UNIVERSITI PUTRA MALAYSIA

GEOSPATIAL MODELING FOR OPTIMIZATION OF SOLID WASTE DISPOSAL IN A RAPIDLY URBANIZING CITY, SARI, IN IRAN

BEHZAD NADI

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GEOSPATIAL MODELING FOR OPTIMIZATION OF SOLID WASTE DISPOSAL IN A RAPIDLY URBANIZING CITY, SARI, IN IRAN

By

BEHZAD NADI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

November 2010

DEDICATION

To God, who gave me the life, strength, and the perseverance

and

To My wife who stayed with me in difficult times

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

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Chairman: Associate Professor Ahmad Rodzi bin Mahmud, PhD

Institute: Institute of Advanced Technology

Solid waste management is an important component in the environmental system, and plays a key role in population health. Furthermore, Municipal Solid Waste Management (MSWM) is one of the critical environmental management challenges which is being faced by many developing countries including Iran due to a rapid urban development.

The aim of this dissertation research was developing models of solid waste management. The developed models were integrated into a Geospatial technology to select landfill sites based on fuzzy logic tools in GIS and artificial neural network analysis by means of weekly quantity prediction data of solid waste. In this regard, the response surface model was applied to optimize the cost of collection and transportation of solid waste.

In this study, extra parameters such as fuel consumption, machinery, and labor force (waste collection and transport) were applied for prediction of solid waste in order to

assess their effect in improving the structure of ANN model and the training performance of generated model.

To select the landfill site, three methods were applied known as additive weighting, ordered weighted averaging, and weighted linear combination. These methods were applied in a Fuzzy logic manner. According to the obtained results, there were many locations detected by OWA but not all of them were qualified.

A Response Surface Model (RSM) was also implemented with conventional optimization techniques of solid waste management. The effects of three parameters such as fuel consumption, total labor, and volume of transport were also investigated. Later on, reasonable and simple expressions for calculating the influential factors were suggested and established out based on distribution of influential factors.

The recommendations of this thesis consist of an implementation of a new solid waste management program which is suitable for recent urbanized area.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagi memenuhi keperluan untuk ijazah doktor Falsafah

PEMODELAN GEOSPATIAL UNTUK MENGOPTIMUMKAN PELUPUSAN SAMPAH DI BANDAR YANG MEMPUNYAI URBANISASI YANG CEPAT, KAJIAN KES DI SARI, IRAN

Oleh

BEHZAD NADI

Pengerusi: Prof. Madya Ahmad Rodzi bin Mahmud, PhD

Institut: Institut Teknologi Maju

Pengurusan sisa pepejal ialah komponen utama di dalam sistem alam sekitar dan memainkan peranan penting dalam pengawalan kesihatan penduduk. Tambahan lagi, ia adalah satu daripada cabaran pengurusan alam sekitar yang kritikal yang dihadapi oleh kebanyakan negara yang membangun termasuk Iran akibat daripada kepesatan pembangunan bandar.

Matlamat kajian disertasi ini ialah membangunkan model pengurusan sisa pepejal. Model yang dibangunkan diintegerasikan ke dalam teknologi Geospatial untuk memilih tapak pelupusan sampah berasaskan fuzzy logik di dalam kesekitaran GIS dan analisis rangkaian buatan neural untuk mendapatkan data ramalan kuantiti sisa pepejal secara mingguan. Dalam hal ini maklumbalas dari Model Permukaan Tindakbalas digunakan untuk mengoptimumkan kos pengumpulan dan pengangkutan sisa pepejal.

Dalam kajian ini, beberapa parameter tambahan seperti penggunaan minyak, jentera dan tenaga buruh (melibatkan pengumpulan dan pengangkutan sisa pepejal) digunakan dalam membuat ramalan sisa pepejal bagi menilai kesan dalam memperbaiki struktur model ANN dan menilai prestasi model latihan yang telah dihasilkan.

Untuk memilih tapak pelupusan sampah, tiga kaedah mudah digunakan iaitu pemberat bahan tambah, purata pemberat yang teratur dan gabungan linear yang mempengaruhi pemberat. Kaedah ini telah digunakan dalam fuzzy logik. Keputusan yang diperolehi menunjukkan kebanyakan lokasi yang dikesan melalui OWA adalah tidak ada kelayakan.

Model Tindakbalas Permukaan (RSM) telah juga digunakan di dalam teknik pengoptimum konvensional pengurusan sisa pepejal. Kesan tiga parameter seperti penggunaan minyak, jumlah tenaga buruh dan jumlah pengangkutan telah juga dikaji. Seterusnya, beberapa istilah mudah dan munasabah daripada faktor yang disarankan dan mempengaruhi keputusan diambilkira dengan berdasarkan kajian taburan faktor yang berpengaruh.

Cadangan-cadangan di dalam tesis ini adalah terdiri daripada perlaksanaan program pengurusan sisa pepejal baru yang sesuai untuk kawasan perbandaran terkini.

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I certify that an Examination Committee has met on (**date of viva**) to conduct the final examination of **BEHZAD NADI** on his Degree of Doctor of Philosophy thesis entitled **"GEOSPATIAL MODELING FOR AN OPTIMIZATION OF SOLID WASTE DISPOSAL OF RAPIDLY URBANIZING CITY IN IRAN"** in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the candidate be awarded the Doctor of Philosophy.

Members of Examination Committee were as follows:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory committee were as follow:

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DECLARATION

I declare that the thesis is my original work except for the quotation and citation which have been duly acknowledged. I also declare that it is not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or other institute.

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BEHZAD NADI

Date:29 November 2010

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