Investigating the Role of Drought and Water Conservation Efforts on the Reuse of Treated Municipal Wastewater

Refat Amin, Kurt A. Schwabe, Quynh K. Tran and David Jassby

UNIVERSITY OF CALIFORNIA , RIVERSIDE

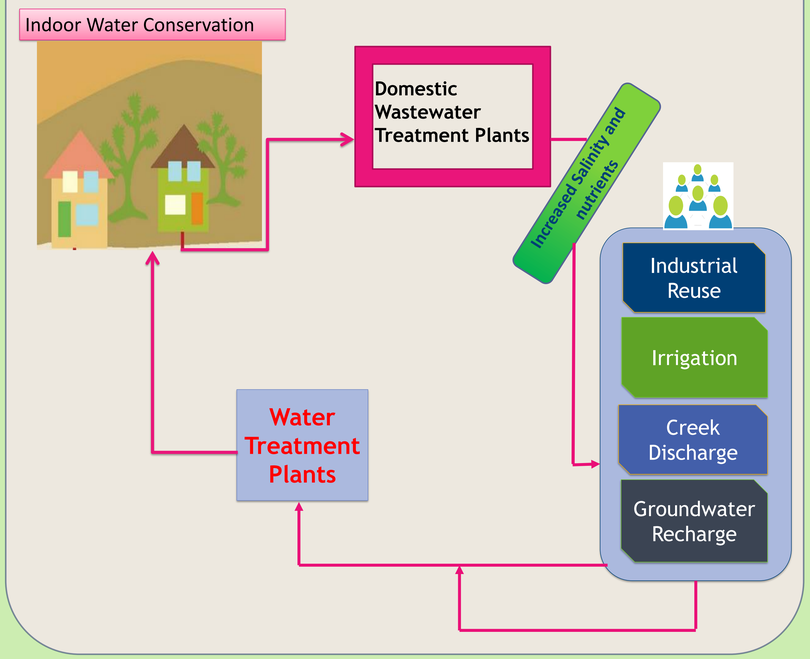
Motivation

- In California, water conservation becoming more important as a means to reduce water scarcity (especially during latest drought).
  - *First time in history State mandated conservation.*
- Measures were often undertaken without a proper knowledge of positive and negative outcomes of conserving water
  - *State and local agencies also engaging in more wastewater reuse, yet do not seem to recognize relationship between certain types of conservation (e.g., indoor residential conservation) and reuse of treated municipal wastewater*
- Questions addressed:
  - *How did the drought and water conservation measures impact wastewater agencies and wastewater reuse?*
  - *What are the effects on recycled water reuse of any changes in the quality of treated municipal wastewater?*
- This study will help support policy and follow-up actions concerning water conservation measures.

How Does Drought Impact Wastewater?

- Indoor conservation⬆ -Wastewater quality⬇ - Demand⬆- Available wastewater to reuse⬇
- Agencies faced
  - *Operational and financial challenges.*
  - *Pollution (e.g. salinity) challenges.*
- These challenges make it harder for agencies to meet their water quality standards (**Title 22, chapter 3**) and/or demands for recycled water.

Graphical Abstract



Lower Flows Causing Higher Salinity Problem

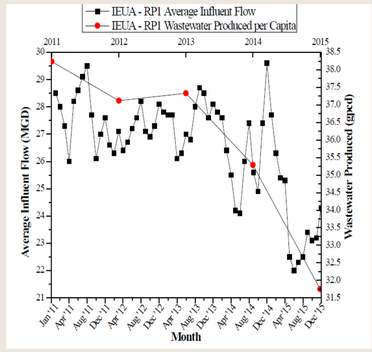


Fig: IEUA – RP1 inflows vs. wastewater produced per capita in the IEUA – RP1 service area in 2011-2015 (Tran et al.2017)

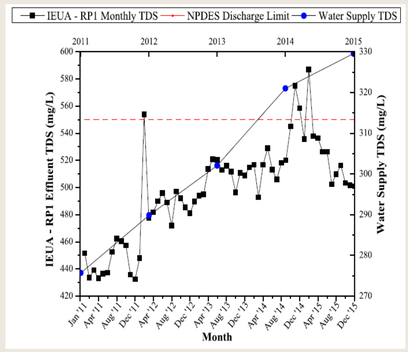


Fig: TDS concentrations in 2010-2015. (Tran et al. 2017)

Data Collection

i. Data on **monthly influent flow and effluent TDS (2013-present) (**CIWQS and individual WWTPs).

ii. **Monthly Conservation mandate and achieved data (2013- present)** (SWRCB).

iii. Wastewater treatment plants regional location, plant design flow, treatment technology, recycled water usage, source data are collected.

Selection Criteria

i. The selection criteria are established to determine the relationship between residential water conservation and wastewater quality.

ii. NPDES permit holding wastewater agencies (authorized by Clean Water Act) are selected mostly; some WDR holders.

iii. Agencies from different hydrologic regions are selected.

Different Phases of the Project

PHASE-1

- Study wastewater agencies background and source.
- Contact with wastewater agencies from Southern California to obtain influent and effluent quantity and quality data.

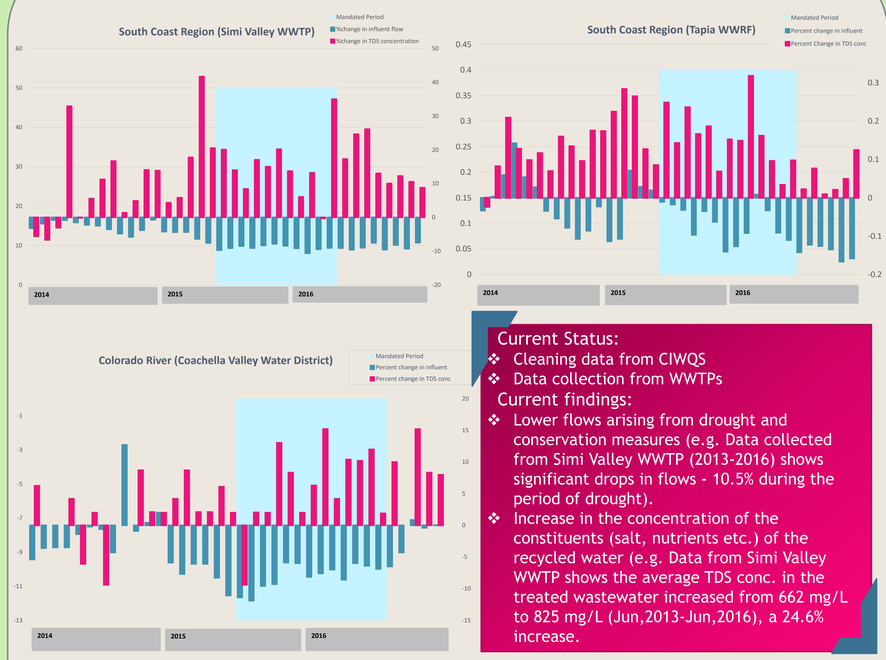
PHASE-2

- Cleaning data collected from California Integrated Water Quality System
- Data collection from rest of California
- Monthly conservation data

PHASE-3

- Statistical model development
- Determine the relationship between influent flow and effluent TDS of WWTPs in California
- Publications and outreach

Current Findings and Status



Current Status:
- Cleaning data from CIWQS
- Data collection from WWTPs

Current findings:
- Lower flows arising from drought and conservation measures (e.g. Data collected from Simi Valley WWTP (2013-2016) shows significant drops in flows - 10.5% during the period of drought).
- Increase in the concentration of the constituents (salt, nutrients etc.) of the recycled water (e.g. Data from Simi Valley WWTP shows the average TDS conc. in the treated wastewater increased from 662 mg/L to 825 mg/L (Jun,2013-Jun,2016), a 24.6% increase.

Future Scope

- Performing an econometric analysis relating conservation measures with flow rates and salinity to investigate the impact of drought and water conservation on reuse of treated municipal wastewater.

Regression Analysis

Equations

$$Y1_{it} = \alpha_i + \lambda_t + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \varepsilon_{it}$$

$$Y2_{it} = \alpha_i + \lambda_t + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \varepsilon_{it}$$

Here,
Y1= Influent Flow
Y2= Effluent Salinity (TDS concentration)

X1= Conservation Mandate
X2= Plant Treatment Technology
X3= Plant Design Flow

i= regional location
t= time

Reference

Tran, Q.K., Jassby, D. and Schwabe, K.A., 2017. The implications of drought and water conservation on the reuse of municipal wastewater: Recognizing impacts and identifying mitigation possibilities. *Water Research*, *124*, pp.472-481.

Acknowledgement

Thanks to my Supervisor Dr. Kurt Schwabe for continuous support and for given me opportunity to work and gain valuable experience while working on this project. Also thanks to Quynh Tran and Dr. David Jassby for providing support during the project.

Contact info:
ramin004@ucr.edu (email),
kurt.schwabe@ucr.edu (Supervisor),
qtran009@ucr.edu (co-author),
djassby@engr.ucr.edu (Co-author)