MAPPING & ASSESSING THE MUNICIPAL IRRIGATION WATER USE:

THE CASE OF DISTRICTS 3 AND 4 IN AL-REHAB SETTLEMENT

By

Sarah Mohammed Salah El-Din Ibrahim Asar

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Architectural Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Prof. Dr. Nabeel Elhady

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Professor of Urban Design
Architecture Department
Faculty of Engineering, Cairo University

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Approved by the
Examining Committee

_____
Prof. Dr. Nabeel Elhady, Thesis Main Advisor

_____
Prof. Dr. Mohammed Anwar Zayed, Internal Examiner

_____
Prof. Dr. Basil Ahmed Kamel, External Examiner
Professor of Architecture and Head of the Architectural Department - American University in Cairo (AUC)

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Engineer's Name: Sarah Mohammed Salah ElDin Asar
Date of Birth: 29/01/1994
Nationality: Egyptian
E-mail: Sarah_asar94@outlook.com
Phone: 01001027996
Address: Maadi Gardens compound, Kattameya ring-road, Cairo, Egypt

Registration Date: 01/03/2016
Awarding Date: …./…./2020
Degree: Master of Science
Department: Architectural Engineering
Supervisors:

Prof. Dr. Nabeel Elhady

Examiners:

Prof. Dr. Nabeel Elhady (Thesis main advisor)
Prof. Dr. Mohammed Anwar Zayed (Internal examiner)
Prof. Dr. Basil Ahmed Kamel (External examiner)
Professor of Architecture and Head of the Architectural Department - AUC

Title of Thesis:

Mapping and Assessing the Municipal Irrigation Water Use: The Case of Districts 3 and 4 in Al-Rehab Settlement

Key Words:

Water consumption; Water scarcity; Green Areas; New Cairo; Irrigation Management

Summary:

Egypt is one of the many countries worldwide that suffer from a per capita water share that is below 1000m^3/person/year. That water share in 2018 was 570m^3/person which indicates that Egypt suffers from water poverty. Of this index, only 103.2m^3/year was a person's share of produced freshwater in 2017. Unfortunately, freshwater is used excessively and with no accountability for irrigation and maintenance purposes in new settlements in Egypt. The green spaces of 2 study areas in the urban settlement of Al-Rehab are monitored and analyzed in terms of irrigation water usage. This analysis is done by comparing the indoor domestic consumption with that of irrigation. Furthermore, 3 climate change scenarios are proposed for study area 2 to understand how those climate projections could affect the region's vegetation. 67.1% of the municipal water used in the settlement is consumed in irrigation practices, while the remaining 32.8% is used indoors. The continuous reliance on freshwater for irrigation, inefficient irrigation systems and practices, and random plant selection and distribution are among the existing challenges. Not to mention that the excessive use of seemingly non-functional groundcovers leads to high irrigation water consumption. These are major problems for Egyptian cities that consist of spacious green areas in need of high irrigation water quantities. The research highlights the main weaknesses in the municipal water system along with the possibilities of reducing water consumption in that sector. It concludes by briefly mentioning and suggesting some measures to be considered when designing green spaces and managing their irrigation in new communities. Those measures are mentioned in hopes of being able to mitigate and reduce the levels of water scarcity and sustain the per capita water share in Egypt.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Date: ../../2020

Signature:

Acknowledgments

This thesis is completed by the help and support of many individuals who I would like to thank. First and foremost, praises and thanks go to Allah for his showers of blessings that I've been granted throughout my personal and academic life.

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Nomenclature

AC - Actual Capacity
AFED - Arab Forum for Environment Development
AP - Ammochloa Palaestina (A native grass species)
BCM - Billion Cubic Meters
BEDI - Built Environment Deprivation Indicator
BOD_5 - Biochemical Oxygen Demand
CAPMAS - Central Agency for Public Mobilization and Statistics
CSBE - Center for the Study of the Built Environment
CW - Constructed Wetland
DC - Design Capacity
DU - Distribution Uniformity
ET - Evapotranspiration
FAO - Food and Agriculture Organization of the United Nations
GCR - Greater Cairo Region
GP - Grayswood Pink (A native evergreen shrub)
HCWW - Holding Company for Water and Wastewater
HSSF - Horizontal Sub-Surface Flow
IFs - International Futures modeling platform
LWD - Low Water Demand
MALR - Ministry of Agriculture and Land Reclamation
MWRI - Ministry of Water Resources and Irrigation
NBI - Nile Basin Initiative
NUCA - New Urban Communities Authority
NWRP - National Water Resources Plan
OFG - Oriental Fountain Grass
RA - Residential Area
SDGs - Sustainable Development Goals
SDS - Sustainable Development Strategy
TDS - Total Dissolved Solids
TL - Typical Landscape
TWW - Treated Waste Water
UFW - Unaccounted-For Water
UN - United Nations
UNDP - United Nations Development Program
USAID - United States Agency for International Development
USDA - United States Department of Agriculture
USEPA - United States Environmental Protection Agency
WF - Water Footprint
WSUD - Water Sensitive Urban Design
WTP - Water Treatment Plant
WWTP - Waste Water Treatment Plant

Terminology

Blue water: Freshwater that flows through water bodies and aquifers; such as lakes.

Green water: The water that is stored as soil moisture and is only available to plants or unproductive evaporation.

Plant’s water demand: The quantity of water required for a plant to carry out a normal metabolism process and thrive. Receiving this quantity should make a plant have an acceptable appearance.

Evapotranspiration (ET): ET is a measure of the plants’ water uptake/consumption and can be regarded as a lower boundary for outdoor water usage.

Luxury consumption: It occurs when there is an abundance of irrigation water or soil moisture that are consumed by the plants.

Deficit irrigation: An irrigation with less than 100% ET. Plants that are capable of using drought adaptation mechanisms could receive deficit irrigation and survive.