

Excess Moisture and Crop Loss in Pennsylvania

Introduction

Agriculture is a pillar of the state's economy, with diverse crops such as corn, soybeans, tomatoes, apples, and specialty crops like grapes and peaches. However, the state's agricultural sector faces increasing risks from climate change, particularly due to excess moisture and flooding. Recent studies show that Pennsylvania farmers are receiving growing payments for crop losses caused by these conditions, emphasizing the significance of understanding this threat [1].

This report highlights the impact of excess moisture and flooding on agriculture, utilizing indemnity payments reported by the U.S. Department of Agriculture (USDA) Risk Management Agency (RMA) available through the USDA Southwest Climate Hub's AgRisk Viewer [2].

Excess Moisture and Flooding Events

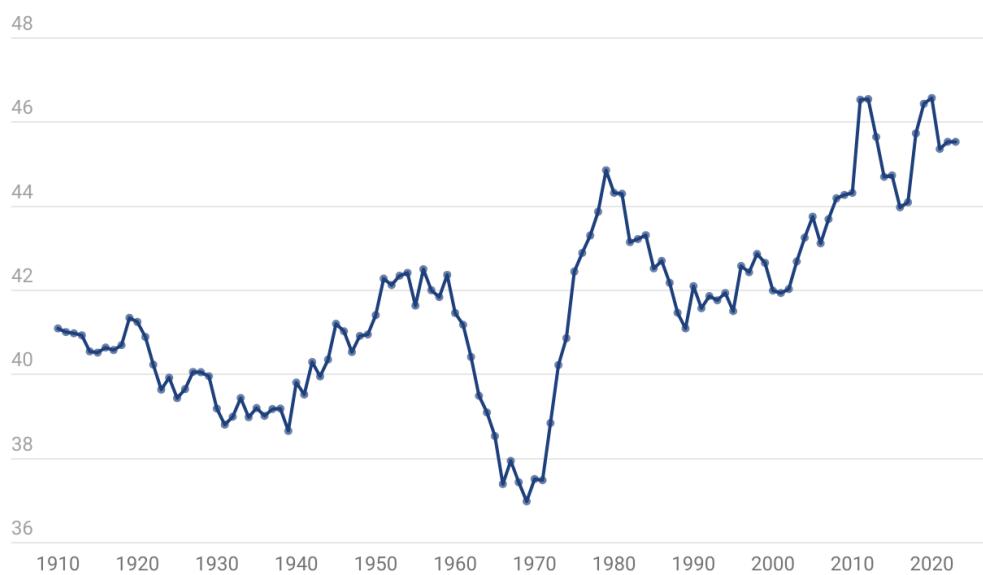
Pennsylvania's climate is projected to experience significant changes in precipitation patterns. From 1989 to 2023, excess moisture, precipitation, and flooding were among the leading causes of crop losses in the state, accounting for a significant portion of federal crop insurance indemnity payments.

By mid-century, Pennsylvania could see an 8-12% increase in total rainfall, with more intense rain events during critical growing periods [3]. Historical analysis has shown that excess moisture and flooding, particularly during the spring and early summer months, have led to substantial crop damage.

Figure 1 shows the ten-year moving average for annual average precipitation in inches across Pennsylvania stations. This trend has been most pronounced in recent years, particularly in 2018 and 2020, when record-level rainfall led to widespread flooding in agricultural areas. As precipitation continues to rise, crop losses due to excess moisture are likely to intensify, putting greater pressure on farmers and insurance programs.

Historic Precipitation Trend in Pennsylvania

Annual precipitation in inches. Right-aligned, ten-year moving average (1900-2023) for select* GHCN stations in Pennsylvania.



* Stations selected on completeness of observations during their operation, with a minimum of data for at least 70% of its monthly records.

Chart: PA State Data Center • Source: NOAA NCEI Climate Data Online • Created with Datawrapper

Use [this link](#) to explore the interactive version of this graphic.

Crop Loss in PA Due to Excess Moisture

The crop loss data used in this report represents indemnity payments made through the USDA crop insurance programs. These payments reflect compensation for losses reported by farmers, particularly due to excess moisture, over the period from 2017 to 2023.

Indemnity payments were normalized by the total acreage of harvested cropland by county as of the 2022 Census of Agriculture. This standardized approach helps identify counties with the most severe per-acre losses, regardless of their total farm size.

Between 2017 and 2023 in Pennsylvania, the total indemnity payments across all causes of crop loss amounted to over \$284.8 million. Of this, excess moisture alone accounted for \$76.1 million, which represents 26.7% of the total payments.

Trends by Season

An analysis of seasonal data shows that most crop losses occur between April and July. Excess moisture tends to be most detrimental during the spring and early summer months when crops are in critical growth phases. This is consistent with meteorological trends indicating higher precipitation levels during these months.

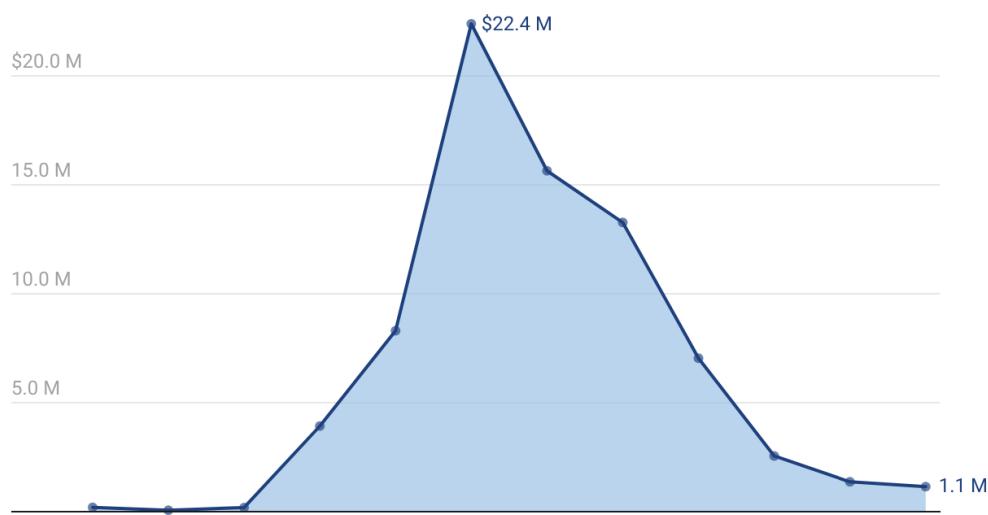
Figure 2 shows the seasonal pattern of crop losses from 2017 to 2023. The highest crop losses due to excess moisture occur during the April to July period, coincide with the critical stages of planting and crop development. As shown in the chart, peak losses occur in June, followed by a decline in July.

During this time, crops are highly vulnerable to flooding and waterlogging, leading to delays in planting and potential crop damage. After

July, losses decline steadily, as the growing season comes to an end and crops mature, making them less susceptible to excess moisture. Conversely, during the winter months (December to March), farming activities are minimal, resulting in very low indemnity payments.

Monthly Total Indemnity Payments for Excess Moisture

Total dollar value of indemnity payments attributed to excess moisture from 2017 to 2023.



Dollar values are in nominal dollars.

Chart: PA State Data Center • Source: USDA Southwest Climate Hub • Created with Datawrapper

Use [this link](#) to explore the interactive version of this graphic.

Trends by County

An analysis of crop loss data reveals that excess moisture and precipitation have been a significant cause of crop damage in Pennsylvania, with several counties bearing the brunt of these weather events. Figure 3 shows the total indemnities for crop loss due to excessive moisture per acre of total cropland by county from 2017 to 2023.

The top five counties with the highest indemnity payments per acre for excess moisture are Adams (\$140.7), Carbon (\$136.7), Venango (\$93.1), Mercer (\$54.0), and Monroe (\$42.1).

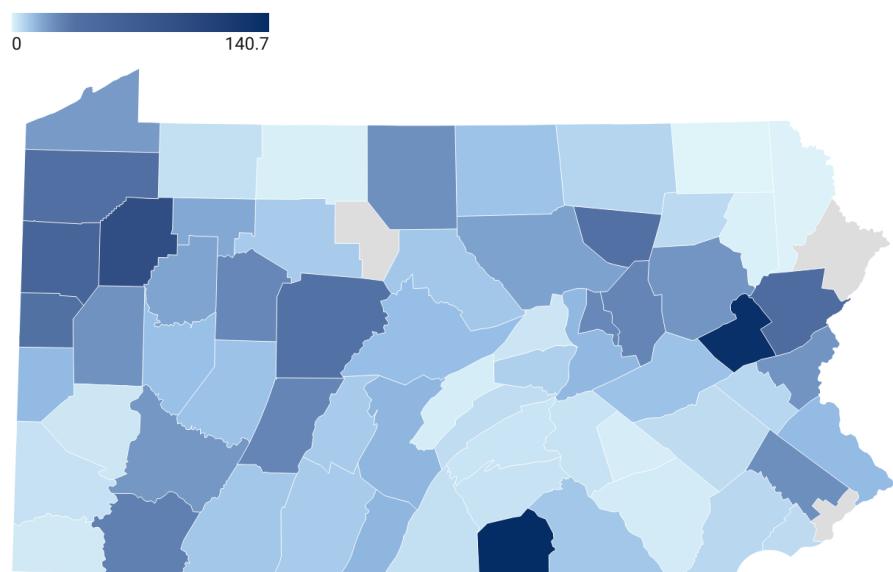
Trends by Crop Type

Certain crops are more susceptible to excess moisture compared to other environmental hazards. Figure 4 shows major crops most impacted by excess moisture, showing the total indemnity of the crop to divided by the amount of indemnity attributed to excess moisture.

Tomatoes have been the most affected crop by excess moisture and flooding, representing over 70% of payments received for weather-related losses between 2017 and 2023. Other crops like Wheat (64.9%), Oats (58.7%), Barley (56.6%), Potatoes (53.9%) and Processing Beans (51.1%) all owe over half of their total indemnities to excess moisture.

Crop Indemnities Attributed to Excess Moisture Per Acre

Total indemnity payments that were attributed to excess moisture from 2017 to 2023 per acre of total cropland.

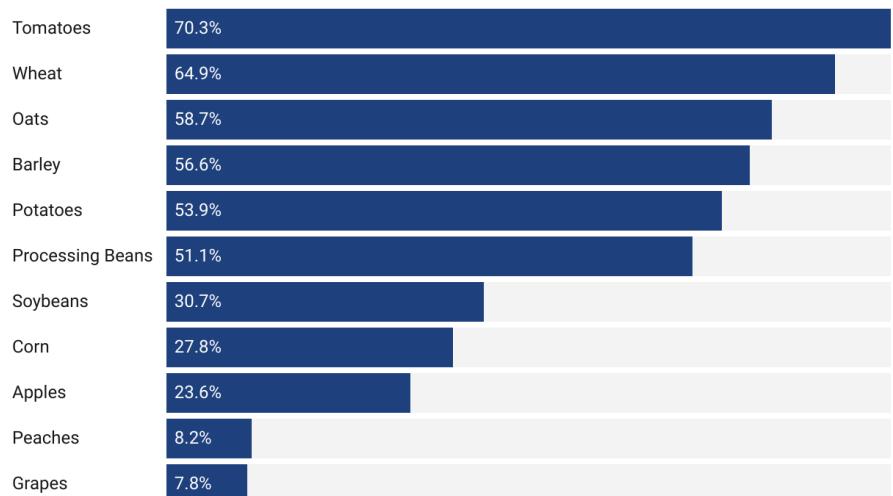


Map: PA State Data Center • Source: USDA Southwest Climate Hub • Created with Datawrapper

Use [this link](#) to see explore interactive version of the graphic.

Crop Indemnities Attributed to Excess Moisture

Percent of total indemnity payments that were attributed to excess moisture for select crops from 2017 to 2023 with non-zero indemnity payments.



Tomatoes and Corn include Fresh Market crops.

Chart: PA State Data Center • Source: USDA Southwest Climate Hub • Created with Datawrapper

Use [this link](#) to explore interactive version of this graphic.

Mitigation and Adaptation Strategies

Farmers in Pennsylvania are actively seeking ways to mitigate the impact of excess moisture and flooding on their crops. Strategies include installing advanced drainage systems, using drought-tolerant crop varieties that can also withstand periods of excess water, and adopting climate-resilient agricultural practices.

The findings suggest that after Adams and Carbon western counties like Crawford, Mercer, and Erie are particularly susceptible to excess moisture, which aligns with local precipitation patterns and soil conditions that exacerbate flooding and waterlogging.

Targeted Mitigation Efforts include Drainage Infrastructure, Crop Insurance Expansion, Climate-Resilient Crops, and Early Warning Systems, among others. Read more about mitigation efforts in [Pennsylvania Climate Impacts Assessment 2021](#).

Conclusion

The analysis presented in this report highlights the growing threat that excess moisture and flooding pose to Pennsylvania's agricultural sector. As climate change continues to influence weather patterns, these risks are expected to increase.

Farmers in high-risk counties will need to adapt through both infrastructure improvements and the adoption of more resilient agricultural practices. The data highlights the importance of proactive planning and investment in climate-smart agriculture to protect the state's economy and food security.

Credit:

Medha Devalraj, MSIS '25, Research Specialist Intern, Institute of State & Regional Affairs

Sources:

1. Imhoff, Kyle Alexander, Suat Irmak, and Meetpal Kukal. "What Does Insurance Loss Data Tell Us About Climate Risks to Agricultural Production?" Pennsylvania State Extension, March 9, 2023. [Document Link](#).
2. Reyes, J., and E. Elias. "Spatio-Temporal Variation of Crop Loss in the United States from 2001 to 2016." *Environmental Research Letters* 14, no. 7 (2019). [Document Link](#). Tool accessed at climatehubs.usda.gov/.
3. Klenotic, Deborah. "Ten Tools to Take Climate Action in Pennsylvania." Pennsylvania Department of Environmental Protection, November 17, 2021. [Document Link](#).

The Pennsylvania State Data Center is the commonwealth's official source for population and economic statistics. It is based at Penn State Harrisburg's Institute of State and Regional Affairs. The Pennsylvania State Data Center is part of the U.S. Census Bureau's National State Data Center Program.

Questions? Contact the Pennsylvania State Data Center at via email: pasdc@psu.edu