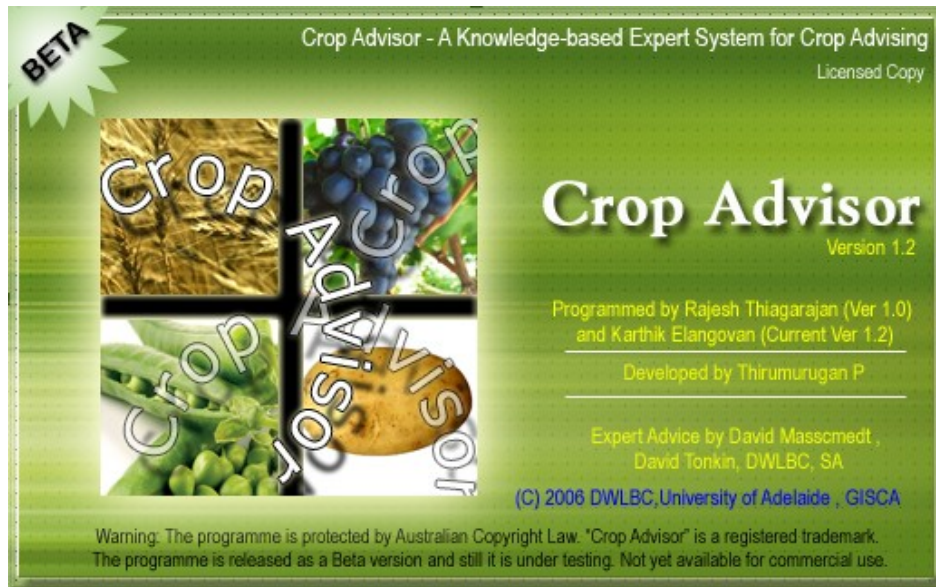


KNOWLEDGE-BASED EXPERT SYSTEM FOR AGRICULTURAL LAND USE PLANNING



Thirumurugan Ponnusamy

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Department of Geography and Environmental Studies
University of Adelaide



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PREFACE

The knowledge-based expert system outlined in this thesis might seem redundant for a developed country like Australia. However, such a system is an essential requirement for developing countries. This expert system was conceived with the needs of Indian farmers in mind, who often do not have access to expert knowledge and advice in agriculture. The expert system is intended to give customized expert advice, anytime and anywhere. Due to the non-availability of geographic data from India, restricted time and financial resources, a study area in South Australia was chosen for conducting the research. The system uses knowledge-bases pertaining to South Australian agriculture, land use practices and crops. The expert system should ideally work for any geographic datasets with necessary changes applied to the knowledge-bases. The Department of Water, Land and Biodiversity Conservation (DWLBC), South Australia has supplied the essential data used for the development of this expert system, which is also beneficial to DWLBC, as the current thesis explores a knowledge-based approach and builds on the existing land evaluation computer program used by the DWLBC in evaluating land and suggesting suitable crops.

ABSTRACT

*The research constitutes a **knowledge-based** approach to **land evaluation for selecting suitable agricultural crops for a land unit**. This thesis presents the design, and development of a prototype Knowledge-based Spatial Decision Support System (KBSDSS) -“Crop Advisor”- for evaluating land resources and choosing suitable agricultural crops for a farm unit. The prototype “Crop Advisor” expert system (ES) utilises multiple knowledge rules to determine suitable, optimal crops for a farm unit considering the farm unit’s resources. It considers the land evaluation process as a group-decision making process involving many experts from diverse scientific domains. The expert system is powered primarily by human knowledge collected from a land evaluator or a crop expert. The knowledge base consists of representative rules to reflect physical, economic, environmental and social factors that affect the choice of land use. The expert system makes use of Geographic Information System (GIS) tools to manage spatial information that are required for the evaluation process. These powerful tools (ES and GIS) help in choosing a crop, from a group of crop choices that gives more economic benefits without compromising environmental values. The expert system model is tested on the soil and physiographic data provided by Department of Water, Land and Biodiversity Conservation, South Australia (DWLBC) and Primary Industries and Resources, South Australia (PIRSA). This knowledge-based approach to land evaluation is built on the land evaluation framework designed by the United Nations Food and Agriculture Organisation (FAO). The DWLBC model of land evaluation suggests a strategic land use plan at regional level considering soil, climate and physiography which eliminates non-feasible land use or crop choices. The “Crop Advisor” expert system takes such regional data and suggests, in consultation with the farmer, a group of suitable crop choices that are best in terms of physical, economic, social and political factors associated with a farm unit.*

DECLARATION

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and that, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text of the thesis.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

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Date: 14th, December 2007

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TABLE OF CONTENTS

PREFACE	2
ABSTRACT.....	3
DECLARATION.....	4
ACKNOWLEDGEMENTS	5
TABLE OF CONTENTS	7
LIST OF FIGURES.....	11
LIST OF TABLES.....	12
DEFINITION OF TERMS	13
CHAPTER 1.....	15
INTRODUCTION.....	15
1.1. Background to the research.....	15
1.2. Purposes and significance of the study	16
1.3. Research methodology	19
1.3.1. Developing an appropriate model for agricultural land use decision making...19	
1.3.2. Developing the expert system.....	19
1.3.3. Testing the expert system	19
1.4. Limitations of the current study	19
1.5. Theoretical contributions.....	20
1.6. Practical contributions.....	20
1.7. Organisation of thesis chapters	21
1.8. Summary	22
CHAPTER 2.....	23
AGRICULTURAL LAND USE PLANNING	23
2.1 Introduction.....	23
2.2 Land and its importance	23
2.3 Land evaluation and land use planning	24
2.4 Strategic land use planning.....	26
2.5 Farm level land use planning	26
2.6 Needs of farmers	29
2.7 Summary	29
CHAPTER 3.....	31
COMPUTERS IN AGRICULTURAL LAND USE PLANNING	31
3.1 Introduction.....	31

3.2	Computers in decision support	31
3.3	Computers in land use planning	32
3.4	Disadvantages of traditional approaches	33
3.5	Expert systems	34
3.6	Components of an expert system	36
3.6.1	Knowledge base	36
3.6.2	Inference engine.....	37
3.6.3	User interface	37
3.7	Importance of GIS.....	38
3.8	Expert systems and GIS in agricultural land use planning	39
3.9	Summary	41
CHAPTER 4.....		42
FRAMEWORK FOR KNOWLEDGE-BASED SPATIAL DECISION SUPPORT SYSTEMS		42
4.1	Introduction	42
4.2	Data, information and knowledge	42
4.3	Knowledge in agriculture	44
4.4	Framework for knowledge acquisition.....	44
4.5	Framework for knowledge-based spatial decision support system	45
4.6	Frameworks for land evaluation.....	46
4.7	Current research framework	48
4.8	Summary	50
CHAPTER 5.....		51
LAND EVALUATION AND CROP SUITABILITY ANALYSIS		51
5.1	Introduction	51
5.2	Different approaches to land evaluation	51
5.3	Knowledge based approach to land evaluation	54
5.4	Crop suitability analysis	55
5.5	Procedure for crop suitability analysis	57
5.6	Summary	58
CHAPTER 6.....		59
METHODOLOGY.....		59
6.1	Introduction	59
6.2	Physical land evaluation by DWLBC.....	59
6.3	Suitability analysis	63

6.4	Study area	64
6.5	Summary	66
CHAPTER 7		67
DESIGN AND SPECIFICATIONS		67
7.1	Introduction	67
7.2	Targeted users and data sources	67
7.3	Knowledge engineering for “Crop Advisor” expert system	69
7.3.1	Deriving the factors	72
7.4	System properties	74
7.5	Development environment and software tools	74
7.6	Architecture of “Crop Advisor” expert system	76
7.7	Summary	77
CHAPTER 8		79
TESTING AND FEEDBACK		79
8.1	Introduction	79
8.2	Functioning of “Crop Advisor” expert system	79
8.3	Farm assessment: an illustrated example	84
8.4	Testing the “Crop Advisor” expert system	88
8.5	Validating the results of “Crop Advisor” expert system	90
8.6	Feedback for “Crop Advisor” expert system	92
8.7	Summary	96
CHAPTER 9		97
DISCUSSIONS AND CONCLUSIONS		97
9.1	Introduction	97
9.2	Demerits of “Crop Advisor” prototype	98
9.3	Merits of “Crop Advisor” expert system	98
9.4	Improvements for “Crop Advisor” expert system	99
9.5	Implementation of “Crop Advisor” expert system	101
9.6	Contributions of the research	103
9.7	Future research directions	104
9.8	Conclusion	105
9.9	Summary	105
References		106

APPENDICES

Appendix I: Factors used in Physical Land Evaluation	114
Appendix II: Factors used in Land Suitability Analysis	115
Appendix III: List of Crop Choices	120
Appendix IV: Criteria for assessing land suitability for Canola crop as developed by DWLBC121	
Appendix V: Source code of the Crop Advisor Expert System	123
Appendix VI: Screenshots of the Crop Advisor Expert System version 1.0.....	136

LIST OF FIGURES

Figure 1.1 Traditional land use planning and a knowledge-based expert system	18
Figure 2.1 Land Evaluation as an economic activity, adapted from FAO framework	25
Figure 3.1 Evolution of Computer Systems in Decision Support	31
Figure 3.2 Components of a typical Expert System	35
Figure 4.1. Knowledge Pyramid	43
Figure 4.2 Figure showing various users associated with expert systems	45
Figure 4.3. Simplified sequence for making decisions about the best use for land	49
Figure 5.1 Different approaches to land evaluation including that taken by the current research	54
Figure 5.2 Stages involved in land evaluation and crop suitability	57
Figure 6.1 Suitable land units for growing Olives	61
Figure 6.2 Suitable land units for growing Ryegrass	62
Figure 6.3 Map showing the study area of Blyth and Clare	65
Figure 7.1 Architecture of Crop Advisor Expert System	77
Figure 8.1 Main screen of Crop Advisor expert system.....	80
Figure 8.2 Executing Crop Advisor expert system to get suitable crops	82
Figure 8.3 Crop Advisor Developer team	83
Figure 9.1 Control panel for Crop Advisor expert system.....	100
Figure 9.2 Determinants of successful implementation	101

LIST OF TABLES

Table 5.1 Factors involved in agricultural land evaluation and crop suitability analysis.....	56
Table 6.1 Five land suitability classes and their general definitions	61
Table 6.2 Database showing suitability order of crops for a farm unit	63
Table 7.1 Datasets used in the research and their sources	69
Table 7.2 Table showing the knowledge base of crop requirements.....	71
Table 8.1 Farm table showing initial crop choices after physical land evaluation by DWLBC ...	84
Table 8.2 Elimination of crop choices based on rainfall	85
Table 8.3 Crop choices after labour availability factor is evaluated.....	87
Table 8.4 Table showing final crop choices for the farm unit with survey number H210800 S605	88
Table 8.5 Characteristics of “Crop Advisor” expert system	89
Table 8.6 Results of “Crop Advisor” system compared with 2003 land use map provided by DWLBC	92

DEFINITION OF TERMS

The following terms and definitions are adapted in the present research thesis.

Land use:

Land use refers to the use of land for raising agricultural crops, dairy and livestock. The current research deals with land use at farm level, a mapping scale of 1:10,000.

Agricultural land evaluation:

The procedure for surveying and assessing land resources in a farm unit to find its suitability to grow agricultural crops is known as agricultural land evaluation.

Crop suitability assessment:

Crop suitability assessment is performed based on the results of agricultural land evaluation. It aims to select an optimal crop that is suitable for growing in a farm unit, based on physical, economic and socio-political factors associated with the farm unit.

Farm unit:

A farm unit refers to a parcel of land used by a farmer or land owner for agricultural purposes. It is defined by a field boundary and usually considered as a management unit for cultivation.

Agricultural land use planning:

Agricultural land use planning refers to the combined procedure of land evaluation for agriculture and crop suitability assessment. In this research, the term "agricultural land use planning" refers to the farm level assessment of land resources and factors that affect the use of land and the act of choosing the most feasible crop option for a farm unit.

Strategic land use planning:

The process of land evaluation and land use allocation performed by the government authorities at regional scale is termed as strategic land use planning. The scale of mapping is usually between 1:50,000 to 1:1,000,000.

Geographic Information System:

A set of tools for managing geographically referenced data and information for planning and decision-making purposes.

Heuristic Knowledge

Heuristic (from the Greek word "heuriskein" meaning "to discover") knowledge pertains to the process of gaining knowledge through experience, trial by error methods rather than by following a formal step-by-step process (Roy 2001). For example, heuristic knowledge includes the knowledge gained from experience, rules of thumb and trial-by-error methods.

Expert

"An expert is a person who has a comprehensive and authoritative knowledge of or skill in a particular area" (Pearsall 1998:647). Experts have prolonged or intense experience, practice or education in a particular field that goes significantly beyond any general or shallow appreciation.

Knowledge Base

A collection of rules, assertions and facts about a problem domain represented in a machine-readable format is termed as a knowledge base.

Expert Systems

An expert system is a program which attempts to emulate the knowledge and reasoning capabilities of a human expert in order to solve a specific problem. Expert systems derive knowledge from various sources in the form of rules and assertions.

Knowledge Acquisition

The process of acquiring knowledge from various sources and converting them into a machine-readable form is referred as knowledge acquisition. The knowledge may come from various sources such as human minds, books, research findings and other reliable sources.

Knowledge Engineer

Knowledge Engineer is the person responsible for acquiring knowledge and coding it into a knowledge base in machine-readable form.

User

User is the person who uses the expert system. It is assumed that a typical user is an owner of a farm who wants to choose an optimal crop for his/her farm unit.