Adoption of Municipal Desalination Plants in California, Florida, and Texas

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Introduction

- Increasing population, economic growth, and changing consumer behaviors are drivers of the world's growing demand for water.
- While the agricultural sector is the major user of freshwater, demand for water in the industrial and municipal sectors is expected to grow more rapidly than in the agricultural sector (WWAP, 2018) and willingness to pay is higher for these sectors.
- Desalination, the process of removing salt from water, is a feasible option to increase freshwater supply, especially for municipal use.
- The U.S. has a high concentration of desalination plants, accounting for 11.2% of global desalination capacity (Jones et al., 2019).
- Figure 1 shows the cumulative number of municipal desalination plants in the U.S. with a capacity of 25,000 gpd or more.
- Around 68% of the municipal desalination plants are in California, Florida, and Texas (Mickley, 2018).

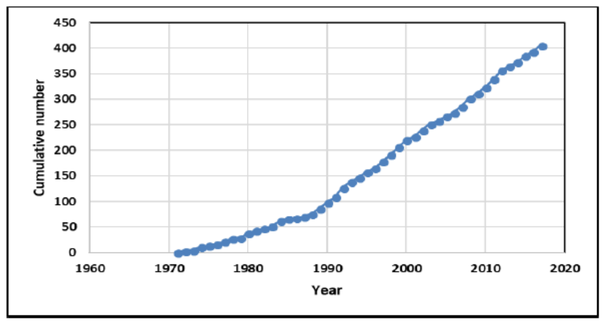

Figure 1.—Cumulative number of U.S., municipal desalination plants.
Source: Mickley (2018)

Objectives

- The objective of this study is to identify the factors affecting the likelihood of desalination plant adoption by municipalities in counties in California, Florida, and Texas.
- Understanding these factors could help water managers to evaluate alternative water supply systems, as well as helping policy makers predict expansion of desalination plants.

Conceptual Model

- We hypothesize that counties with a higher population are more likely to adopt a desalination plant due to both demand and economies of scale.
- Counties that have brackish groundwater sources are expected to be more likely to adopt a desalination facility.
- We hypothesize that counties located adjacent to surface saline water bodies are more likely to adopt than non-adjacent ones.
- We hypothesize that counties with higher average precipitation and lower average temperature are less likely to adopt due to lower demand for residential irrigation.

Data and Methods

- We used the U.S desalination plant data from the Desalination and Water Purification Research Program (DWPR) of the Bureau of Reclamation, which is at the county level (Mickley, 2006; Mickley and Jordahl, 2013; Mickley, 2018).
  - The data includes municipal membrane desalination facilities built between 1971–2017 that produce ≥ 25,000 gpd.
- The population, climate, and brackish groundwater data were from the U.S. Census Bureau, NOAA, and USGS.
- The dependent variable was whether a county had adopted one or more desalination plants.

Table 1. The percentage of counties in a state that have a desalination plant

State	Percentage
California	52%
Florida	31%
Texas	15%

- The likelihood of a county adopting a desalination plant was analyzed using a probit model since the dependent variable is binary:

$$P(y = 1|X) = \Phi(X'\beta)$$

where $X = (x_1, x_2, \dots, x_k)$ is a vector of independent variables, $\beta = (\beta_1, \beta_2, \dots, \beta_k)$ is a vector of coefficients, and $\Phi(\cdot)$ denotes the cumulative standard normal distribution.

Results

Table 2. Results of probit regression for adoption of desalination plants by counties in California, Florida, and Texas

Variables	Coefficients	Standard Error
Population (1,000 people)	0.0009***	0.0002
Precipitation (inches)	-0.0174**	0.0076
Temperature (Fahrenheit)	0.0033	0.0159
Brackish groundwater sources (1:yes; 0:no)	0.1604	0.2619
Adjacent to surface saline water bodies (1:yes; 0:no)	2.0393***	0.7173
Precipitation * surface saline water	-0.0190	0.0160
Constant	-0.9390	0.9529
Pseudo r-squared	0.2176	
*** $p < 0.01$,** $p < 0.05$,* $p < 0.1$		

Conclusions

- Of the 379 counties in California, Florida, and Texas, 23% have desalination plants.
- The probit regression results showed that counties with a higher population were significantly more likely to adopt desalination plants.
- Counties with higher precipitation were less likely to adopt.
- Counties adjacent to surface saline water bodies were more likely to adopt desalination plants.
- Future work will include more variables such as state policies, income, and time period.

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