



# **ACHIEVING SUSTAINABILITY GOALS THROUGH WATER EFFICIENCY IN RESIDENTIAL BUILDING**

**BY**

**Alaa Badr El-Deen Mohamed Hussain**

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**

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**Title of Thesis:**

**Achieving Sustainability Goals Through Improving Water Efficiency in Residential Building**

**Key Words:**

Water efficiency – water consumption – grey water – black water – rainwater harvesting system.

**Summary:**

The Research highlighted the improvement of water use efficiency as the best solution for exploiting available water resources in Egypt during water conservation techniques, which in turn reduces energy consumption as it relates to water consumption. This is done through the use of high efficient products in using water and studying how to apply them in buildings. Or buildings under construction. This study led to knowledge of the water saving rate after application. Since the world is currently pursuing the principle of sustainability and green architecture and the principle of recycling and reuse, it realized that some of the objectives of sustainability is to improve the efficiency of water use by recycling rain water, gray water and black water and reuse for purposes that do not require potable water such as agriculture, Cars and others. After comparing traditional buildings with buildings with water recycling systems applied and applying modern technologies that increase water use efficiency, these systems provide 80% water.

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# INTRODUCTION

## A. Introduction

Water efficiency is an issue of growing importance due to unsustainable water use in the world, as a result of the exponential population growth and the current sources of pollution. Climate change can aggravate this problem and it is expected that in many countries the predicted reduction in rainfall or change in the environmental system can create or aggravate situations of scarcity.

Water efficiency is the smart use of our water resources through water-saving technologies and simple steps we can all apply it in our houses. Using water efficiently will help us to save our water supplies today and for future generations.

Grounds for sustainability require the introduction of measures for efficient water use in all sectors, including the buildings embodied in the so-called principle of "5R". The first R, reduction of consumption, is a priority measures and passes through the adoption of efficient products or devices and other non-technical measures. The second R, reduction of losses and waste, such as the control of losses or installation of circulation circuits of hot water. The reuse and recycling of water constitute the third and fourth R, whose difference is to consider a "serial" use or the reintroduction of water in the circuit (after treatment). Finally, the fifth R, the use of alternate sources, may involve the use of rainwater, groundwater or even saltwater.

These various water efficiency measures naturally reduce the average consumption of drinking water from the public network, but can also cause changes in the diagrams of consumption. In the case of rainwater harvesting systems, for example, with the use of non-potable water for watering gardens and flushing cisterns, the coefficients of simultaneity commonly used in the sizing of the inner water networks are significantly changed with the grouping of devices with similar characteristics. Therefore, with the trend towards increasing the use of water efficiency measures in buildings, it becomes necessary to revise and validate new bases for the design of the installations, in regard to drinking and non-potable water supply networks.

Water efficiency is also reflected to energy efficiency. A study carried out revealed that the adoption of simple water efficiency measures in houses could lead to an average of 30% - 80% savings in water consumption, meaning a reduction in energy consumption in public networks and in heating and pumping water in the buildings.

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## B. Problem statement

The world's freshwater sources are threatened by climate change. Scientists around the world agree that recent climatic changes occurring globally are the result of human activities (Parry et al., 2007). Rising global temperatures lead to a condensation of the hydrological cycle and heightened risks of more frequent floods and drought. By the early 21st century, there are already acute water shortages in large parts of Australia, Asia, Africa, and the United States. In Perth, Western Australia (WA), winter rainfall has declined by 15% since 1975, reducing run-off into metropolitan dams and estuaries by more

# INTRODUCTION

than 50% this has resulted in extremely high water demand between the growing city and nature requirements.

Increasing populations are contributing to the increasing frequencies of water scarce events. It is estimated that the global population will increase from the current 51% to 67% by 2050. This increase in populations exacerbates environmental problems already experienced in urban areas, including: air and water pollution, availability of clean water resources. Accessibility to clean water in urban areas is an increasing global issue. The World Water Organization predicts that by 2025, two thirds of the global population will face water shortages.

Water is becoming scarce not only in arid and drought prone areas, but also in regions where rainfall is relatively abundant. With water restrictions in place, people are looking for ways to reduce their water consumption. Water used in house typically makes up between 50 and 80% of total household water usage. Strategies and programs are being established to promote water as a precious resource, incorporating the smart and efficient use of it, one aim being to “ensure that all available non-potable wastewater is being used appropriately”. This, combined with an increasing community interest in water conservation, has led to recycling of wastewater.

One of the events that can't be overlooked may be one of the reasons for the increased scarcity of water expected in Egypt in the next few years is the dam of Ethiopia, which is called "El-Nahda dam".

## **C. Scope of Research**

The selected scope of the study is Achieving Sustainability Goals through Water efficiency in residential Buildings.

## **D. Research Aims and Objectives**

The research aims to provide a framework for how to Achieve Sustainability Goals through Water efficiency in residential Buildings that helps in reducing water consumption which enable to save water, this is achieved through:

- Reviewing the current issues facing the world in water problem issues specially in building sector thus revealing the need to save water.
- Literature review on The Technologies for Increasing Water Efficiency in the existing residential building to save water.
- Studying the international examples that applied the methods of retrofitting the existing residential building and investigate of the retrofitting.
- Evaluating the building performance and assess the improvements.
- Illustrating the role of the government, architects, the private sector, owners, and tenants to improve the existing residential buildings in Egypt