

# Water Insecurity

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## Executive Summary

Analysis of water insecurity data enables the production of insightful maps of water resources and infrastructure nationwide in the US. These maps show socio-economic elements like housing and indoor plumbing that affect water use and needs. We integrate ACS data to help water resource managers and policymakers identify vulnerable people and infrastructural needs.

## Introduction

Effective water management and policymaking need to understand the intricate relationship between socio-economic factors and water supplies. Annually updated, the U.S. Census Bureau's American Community Survey (ACS) provides demographic, social, economic, and housing data. The `water_insecurity_2022` and `water_insecurity_2023` datasets used in this study are compiled from relevant indicators within the ACS to answer: 1. How is indoor plumbing insecurity spatially distributed across US counties in 2022 and 2023? 2. What are the significant county-level changes in plumbing insecurity between these years? 3. How do these county-level rates compare to the national average for plumbing access?

## Methodology

This report explores the spatial and temporal variation in USA water insecurity levels utilizing the `water_insecurity_2022` and `water_insecurity_2023` data sets.

The spatial distribution of USA water insecurity was mapped using the `dplyr` and `purrr` packages for 2022 and 2023 separately. In this way, it can see if there are differences in indoor plumbing availability between western and eastern counties in the United States. (Figure 1 Figure 2)

The lacking of intact indoor plumbing is analysed by mapping the regional distribution of changes in plumbing insecurity by county through changes in the number of in Plumbing Insecurity from 2022-2023. The map visualisation and colour differentiation shows the regional distribution and drasticness of changes in plumbing facilities.(Figure 3)

We compare each of the counties to the national average so that we can see whether the lack of plumbing facilities in each county is higher or lower than what is typical across the United States. In addition, the maps are used to visually highlight the relative condition of counties, clearly depict their deviation from the national average, and illustrate regional patterns and differences.(Figure 4 Figure 5)

This Comparative analysis of county-level 2022-2023 data on the percentage of counties lacking piped facilities across the U.S. using bar charts reveals that the top 10 counties with the largest changes show a clear trend of differentiation. This reflects the dramatic localized changes in county-level water supply infrastructure across the United States. Such changes may be influenced by regional differences in economic development, infrastructure investment priorities, and socioeconomic context. (Figure 6)

Percent of Households Lacking Plumbing Facilities  
by USA County (2022)

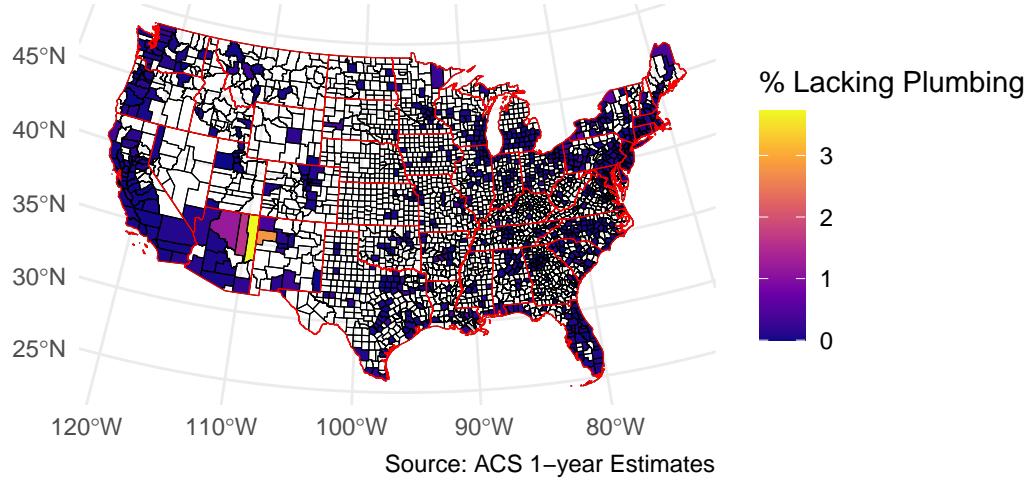


Figure 1: Percent of Households Lacking Plumbing Facilities by USA County (2022)

Percent of Households Lacking Plumbing Facilities  
by USA County (2023)

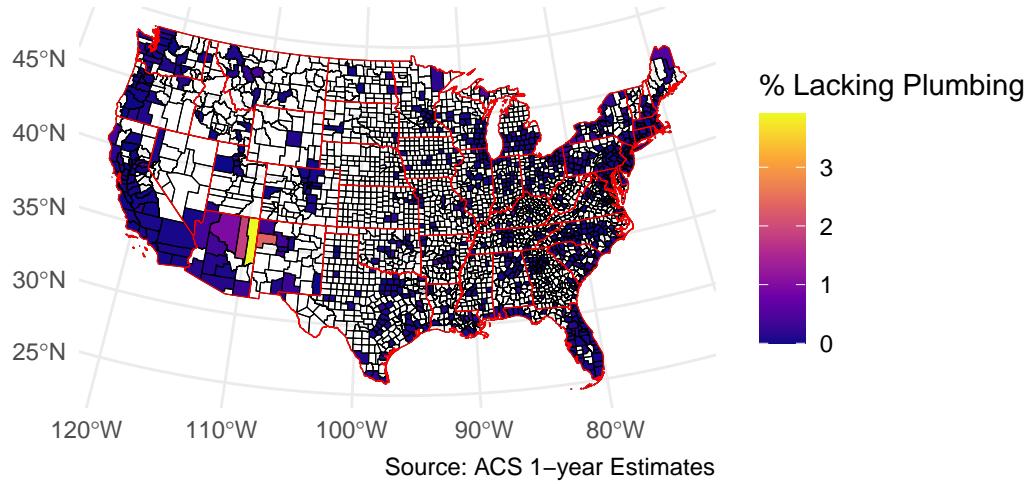


Figure 2: Percent of Households Lacking Plumbing Facilities by USA County (2023)

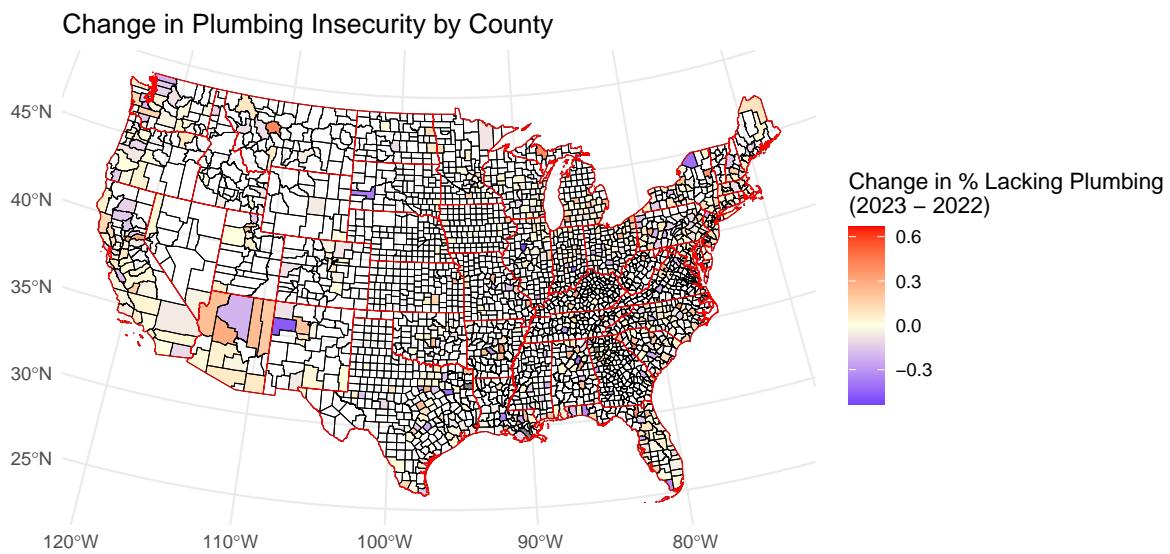


Figure 3: Change in Plumbing Insecurity by County

Differences in the proportion of regions lacking  
indoor plumbing relative to the USA average  
USA mean: 0.1 %

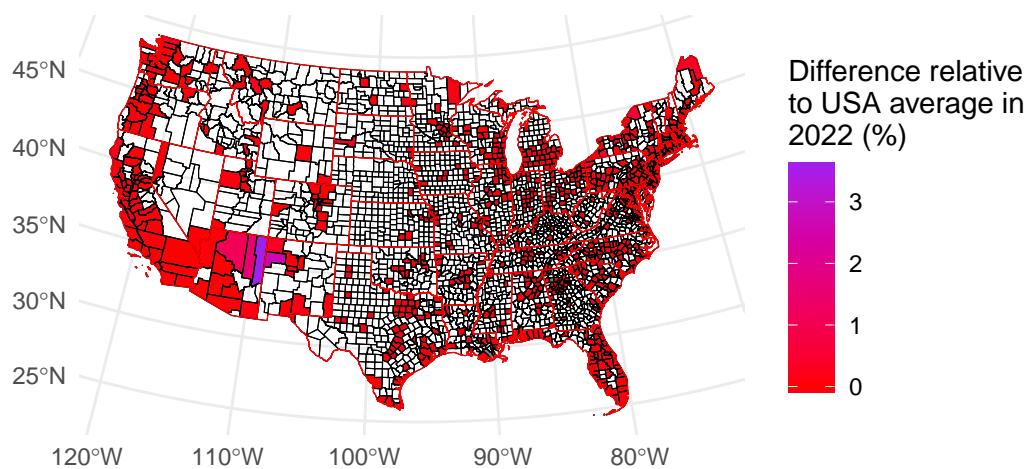


Figure 4: Differences in the proportion of regions lacking indoor plumbing relative to the USA average(2022)

Differences in the proportion of regions lacking  
indoor plumbing relative to the USA average  
USA mean: 0.1 %

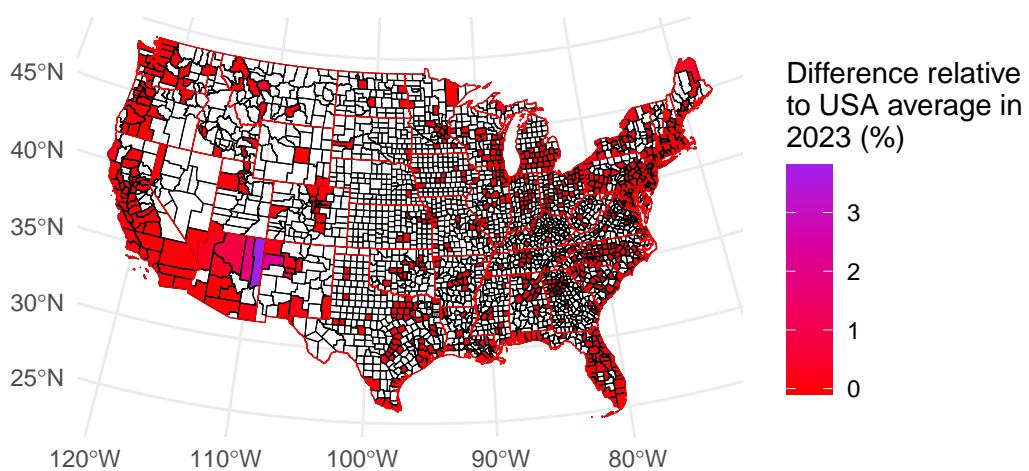


Figure 5: Differences in the proportion of regions lacking indoor plumbing relative to the USA average(2023)

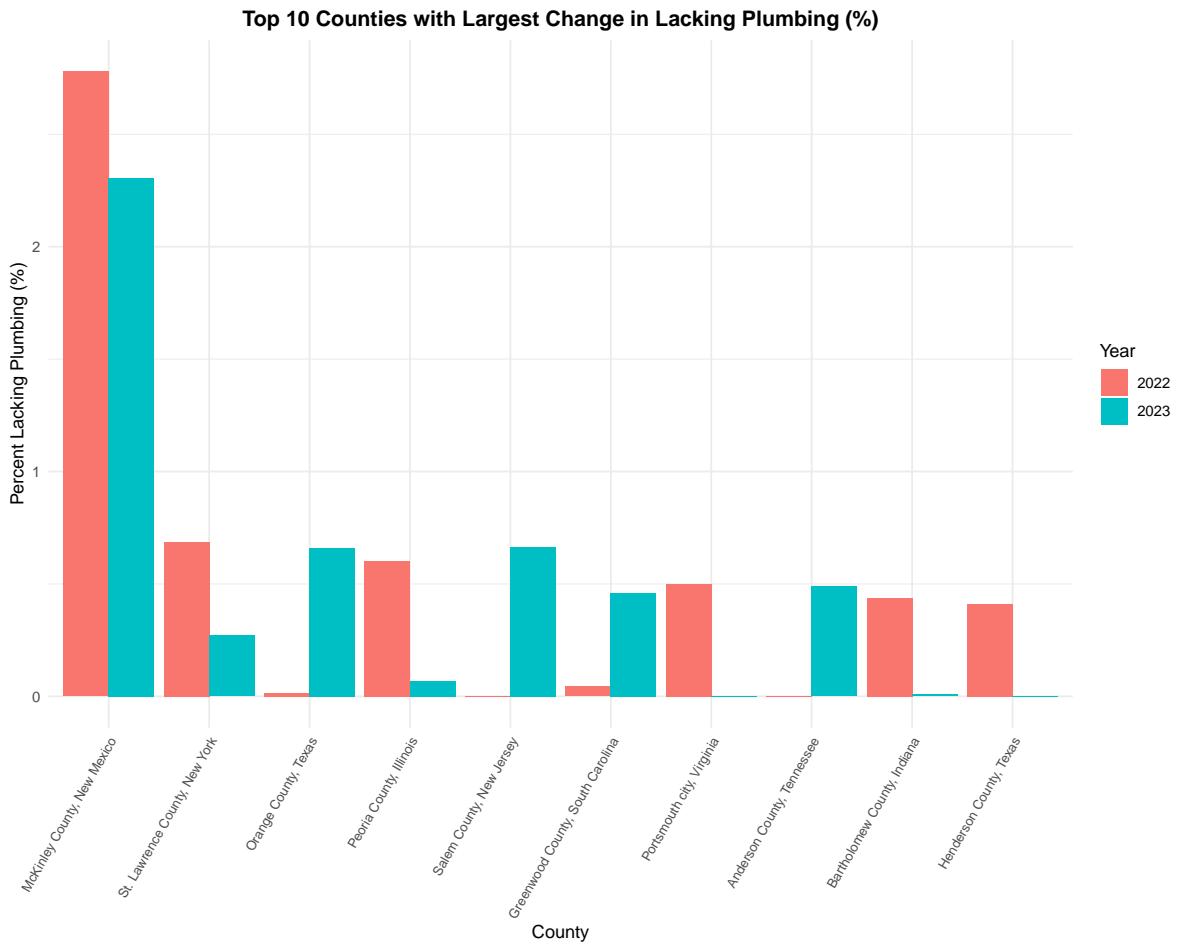


Figure 6: Top 10 Counties with Largest Change in Lacking Plumbing(%)

## Results

Based on Figure 3, it can be concluded that the majority of Change in Plumbing Insecurity is concentrated in the western United States. Changes in the eastern U.S. are concentrated in only a scattering of counties. The situation in 2023 improves slightly compared to 2022, but high-risk counties are still concentrated, suggesting that local water security and infrastructure investments still need to be further strengthened.

The Western compared to the national average shows a generally higher percentage of lack of indoor plumbing than the national average. This indicates that the West is significantly weaker than the national average in terms of indoor plumbing availability. (Figure 4)

The majority of eastern counties show red (near 0%) or slightly higher values, indicating better accessibility. This indicates that the East is on par with the national average in terms of indoor plumbing availability. (Figure 5)

The top 10 counties with the highest percentage of households lacking plumbing as well as the greatest change in 2022-2023 are shown through Figure 6.

### **Discussion, conclusion and recommendations**

End of Report