North America Residential Water Usage Trends Since 1992
[Project #4031]

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OBJECTIVES:
The purpose of this study was to investigate trends in household water usage in North America during the past 30 years and draw preliminary conclusions on the magnitude and causes of declining usage per residential customer. The study focused on (1) understanding residential water-usage behavior patterns and trends, (2) assessing the impact of those patterns on water utility operations, and (3) providing data that can be correlated with future trends for planning purposes.

BACKGROUND:
The decline in residential water usage per customer has occurred as the number of residents and households continues to grow and as household incomes continue to rise. A variety of theories have been advanced to explain the declining usage, including wetter weather, changes in household size and type, water-conserving fixtures and appliances, customer classification anomalies, and price increases. However, to date, no definitive statement has been made as to the validity of these theories or the amount each contributes to residential water-usage decline. For utilities to both encourage conservation and have sufficient financial reserves for maintenance and growth, it is necessary to better understand how water-use patterns have changed over the last 30 years, what factors are driving usage, and how these factors might impact utilities in the future.

APPROACH:
The purpose of this research was to quantify residential water-use changes across North America observed during the past 30 years. The study consisted of three elements, beginning with a macro view of the issue and developing into a micro view, with assessments of household water consumption behavior at the national, regional, and local levels.

The national trends component of the study analyzed the historic databases of 43 representative utilities. The analysis estimated the statistical relationships among six variables over time: utility size, water source, ownership type, precipitation zone, temperature zone, and drought index. The regional component of the study examined the specific experiences reported by 11 utilities who agreed to participate and provide background information and data. The local component assessed the independent impacts of many water-conservation fixtures and household demographics.

RESULTS/CONCLUSIONS:
This research documents a pervasive trend toward lower water usage per household. The national and regional components of the study found that residential water usage per customer has decreased more than 380 gallons annually over the last three decades. Similar to the national and regional findings, the local study with Louisville Water Company showed a reduction in water usage per residential customer. The magnitude of the decline is consistent across North American utilities and is confirmed by more detailed data provided by the study’s 11 partner utilities, although there were annual variations due to regional factors. The results of the
The study's statistical models identify the magnitude of both positive and negative forces affecting water usage. The decline in number of residents per household is clearly an important factor in falling water consumption per residential customer. However, the negative consequences of smaller households appear to be more than offset by the positive consequences of higher household incomes. Higher incomes have led to larger homes, with more water-using appliances, and more landscape irrigation. Thus, the net decline in water usage per household appears to be due to the steady penetration of low-flow appliances over the past 20 years.

APPLICATIONS/RECOMMENDATIONS:

Developing Management Plans
The steady decline in usage per household has important financial-planning consequences for water utility companies, as infrastructure is spread over more housing units using less water than before. The data compiled in this research are intended to assist utilities in developing realistic management plans that take into account the primary causes of declining residential water usage. The data provide a tool for projecting residential water usage in light of utility-specific trends. Utilities serving communities with growth in single-occupant households are likely to see erosion in revenues per household. Additionally, new federal regulations governing water-conserving appliances and fixtures further indicate that residential water usage will continue to decline as newer homes make up a larger component of the housing stock. Utilities may find it useful to track persons per household in addition to number of households as they plan infrastructure and set rates.

Standardized Classification and Data Management Practices
Researchers faced difficulties in obtaining accurate data for measuring usage and identifying patterns. Water-usage data obtained from utilities reflect information captured for billing and metering reasons, not for analysis. It is challenging to assemble consistent household water-usage data over time across utilities because of the lack of universal metering practices, a standardized method for classifying customers, and maintaining databases. Thus, it is recommended that standardized customer classifications and database maintenance practices be established.

Local Level Studies
Though the water usage model developed for this study provides valuable insight into the detailed structure of residential water usage, these models are still weak in explaining the huge variations in residential water usage among the participating utilities. Others studies have also found only weak relationships between water usage and traditional socio-economic and physical factors. Further research is needed on other demographic and housing variables to obtain a more comprehensive understanding of the determinants of residential water usage, especially in areas periodically affected by water stress.

For a utility to adequately understanding the local factors influencing residential usage, it needs to conduct an in-depth demographic study of existing customers. Combining this information with daily household usage data gathered via data logging allows utilities to gain valuable insight into the impacts of local factors on residential water usage. The model employed in this study provides a reasonable methodology for utilities to adopt and extend.

RESEARCH PARTNER:
USEPA

PARTICIPANTS:
Fifty-four North American water utilities participated in this project.