شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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قسم

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Ain Shams University
Faculty of Engineering
Irrigation & Hydraulics Department

Enhance Irrigation and Drainage Management Under the Water Scarcity in Egypt

By

Eng. Emad Mohamed Mahmoud Khalil
M.Sc. Civil Engineering – Cairo University 2016
Ministry of Water Resources and Irrigation

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of philosophy in Civil Engineering

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Cairo 2021

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Examiners' Committee

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Date: …/…/ 2021

STATEMENT

This dissertation is submitted to Ain Shams University for partial fulfillment of the requirements for the Degree of Doctor of philosophy in Civil Engineering.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Date : / /2021

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CURRICULUM VITAE

Emad M. Mahmoud Senior Water Resources Engineer with over 18 years of experience in the field of water resources management, irrigation and drainage management covering the full spectrum of: strategic planning, design, operation, follow up, field reconnaissance, project planning and management, capacity building, awareness raising, monitoring, and program appraisal.

Having vast professional experience in Water Resources Engineering, I have been involved in diversified domain projects of Water Resources Engineering ranging from medium to large scale projects.

A considerable experience in hydrology, water resources management, environmental engineering, and development–related fields have been acquired Throughout my career.

For more than 5 years, I was involved in direct coordination with decision makers in the water sector including equal experience with several international institutions; World Bank (WB), Golable Environmental Facility (GEF) and other international organizations.

ACKNOWLEDGEMENT

First, I would like to express my sincere gratitude to my supervisor Prof. Mohamed Nour El Din for the continuous support, his patience, motivation, and immense knowledge. His guidance helped me in all the time of research and writing of this thesis.

I would like to thank Prof. Safwat Abdel-Dayem for his insightful comments and encouragement. His hard questions incented me to widen my research from various perspectives.

My sincere thanks also go to Dr. Peter Raid, Dr. Ehab Mostafa and Dr. Aiman AL Saadi who provided me with valuable advice, and stimulating discussions. Without their precious support it would not be possible to conduct this research.

My deepest gratitude goes to the Examiners' committee Prof. Nagy Ali and Prof. Hussien EL Gammal for the guidance and suggestions brought in threads of thought that made my research so much richer and my dissertation something I can be proud of having written.

I am also grateful to Dr. Eman Syed, Head of Planning Sector for her continuous support and guidance throughout the development of this thesis.

Great thanks are due to my family and colleagues who patiently supported and encouraged me during the years of research.

ABSTRACT

Agricultural subsurface drainage is a common practice designed to maintain the water table depth in order to prevent waterlogging, increase agricultural crop yield and provides leaching capability to control salinity build-up in the root zone. Egypt adopted a strategy to cover all the arable lands with artificial drainage systems. However, loss of excess water through free drainage system is a major cause of low irrigation efficiency at field level in Egypt. The drainage water is left to flow continuously where water is quickly removed from the soil profile before the plants have enough chance to benefit from the shallow water table and the applied nutrients after irrigation (over drainage).

Egypt's major challenge is to close the rapidly growing gap between the limited water supply and the increasing water demands by various economic sectors. Agriculture sector alone utilizes about 76 percent of Egypt's fresh water resources. Policies, strategies and measures aiming to increase water efficiency through improved irrigation and drainage systems have been implemented with the objective to save irrigation water and increase water productivity.

This research aims to develop a decision support tool to evaluate the effects of controlled drainage -the system which physically restricts drainage water volumes through controlling the outlet of the subsurface drains- associated with irrigation scheduling on; applied irrigation water volumes, soil salinity and crop yield to determine the best promising measures that increase water productivity. Actual field measurements have been collected for conventional and controlled drainage systems during the growing seasons 2015 and 2016 in El-Baradi area in Western Nile Delta. The field data were used to setup and validate the DRAINMOD-S field-scale simulation model. The validated

model was used as a tool to simulate three drainage systems; free subsurface drains (FD) at depth of 1.2 m, controlled drainage system with changeable depths (CDch) at 0.8, 1.00, and 1.20 m depending on the crop stage, controlled drainage system (CD0.8) at fixed depth of 0.8 m. Short-term and long-term simulations runs have been carried out for wheat and maize crops to predict the effects of stresses caused by extreme soil water conditions (wet stress), soil water dry stress, and salinity on crop yields. The Model was used also to predict the effect of changing control depth, control period and irrigation schedule on crop yield and soil salinity, where 2 irrigation strategies were used for 9 years simulation period combined with both conventional and controlled drainage systems.

The simulation results showed that, the shallow groundwater resulting from using controlled Drainage (CD) eliminates crop water stress under water shortage condition. Controlled drainage system increases the average relative yield for maize crop by 6.0 % compared to free drainage system, even with 14% reduction in irrigation water volumes. Using evenly irrigation gifts (irrigation strategy 2) with a reduction of 14% in applied irrigation water; increase the relative yield of wheat by 2.0% and 9.4 % in conventional and controlled drainage systems respectively compared to traditional irrigation strategy (irrigation strategy 1). While the average relative yield for the summer crop (maize) has been reduced by 12.6% in controlled drainage system compared to free drainage system when using irrigation strategy 2. This loss yield was attributed mainly to salinity stress.

Key words; Subsurface drainage, controlled drainage, DRIANMOD-S, irrigation scheduling, crop yield

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