



UNIVERSITI PUTRA MALAYSIA

**DEVELOPMENT OF AN EXPERT SYSTEM FOR PREDICTING THE
EFFECTS OF ECONOMIC ACTIVITIES ON GROUNDWATER
QUALITY**

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FK 2000 42

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**DOCTOR OF PHILOSOPHY
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2000



**DEVELOPMENT OF AN EXPERT SYSTEM FOR PREDICTING THE
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By

MONGKON TA-OUN

**Thesis Submitted in Fulfilment of the Requirement for
the Degree of Doctor of Philosophy in the Faculty of Engineering
Universiti Putra Malaysia**

July 2000



**I dedicate this work to my parents and my family
with great appreciation for their understanding and encouragement
which have been a constant source of inspiration to me**



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the Degree of Doctor of Philosophy

DEVELOPMENT OF AN EXPERT SYSTEM FOR PREDICTING THE EFFECTS OF ECONOMIC ACTIVITIES ON GROUNDWATER QUALITY

By

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July 2000

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Presently, groundwater conservation has become a very important issue in the world. The attention has been given to groundwater pollution problems. The application of Information Technology (IT) in the form of an expert system namely GWPES (Groundwater Pollution Expert System) will be able to help in information retrieval and decision support when dealing with groundwater pollution and protection. The rule base and Graphic User Interface (GUI) of GWPES was developed using wxCLIPS version 1.62 for Personal Computer (PC), version 1.49 for Local Area Network (LAN) system and Authorware 3.5 for developing graphic presentation files. These application softwares also supported the GWPES for the interpretation of some knowledge data bases. The wxCLIPS expert system shell was originally designed by NASA (National Aeronautics and Space Administration). The rules were developed according to the comprehensive groundwater pollution information and Environmental Impact Assessment (EIA) procedure. The main menu of GWPES consists of six main parts as follows; Introduction, EIA Procedure, Concept,



Prediction, Mitigation and Monitoring. The first three parts help all interested people related to EIA to understand groundwater pollution information and EIA procedure. The next three main parts have been incorporated into an expert system to predict future situation of groundwater [Pollution Vulnerability, Nitrogen Fertiliser Impact and Project Activities Impact], and to propose possible mitigation measures as well as to approach groundwater quality-monitoring plan. Knowledge bases for GWPES have been elicited from domain experts (2 geologists, 1 hydrologist, 1 civil engineering majoring in groundwater, 2 soil scientists and 1 soil & water engineering expert) through interviews, existing established literature, EIA reports and field study. The GWPES has friendly graphical user interface that has been accepted satisfactorily by external domain experts and end-users.



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

**PEMBENTUKAN SATU SISTEM PAKAR UNTUK MERAMAL KESAN
AKTIVITI EKONOMI TERHADAP KUALITI AIR BAWAH TANAH**

Oleh

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Pada masa ini, pemuliharaan air tanah telah menjadi satu isu penting di dunia. Perhatian telah diberik kepada masalah pencemaran air tanah. Aplikasi teknologi maklumat (TM) dalam bentuk sistem kepakaran seperti GWPES a berkebolehan membantu pengurusan semula maklumat dan menampung daya keputusan apabila menyentuh perihal pencemaran air bawah tanah. Asas-asas pengetahuan dan penggunaan GUI di dalam GWPES telah dibangunkan dengan menggunakan wxCLIPS versi 1.62 bagi komputer peribadi; versi 1.49 bagi sistem LAN dan Authowde 3.5; di mana fail dipaparkan secara grafik bagi menampung sistem berkenaan untuk menginterpretasi sesetengah pengetahuan asas di dalam sistem kepakaran wxCLIPS (rekabentuk oleh NASA). Peraturan-peraturan dibentuk berdasarkan kefahaman maklumat pencemaran air bawah tanah dan prosedur EIA. Enam faktor yang ditekankan di dalam GWPES adalah: Pengenalan, Prosedur EIA, Konsep, Ramalan, Mitigasi dan Pemantauan. Tiga fakta pertama membantu mereka yang berminat mengenai EIA bagi memahami prosedur EIA dan maklumat

pencemaran air bawah tanah. Tiga fakta selepasnya akan digabungkan ke dalam sistem kepakaran untuk: 1. meramal situasi air bawah tanah pada masa hadapan; 2. mencadangkan ukuran mitigasi yang berkemungkinan, dan 3 untuk pendekatan plan kualiti air bawah tanah. Asas pengetahuan GWPES diambil dari pakar-pakar bidang (2 ahli geologi, 1 ahli hidrologi, 1 jurutera civil major air bawah tanah, 2 saintis tanah dan 1 jurutera air dan tanah) melalui temubual, kajian bahan bertulis sedia ada, laporan EIA dan kajian ujian di lapangan. Oleh kerana GWPES dilengkapi dengan GUI bersifat mesraguna, ramai di antara pakar bidang luaran dan pengguna terkini berpuas hati dengan sistem berkenaan.

ACKNOWLEDGEMENTS

I would like to express my appreciation and sincere gratitude to my supervisor, Associate Professor Ir. Dr. Mohamed Daud for his invaluable guidance, suggestions, constructive criticisms and constant encouragement throughout the course of study and in the preparation of this dissertation. My deep appreciation and gratitude also go to Professor Dato' Dr. Zohadie Bardaie and Professor Dr. Shamshuddin Jusop, members of my supervisory committee for their invaluable guidance and suggestions, constructive criticisms and encouragement.

I would like to thank the Department of Biological Agricultural Engineering, Universiti Putra Malaysia for providing the research facilities. I wish to thank domain experts: Associate Professor Dr. Haji Mohamad Ali Hasan, Associate Professor Chalong Buaphan, Dr. Aminuddin Bin Yusoff, Ir Dr Azuhan Mohamed, Dr. Samarn Panichapong, Mr. Mohammed Hatta Abd Karim, Mr. Muhamad Zin bin Mohamed, Mr. Mohd Jafri Md. Noor, Mr. Charoen Phiancharoen, and Mrs. Somkid Buapeng for their kind opinions and suggestions. Appreciation also goes to Khon Kaen University, Ministry of University Affairs, the Kingdom of Thailand for permitting me to take the study leave.

Last but not the least, I am greatly indebted to my mother, Mrs. Buerat Ta-oun, and my father, Mr. Kongkum Ta-oun for their great loving support. I wish to express my deepest appreciation to my lovely wife; Mrs. Sumala Ta-oun, son: Pum Ta-oun and Daughter: Puping Ta-oun for their encouragement. Special thanks to Dr. Suttipong Pruangka who kindly offered help and encouragement during my study.



I also would like to thank all my friends (Dr. Tongsuk Jetana, Dr. Chaiyawan Wattanachant, Tang Boon Cheng, Dr. Benchamaporn Wongsuban, Saowakon Suwanliwong, Pensri Sornprasitti, Dr. Opart Pimpa, Bodee Kamsikeaw, Cheunsikah Chemong, Wanna Ammawath, Apinya Wanichapan, Dr. Pramote Pengkham, Dr. Narumon Sumalee, Pitoon Nopnakorn, Lee Chain Yong, Yip Weng Hoong, Elia Godoong and Ma Choon Kwong) who gave me encouragement and support during the period of my study at Universiti Putra Malaysia (UPM).

I wish to thank chairman of examination committee: Associate Professor Ir. Dr. Salim Said and external examiner: Professor Dr. Prokob Wirojanagud for their suggestions and thanks to Ms Tan Bee Hoon from Faculty of Modern Languages, Universiti Putra Malaysia for editing this thesis.

Finally, I am grateful to the Ministry of Science, Technology and Environment Malaysia through the Intensification Research in Priority Areas (IRPA) for providing the scholarship for me to complete my study.



I certify that an Examination Committee met on 25th July 2000, to conduct the final examination of Mongkon Ta-oun, on his Doctor of Philosophy thesis entitled "Development of an Expert System for Predicting the Effects of Economic Activities on Groundwater Quality" 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 relevant degree. Members of the Examination Committee are as follows:

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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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