UNIVERSITI PUTRA MALAYSIA

WATER MANAGEMENT FOR KERIAN IRRIGATION SCHEME USING GEOGRAPHICAL INFORMATION SYSTEM

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By

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Thesis Submitted in Fulfilment of the Requirements for the Degree of Master of Science in the Faculty of Engineering
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Dedicated
To
My Parents and Alpona

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science.

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Faculty: Engineering

A GIS-based model was developed to integrate the vast amounts of spatially distributed information of the Kerian Irrigation Scheme. The scheme has a command area of 24,000 ha, comprising eight compartments which is further subdivided into 28 blocks. The model requires the input of spatial and temporal information from various fields to compute irrigation deliveries for the upcoming period. It also runs periodic and seasonal monitoring and evaluation programs to improve water management of the scheme. The system permits display of information in the form of maps for easy visualization. The software MapInfo Professional 4.5 was used to demonstrate the concepts and MapBasic Professional 4.5 programming language for the development of the user-interface tool. The scheduling program computes irrigation deliveries based on spatial and temporal demand of the paddy field by each compartment, block and Secondary Canal. The monitoring program gives information by compartment and by block at the end of each period on uniformity of water distribution to the field as well quantity to be delivered for the next period. The computed discharges were used to monitor the performance of irrigation delivery at the end of each period.

Relative Water Supply (RWS), Water Use Efficiency (WUE), Cumulative Relative Water Supply (CRWS), Water Productivity Index (WPI) and Cropping Intensity (CI) have been used for monitoring and evaluation of the irrigation system performances. Hydro-climatological parameters like Evapotranspiration (ET), Effective Rainfall (ER), Irrigation Depth (IR) and Drainage Requirement (DR) also were computed. The post-season analysis provides weekly distribution of hydro-climatological parameters, irrigation delivery and performance by block. On a weekly basis, RWS and WUE were found to range from 1.01 to 2.24 and 45% to 99% respectively in the main season and 1.01 to 1.87 and 53.6% to 96.2% in the off season. The average values of RWS and WUE were found to be 1.53 and 68.15% in the main season and 1.33 and 78.5% in the off season respectively. The average values of WPI were also found to be 0.1267 and 0.2171 kg/m^3 in the main season and off season respectively. The color-coded thematic maps were produced for the monitoring of seasonal yields and cropping intensity by block and compartment of the scheme.

The user-interface technique for the irrigation system promises to provide comprehensive results along with new data sets and improve the decision-making processes in the operation and management of the scheme. The computed results are rapidly displayed allowing the manager to view maps, tables and graphs in a more comprehensive form, allowing time to make appropriate decision as the season progresses. This technique was found to be for improving the irrigation system management along with the actual feedback of the field information.

Abstrak tesis yang dikemukakan kepada Senat Univerisiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENGURUSAN AIR UNTUK SKIM PENGAIRAN KERIAN DENGAN MENGGUNAKAN TEKNOLOGI MAKLUMAT GEOGRAFI

Oleh

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Satu model yang menggunakan GIS telah dibina untuk mengumpul maklumat Skim Pengairan Kerian. Keluasan skim ini adalah 24,000 ha yang terdiri dari 28 blok dalam 8 kompatmen. Model ini memerlukan maklumat tempatan dan semasa yang dikumpul dari blok-blok sebagai input untuk menjangka keperluan penghantaran pengairan untuk jangka masa yang akan datang. Ia juga boleh digunakan untuk mengawal dan menilai prestasi sesuatu projek pengairan secara berkala dan bermusim. Sistem ini menukarkan maklumat dalam bentuk peta supaya ia mudah digambarkan. Perisian MapInfo Professional 4.5 telah digunakan untuk menunjukkan konsep-konsep dan Program MapBasic Professional 4.5 pula digunakan sebagai alat-alat kawalan yang berdasarkan pengguna. Pengaturcaraan program mensimulasikan penghantaran pengairan berdasarkan keperluan tempatan dan semasa sawah padi untuk setiap kompatmen, blok dan terusan sekunder. Program Pengawalan pula memberikan maklumat berkaitan sistem pengagihan pengairan berdasarkan kuantiti yang perlu dibekalkan bagi setiap kompatment dan blok bagi satu jangkamasa

hadapan. Pengiraan bekalan digunakan bagi mengawal peristasi penghantaran pengairan pada setiap penghujung suatu pengairan. Jumlah Bekalan Air Relatif (RWS), Kecekapan Guna Air (WUE), Bekalan Air Relatif Kumulatif (CRWS), Indeks Produktiviti Air (WPI), dan Keamatan Penanaman (CI) telah digunakan untuk mengawal dan menilai prestasi sistem pengairan ini. Selain ini, parameter-parameter hidro-klimatologikal seperti Sejat Pemelukan (ET), Hujian Berkesan (ER), Kedalaman Pengairan (IR) dan Keperluan Penanaman (DR) juga telah diambilkira. Berasaskan keputusan mingguan, RWS dan WUE didapati bernilai di antara 1.01 hingga 2.24 dan 45% hingga 99% pada musim-musim utama, dan 1.01 hingga 1.87 dan 53.6% hingga 96.2% semasa di luar musim tanaman. Nilai purata untuk WPI yang didapati pula ialah 0.1267 dan 0.2171 kg/m^3 masing-masing pada musim penanaman dan di luar musim. Peta thematik yang mempunyai kod warna juga telah dihasilkan untuk mengawal hasil-hasil semusim dan intensiti tanaman berdasarkan blok dan kompatman bagi skim tersebut.

Teknik antaramuka pengguna untuk sistem pengairan menjanjikan pemerolehan keputusan yang menyeluruh dengan set-set data yang baru. Ini dapat meningkatkan proses membuat keputusan dalam operasi dan pengurusan untuk suatu skim. Keputusan simulasi dapat dipaparkan dengan cepat, ini membolehkan pengurus untuk sesuatu projek melihat peta, jadual dan graf dengan cara yang lebih menyeluruh serta membuat keputusan yang wajar untuk sesuatu musim penanaman. Dengan maklum balas yang sebenar dari lapangan, kajian adalah sangat berguna untuk memperbaiki sistem pengairan.

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