



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Irrigation and Hydraulics

A Planning Model for Water Demand Management in the Nile Delta under Water Scarcity

A Thesis submitted in partial fulfillment of the requirements of the degree of
Doctor of Philosophy in Civil Engineering
(Irrigation and Hydraulics)

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Statement

This thesis is submitted as a partial fulfillment of Doctor of Philosophy in Civil Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis to identify a planning tool for water demand management under water scarcity expected in the future by developing suitable mathematical models, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Thesis Summary

In the light of increasing competition for a relatively finite water resource in Egypt, it is essential to have accurate methods of predicting future water demands. Water Demands include municipal, industrial, agriculture, livestock, fish farming and unavoidable losses. On the other hand, non-withdrawal demands comprise hydropower generation, navigation and network constraints. Each type of demand has its own characteristics and is influenced by many factors such as; Population growth both urban and rural, Economic growth and economic cycle, Water pricing and related water services charges, Technological transfer and its impact on reducing consumption via losses reduction and water recirculation, Climatic changes and out coming meteorological effects.

These factors individually or combined will have a strong effect on projected water demand at various sectors.

A major challenge facing the Ministry of Water Resources and Irrigation of Egypt is to close the rapidly increasing gap between the limited water resources and the sustainable exploitation of the water resources system in support of production of economic goods and services that are required to meet national and regional development objectives.

The water requirements of the agricultural sector represent the largest component of the total water demand in Egypt. Agriculture consumes more than 80% of Egypt's share of Nile water annually. Municipal and industrial water requirements represent a relatively small portion of Egypt's total requirements. Other usages are livestock, fish farming and non-withdrawals for navigation and hydropower generation. The remaining portion has to be drained to the sea in order to maintain the ecological balance of the Delta region.

In this research, two models have been followed:

- Water Demand Forecasting Model (WDFM) to combine the various water demand component with all effects. The model represents comprehensive tools for policy making and provide water resource analyst in Egypt with versatile modules to test combination of effects on future water demand projections.

- Agriculture Sector Model for Egypt (ASME) as a planning tool to assess the impacts of various external conditions and governmental strategies on the water resources system and the food supply for Egypt. The model consists of a set of databases, modules and tools for simulation and analysis, and for the presentation of results. The model is a quantitative model of the agricultural sector; it has been used to evaluate alternative water allocation options in terms of their impacts on cropping patterns, domestic food consumption, foreign trade and employment.

Finally, a case study of Behira Governorate, Egypt, is presented to demonstrate the combination of WDFM and ASME in evaluating the future water demands and the different tools to match expected supply with projected demands, considering different target years (2017, 2022, 2027, 2037 and 2050).

Key words: Water Demand Forecasting. Matching Supply and Demand, Decision Support System, Agriculture Sector Model for Egypt and Modeling of Predicted Water Demand

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