the Office of the Chief Economist. This Climate Adaptation Plan will help to ensure that FSIS employees have a deeper understanding of the potential impacts of climate change on FSIS employees, animal welfare, and food safety hazards and the actions FSIS can take to mitigate these impacts.

### 3.0 About FSIS

FSIS focus is to ensure food safety and proper labeling of meat, poultry, and egg products. FSIS inspection program personnel (IPP) verify industry compliance with applicable food safety and labeling regulatory requirements. This ensures that regulated establishments have sound food safety systems to protect public health. The "food safety system" can be defined as a systematic approach implemented to prevent foodborne illness. It includes developing and implementing a Hazard Analysis and Critical Control Point (HACCP) system in accordance with 9 CFR Part 417 and a Sanitation Standard Operating Procedure (SOP) in accordance with 9 CFR Part 416. It also includes any programs or procedures an establishment uses (e.g., prerequisite programs) to prevent food safety hazards from occurring and to support decisions in the hazard analysis.



FSIS has personnel skilled and trained in food science, public health, policy development, risk analysis, epidemiology, microbiology, toxicology, data analytics, bioinformatics, and related sciences. FSIS also employs personnel who perform a range of financial, human resources, administrative, investigative, technical, communications, and Equal Employment Opportunity functions, and other functions that support FSIS' food safety and public health mandates and policies.

The FSIS Vision and Mission—underpinned by FSIS' Core Values: *Accountable, Collaborative, Empowered, and Solutions-Oriented*—were designed to move the agency closer to accomplishing its goals and the associated outcomes and objectives presented in the next section.

### FSIS Vision

Everyone's food is safe.

### FSIS Mission

Protect public health by preventing illness from meat, poultry, and egg products.

### Fiscal Year (FY) 2023–2026 Strategic Goals

#### **Goal 1: Prevent Foodborne Illness and Protect Public Health**

Outcome 1.1: Prevent Adulteration and Misbranding

Outcome 1.2: Limit Illness From FSIS-Regulated Products

#### **Goal 2: Transform Inspection Strategies, Policies, and Scientific Approaches to Improve Public Health**

Outcome 2.1: Improve Food Safety Through the Adoption of Innovative Approaches and Technologies

Outcome 2.2: Optimize Data Use at Every Level of Agency Decision Making

#### **Goal 3: Achieve Operational Excellence**

Outcome 3.1: Sustain and Advance an Adaptable, High-Performing and Engaged Workforce

Outcome 3.2: Optimize Service Delivery

## 4.0 Climate Change Vulnerabilities and Adaptation Actions

The USDA Department-Wide [action plan for climate adaptation and resilience](#) identified five potential climate change impacts (vulnerabilities) to agriculture, based on their vulnerability assessment.

These are:

- Decreased agricultural productivity
- Threats to water quantity and quality
- Disproportionate impacts on vulnerable communities
- Shocks due to extreme climate events
- Stress on Infrastructure and public lands

FSIS established a team of scientists, public health professionals, veterinarians, risk assessors, an emergency response specialist, policy experts and communicators to develop this climate adaptation

plan (Appendix 1). The team assessed vulnerabilities based on our mission, which align with those of the Department (Table 1). The strategic goals, outcomes, and objectives outlined in the FSIS [FY 2023–2026 Strategic Plan](#) provide an integrated framework for understanding how FSIS is fulfilling the agency’s mission to protect public health by preventing illness from meat, poultry, and egg products. All three agency goals may be impacted by a changing climate. The adaptation actions are tied to one or more of the agency’s strategic goals.

#### 4.1 Identifying and Ranking Climate Change Vulnerabilities

To estimate the relative risk of climate change vulnerabilities to FSIS operations, FSIS team members reviewed the relevant literature and used their expert judgement to identify potential vulnerabilities to FSIS employees, food safety hazards, and animal welfare. This approach ensured that the FSIS’ adaptation plan addressed the vulnerabilities that pose the greatest risk, considering both their likelihood and potential impact.

The team began by compiling a list of over 40 potential vulnerabilities that could affect FSIS operations, derived from the scientific literature, review of other USDA agencies’ climate adaptation plans, and consultations with FSIS scientists and technical experts. We sought experts from within FSIS to advise on which of the vulnerabilities were most relevant to FSIS operations and which were similar enough to be combined. The final list included 10 vulnerabilities.

We then ranked the 10 climate change vulnerabilities, based on a scoring methodology that considered the likelihood of the event occurring, multiplied by the estimated consequences (potential impact to human health, animal welfare and/or food safety; Table 1). Impacts could be at the national, regional, or local (i.e., one or a small number of establishments) level.<sup>1</sup> The lowest likelihood (i.e., least likely) and consequence (i.e., minimal impact) outcome was defined as having a value of one and the highest outcome (i.e., most likely or most severe consequence) was defined as having a value of five. The expert panel then assigned values for likelihood and consequence for each vulnerability. The likelihood and consequence values were multiplied to give a measure of relative risk for each vulnerability, which were then ranked from 1 (most risky) to 10 (least risky) (Table 1).

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<sup>1</sup> While we considered some climate vulnerabilities whose impacts may be localized to one or a limited number of establishments, we cannot account for the business decisions that individual establishments will make in response to these climate-driven conditions. This plan focuses on FSIS’ national-level authorities to ensure that statutory obligations are met in the face of these climate vulnerabilities.



**Table 1. Risk Ranking of the Vulnerabilities (from Riskiest to Least Risky)**

<b>Rank</b>	<b>Brief Description of Vulnerability</b>	<b>FSIS Goal(s) Impacted</b>	<b>Impact on FSIS employees</b>	<b>Impact on animal welfare</b>	<b>Impact on food safety</b>
1	More frequent natural disasters/extreme weather events, e.g., wildfires, drought, floods, heat waves, extreme cold (Shocks due to extreme climate events) *	Goal 1, 2, 3	X	X	X
2	Changes in the geographical distribution of animal pests and diseases due to warmer temperatures (Decreased agricultural productivity) *	Goal 1, 2		X	X
3	Heat stress on FSIS employees (Shocks due to extreme climate events) *	Goal 3	X		
4	Decreased animal welfare (Decreased agricultural productivity) *	Goal 1		X	X
5	Heat stress to animals during transport and lairage (Decreased agricultural productivity) *	Goal 1		X	X
6	Less water or contaminated water at processing plants (Threats to water quantity and quality) *	Goal 1			X
7	Less water availability in pre-slaughter/ante-mortem (Threats to water quantity/ quality) *	Goal 1		X	X
8	Increased inspector workload due to greater numbers of sick or disabled animals (Decreased agricultural productivity) *	Goal 1, 3	X		
9	Increased processing, storage, and transport costs (Decreased agricultural productivity) *	Goal 1			X
10	Slower laboratory sample transportation and storage issues (Decreased agricultural productivity) *	Goal 1, 2			X

\*Link to USDA Department-wide vulnerability.

## 4.2 Climate Change Risks to FSIS Employees

### 4.2.1 Vulnerability

- ✓ More frequent natural disasters/extreme weather events
- ✓ Heat stress on FSIS employees
- ✓ Reduced FSIS employee availability

FSIS employs a frontline workforce comprised of approximately 8,700 employees, the majority of whom work in more than 6,800 Federally regulated establishments in the United States and its territories. FSIS employees may work outdoors, where the temperatures could be extremely high or extremely low, as they ensure the welfare of animals when they arrive for slaughter, or they may work inside establishments, where the ambient temperature may be very high, as air conditioning may not be available. Fans may be used for cooling in these areas (See Appendix 2).

Health hazards related to climate and heat or cold stress can result in injuries, disease, death, and reduced productivity.<sup>2</sup> Climate-related hazards for workers may include (1) increased ambient temperature, (2) air pollution, (3) ultraviolet light, (4) extreme cold weather leading to frostbite, and (5) vector-borne diseases.<sup>3</sup> Of these hazards, FSIS employees are most likely to be exposed to increased ambient temperature and extreme weather events. Occupational exposure to hot environments and extreme heat can result in heat stroke, heat exhaustion, heat syncope, heat cramps, and heat rashes, or death. Heat also increases the risk of workplace injuries, such as those caused by sweaty palms, fogged-up safety glasses or face shields, and dizziness. This may make frontline jobs undesirable, if provisions are not in place to protect workers and give leave options, negatively impacting recruitment and retention goals.

FSIS is responsible for ensuring the safety of its employees. The Department of Labor’s (DOL) Occupational Safety and Health Administration (OSHA) is responsible for setting and enforcing standards to ensure safe, healthy working conditions.<sup>4</sup> Across the United States, heat is a growing workplace hazard, with climate change making extreme heat more frequent and severe. There is no current OSHA standard related to heat index and heat-related interventions; however, the Centers for Disease Control and Prevention’s National Institute for Occupational Safety and Health (NIOSH) has recommended an occupational standard for workers exposed to heat and hot environments, which

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<sup>2</sup> NIOSH [2016]. NIOSH criteria for a recommended standard: occupational exposure to heat and hot environments. By Jacklitsch B, Williams WJ, Musolin K, Coca A, Kim J-H, Turner N. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 2016-106. <https://www.cdc.gov/niosh/docs/2016-106/>

<sup>3</sup> Schulte PA, Chun H [2009]. Climate change and occupational safety and health: establishing a preliminary framework. [J Occup Environ Hyg 6\(9\):542-554](#).

<sup>4</sup> Fact sheet: Biden Administration Mobilizes to Protect Workers and Communities from Extreme Heat, <https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/20/fact-sheet-biden-administration-mobilizes-to-protect-workers-and-communities-from-extreme-heat/>, September 20, 2021



includes guidance on how to prevent adverse outcomes.<sup>3</sup> In addition, in 2023, DOL issued the first-ever Hazard Alert for heat, reaffirming that workers have heat-related protections.<sup>5,6</sup>

Extreme weather events can disrupt transportation networks which may affect the movement of people, animals, and products. Establishments may have to temporarily suspend operations due to fluctuations in the number of animals available for slaughter, power outages, flooding, or if establishment workers are unable to safely travel to work. Similarly, FSIS IPP may be unable to safely access establishments if roads, rails, bridges, waterways, and utilities are damaged or blocked.

**4.2.2 Climate Change Adaptation Actions** [FSIS Goal 2, 3]

FSIS is committed to the safety of our employees. We will continue to encourage safety and hazard reporting (FSIS Directives [4791.12](#) and [4791.13](#)) to ensure safe and healthful working conditions for all FSIS employees in all environments. Additionally, we ensure our employees are trained in workplace safety. IPP are required to complete training on Workplace Safety and Health Hazards every year. FSIS also issues policy guidance to IPP on preventing heat stress illness. The agency provides IPP with a range of items to protect them from heat stress and continually monitors the use of these and the selection of items available. Regulations require that safe drinking water is available to all FSIS employees.

[FSIS Directive 5500.2 Significant Incident Response](#) outlines the procedures for the FSIS Emergency Management Committee (EMC) and programs within FSIS to follow while managing significant incidents. A significant incident is one that presents a grave, or potentially grave, threat to public health, to the safety of FSIS-regulated products, or FSIS personnel (e.g., natural disasters). These procedures outline communication and coordination protocols, including program area reporting responsibilities, reporting system and email outage contingencies, and triggers for activating the EMC. Additionally, FSIS participates in locally led natural disaster planning in rural and urban settings to continuously assess response procedures and identify opportunities for further development and improvement.

As per [FSIS Directive 4630.2](#), weather and safety leave may be granted when it is determined that an [FSIS] employee or group of employees cannot safely travel to or from, or perform work at, their normal worksite, a telework site, or other approved location (i.e., remote) due to severe weather events. This form of administrative leave is used in conjunction with operating status announcements issued by the U.S. Office of Personnel Management or Federal Executive Boards. There is no limit to the number of hours that may be recorded as weather and safety leave.

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<sup>5</sup> FACT SHEET: President Biden Announces New Actions to Protect Workers and Communities from Extreme Heat, <https://www.whitehouse.gov/briefing-room/statements-releases/2023/07/27/fact-sheet-president-biden-to-announce-new-actions-to-protect-workers-and-communities-from-extreme-heat/>, July 27, 2023

<sup>6</sup> Hazard Alert, Extreme Heat Can Be Deadly to Workers, Occupational Safety and Health Administration, issued July, 2023, [https://www.osha.gov/sites/default/files/publications/OSHA\\_HA-4279.pdf](https://www.osha.gov/sites/default/files/publications/OSHA_HA-4279.pdf)

## 4.3 Climate Change Risks to Animal Welfare

### 4.3.1 Vulnerabilities

- ✓ More frequent natural disasters/extreme weather events
- ✓ Changes in the geographical distribution of animal pests and diseases
- ✓ Decreased animal welfare
- ✓ Heat stress during transport and lairage
- ✓ Less water or contaminated water at processing plants
- ✓ Less water availability in pre-slaughter/ante-mortem

Livestock and poultry production systems may be impacted by changes in environmental conditions, such as air temperature, relative humidity, precipitation, and frequency and magnitude of extreme events (i.e., heat waves, severe droughts, extreme precipitation events, and coastal floods). Extreme weather events are impacted by climate change, either being more frequent or more severe. Some animal welfare conditions, such as frostbite or heat stress, are the direct results of environmental conditions. Climate change can also indirectly affect animal welfare when it leads to changes in the geographical distribution of animal pests and diseases. This section will focus on the direct effects of climate change on animal welfare in the context of ensuring humane handling of livestock and poultry.

As temperatures rise, animals are more likely to experience heat stress. Acute heat stress can lead to death during transportation or lairage. Extreme heat conditions can also increase stress that livestock and poultry experience during transportation to slaughter. Stressed livestock can have difficulty unloading from the trailer and walking to holding pens. Animals that become overheated in the trailer and during lairage may become disabled. Livestock that are sick or disabled will need to be protected, separated from healthy animals, and evaluated by a veterinarian. Establishments are required to humanely move disabled animals with appropriate implements and equipment.

Extreme weather events can affect an establishment's ability to humanely handle animals.<sup>7</sup> Floods can introduce contaminated water (e.g., human and animal waste, pesticides, and industrial wastes) into processing plants. Establishments need to modify animal handling practices if water sources become contaminated and if there is limited or no access to water for drinking or cooling of animals. Furthermore, loss of electricity could prevent the use of fans or other cooling systems. Trucks already in transit would either need to delay their arrival or keep moving to provide air flow to animals prior to unloading.

### 4.3.2 Climate Change Adaptation Actions [FSIS Goal 1, 2]

Once a truck transporting livestock and poultry for slaughter enters the premises of an official establishment, the establishment must comply with the FMIA, PPIA, and HMSA. The Directives that describe the procedures FSIS uses to verify compliance with the Acts are summarized in Table 2.

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<sup>7</sup> Duchenne-Moutien, R and Neetoo, Hudaa. Climate Change and Emerging Food Safety Issues: A review. Journal of Food Protection, Vol. 84, No. 11, 2021, Pages 1884–1897 <https://doi.org/10.4315/JFP-21-141>.

On September 9, 2004, FSIS announced that livestock slaughter establishments should implement and maintain a systematic approach to humane handling and slaughter to best assure compliance with the regulations ([69 Federal Register 54625](#)). A systematic approach is a comprehensive way of evaluating how livestock enter and move through an establishment. Establishments should (1) assess the ability of their livestock handling and slaughter practices to minimize distress and injury to livestock; (2) design facilities and implement handling practices that minimize distress and injury to livestock; (3) periodically evaluate facilities and handling methods to ensure that they continue to minimize distress and injury to livestock; and (4) when necessary, modify facilities and handling methods to ensure that they continue to minimize distress and injury to livestock. For FSIS to consider a systematic approach to be robust, the agency expects that the systematic approach will include a written animal handling program and program records. The records need to be available for FSIS review.

When FSIS IPP perform FSIS verification tasks, the amount of time focused on a specific humane handling or slaughter of livestock regulation is entered into the Humane Handling Activities Tracking System (HATS). IPP verify the specific facility, handling, and slaughter requirements for each of the categories, which are described in Table 3. Specifically, HATS Category I and Category III address identified climate vulnerabilities of inclement weather and water and feed availability. HATS violations are monitored to ensure trends are responded to with appropriate outreach to establishments. FSIS will continue its outreach efforts to help ensure that slaughter facilities have sound commercial practices and livestock humane handling programs resulting in compliance with the regulations ([9 CFR 381.90](#) and [313](#)) and improved animal welfare. To assist with outreach, FSIS has developed the [Compliance Guide for a Systematic Approach to the Humane Handling of Livestock](#) so that all slaughter establishments may apply the recommendations in these guidelines, as appropriate, such as conducting assessments of their facility, adapting its facilities to inclement weather, and handling of disabled animals humanely. Those establishments exposed to blizzards or extreme freezing conditions need to evaluate their facilities to prevent water and carbon dioxide lines from freezing, slips and falls due to the formation of ice in walkways, and frostbite if the temperature in their holding area is not maintained.



**Table 2. Selected Directives and Verification Tasks used by FSIS to Ensure Compliance with the FMIA, PPIA and HMSA**

<b>FSIS Directive Number</b>	<b>FSIS Directive Title</b>	<b>FSIS Verification Task</b>
<a href="#">6100.1</a>	Ante-Mortem Livestock Inspection	FSIS examine and inspect all livestock before slaughter to determine whether the animals are fit for slaughter for food.
<a href="#">6100.3</a>	Ante-Mortem and Post-Mortem Poultry Inspection	IPP inspect poultry prior to slaughter.
<a href="#">6110.1</a>	Verification of Poultry Good Commercial Practices	IPP verify the implementation of Good Commercial Practices. Poultry are to be handled in a manner that prevents needless injury and suffering. Water must be available for drinking.
<a href="#">6900.2</a>	Humane Handling and Slaughter of Livestock	Lists requirements, verification activities, and enforcement actions for ensuring that the handling and slaughter of livestock is always done humanely.

**Table 3. HATS Categories Used by FSIS to Verify Compliance With the FMIA and HMSA**

<b>HATS Category</b>	<b>Description<sup>1</sup></b>
<b><u>Category I: Inclement Weather</u></b>	The establishment needs to adapt its facilities and handling practices to inclement weather to ensure the humane handling of animals. Inclement weather (e.g., rain, heat, snow, or ice) may cause adverse effects on facilities and animal handling.
<b><u>Category II: Truck Unloading</u></b>	Livestock handling and facilities should facilitate humane handling procedures during livestock unloading activities. Animals prone to heat stress or that are injured can be difficult to unload.
<b><u>Category III: Water and Feed Availability</u></b>	Water is required to be accessible to livestock in all holding pens. Animals held longer than 24 hours must have access to feed.
<b><u>Category IV: Ante-mortem Inspection</u></b>	Livestock facilities and handling practices are to be maintained in a humane manner to prevent stress or injury to the animal.
<b><u>Category V: Suspect and Disabled</u></b>	U.S. suspect and disabled livestock* are required to be handled humanely and provided or placed in a covered pen.
<b><u>Category VI: Electric Prod/Alternative Object Use</u></b>	Establishment’s procedures for humanely and effectively moving livestock do not involve excessive prodding or use of objects in a manner that cause injury.
<b><u>Category VII: Slips and Falls</u></b>	Establishments must provide adequate footing in livestock facilities to prevent animals from slipping and falling as they are handled and moved through livestock facilities.
<b><u>Category VIII: Stunning Effectiveness</u></b>	Stunning methods are required to be appropriate and effectively administered, producing immediate unconsciousness of the animal. Ante-mortem condemned animals are to be humanely euthanized.
<b><u>Category IX: Conscious Animals on the Rail</u></b>	Establishments are required to produce, at a minimum, unconsciousness, or surgical anesthesia after application of the stunning method and remain in this state until death.

\* Animals showing signs of abnormalities, injuries, or diseases that require further examination by the PHV.

## 4.4 Climate Change Risks to Food Safety

### 4.4.1 Vulnerabilities

- ✓ More frequent natural disasters/extreme weather events
- ✓ Changes in the geographical distribution of animal pests and diseases
- ✓ Less water or contaminated water at processing plants
- ✓ Slower laboratory sample transportation and storage issues
- ✓ Increased processing, storage, and transport costs

Microbiological, chemical, and physical hazards can contaminate food at various points along the production chain. Contamination of food is highly influenced by environmental conditions such as climate, which impacts the prevalence, distribution, and transmission of many foodborne diseases.<sup>8</sup> As the climate warms, higher ambient temperatures may result in chronic heat stress in animals, leading to reduced immunity to disease and increased susceptibility to parasites and pathogens. Warming temperatures are causing disease vectors such as mosquitos and ticks to move northward. This may change the distribution of zoonotic diseases and result in conditions not commonly seen at slaughter.

*Salmonella* and *Campylobacter* are common causes of foodborne illness, and a changing climate could potentially impact their prevalence in meat, poultry, and egg products.<sup>8</sup> Past research has documented that *Salmonella* and *Campylobacter* infections in humans are influenced by temperature. Warming temperatures favor the growth of *Salmonella* in broiler flocks.<sup>9</sup> In addition, milder winters will increase the survival of microbiological vectors such as flies, resulting in an increase in illnesses in food production animals. The higher incidence of illness in production animals may require increased verification activities by FSIS IPP to protect the food supply.

High ambient temperatures can also influence the growth of *Salmonella* during food production, transport, and storage.<sup>10</sup> Increasing ambient temperatures will increase the heat load on refrigerated production, storage, and distribution facilities, making it more costly and difficult to hold products at appropriate temperatures. A 2-to-3-degree Celsius rise in temperature could reduce the chilled storage life of food products and lead to increased food spoilage and foodborne illness, unless technology

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<sup>8</sup> Lancet. The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels. Published online October 25, 2022 [https://doi.org/10.1016/S0140-6736\(22\)01540-9](https://doi.org/10.1016/S0140-6736(22)01540-9)

<sup>9</sup> Jiang, C., K. Shaw, C. R. Upperman, D. Blythe, C. Mitchell, R. Murtugudde, A. R. Sapkota, and A. Sapkota. 2015. Climate change, extreme events and increased risk of salmonellosis in Maryland, USA: evidence for coastal vulnerability. [Environ. Int. 83:58–62.](https://doi.org/10.1016/j.envint.2015.08.012)

<sup>10</sup> Dietrich J, Hammerl JA, Johne A, Kappenstein O, Loeffler C, Nöckler K, Rosner B, Spielmeier A, Szabo I, Richter MH. Impact of climate change on foodborne infections and intoxications. *Journal of Health Monitoring* · 2023 8(S3) [DOI 10.25646/11403](https://doi.org/10.25646/11403)

improves to maintain the required low-temperature range.<sup>11</sup> Higher temperatures may also result in slower post-mortem carcass cooling, which could potentially lead to increases in pathogens on meat and poultry.

Natural disasters, such as hurricanes, tornadoes, floods or wildfires, negatively impact FSIS-regulated establishments' ability to produce safe and wholesome products. A review of FSIS data and published research indicates that there is a potential for an increase in *Salmonella* and other pathogens in regulated food products following flood events.<sup>12</sup> A review of noncompliance records (NR) showed an increase in NR for sanitation and HACCP within 1–90 days after heavy rain periods ([FSIS Directive 5000.7](#)). The introduction of contaminated water can cause flood-related diseases in animals in the pre-harvest environment (e.g., clostridial diseases, mastitis, and tetanus), and some of these diseases may present food safety hazards not commonly seen by IPP.

Droughts can reduce water availability, which may cause insanitary conditions in food processing plants if there is a decreased ability to clean and sanitize equipment. This may result in increased transmission of foodborne pathogens. Reuse of water during water shortages may create food safety issues unless it has been appropriately treated.

IPP collect samples to send to one of FSIS' three analytical laboratories (located in Athens, GA, St. Louis, MO, and Albany, CA) for testing for foodborne pathogens and contaminants. FSIS laboratories could be impacted by extreme weather which could lead to power outages. FSIS employees may be unable to travel to the laboratories during extreme weather events. In addition, disruptions in courier services may delay the pickup and transportation of samples to the FSIS laboratories. Samples may need to be stored frozen or under refrigeration to prevent excess microbial growth and delays in receipt of samples by the laboratory may render them compromised and unable to be analyzed.

#### 4.4.2 Climate Change Adaptation Actions [FSIS Goal 1, 2]

[FSIS Directive 5000.1](#), *Verifying an Establishment's Food Safety System*, provides comprehensive instructions to IPP in meat, poultry, and egg products establishments on how to protect public health by properly verifying an establishment's compliance with the pathogen reduction, sanitation, and HACCP regulations. Establishments are to implement a food safety system that includes assessing which food safety hazards are reasonably likely to occur in the establishment's production process, and to maintain controls necessary to prevent contamination by microbiological, chemical, or physical hazards. The regulations also require that the establishment maintain Sanitation SOPs. FSIS Directive 5000.1 also provides instructions to IPP on how to protect public health by properly verifying an establishment's compliance with the Sanitation Performance Standard requirements.

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<sup>11</sup> James, S. J. and C. James 2010. The food cold-chain and climate change. *Food Research International* 43 (2010) 1944–1956. <https://doi.org/10.1016/j.foodres.2010.02.001>

<sup>12</sup> Linville JW, Schumann D, Aston C, Defibaugh-Chavez S, Seebohm S, Touhey L. Using a Six Sigma Fishbone Analysis Approach to Evaluate the Effect of Extreme Weather Events on Salmonella Positives in Young Chicken Slaughter Establishments. *J Food Prot.* 2016 Dec;79(12):2048-2057.



Regulatory requirements ([9 CFR 416](#)) state that a supply of running water that complies with the National Primary Drinking Water regulations ([40 CFR Part 141](#)), must be provided in all areas where products are processed, and for cleaning rooms and equipment, utensils, and packaging materials. IPP are also to determine whether the establishment is reusing water, ice, or solutions (such as brine, liquid smoke, or propylene glycol) to chill or cook ready-to-eat product and verify that the reuse meets regulatory requirements. Any establishment that reuses water, ice, or solutions in their process needs to consider that reuse in the hazard analysis and support any resulting decision regarding chemical, physical, or microbiological hazards.

FSIS collects data, analyzes data for trends, and takes data-driven actions to mitigate hazards and ensure food safety. FSIS routinely collects samples at establishments for regulatory testing. These samples are used to assess and categorize each establishment's performance to a standard and to prevent foodborne illness. FSIS evaluates data and develops strategies to address food safety concerns, including those exacerbated by climate change.

Under the current FSIS regulations, every establishment is to reassess the adequacy of its HACCP plan whenever changes occur that could affect the hazard analysis or alter the HACCP plan ([9 CFR 417.4](#)). Climate change is increasing the risks associated with natural disasters, such as hurricanes, floods, or wildfires. Natural disasters are a "change" that could affect the hazard analysis or alter the HACCP plan. If an establishment's HACCP plan documents that a hazard is not reasonably likely to occur based on a prerequisite program, the impact of a natural disaster on the prerequisite program must be evaluated to determine whether the program needs to be modified, to mitigate any effects caused by the natural disaster. This would require the HACCP plan to be updated.

[FSIS Directive 5000.7](#) provides instructions to IPP assigned to establishments in areas affected by a natural disaster. IPP are to inform affected establishments that they are required to reassess their HACCP plans and are to verify that establishments take appropriate actions to produce wholesome and unadulterated products. FSIS remains committed to implementing initiatives that will have a positive impact on the safety of regulated products and lead to illness reduction.

FSIS currently has procedures in place to help mitigate the impacts of extreme weather on FSIS laboratory operations and processes. FSIS Continuity of Operation plans are reviewed annually to ensure that they are working as intended. These plans include options to divert samples from an impacted FSIS laboratory to one of the other two laboratories and promote the use of backup generators. Contingency plans also exist in the event FSIS leadership is not able to operate from primary work sites to ensure no interruption to the FSIS mission.

The laboratories test samples on receipt for temperature and will discard samples that arrive above 15°C, to prevent the growth of microorganisms in the sample during shipment. While 15°C is the upper allowable limit, samples received at the laboratory are typically much lower. FSIS monitors the rates of sample discards and can respond by adjusting sampling schedules or supplies as needed in response to sample quality issues.



## 5.0 Data and Research Needs

FSIS maintains a list of [research needs](#) on its website. Each year, the Research Priority Review Panel identifies new research priorities and studies, based on outbreaks, laboratory data and findings in the field. FSIS does not do research, nor do we fund research, but we provide the list to encourage researchers to undertake projects relevant to food safety. The current list contains one relevant project:

- Determine the impact of climate and weather conditions on microbial pathogens in FSIS regulated products.

FSIS collaborates with other federal agencies and trusted partners and uses their climate data and resources to guide short- and long-term decision making. For example, weather data can be obtained from the National Oceanic and Atmospheric Administration and air quality data from [AirNow](#).

FSIS Significant Incidence Preparedness and Response Staff (SIPRS) compile and track data on significant incidents impacting FSIS regulated facilities, product, consumers, and personnel. SIPRS collects information related to regulated facilities that are at reduced operations or non-operational for reasons related to climate change, such as power outages, hazardous weather, and insufficient facility personnel or building damage/destruction related to extreme weather. Additionally, information is collected if FSIS employees are on leave or reassigned due to incidents related to extreme weather or displacement from their home. The data collected by SIPRS are utilized to develop situation reports that are provided to FSIS leadership, the Office of Food Safety, and the USDA Operations Center.

Some data specific to FSIS operations can be generated as needed. The following data and research may be useful to FSIS to inform decision making concerning climate change.

### 5.1 Data Needs on Risks to FSIS Employees

- Wet bulb temperatures inside establishments when there is an extreme heat event
- Local data on extreme weather events to determine impacts on FSIS employee safety and health

### 5.2 Data Needs on Risks to Animal Welfare

- Local data on extreme weather events to determine impacts on animal welfare
- Research on impact of increasing ambient temperatures on animal welfare (e.g., heat stress)

### 5.3 Data Needs on Risks to Food Safety

- Data on temperatures inside establishments to determine likelihood of increased carcass cooling times that could permit microbial growth
- Data on extreme weather events to determine whether there is an increase in power outages and whether this leads to microbial contamination
- Data on pathogen contamination over time to determine whether it can be correlated with extreme weather events
- Research on impact of extreme weather events/ climate change on food safety

The impacts on small establishments, very small establishments, establishments in rural areas, and establishments in underserved communities should be considered when addressing data and research needs.

## 6.0 Crosscutting Topics

### 6.1 Equity Issues – Small Business Support

FSIS has implemented several efforts in support of small and very small establishments in underserved or rural communities.<sup>13</sup> By supporting small and very small establishments, FSIS contributes to strengthening regional and local supply chains and to the USDA Food System Transformation framework’s goal of building a more resilient food supply chain while reducing carbon pollution.<sup>14</sup>

Some of the actions FSIS has taken in support of small and very small establishments include:

- New and updated guidelines and translations into several languages: FSIS continually publishes guidance materials to support small and very small establishments and to help them understand and comply with regulatory requirements. FSIS has translated several guidance documents into Chinese, Vietnamese, Spanish, and Arabic.
- Integrated Small Plant Help Desk with askFSIS: FSIS operates the Small Plant Help Desk to allow industry stakeholders to get their questions addressed by technical experts. FSIS personnel are available via email and phone, or via electronic submission, which is integrated with the askFSIS application. FSIS uses askFSIS, a web-based computer application and phone system to receive and respond to technical and policy-related questions from stakeholders.
- Small Plant Roundtables: FSIS holds Small Plant Roundtables between agency leaders and establishment owners and operators throughout the country in a hybrid format (i.e., in person and virtual attendance) several times a year. The agency shares updates and information with attendees and invites representatives from USDA agencies to share information relevant to small and very small establishments. Interpreter services are available on request.
- FSIS leadership holds monthly establishment town hall meetings to provide information on FSIS initiatives and requirements and to answer questions from participants. FSIS posts recordings of the monthly calls to the agency’s website.
- Direct outreach by FSIS personnel: Enforcement, Investigation and Analysis Officers dedicate up to 25 percent of their time to conducting outreach activities at small and very small establishments as part of their regular duties, to promote food safety, animal welfare and understanding of regulatory requirements. District Veterinary Medical Specialists visit new establishments during the initial 90 calendar days of operation to provide outreach on handling livestock humanely at slaughter establishments and handling poultry in a manner consistent with poultry good commercial practices.

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<sup>13</sup> Small establishments are defined as those with between 10 and 499 employees and very small establishments have less than 10 employees or \$2.5 million in annual sales ([61 FR 38806](#)). Combined, these represent over 90 percent of the total FSIS-regulated establishments.

<sup>14</sup> <https://www.usda.gov/media/press-releases/2022/06/01/usda-announces-framework-shoring-food-supply-chain-and-transforming>

- FSIS created a monthly newsletter for small and very small establishments, which includes relevant information for these establishments such as announcements for the FSIS Roundtables.

## 6.2 FSIS Employee Climate Literacy

Currently, FSIS provides training to employees on the specific aspects related to climate change that directly impact its workforce, such as training on how to avoid heat stress illness. This Climate Adaptation Plan will help to ensure that FSIS employees have a deeper understanding of the potential impacts of climate change on the FSIS workforce, animal welfare, and food safety hazards and the actions FSIS can take to mitigate these impacts. FSIS leadership and subject matter experts can introduce the plan to FSIS staff through employee town halls, seminars, and the employee newsletter.

## 7.0 Appendices

### 7.1 Team Members

This report was written by a team of FSIS employees, representing most offices within the agency:

Elizabeth Van Dyne, Office of Management, co-lead  
Isabel Walls, Office of Public Health Science, co-lead  
Heather Bopes, Office of Field Operations  
Christy Chanin, Office of Planning, Analysis and Risk Management  
Stephanie Defibaugh-Chavez, Office of Policy and Program Development  
Sarah Edwards, Office of Public Health Science  
Gamola Fortenberry, Office of Public Health Science  
Sally Ann Iverson, Office of Food Safety  
Sunil Kumar, Office of Public Health Science  
John Linville, Office of Policy and Program Development  
Scott Malcolm, Office of Public Health Science  
Lucy Touhey, Office of Management  
Ted Toussaint, Office of Management

### 7.2 Case Study

An FSIS supervisory employee works at a poultry slaughter facility where the outside temperature was over 90 °F for 83 days during June, July, and August 2023. This establishment does not have air conditioning on the kill floor, but fans are available to circulate air. Air conditioning is available in the FSIS break room. Temperatures on the kill floor inside the establishment were higher than outside.

The supervisor reviewed the annual FSIS summer communications campaign on tips to avoid heat stress and available cooling items available to employees. The supervisor shared this information with employees prior to the increase in temperatures.



On this day, the supervisor used her best judgment to determine that it was hot enough to potentially affect the health of FSIS employees. The FSIS supervisor ensured that water, hydration fluids with electrolytes, and cooling items such as cooling neck scarfs were accessible. She provided personnel so that on-line employees could take breaks to rest in the air-conditioned break room and rehydrate with hydration drinks provided by FSIS. Staff were rotated on and off the line regularly to give breaks from the heat of the environment.

To ensure animal welfare, as there can be a risk to live animals on a hot day, the supervisor verified good commercial practices (GCP) for the incoming poultry. When the poultry arrived for slaughter, she communicated with the establishment staff to minimize the time the animals spent sitting in a still, parked truck without air flow. She verified that the establishment followed the procedures listed in their live poultry receiving program, which included the use of misters in the receiving area. She documented that the misting stations were on and being used. She observed the poultry and noted that they were not displaying any major signs of heat stress. She verified that the animals were being handled according to GCP and reported no concerns.