UNIVERSITI PUTRA MALAYSIA

DECISION SUPPORT SYSTEM FOR DESERTIFICATION CONTROL THROUGH FLOODWATER SPREADING IN ISLAMIC REPUBLIC OF IRAN

MASOUD NEJABAT

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DECISION SUPPORT SYSTEM FOR DESERTIFICATION CONTROL THROUGH FLOODWATER SPREADING IN ISLAMIC REPUBLIC OF IRAN

By

MASOUD NEJABAT

Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfillment of the Requirement for the Degree of Doctor of Philosophy

July 2009

DEDICATION

Dedicated to:

my dear family

for their moral support

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

DECISION SUPPORT SYSTEM FOR DESERTIFICATION CONTROL THROUGH FLOODWATER SPREADING IN ISLAMIC REPUBLIC OF IRAN

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July 2009

Chairman: Associate Professor Anuar Abd Rahim, PhD

Faculty: Agriculture

Floods and droughts have resulted accelerated land degradations in Iran. Land degradation in arid, semi-arid, and dry sub-humid areas is desertification and more than 90% of Iran's area is classified as arid or semi-arid with 43% being susceptible to land degradation. Different forms of floodwater storage have been proposed as solutions that not only reduce flood damages in wet years but also decrease undesirable effects of water shortage during droughts. Floodwater spreading (FWS) is one of the most logical solution for desertification control (DEC) in Iran. FWS increases soil moisture, improves vegetation cover, and diminishes flood-related damages. The FWS requires diligent planning and as such, site selection is expected to be the foremost priority. Decision Support System (DSS) is a new approach capable of facilitating selection and planning of the most appropriate sites for FWS.

To identify the optimum diagnostic problems, updated situation and achievements of 37 FWS research stations all over Iran were investigated. Some of the stations (11 of

them) with more reliable data that represent the diversity of Iran's climate, morphological zones, and soil types were chosen. From these investigations, 21 new effective factors were defined and the data required for data-base and knowledge-base components of the DSS were gathered. In order to adopt the DSS to FWS conditions, multicriteria decision analysis (MCDA), weighted summation, and expected value methods were selected for ranking, appraising, and weighting, respectively. Validity of DECFWS, a certain DSS developed for Desertification Control through Flood Water Spreading, was tested by 1) comparing results with vegetation results of implemented scenarios at FWS research stations, and 2) comparing with results of land suitability evaluation for controlled alternatives based on USDA 2003 method. The latest version, DECFWS 3.31, was developed under Visual Basic that can help decision makers with presenting the: the most appropriate alternative for a chosen scenario, the most reasonable scenario for each alternative, the alternative with the highest benefit-to-cost ratio, the most appropriate alternative in general (for several scenarios), the irrelevant alternatives, and the uncertainty analysis in ranking. Some advantages of this DSS are: accurate assessment, targeted evaluation and ranking, rapid appraisal, low cost, ease of application, flexible to variations, helpful in presenting irrelevant alternatives, executable despite data scarcity, editable in report presenting, assessing effects score uncertainty, precision in ranking, exact in converting qualitative to quantitative data. Results of this dissertation demonstrate the ability of DSS to solve unstructured problems and yield a variety of alternatives in dry regions. It prompts soil scientists interested in land and environmental managements to become familiar with DSS and its application for sustainable managements, especially under fragile circumstances. However, more comprehensive researches on DEC and new emerging technologies (such as the one used in this thesis) are needed to help conserve the degrading land.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

SISTEM SOKONGAN KEPUTUSAN BAGI KAWALAN PENGGURUNAN MELALUI PENYEBARAN AIR BANJIR ISLAM REPUBLIK DI IRAN

Oleh

MASOUD NEJABAT

July 2009

Pengerusi: **Professor Madya Anuar Abd Rahim, PhD**

Fakulti: **Pertanian**

Banjir dan kemarau adalah masalah utama dalam pertanian lestari dan pengurusan sumber asli di Iran, yang mana ia mempercepatkan proses degradasi tanah. Lebih daripada 90% kawasan di Iran dikelaskan sebagai gurun atau separa gurun dan 43% adalah dalam keadaan degradasi tanah yang kritikal. Menunjukkan bahawa aplikasi penyebaran air banjir (FWS) adalah penyelesaian yang paling logik untuk kawalan penggurunan (DEC) di Iran. Penyebaran air banjir meningkatkan kelembapan tanah, memperbaiki liputan tanaman dan menghapuskan masalah-masalah berkaitan dengan banjir. Rancangan ini memerlukan perancangan yang rapi dan oleh yang demikian pemilihan kawasan FWS adalah diutamakan. Kajian ini berusaha untuk menunjukkan: aplikasi sistem sokongan keputusan (DSS) boleh membawa kepada pembaikpulihan dalam DEC untuk mengoptimumkan pemilihan kawasan FWS di kawasan kering berdasarkan kepada pengurusan lestari (senario penggunaan tanah yang dikehendaki) sumber semulajadi. Untuk mengoptimumkan diagnosis masalah, keadaan keputusan dan objektif 37 stesen penyelidikan FWS sekitar Iran telah di kaji. Daripada projek FWS ini, 11 stesen yang mempunyai data yang boleh diterima

pakai untuk menggambarkan sebaran cuaca utama di Iran dan kawasan morfologi serta jenis tanah telah dipilih. Berdasarkan kepada data kajian ini, keperluan pengkalan data dan pengkalan maklumat telah ditentukan (21 faktor baru yang efektif telah ditentukan). Kajian tentang DSS yang tersedia ada (untuk rancangan penggunaan tanah dan sistem pengairan) menunjukkan kajian ini memerlukan DSS yang khusus yang berupaya menyelesaikan masalah lokasi spesifik untuk pemilihan kawasan FWS. Pelbagai kriteria analisis keputusan (MCDA), 'weighted summation', dan 'expected value methods' telah dipilih untuk 'ranking' 'appraising' dan 'weighting' bagi adaptasi kepada DSS untuk keadaan FWS. Sistem sokongan keputusan yang khusus ini telah direka dan dihasilkan untuk memperbaiki kualiti membuat keputusan dalam Kawalan Penggurunan Melalui Penyebaran Air Banjir yang dinamakan DECFWS. Kesahihan DECFWS telah diuji menggunakan data sebenar daripada stesen kajian DSS yang dikawal menggunakan dua kaedah: 1. perbandingan dengan keputusan penanaman daripada setiap senario yang telah diimplimentasikan, 2. perbandingan dengan keputusan penilaian kesesuaian tanah menggunakan kawalan alternatif berdasarkan kepada kaedah USDA 2003. DECFWS 3.31 telah dihasilkan di bawah Visual Basic bersama dengan keupayaan tambahan. Perisian ini boleh membantu pembuat keputusan mempersembahkan dengan mudah: alternatif yang paling sesuai untuk senario terpilih, senario yang paling munasabah untuk setiap alternatif, alternatif yang paling dikehendaki dalam 'benefit- to cost ratio', alternatif yang paling sesuai secara keseluruhan (untuk beberapa senario), alternatif tidak sesuai untuk FWS dan 'constraints', dan sensitiviti analisis susunan untuk nilai kesan tidak pasti. Diantara kebaikan DSS ini adalah: penilaian tepat, sasaran nilaian dan susunan, taksiran pantas, kos rendah, mudah diaplikasi, mudah diubah mengikut keadaan, membantu dalam mempersembahkan alternatif yang tidak

berkaitan, boleh menyunting laporan, menilai kesan ‘score uncertainty’, ketepatan dalam susunan, tepat dalam menukar data daripada kualitatif kepada kuantitatif. Keputusan tesis ini menunjukkan keupayaan DSS dalam menyelesaikan masalah pembentukan struktur di kawasan kering. Kajian yang komprehensif tentang DEC dan menggunakan teknologi baru (seperti dalam tesis ini) boleh membantu memulihara tanah (mengurangkan degradasi tanah) dan alam sekitar dengan lebih cekap.

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APPROVAL

I certify that an Examination Committee has met on July 13th 2009 to conduct the final examination of Masoud Nejabat on his Doctor of Philosophy thesis entitled "Decision Support System for Desertification Control through Floodwater Spreading in Islamic Republic of Iran" in accordance with Universiti Pertanian Malaysia Act 1980 and Universiti Putra Malaysia (Higher Degree) Regulations 1981. The committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

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MASOUD NEJABAT

Date

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