

Analysis of Domestic Water Demand under Different Drought Conditions: A Case Study of Hunan Province, China

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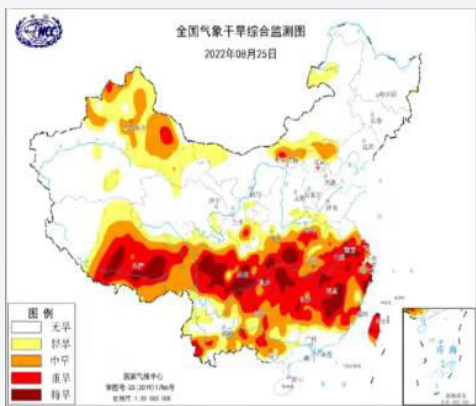
China Institute of Water Resources and Hydropower Research

Content

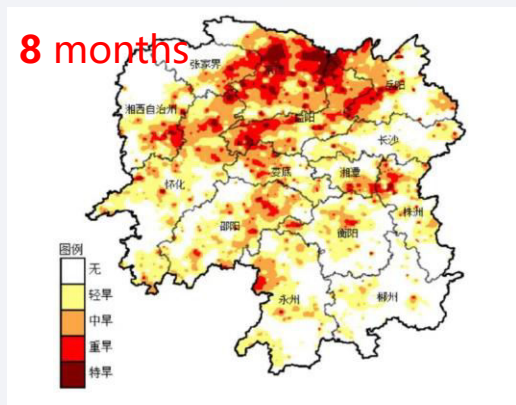
- Introduction
- Methodology
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- Conclusions

1.Introduction

- ❑ The frequency of heatwaves and drought events is steadily increasing.



Drought in China,2022



Drought in Hunan,2023

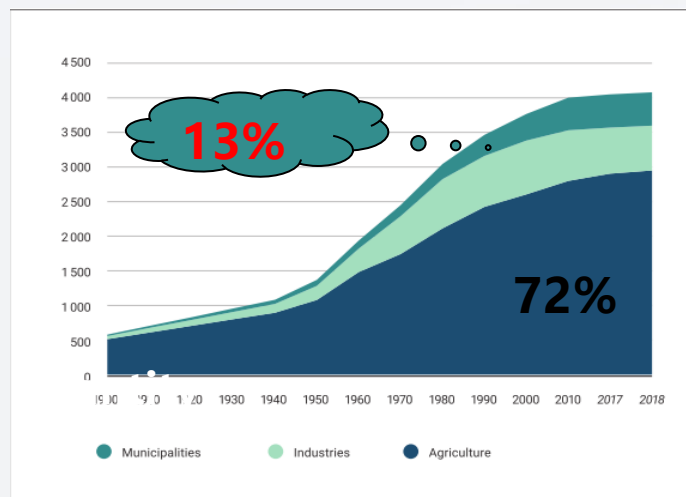


Dongting Lake

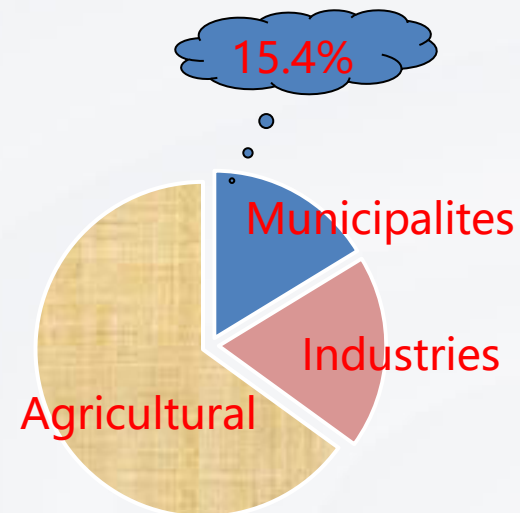


Hazards of drought

- ❑ The water consumption of households is basically close to industrial water consumption.



Global Water Use from 1990 to 2018



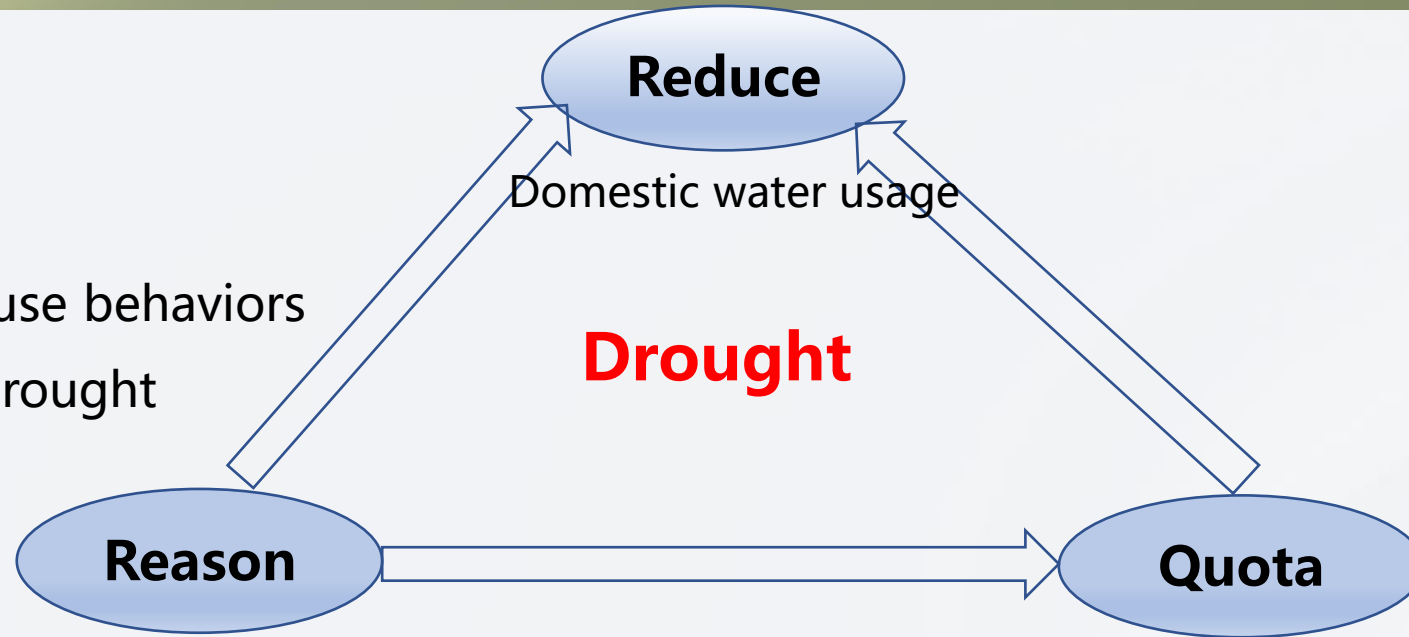
Water Usage in China

- **Reducing** urban household water consumption is an important way to alleviate water stress during drought periods.

1. Introduction

Why and How

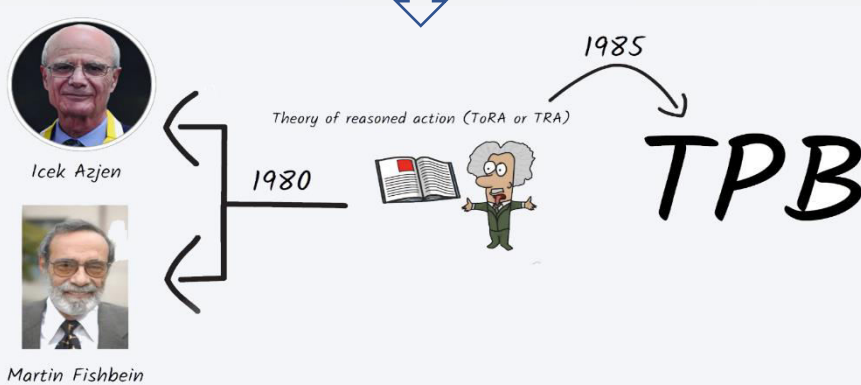
urban household water use behaviors can be changed under drought conditions.



Explored the socio-psychological factors

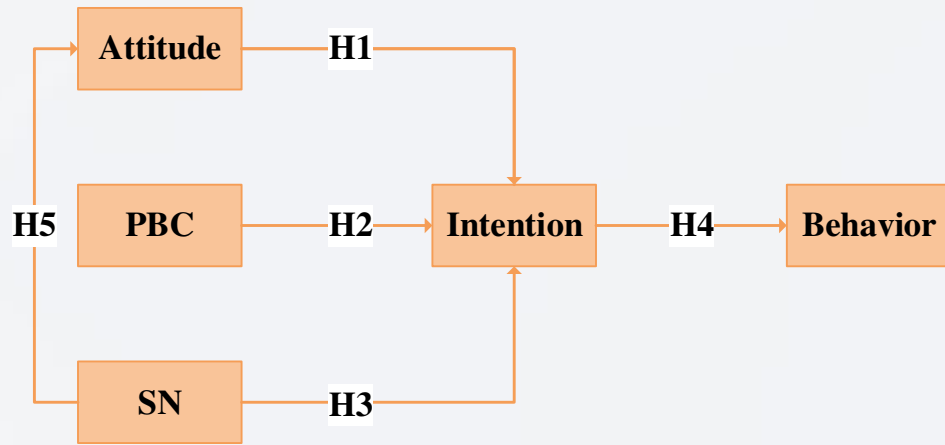
Calculated the water and the compressible proportion

Theory



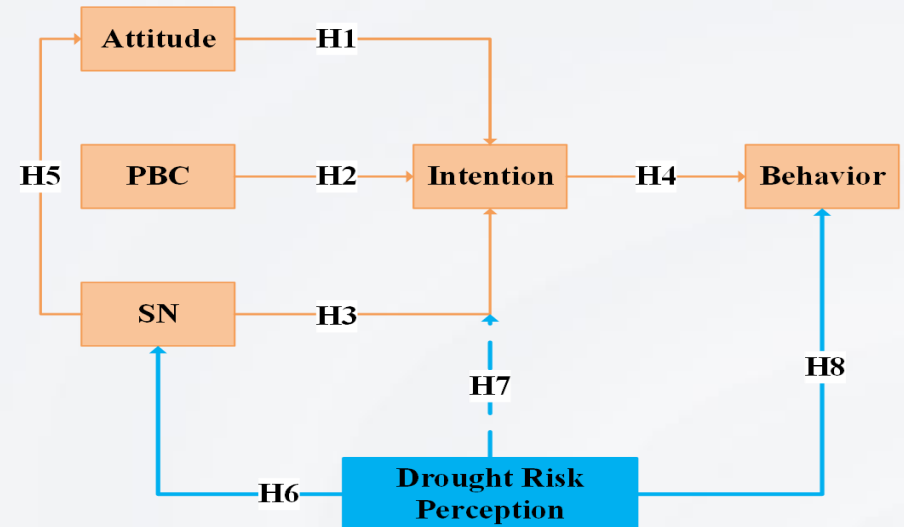
2. Methodology

Theory of Planned Behavior (TPB)



- **Attitude, subjective norm (SN) and perceived behavioral control (PBC)** directly influencing behavioral intention and indirectly affects individual behavior.
- **Intention** is the most direct indicator of individual **behavior**.

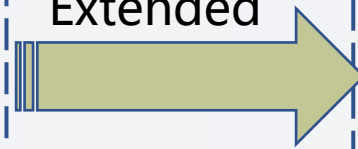
Extended Theory of Planned Behavior (ETPB)



Introducing **drought risk perception** variable

- **Risk perception** is a subjective judgment people make about the characteristics and severity of a specific risk.

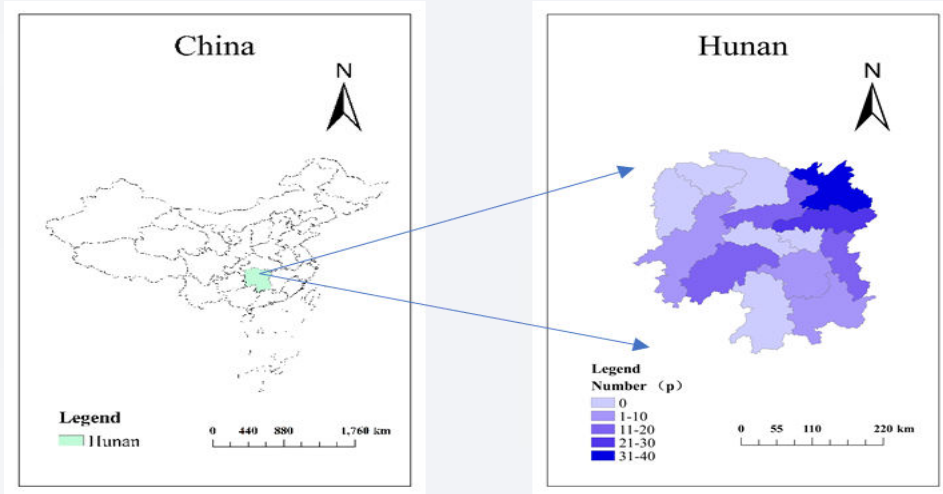
Extended



- TPB and ETPB are used to analyze how variables consciously influence an individual's behavior in order to make predictions and explanations.

2. Methodology

- Hunan Province is located in the middle reaches of the Yangtze River.



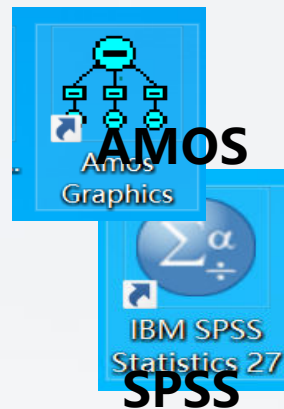
- A questionnaire survey (125p)
 - The first part includes the **basic personal information** of the respondents;
 - The second part comprises questions measuring the TPB/ETPB **principles**.
 - The third part focuses on the **elastic water consumption segment**.

The measurement variables use a **Likert five-point scale**

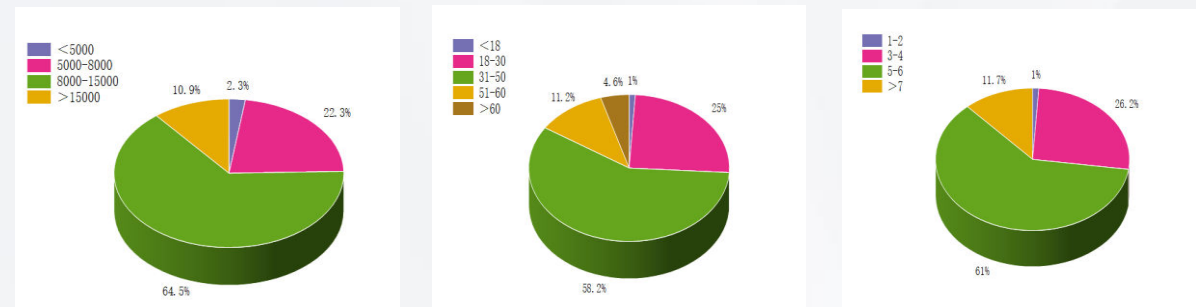


- Structural equation modeling

SEM is a multivariate statistical method that analyzes the relationships between variables based on the variable covariance matrix, providing a quantitative method for hypothesis testing.



- Description of sample characteristics distribution



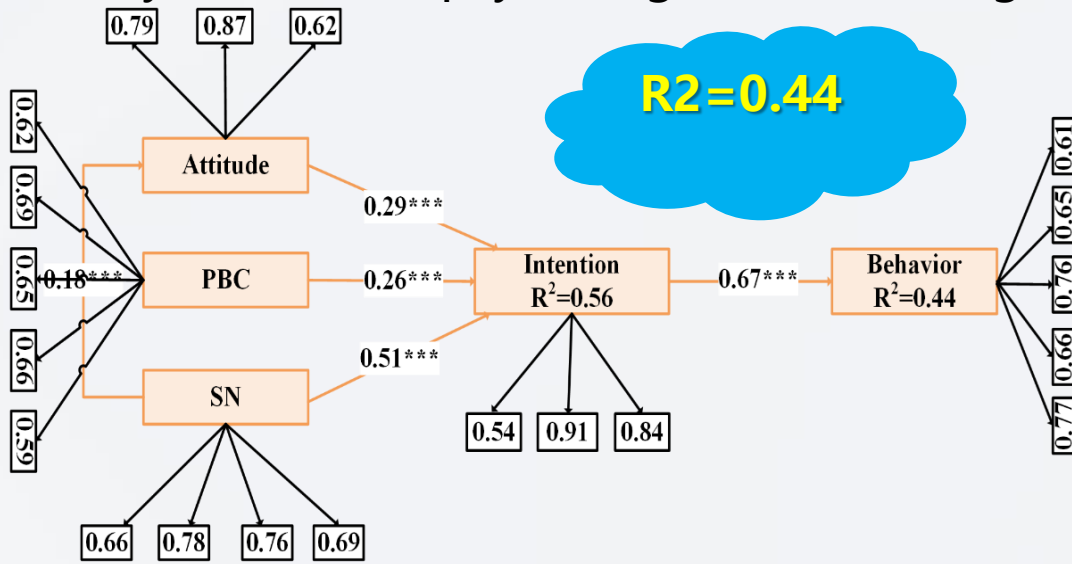
Monthly Family Income

Age

Number of Household

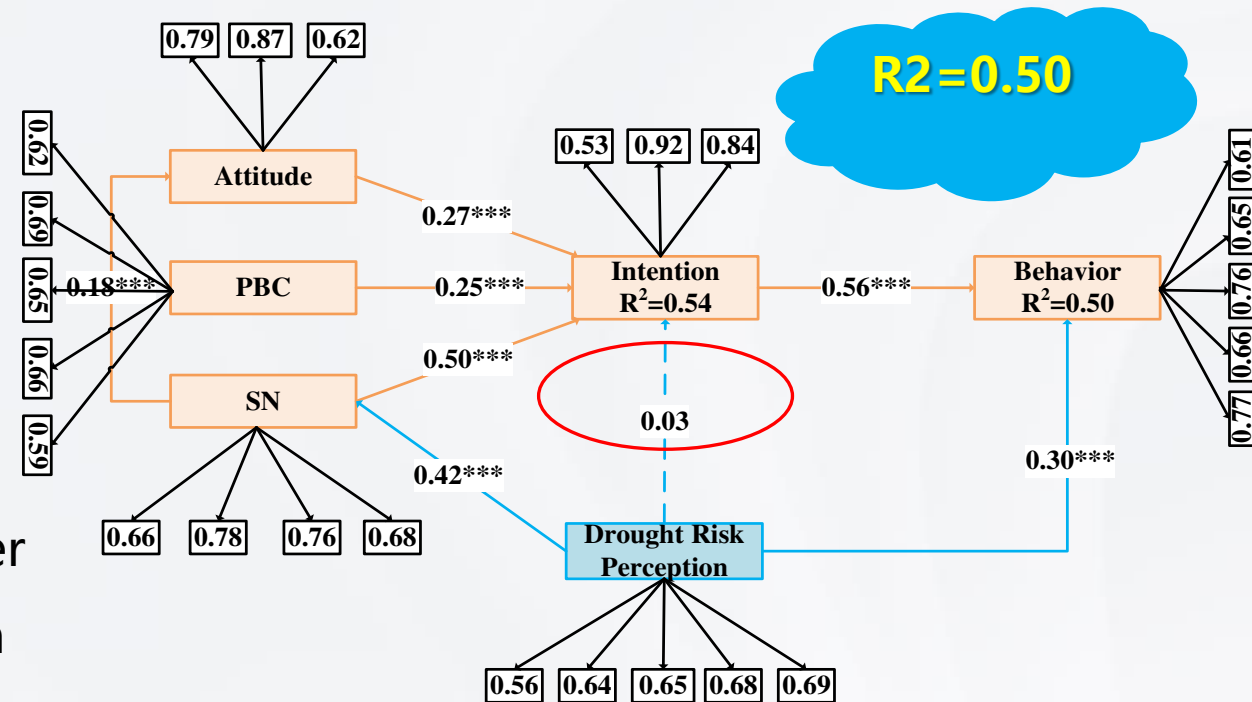
3. Results and Discussion

Analysis of socio-psychological influencing factors based on TPB and ETPB



➤ **Drought risk perception** has a significant positive correlation with SN ($\beta=0.42$, $p<0.001$) and individual behavior ($\beta=0.30$, $p<0.001$), but not with behavior intention.

➤ The predictive explanatory power of ETPB for water reduction behavior intention and water consumption behavior are **54% and 50%**, respectively.



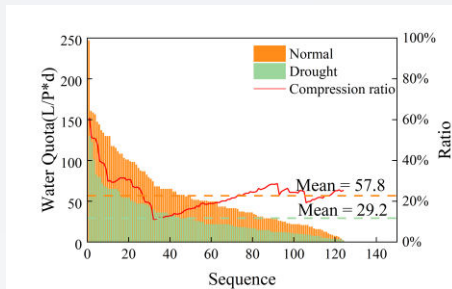
➤ **The explanatory power** of the model to predict water reduction behavior increased from **44% to 50%** when the risk perception variable was added.

3. Results and Discussion

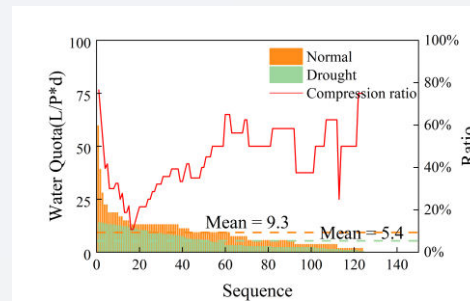
Compressible Proportion of Elastic Water Consumption Behavior under Drought Conditions

- Calculated the water quotas for various elastic water consumption behaviors under **regular non-water-scarce** conditions and **drought-induced water-scarce** conditions.
- Analyzed the compressible status of elastic water consumption behavior under different drought scenarios. And proposed the **compressible proportion** of water quotas.

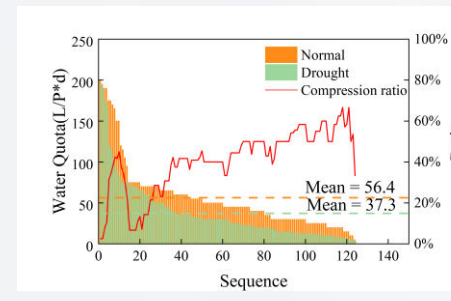
Bathing



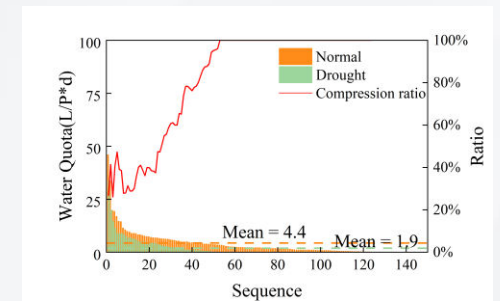
Washing



Flushing

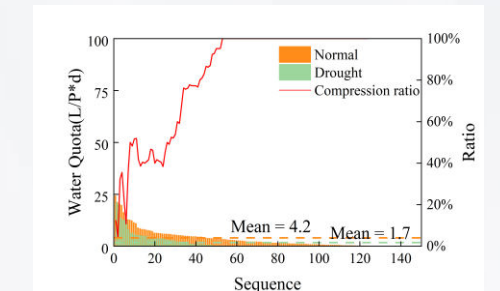
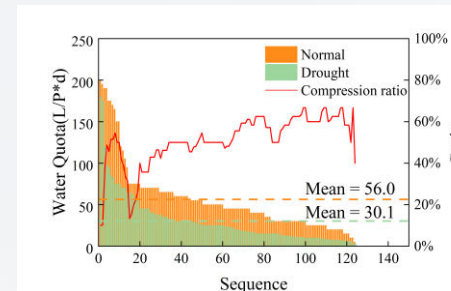
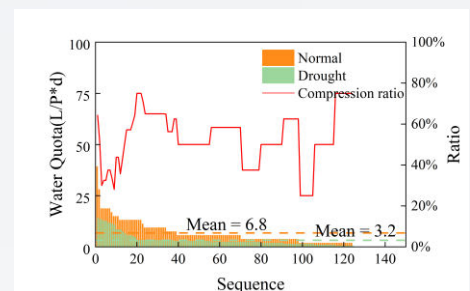
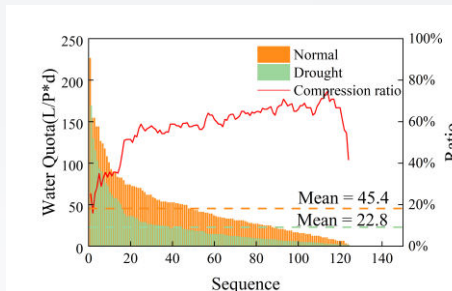


Cleaning



Summer:

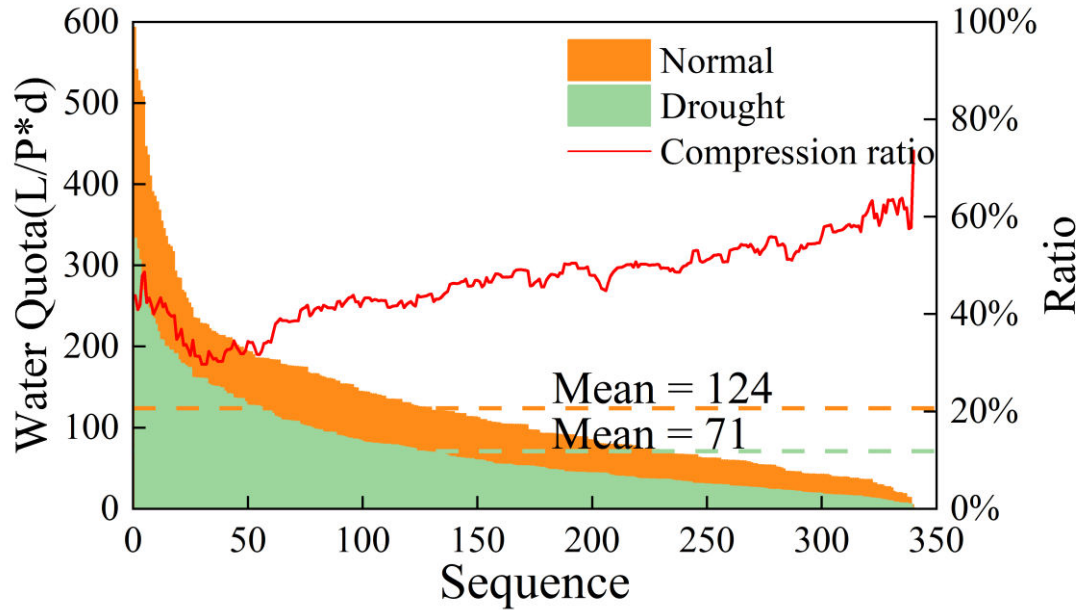
Winter:



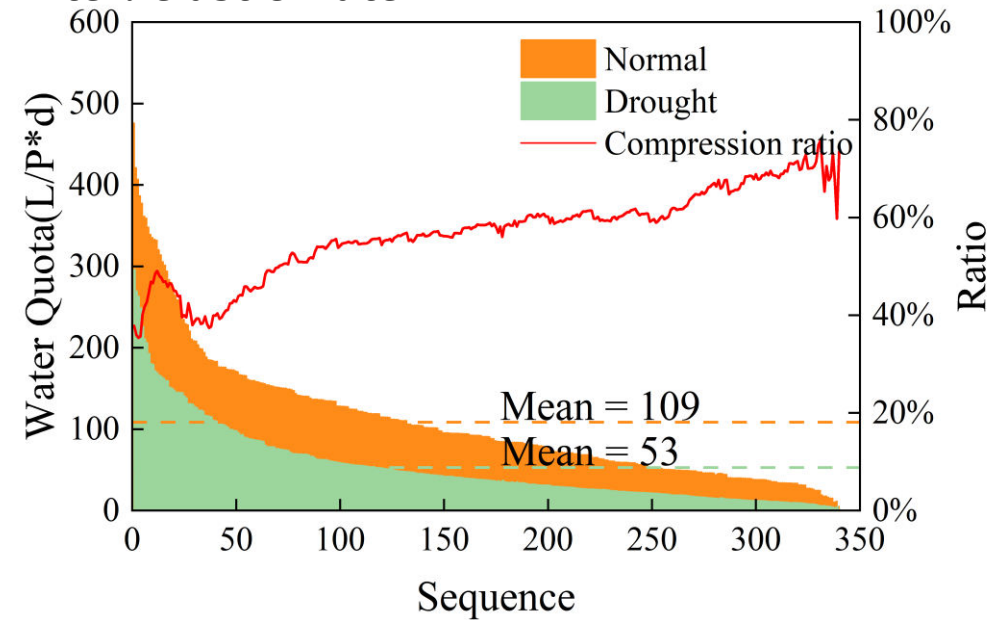
3. Results and Discussion

Compressible Proportion of Elastic Water Consumption Behavior under Drought Conditions

Summer: elastic water



Winter: elastic water



- Under normal : the average total water quota for summer elastic water consumption behavior is 124L/(p·d), the winter water quota is 109L/(p·d);
- Under drought :the average total water quota for summer elastic water consumption behavior is 71L/(p·d), the winter water quota is 53 L/(p·d).
- The compressible proportion of the total water quota for summer elastic water consumption behavior is approximately **43%**, and for winter elastic water consumption behavior, it is **51%**.

4. Conclusions

- **Structural Equation Modeling** are constructed to analyze the relationship between the **socio-psychological factors** of urban residents in Hunan and their willingness and behavior to reduce water consumption.
- A mathematical statistical analysis method is used to **quantify the compressible proportion** of urban residents' elastic water consumption under drought scenarios.
- **The explanatory power** of the model to predict water reduction behavior increased from **44%** to **50%** when the risk perception variable was added.
- During droughts, the total water quota for the elastic water consumption portion can be compressed by approximately **43%** in summer and **51%** in winter.

Thanks!

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