# Using Integrated Management Methodologies for Conservation of Water Resources in Eastern Nile Delta, Egypt

**By**

**Neveen Ramadan Ali Mohamed**

**B.Sc. in Civil Engineering, Faculty of Engineering, South Valley University, 2003**

**A Thesis Submitted in Partial Fulfillment**

**Of**

**the Requirement for the Master Degree**

**in**

**Environmental Engineering**

**Department of Environmental Engineering**

**Institute of Environmental Studies and Research**

**Ain Shams University**

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## ABSTRACT

Water is a finite resource that is essential for agriculture, industry, and human existence. Egyptian water resources are quite limited; challenges for achieving the highest possible water use efficiency are particularly difficult. It is important to save and conserve water while providing necessary quantities to satisfy social and economic requirements as well as conserve the environment. However, due to the increase in population and associated rise in the standards of living human economic and social activities, the demands of water are significantly intensifying. The population growth needs more cultivated area for producing extra food and job opportunities. Therefore, there is a growing pressure to achieve better performance from this limited water resource to increase the productivity and saving water to assist in new land reclamation.

the overall objective of this study illustrate how using integrated management methodologies for conservation of water resources and facing challenges of increasing water demand due to the rapid population growth, by best utilizing of the limited water supply. In additions, the current study provides and assesses certain scenarios towards the optimum use of this limited water supply in further land reclamation in east Nile delta. To achieve this objective, data was collected from different source to describe area study and mathematical model was developed as an easy tool to help the decision making to achieve the integrated water resources management. That has been achieved by constructing a comprehensive geographic Information System (GIS) for all water supplies and water demands in the Eastern Delta

The study concluded that the proposed IWRMI System as DSS tools are effective and efficient for modeling, monitoring, and estimating the water demands and share the information between different involved partners. That will be helpful in the prediction of the impacts of alternative management policies in plans. Constructing a Geo-database of the different entities of the water resources and its related data is very important in developing the optimum water resources allocation alternatives. Also, it allows generating different scenarios for cropping pattern (based on different objectives and according to the fluctuation in water resource), and optimizing the results by re-allocating crops at the least water consumption locations over the arable land in the eastern Nile delta

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# CHAPTER ONE
# INTRODUCTION

## 1.1 Overview

There is no doubt that the problem of water shortage may cast a shadow over the Middle East region and forced many countries to re-plan of water resources in a different way. They are considered one of the greatest challenges facing Egypt. That may affect the operations of economic and social development. This is due to the continuous increase in water needs with limited water resources that require concerted efforts of all for the integrated management of water resources, which will meet those challenges. Good water management constitutes a major challenge and calls for integrated and holistic planning .

IWRM is a cross-sectoral policy approach to respond to the growing demands for water in the context of finite supplies. It is an approach that aims to ensure the coordinated development of water, land and related resources to optimize economic and social welfare without compromising the sustainability of environmental systems, (GWP, 2000) .

The present study aims at contributing to IWRM process by developing methods to facilitate spatial planning and decision making in water resources management. The development tool is capable of archiving, analyzing, handling the huge amount of data at different scales. That will be able to provide a complete picture of spatial water resources allocation and good analysis platform for better management and planning.

## 1.2 Problem Definition

Water shortage is one of the greatest challenges facing Egypt that may affect the operations of economic and social development. This is due to continuous increase in water needs (because of rapid growth of population, urbanization, the expansion of the developed projects) with limited water resources. All that put further stress on the existing problems of water scarcity, water pollution, sinking groundwater tables, seawater intrusion… etc. That requires concerted efforts of all, for the integrated management of water resources and that will meet those challenges.

## 1.3 Objectives

The overall objective of this study is to develop an integrated information system as a tool to support the decision maker to using integrated management methodologies for conservation of water resources.

## 1.4 Methodology

To achieve the objectiveofthis studythe following methodology:

1. Review of the previous studies of integrated water resources management for general and in the study area in particular,
2. Develop a modeling tool for estimating the water gap between the water supply and water demand for different uses. Themodeling tool three main components are,
   - Databasewas designed for spatial and temporal data.
   - Model baswas developed using a database and GIS as the programming environment. Through the model, the value of the water shortages is calculated, moreover shown this in maps, tablesand queries.
   - User interface, were designed and implemented. Through which the user of the modeling tool can easily handle the data and information and retrieve the results and outputs from the model.
3. Collection of data and information about, water supply from different sources, water demand for different activities such as agriculture, domestic, industrial and horizontal expansion projects in the study area to construct and develop an information system for the integrated water management.
4. Applying the developed model for:
   - Assess (quantity and quality) water resources in the study area .
   - Assess of water consumption for different uses in the region to the current situation and the future based on the horizontal expansion plan developed by the Ministry of Irrigation and the Ministry of Agriculture for the reclamation of land.
   - For estimating the water shortages value between the water supply and water demand
   - Developingofthe water gap (MCM/year) maps, represent the spatial distribution of the difference between the water supply and water demand at a medium level (canal command area).
5. Analysis of the different developed maps,
6. Design and generate various scenarios for different development measures.
7. Adoption of IWRM approach for analysis of water management scenarios,

8. Present the results of the study of the maps, which allows decision makers to take a comprehensive vision and visual data and the possibility of review of any alternative proposals based on the spatial location and associated data.

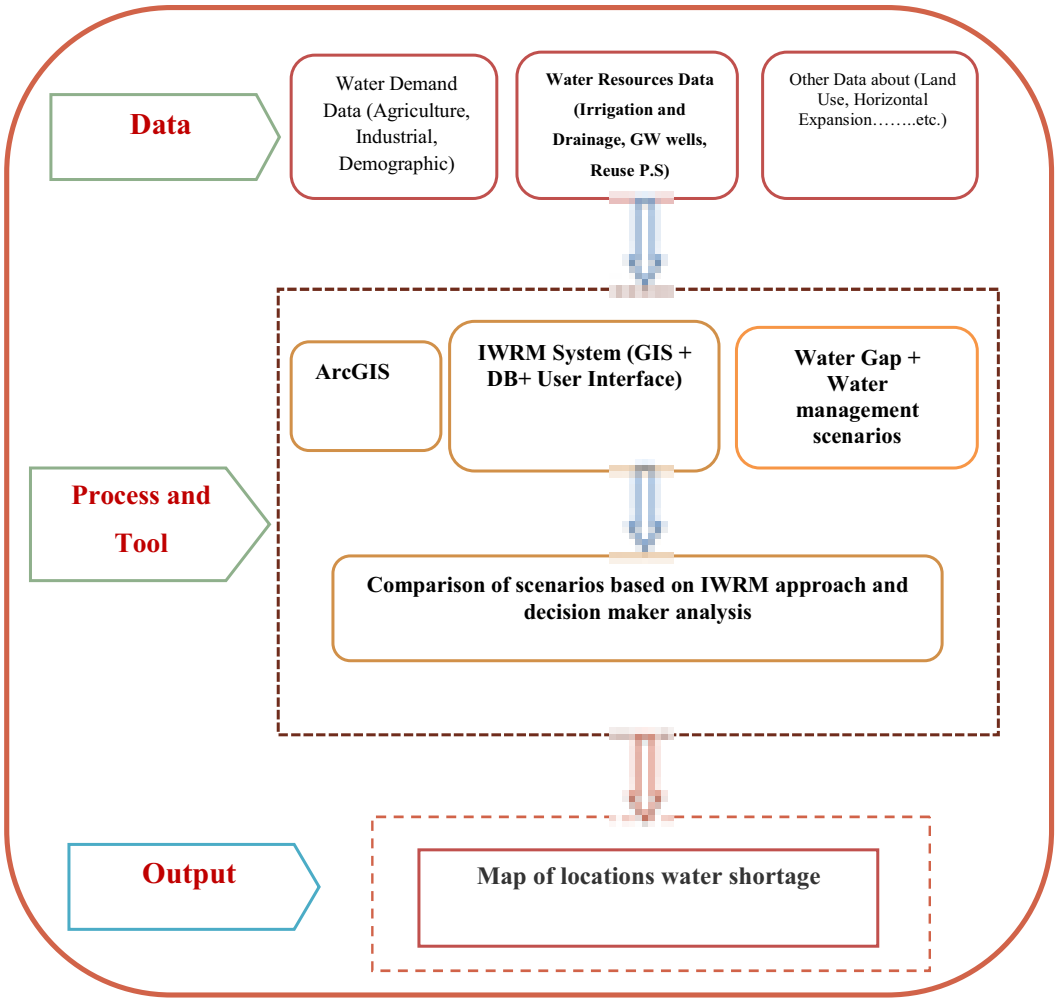


Figure (1): Methodology Frame Work

## 1.5 Structure of the Thesis

This thesis consists of six chapters, list of references and Arabic summary.

**Chapter (1),**is an introduce that encompasses an overview, problem definition, significance of the study, study objectives, study methodology and outline of the thesis

.

**Chapter(2), literature review** presents an overview of the Literature that deals with the research topic, including the relevant papers, technical reports, and textbooks. It covers

different related IWRM issues, GIS application and DSS In general and the study area particular.

**Chapter (3), Description of the Study Area:** contains a detailed of the reasons for selecting East Delta for this study and description of this area of determining the geographic location and the climate and water resources of different form, water consumption by for various uses, land use, the proposed horizontal expansion plan in the region.

**Chapter (4), Development of Modeling Tool**: present a detailed explanation to the developedmathematical model, whichwas built in this study and the constraints that took into account when built it and what the possibilities of work are, in addition to the data required to apply this model.

**Chapter (5), Applying The Developed Model and Analysis of Results:**In this chapter, were presented the results of applying the model was developed during the study on the selected area from the east of the Delta (Ismailia Canal Command Area) to manage the distribution of water in the medium level (canal command area) based on an approach to integrated management of water resources.In addition, the estimated water gap between supply and demand of water for different uses in the area that has been selected.Moreover, contains an explanation of different scenarios of management and that have been proposed and the results of applying the modeltothescenarios are shown in the maps, tables andgraph formats, and the various comments it.

**Chapter (6), Conclusions and Recommendation:** this chapter exemplifies the conclusions from the study, as well as a summary of the recommendations of the researcher for the current or future studies