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Crop Pattern Assessment in Western Delta Using GIS

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Ministry of Water Resources and Irrigation

Thesis Submitted in Partial Fulfillment of
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STATEMENT

This thesis is submitted to Ain Shams University for the degree of Master of Science in Civil Engineering.

The work included in this thesis was carried out by the author in the Department of Irrigation and Hydraulics, Ain Shams University and the Planning Sector of the Ministry of Public Works and Water Resources from August r, 2003 to June 2005.

No part of this thesis has been submitted for a degree or qualification at any other University or Institution.

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ABSTRACT

Changing the policy reform from a centralized economy to market economy has led to the liberalization of the cropping pattern (CP). Since then the area cultivated with rice has doubled from the 700,000 fed. to some 1,500,000 fed. Rice considered as low profitable crop and, in the same time, it is one of the highest water consuming crops. Which requires well control on the irrigation efficiency, as well as design of an indicative cropping pattern for each region in the country based on climatologically conditions, soil characteristics, and water resources availability in terms of quantity and quality.

The study is conducting on a pilot area level (Abou-Hummus irrigation district in western delta). The study main objectives are to; Maximize the benefits from the water resources through selecting the most suitable CP to maximum production considering either the economic or the environmental aspects besides the quantity and the quality of water used, in addition developing a GIS tool to help in selecting the most suitable CP. Finally, the study tries to assess the suitability of the current CP for the system.

The Study Outputs are:- 1) Maps and Information about Abou-Hummus irrigation districts land and water resources. An understanding of the Cropping Pattern trends in the area. 2) A decision support system for Cropping Pattern selection. 3) Suggestions of different Cropping Pattern scenarios according to different objectives. 4) Assessment of different CP Scenarios and perform comparison between them, as well as compare the total water needs for different scenarios against the water delivered to the area, and the total income for the different scenarios. 5) Recommendations to apply the suggestions on different areas and link it to the Integrated Water Management District implemented by Ministry of Water Resources and Irrigation.

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List of Acronyms and Abbreviations

APRP	Water Policy Reform Activity
ASME	The Agriculture Sector Model of Egypt
B	Boron
CALAG	California Agricultural Model
CLEQM	Central Laboratory for Environment Quality
CAPMAS	Agency for Public Mobilization and Statistics
Cl	Chloride
CPDSS	Cropping pattern decision support system
DAE	Description of The Affected Environment
DEM	Digital Elevation Model
ds/m	deciSiemens per meter
DSS	Decision Support System
EC	Electrical Conductivity
Ecw	Irrigated Water Salinity
EEAA	Egyptian Environmental Affairs Agency
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan And Monitoring
EPADP	Egyptian Public Authority for Drainage Projects
ET	Evapo-Transpiration
Etc	ET Under Standard Conditions
ETo	Reference Crop Evapotranspiration
FAO	Food And Agricultural Organization of The United Nation
Fed.	Feedden
G	Soil Heat Flux
GAMS	General Algebraic Modelling System
GIS	Geographic Information System
GLI	Guidelines for Interpretations of Water Quality for Irrigation
GWD	Groundwater Depth Measured from The Land Surface
IA(PP)	Impact Assessment (Planning Program)
H.C	Hydraulic Conductivity
IIIP	Integrated Irrigating Improvement Project
IIP	Irrigating Improvement Project
IM	Impact Mitigation
IP	Impact Prediction
IPI	Identification of Potential Impacts
IWRMS	Integrated water resources management system
K (m/d)	Soil Permeability
K_c	Crop Coefficient
LP	Linear Programming
Mm3	Million Cubic meter
MWRI	Ministry of Water Resources and Irrigation
NAWQAM	National Water Quality and Availability Management Project
NILECON	The Nile Economic Model

NO_3	Nitrogen
NWRC	National Water Research Centre
NWRP	National Water Resource Plane
MALR	Ministry of Agriculture and Land Reclamation
OPDM	The Operational Planning Distribution Model
PDN	Project Description And Needs
PII	Pertinent Institutional Information (Scoping)
PS	Planning Sector
P.S.	Pump Station
PSM	Planning Studies and Models
PWD	Preparing the Writing Documentation
R.H	Relative Humidity
RIGWA	Research Institute Of Ground Water
S	Salinity
SAR	Sodium Adsorption Ratio
Sc	Scooping
SDSS	Spatial Decision Support System
SEA	Strategic Environmental Assessment
SL	Land Slope
SPA	Selecting Proposed Action
T	Air Temperature
TDS	Total dissolved solids (mg/l).
WQ	Water Quality
WR	Water Requirements
WMRI	Water Management Resources Institute
WQGL	Water quality guidelines for irrigation

2. Introduction

2.1 Background

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 small portion of Egypt's total requirements. Other usage is livestock, fish farming, and non-withdrawals for navigation and hydropower generation. It is expected that the future demands definitely increase for all uses due to the rapid increase in population and the land reclamation and industrialization policies. The rate or increase will vary from one sector to another according to the government national policy and, thus, reallocation of the available water resources will be needed to meet these future demands. Figure (1.1) shows the demand in the agriculture sector, as it will consume about 75,000 mm^3 by the year 2020 (NAWQAM, 2002), which is considered a large number. And requires a broader vision to reduce the agriculture demand and control the cropping pattern as well as reduce the area cultivated with high water consumer crops.

Demand-oriented approach looks at the real demand for water and tries to urge the users to make better use of this valuable resource. This can be achieved by creating awareness among the users that the resource is precious for example by letting them pay for it, or pay the costs to treat and deliver it. Over the agricultural, institutional measures include public awareness programs for water