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ISSUE BRIEF

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HEALTH AND CLIMATE CHANGE IN KANSAS

Few issues are as politically charged as climate change. According to many recent surveys, a majority of Americans believe that climate change is occurring, while opinions vary as to whether or not it is caused primarily by human activities. Among scientists, however, there is a strong consensus that our planet is warming and that the warming over the past 50 years has been caused primarily by human activities. Numerous studies indicate that the rising average temperature globally is associated with melting of snow and ice, particularly at the poles, rising sea levels and changes in weather patterns, such as extreme heat and precipitation. Changes in climate and weather patterns are impacted largely by changes in atmospheric gas concentrations, thereby prompting governments around the world to adopt regulatory policies to mitigate emissions.

Given that Kansas has a substantial agricultural industry, with an economy that is highly dependent on the weather, climate change is a substantial concern in Kansas. Additionally, research suggests that the projected climate changes are likely to have negative impacts on human health. This issue brief discusses the health conditions most likely to be exacerbated by key climate factors and examines the feasibility of using climate change literature and data sources to estimate impacts in Kansas.

Key Terms

Emissions: *Production of air pollutants and greenhouse gases that contribute to climate change and/or poor air quality.*

Mitigation: *Laws, policies and regulations that limit emissions.*

Greenhouse Gases (GHG): *Atmospheric gases that absorb radiant energy and warm the surface of the earth, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and ozone (O_3), as well as chlorofluorocarbons, hydrofluorocarbons and water vapor.*

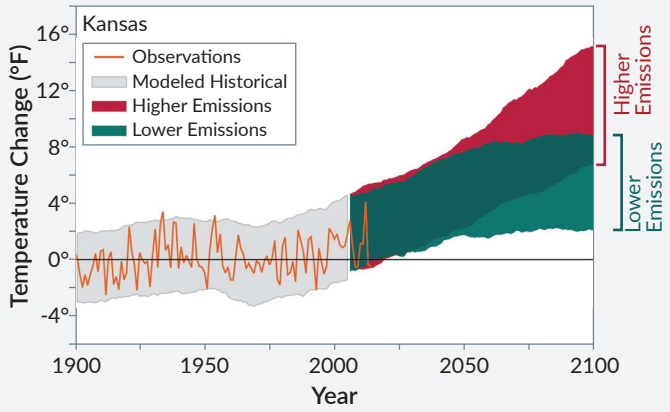
Air Pollutants: *Harmful gases, particles or molecules suspended in the atmosphere, including particulate matter (PM), carbon monoxide (CO), nitrogen oxides (NO_X), sulfur oxides (SO_X), volatile organic compounds (VOC) and ammonia (NH_3), among others. Some air pollutants can be GHGs or are precursors to GHGs.*

Particulate Matter (PM): *Microscopic liquid or solid particles suspended in the air, including pollen, mold spores, smoke particles, ozone and atmospheric dust.*

KEY POINTS

- ✓ As a result of global climate change, the major environmental effects expected in Kansas are increasing temperatures and more variable precipitation.
- ✓ The substantial agriculture industry in Kansas makes climate change a concern.
- ✓ Hotter, drier conditions affect the major areas of air quality concern: ozone (smog) and particulate matter (PM).
- ✓ Rates of cardiovascular diseases, respiratory diseases and other chronic conditions are likely to increase under projected climate change scenarios.
- ✓ A longer period for pollen production will expand the allergy season and worsen asthma symptoms.
- ✓ Warmer temperatures increase the length of the season for insect vectors, such as mosquitoes and ticks, of transmissible diseases.

Figure 1. **Observed and Projected Temperature Change**



Source: CICS-NC and NOAA NCEI; Frankson, R., K. Kunkel, L. Stevens, D. Easterling, X. Lin, and M. Shulski, 2017: Kansas State Climate Summary. NOAA Technical Report NESDIS 149-KS, 4 pp.

Predicting Changes in Climate

Weather describes the daily state of the atmosphere, with short-term forecasting spanning minutes to weeks. Typical weather conditions at a location over a long period of time, spanning decades to centuries, are described as climate. Climate models are used for forecasting weather in the short term and projecting changes in climate over the long term. Various scenarios are used to predict changes under certain emission mitigation conditions that impact temperature, air quality and weather parameters. There are multiple models available based on different mitigation assumptions. And while most of the models agree that the climate will change, the results vary from model to model. This variation is based primarily on the assumptions used, including the effects of emission mitigation strategies that could be implemented. Higher emission scenarios assume that new laws and policies designed to limit or mitigate the emission of greenhouse gases will be few to none. Lower emission scenarios assume a greater number of more aggressive policies to limit emissions being implemented. Scenarios projecting growth in emissions or minimal mitigation result in worsening air quality, greater warming and more health impacts.

Changes in the Kansas Climate

The major climatic changes expected to occur in Kansas are increasing temperatures and more variable precipitation. Temperatures are projected to rise in all seasons throughout the state ranging from 2°F (low emission scenario) to more than 14°F (high emission scenario) by the year 2100 above the average between 1901 and 1960 (Figure 1). Higher temperatures mean more heat waves and frost-free days. Cold spells will decrease in length and intensity. Already, the freeze-free season in Kansas has become longer by an average of nine days in the 21st century than it was in the 20th century. The frequency of extreme precipitation in Kansas has been variable over the past few decades, but with higher than average numbers of 3-inch rain events during 1995-1999 and 2005-2009. Climate change models project an increase in winter precipitation in Kansas. However, under a higher emissions pathway model, rain frequency is projected to decrease 5-10 percent in the summer months by the year 2050 and become less predictable, with longer droughts, greater evaporation rates and drier soils.

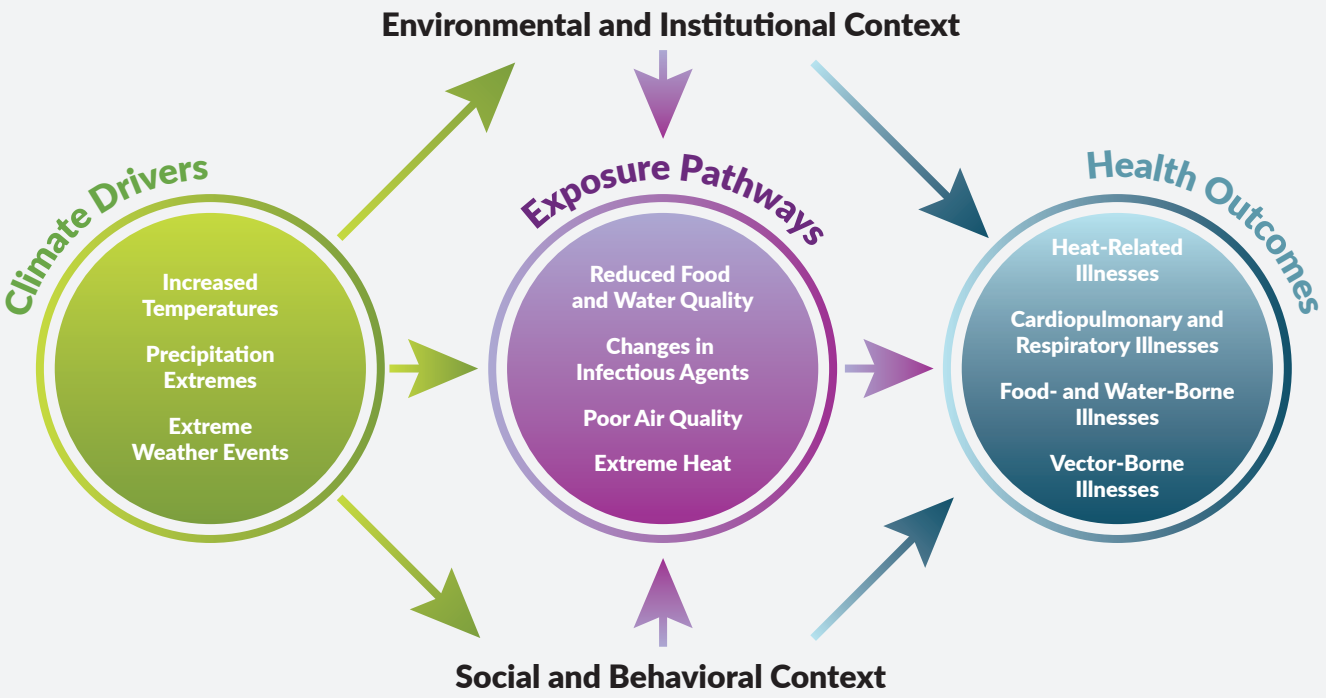
Projections suggest that eastern and western Kansas will be affected in different ways. Western Kansas likely will become warmer and drier, with temperature increases in the summer and fall, and a decrease in spring rains. The eastern part of the state is projected to become warmer and wetter. Yet, despite more precipitation, higher temperatures may negate any contributions to soil moisture due to higher evaporation rates.

The projected hotter, drier conditions in some areas of the state also are likely to affect the major areas of air quality concern: ozone (smog) and particulate matter (PM). The highest ozone levels in Kansas occur during summer in response to heat and are most pronounced over urban areas. PM has a long history of impacting air quality in Kansas via dust and smoke caused by dry weather conditions. Ozone and PM can stay suspended in the air and are carried by the strong Kansas winds over large areas, increasing the chances of exposure to more people.

Health Impacts

A conceptual model (Figure 2, page 3) shows the exposure pathways through which changes in climate can impact human health. Climate drivers create exposure pathways that interact with other factors (e.g., social, behavioral, environmental, institutional) to affect health outcomes. The extent to which climate change impacts the burden of disease depends on local climate factors, individual and population vulnerabilities,

Figure 2. **Climate Exposure Pathways Impact Health**



Source: Adapted by KHI from Balbus, J., Crimmins, A., Gamble, J. L., Easterling, D. R., Kunkel, K. E., Saha, S., & Sarofim, M. C. (2016). Ch. 1: Introduction: Climate Change and Human Health (pp. 25–42). U.S. Global Change Research Program, Washington, D.C.

environmental exposure and capacity to manage risk. For example, rates of cardiovascular diseases, respiratory diseases and other chronic conditions are likely to increase, particularly among vulnerable populations, under projected climate change scenarios. Also, people with dementias, mental illness and disabilities are more vulnerable during extreme weather events such as heat waves, floods and tornadoes.

In Kansas, extreme heat and air quality are the pathways most likely to have the largest impact on health.

Temperatures

Exposure to higher temperatures and extreme heat can increase body temperatures to unsafe levels, stressing vital organs – such as the heart, lungs, kidneys and brain – and increase the risk of heat stroke and other heat-related injuries or illnesses. Hospitalizations for respiratory and cardiovascular conditions have been observed to increase during extreme heat days, particularly for chronic airway obstruction, asthma, ischemic heart disease and cardiac dysrhythmias. Hospitalizations and deaths due to heat-related causes vary substantially from year to year in Kansas. Between 2000 and 2014, heat-related illness hospitalizations ranged from a low in 57 in 2004 to a high of 180 in 2011. The heat-related death toll between 2000 and 2012 was also highest in 2011, at 37. Fewer than 5 deaths occurred in 2002, 2004 and 2010. The true burden is likely much higher, as these numbers reflect only those deaths in which exposure to excess heat was listed explicitly on the death certificate.

The elderly, very young, people with certain medical conditions, urban residents and laborers working in extreme heat are at greater risk of dying from heat stress. Studies report increases in cardiovascular and respiratory mortality, higher kidney failure rates and more hospital admissions among older adults during heat waves.

Prolonged exposure to extreme heat increases perspiration and decreases urination, which stresses the kidneys, leading to kidney stones and chronic damage over time. The 50-percent higher prevalence of kidney stones in the southeastern part of the country versus the northwest has led the former to being called the "kidney stone-belt." As temperatures rise across the country the stone-belt is projected to spread northward, encompassing Kansas by 2050.

Warmer temperatures increase the length of the season for insect vectors of transmissible diseases. Fewer hard winter freezes will contribute to more mosquitoes and ticks, increasing the risk of insect-borne diseases such as West Nile virus and Lyme disease. Since 1970, the risk of disease transmission by mosquitoes has increased by 13 days per year in the northern part of Kansas, and 18 days in the southern part. Mosquito-borne disease cases were 35 percent higher in 2016 than in 2004. Kansas has experienced a dramatic increase in tick-borne diseases cases, which were 20 times more common in 2016 (251) than in 2004 (12).

Air Quality

Ozone and PM less than 10 microns (PM10) can be inhaled into the lungs, causing airway muscles to constrict, trapping air in the lung alveoli. Particles smaller than 2.5 microns (PM2.5) can penetrate deeper into the lungs and enter the circulatory system. Impacts range from minor upper respiratory irritation, wheezing and shortness of breath, to acute respiratory infections and chronic conditions such as chronic obstructive pulmonary disease (COPD), lung cancer, aggravation of heart and lung conditions, and asthma attacks. Short- and long-term exposures to PM2.5 are linked with reduced life expectancy.

Warmer temperatures lead to a longer plant growing season and greater pollen production. The mid-section of America has seen the pollen season increase by 10-18 days since 1995. A longer period for pollen production will expand the allergy season and worsen asthma symptoms. Allergies and asthma also will worsen in response to higher levels of CO2 and pollutants in the air. Higher CO2 concentrations increase the amount of ragweed pollen, the main contributor to hay fever. Air pollutants (particulate matter, CO, NO2, SOX) have been shown to increase the effects of aeroallergens (fungal spores, tree and weed pollens) in people with asthma.

Can Future Health Impacts be Estimated for Kansas?

Researchers have attempted to quantify the future impact of climate change on health at the regional, national and global levels. Can these studies be used to predict what will happen in Kansas, specifically, regarding increases in deaths, illnesses and injuries? The greatest sources of uncertainty in predicting health impacts are the climate modeling system and emission mitigation scenario used. The base epidemiological study and data, and population projection used, also are important. As a result, predictions vary markedly. For example, studies on ozone-related mortality suggest that by 2030, the number of additional deaths in the U.S. could range from 12 to 2,500.

Given the inherent variability in the methods and scenarios used by researchers, precise quantitative projections from the present literature are difficult, particularly for smaller geographic areas like states. However, some aspects of the potential health effects of climate change, such as temperature and air quality on mortality, have been widely studied. While research to quantify other medical and social impacts has been more limited, epidemiological studies and models suggest that the prevalence of cardiovascular, respiratory and certain other chronic diseases will increase in response to higher temperatures and declining air quality.

It is imperative that state and local governmental officials and other stakeholders in communities across Kansas develop strategies to mitigate the potential negative health effects as they develop climate preparedness and resiliency plans.

For more information about this subject, visit khi.org for the list of reference materials used in this analysis.

ABOUT THE ISSUE BRIEF

This brief is based on work done by Steve Corbett, Ph.D., Jason M. Orr, M.P.H., and Charles Hunt, M.P.H. It is available online at khi.org/policy/article/19-35.

KANSAS HEALTH INSTITUTE

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