



جامعة الإمارات العربية المتحدة  
United Arab Emirates University

# Spatio-Temporal Mapping of Water Consumption at Public Institutions: Case of United Arab Emirates University

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## Introduction

- Large portion of human activities take place within buildings. Therefore, if energy and water consumption are minimized in buildings this will help in reducing climate change.
- UAE demarcated water in its vision 2021 as one of the areas that need more researches. This is because water is one of the basic human needs and the country spends millions of dollars every year in desalinating and transporting water to various cities and villages across UAE.
- Efforts could be done at individual and institutional level to optimize water usage and consequently save money and environment.

## Objectives

- Assess the relationship between activities and water consumption.
- Model the relationship between number of users and water consumption.
- Benchmark the water consumption at the university with other public institutes in UAE and abroad.
- Evaluate students water consumption habits and their awareness level related to UAE water shortage issues.

## Study Area



- The United Arab Emirates University (UAEU) founded in 1976 by the late Sheikh Zayed Bin Sultan Al Nahyan.
- 14,000 students. Male students represented 19% (2,660), while female students represented 81% of the entire student population (11,340).
- The total number of faculty members in the university during the academic year 2016-2017 was 630, in addition to 290 instructors, and 61 Teaching Assistants (UAEU, 2018).
- The university has nine colleges and offers nearly all major disciplinary fields with the exception of dentistry medicine.

## Methodology

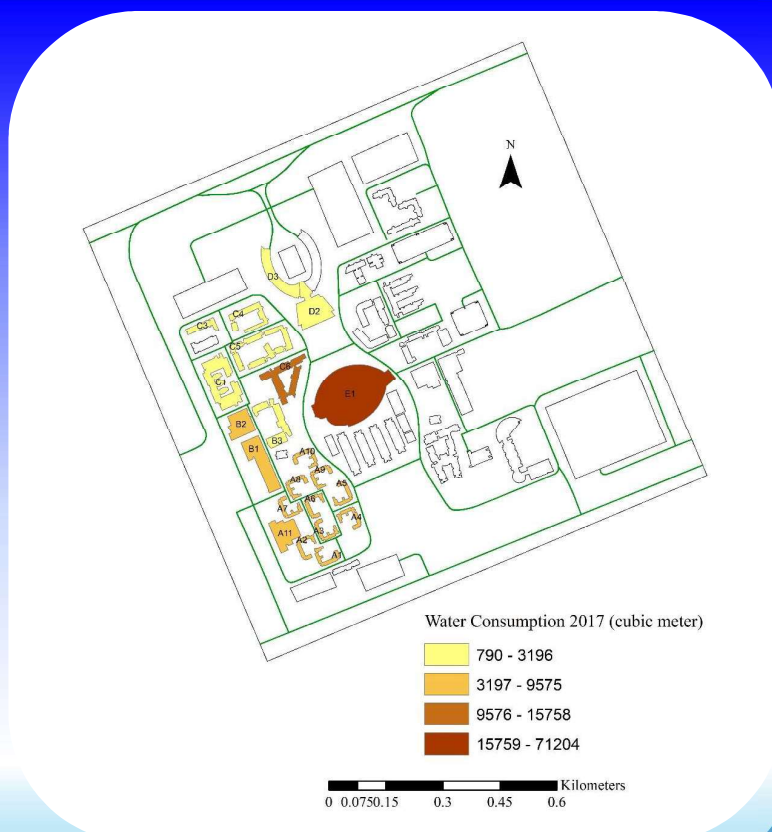
- Classification of building based on activities e.g. Academic, residential, dining halls, sport complexes.
- The relationship between water consumption and number of students in five academic buildings is model using least square.
- Monthly water consumption for 2016 and 2017 data is summarized by totals and averages in space (cross-sectional) and time (longitudinal).
- GIS is used to provide better visualization for the water consumption data at the university.
- Survey is conducted to study students water consumption habits and measure their awareness level about UAE water Issues.

## Results

Relationship between building type and water consumption

Building Type	Total water consumption in 2016 (cubic meter)	%	Total water consumption in 2017 (cubic meter)	%	Average %
Academic	10,489	9.5	23,781	20.8	15.15
Residential	81,776	74.3	70,218	61.3	67.8
Dinning	10,298	9.4	13,522	11.8	10.6
Sport	6,633	6	6,295	5.5	5.75
Library	802	0.7	790	0.7	0.7
Total	109,998	100	114,606	100	100

## Results



## Results

Number of students who visited the CIT to get their hardcopy textbooks

Semester	Female	Male	Total	% from the total number of students (13810)
Fall 2016/2017	10,454	1,374	11,828	86
Spring 2016/2017	9,439	1,258	10,697	77
Fall 2017/2018	8,268	1,016	9,284	67
Spring 2017/2018	5,696	1,035	6,731	49

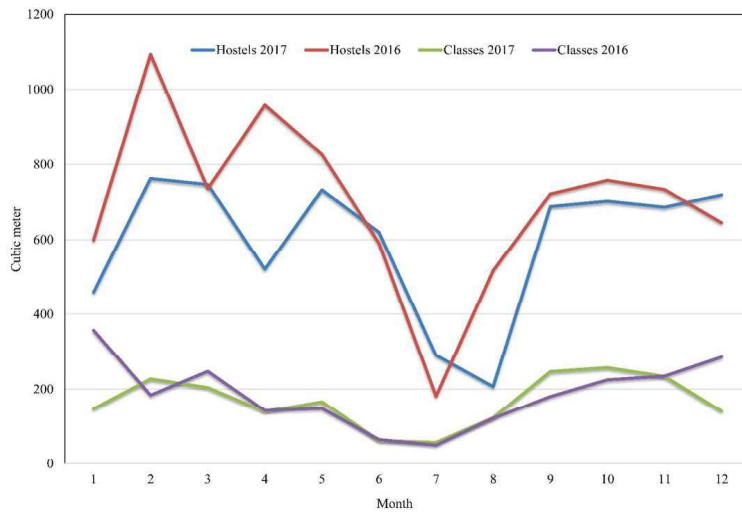
## Results

Relationship between water consumption (dependent variable- y) and number of students (independent variable-x) in academic buildings

Semester	Model	R <sup>2</sup>
Fall 2016/2017	$y = 0.1114x + 682.72$	0.4689
Spring 2016/2017	$y = 0.147x + 516.69$	0.4299
Fall 2017/2018	$y = 0.2331x + 1182$	0.0896
Spring 2017/2018	$y = 0.328x + 1128.8$	0.1328

## Results

### Temporal Variation of water consumption at UAEU (2016-2017)



Generally, the lowest water consumption was noticed during holidays

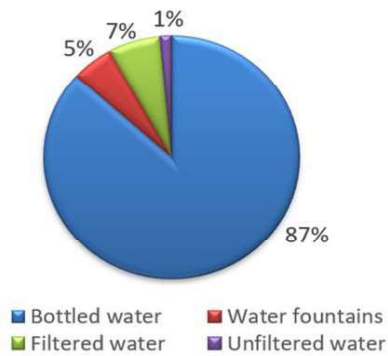
## Benchmarking the water consumption at UAEU with other public institutes:

- The total water consumption for all buildings in 2016 is 201,626 cubic meter and in 2017 is 188,467 cubic meter with an average of 195,046 m<sup>3</sup>/year.
- The average divided by the total number of female students (11,340) gives 17.2 cubic meter per year per student and this equals 47 Liters per person per day (LPD).
- The average water consumption at the hostels is found higher and equals 83.3 LPD.
- Both values are lower than the USA metric for dormitories (121 LPD) and European metric (143 LPD) .

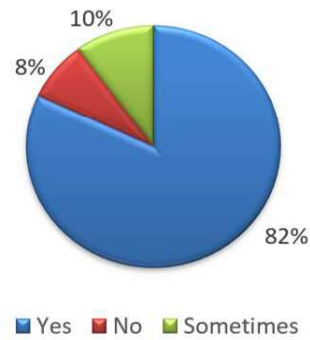
## Survey Results

- ▶ A total of 412 students at UAEU answered the online survey questions.

Primary source of drinking water on campus

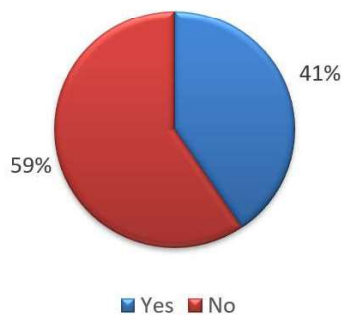


Shower taking more than five minutes

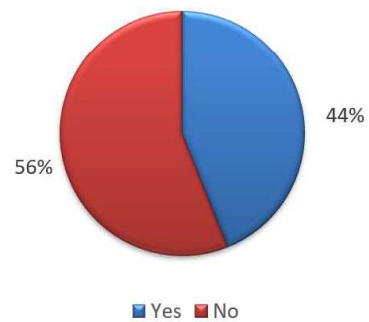


## Survey Results

Willingness to use urinals if they are installed at some toilets in the university

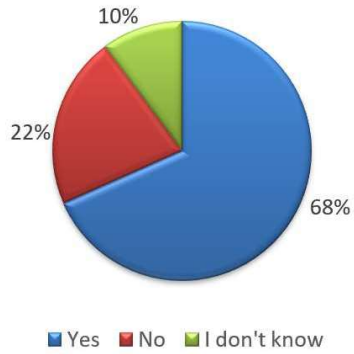


Willingness to use grey water for toilets flushing

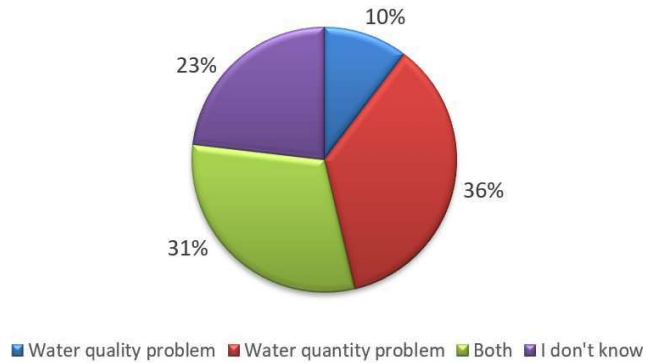


## Survey Results

Is there a water problem in the UAE?



What is the water problem in the UAE?



## Results

- ▶ The lower LPD water consumption at UAEU is attributed to many factors:
- 1) Residential buildings which consume 67.8% of water is not fully occupied throughout the semester.
- 2) Students have to go home every week on Thursday on Saturday. Thus, Students stay only 68% of the week's hours in the hostels.
- 3) Majority of the students are in classes during the day, 86% of them do not use the water tap for drinking and 94% do not wash their clothes in hostels.

## Conclusion

- The outputs from the study includes statistical maps showing buildings with high water consumption (hot spots) and graphs displaying temporal variation of water consumption.
- The results will help in getting better knowledge about the broad pattern of water uses in the UAE university campus and formulating a plan to minimize it.
- The water consumption per year per student at the University of Bordeaux is  $14 \text{ m}^3/\text{year}$  while at UAE university is  $17.2 \text{ m}^3/\text{year}$  which is higher.
- The average water consumption at public institutes in Al Ain is  $752 \text{ m}^3$  per month while at UAE university is below  $752 \text{ m}^3$  except at the college of IT.
- Students/faculty/staff are encouraged to participate in water conservation efforts and report about water waste and leaks.

## Recommendations

- The university should set certain standards for the usage of water saving installations, pipes, faucets and fittings, using efficient taps and closets, water saving-low-flow shower heads.
- Increase the acceptance of urinals and greywater, as a means of water conservation methods.
- Introduce courses in the curricula related to water conservation methods, specially in the university foundation courses.
- Install water meter for each room in the hostels and awards/competition for the best students who consumed less water in their rooms.

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