AYSAR TUAMA AL AWADI. Optimal Water Allocation Management of Al-Hussainiyah Irrigation Project with GIS Support. University of Technology, Building and Construction Engineering Department, Water and Dams Branch. M.Sc. Supervised by PROF. DR. KARIM KAHLAF. AL JUMAILI and LEC. DR. MAHMOUD SALEH. AL KHAFAJI. 2013. 216 p.

ABSTRACT

In this study, a decision support system for irrigation water management and optimal cropping patterns has been developed in order to help water managers and irrigation projects decision makers to face the problems related to water scarcity and possible drought conditions for Al-Hussainiyah Irrigation Project in Karbala province. Five evapotranspiration (ET_0) models have been analyzed by comparing Penman-FAO-24 (PF) model with: Penman Monteith -FAO-56 model (PM), Penman-Kimberly model (PK), Jensen -Haise model (JH) and Hargreaves model (H). A Regression analysis for predicting (ET_0) from minimum climatic data has been developed. The developed linear regression model from minimum climatic data (H) model with slope of **1.254**, interception point of **-1.801** and coefficients of determination R^2 of **0.988** matched very closely to (PF**)** model values. The average value of (ET_0) **[** (PF), (PM), (PK), (JH) **]** was used to estimate crop water requirements.

The balance of irrigation water supply and demand with respect to planned and present state of agriculture during (2006 to 2011) has been evaluated. According to this evaluation, the monthly deficit or excess in irrigation water was estimated.

GIS database for evaluation irrigation water availability have been created. It was found that the irrigation water demands can not be provided compared to available discharges, and thus the planned and present agriculture cannot be sustained. Generally, the deficit in irrigation water demand is very clear during the months **(Feb to Sept)** for the state of agriculture during (2006 to 2011). The excess over irrigation demand occurs in three months **(Jan), (Nov**) and **(Dec)** with respect to years **2006, 2007, 2010 and 2011.** Also, the planned agriculture water demand is far from present state of agriculture.

An optimization linear model was developed and tested in the area of Al- Hussainiyah Irrigation Project for each main canal zone. The model was tested to find an optimum cropping pattern that maximizes the total net revenue during drought season **(Mar to Sept)**. The sensitivity of this model was tested by applying different changes in, water availability, conveyance efficiency and irrigated area for Old Hussainiyah, Al Wand, New Hussainiyah, Al Kamaliah, Abu Zarah and Al Rushdiyah canal zones based on analyzing six scenarios for each canal zone with seven land used types (Maize, Cotton, Sunflower, Sesame, Small grain, Summer vegetables and Alfalfa) in the considered project during drought season. GIS database for optimal management scenarios results have been created. It was found that the increase in water availability from **[(239 to 288)× $10^6 m^3$]** and conveyance efficiency from **(0.8 to 0.85)**, increased the total benefit with (**28%),** increased the summer vegetables area with (**28%)** and decreased the fallow area with **(15%).** A sensitivity analysis showed that the variation of the water irrigation availability and conveyance efficiency had a clear impact on the optimal solution.

On the other hand the results tended towards the crops that require less water irrigation (maize), when there was restriction to summer vegetables area**.** The integration of GIS and LP optimization model can

help decision makers in choosing the most economical cropping pattern, allowing the farmer to have the highest income. Further inputs related to crop rotation over the year should be investigated. This would help in optimizing the water use over the year.