

Table of Contents

	Page
Acknowledgement	i
Abstract	ii
Thai Abstract	iv
List of Abbreviations	vi
Table of Contents	vii
List of Tables	ix
List of Figures	x
List of Appendix Tables	xi
List of Appendix Figures	xiv
Chapter 1 Introduction	1
Chapter 2 Literature Review	3
2.1 Spatial Information System	3
2.2 Land Evaluation	6
2.2.1 FAO Framework	6
2.2.1.1 Law of Minimum	7
2.2.1.2 Multiplication Method	7
2.2.1.3 Modified Multiplication Method	9
2.2.2 Automated Land Evaluation	9
2.2.3 Fuzzy Land Evaluation	11
2.3 Map Outputs Comparison	15
Chapter 3 Materials and Methods	18
3.1 Study Area	18
3.2 Framework of the Study	19
3.3 Database Design and Implementation	21
3.3.1 Spatial Database	21
3.3.2 Non-Spatial Database	22
3.4 Land Evaluation	23
3.4.1 Fuzzy Land Evaluation	23
3.4.2 Law of Minimum	24
3.4.3 Multiplication Method	25
3.4.4 Modified Multiplication Method	26
3.5 System Shell	26
3.6 Outputs of Evaluation	27
3.6.1 IDRISI	27
3.6.2 PC ARC/INFO	28
3.7 Comparison of the Outputs	28
Chapter 4 Results	29
4.1 Database Design	29
4.1.1 Spatial Database	29
4.1.2 Non-Spatial Database	30
4.2 Land Evaluation Models	31
4.2.1 Land Mapping Units	31
4.2.2 Fuzzy Land Evaluation by Wang's Method	32

4.2.3 Law of Minimum	37
4.2.4 Multiplication Method	39
4.2.5 Modified Multiplication Method	41
4.3 System's Shell	43
4.3.1 Main Menu	43
4.3.2 Area Selection Menu	43
4.3.3 Thematic Map Menu	45
4.3.4 Land Evaluation Menu	45
4.4 Outputs of Evaluation	50
4.5 Comparison Among Different Methods	58
Chapter 5 Discussion	64
Chapter 6 Conclusion and Recommendation	70
References	72
Appendix	77

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
 Copyright© by Chiang Mai University
 All rights reserved

List of Tables

Table	Page
1 Characteristics of some LMU in Prao for evaluation	31
2 Land quality values for wetland-rice converted from land characteristics of LMU in Table 1	33
3 Membership grades of the selected LMU for wetland-rice as evaluated by Fuzzy land evaluation	33
4 Membership grades of seven LUT in the selected areas as evaluated by Fuzzy land evaluation	33
5 Relative suitability values (R_i) for selected LUT based on Fuzzy land evaluation	34
6 The maximum relative suitability values and their associate LUT for selected LMU	34
7 Land quality values for wetland-rice converted from data in Table 1 according to LUR from FAO	37
8 Suitability classes for wetland-rice as defined by the Law of Minimum	37
9 Absolute suitability classes for wetland-rice as calculated by equation (1) according to the Multiplication method	39
10 Absolute suitability classes for wetland-rice as calculated by equation (2) according to the Modified Multiplication method	41
11 Area (%) in each suitability class for various LUTs using Fuzzy land evaluation method and LUR as defined by FAO and DLD	51
12 Area (%) in each suitability class for various LUTs using the Law of Minimum method and LUR as defined by FAO and DLD	51
13 Area (%) in each suitability class for various LUTs using the Multiplication method and LUR as defined by FAO and DLD	52
14 Area (%) in each suitability class for various LUTs using the Modified Multiplication method and LUR as defined by FAO and DLD	52
15 The overall KHAT statistics as a result of comparison between LUR defined by DLD and FAO in each method of suitability rating	58
16 The overall KHAT statistics values to compare different methods of suitability ratings of various LUTs using LUR defined by FAO	61
17 The overall KHAT statistics values to compare different methods of suitability ratings of various LUTs using LUR defined by DLD	62
18 The error matrix (expressed in number of pixels) of relative suitability by Fuzzy land evaluation method using LUR defined by FAO and DLD	63
19 The error matrix (expressed in number of pixels) of relative suitability by Fuzzy land evaluation method using LUR defined by FAO compared with present landuse	63
20 The error matrix (expressed in number of pixels) of relative suitability by Fuzzy land evaluation method using LUR defined by DLD compared with present landuse	63

List of Figures

Figure	Page
1 Procedures in land evaluation	8
2 ALES program flow	10
3 (a) Boolean set and (b) Fuzzy set	12
4 Chiang Mai province and Prao district	19
5 Framework of the study	20
6 Absolute suitability for wetland-rice in Prao by Fuzzy land evaluation	35
7 Relative suitability for different land utilization types (LUT) in Prao by Fuzzy land evaluation	36
8 Absolute suitability for wetland-rice in Prao by the Law of Minimum	38
9 Absolute suitability for wetland-rice in Prao by the Multiplication method	40
10 Absolute suitability for wetland-rice in Prao by the Modified Multiplication method	42
11 The starting menu of the system shell.	44
12 A menu to select the location	44
13 A menu to select thematic map, land evaluation or other	46
14 A menu to select a thematic map	46
15 Prao district and subdistricts	47
16 A menu to select land evaluation	48
17 A menu to select absolute suitability evaluation and land utilization types to be evaluated	48
18 Absolute suitability menu for selection of crop and evaluation method	49
19 Relative suitability menu for selection of evaluation method	49
20 Absolute suitability of peanut in Prao district by Fuzzy land evaluation method in IDRISI format	53
21 Relative suitability in Prao district by Fuzzy land evaluation method in IDRISI format	54
22 Absolute suitability of peanut in Prao district by the Modified Multiplication method in IDRISI format	55
23 Absolute suitability of peanut in Prao district by DLD suitability rating in IDRISI format	56
24 Absolute suitability of peanut in Prao district by Fuzzy land evaluation method in PC ARC/INFO format	57
25 Relative suitability in Prao district by Fuzzy land evaluation using LUR defined by FAO	59
26 Relative suitability in Prao district by Fuzzy land evaluation using LUR defined by DLD	60

List of Appendix Tables

Appendix Table	Page
1 Data dictionary of Soil Series coverage	91
2 Data dictionary of Soil Units coverage	92
3 Data dictionary of Contour coverage	93
4 Data dictionary of Landuse coverage	94
5 Data dictionary of Administrative boundary	95
6 Data dictionary of Road coverage	96
7 Data dictionary of River coverage	97
8 The UTM of TIC #1-4 in Prao District on 8 map sheets which cover the study area	98
9 Land use requirements (LUR) for wetland rice in different suitability ratings according to CSR/FAO (1983)	99
10 Land use requirements (LUR) for upland rice in different suitability ratings according to CSR/FAO (1983)	100
11 Land use requirements (LUR) for soybean in different suitability ratings according to CSR/FAO (1983)	101
12 Land use requirements (LUR) for maize in different suitability ratings according to CSR/FAO (1983)	102
13 Land use requirements (LUR) for groundnut in different suitability ratings according to CSR/FAO (1983)	103
14 Land use requirements (LUR) for mungbean in different suitability ratings according to CSR/FAO (1983)	104
15 Land use requirements (LUR) for sugarcane in different suitability ratings according to CSR/FAO (1983)	105
16 Land use requirements (LUR) for wetland rice in different suitability ratings according to DLD (1992)	106
17 Land use requirements (LUR) for upland rice in different suitability ratings according to DLD (1992)	107
18 Land use requirements (LUR) for soybean in different suitability ratings according to DLD (1992)	108
19 Land use requirements (LUR) for maize in different suitability ratings according to DLD (1992)	109
20 Land use requirements (LUR) for groundnut in different suitability ratings according to DLD (1992)	110
21 Land use requirements (LUR) for mungbean in different suitability ratings according to DLD (1992)	111
22 Land use requirements (LUR) for sugarcane in different suitability ratings according to DLD (1992)	112
23 File structure of LUR in .DBF format	113
24 File structure of LUT in .DBF format	113
25 File structure of LMU in .DBF format	114
26 File structure of LC in .DBF format	114
27 Program listing of WANG.PRG to calculate fuzzy set by Fuzzy land evaluation method	115

28	Maximum and minimum values of soil characteristics for calculating membership grades by Fuzzy land evaluation method	125
29	File structure of EVALUATE.DBF	126
30	File structure of WANG_F.DBF	127
31	File structure of WANG_F1.DBF	127
32	File structure of WANG_D.DBF	128
33	File structure of WANG_D1.DBF	128
34	Program listing of EVALUATE.PRG to calculate suitability Class by the Law of Minimum, the Multiplication and the Modified Multiplication method	129
35	File structure of suitability class as evaluated by the Law of Minimum method with LUR as defined by CSR/FAO (1983)	138
36	File structure of suitability class as evaluated by the Law of Minimum method with LUR as defined by DLD (1992)	138
37	File structure of suitability class as evaluated by the Multiplication method with LUR as defined by CSR/FAO (1983)	139
38	File structure of suitability class as evaluated by the Multiplication method with LUR as defined by DLD (1992)	139
39	File structure of suitability class as evaluated by the Modified Multiplication method with LUR as defined by CSR/FAO (1983)	140
40	File structure of suitability class as evaluated by the Modified Multiplication method with LUR as defined by DLD (1992)	140
41	Program listing of SML file to plot absolute suitability output plot files in PC ARC/INFO	141
42	Program listing of SML file to plot relative suitability output plot files in PC ARC/INFO	143
43	Program listing START.SPR containing the source codes of the System Shell to define environment, variables and starting system shell	144
44	Program listings UTILITY.PRG containing source codes to define window of the System Shell	146
45	Program listing MAIN.MPR containing source codes of the System Shell to create the menu bar for select the location	148
46	Program listing SUIT.MPR containing source codes of the System Shell to create the menu bar for select the thematic map or land evaluation	152
47	Program listing PROCESS1.PRG containing source codes of the System Shell to produce the map shown on the screen from thematic map menu bar selection	159
48	Program listing ABSO.PRG containing source codes of the System Shell to produce the map shown on the screen from land evaluation menu bar selection	162
49	Program listing PROJ13.PRG containing source codes of the System Shell to produce the map from project area selection	164
50	The error matrix (no. of pixels) from Fuzzy method comparing LUR defined by DLD and FAO	165

51	The error matrix (no. of pixels) from the Law of Minimum comparing LUR defined by DLD and FAO	166
52	The error matrix (no. of pixels) from the Multiplication method comparing LUR defined by DLD and FAO	167
53	The error matrix (no. of pixels) from the Modified Multiplication method comparing LUR defined by DLD and FAO	168
54	The error matrix (no. of pixels) from comparison of the Modified Multiplication method and the Law of Minimum using LUR defined by FAO	169
55	The error matrix (no. of pixels) from comparison of the Modified Multiplication method and the Multiplication method using LUR defined by FAO	170
56	The error matrix (no. of pixels) from comparison of the Modified Multiplication method and the Fuzzy land evaluation using LUR defined by FAO	171
57	The error matrix (no. of pixels) from comparison of the Law of Minimum method and the Multiplication method using LUR defined by FAO	172
58	The error matrix (no. of pixels) from comparison of the Law of Minimum method and the Fuzzy land evaluation using LUR defined by FAO	173
59	The error matrix (no. of pixels) from comparison of the Multiplication method and the Fuzzy land evaluation using LUR defined by FAO	174
60	The error matrix (no. of pixels) from comparison of the Modified Multiplication method and the Law of Minimum using LUR defined by DLD	175
61	The error matrix (no. of pixels) from comparison of the Modified Multiplication method and the Multiplication method using LUR defined by DLD	176
62	The error matrix (no. of pixels) from comparison of the Modified Multiplication method and the Fuzzy land evaluation using LUR defined by DLD	177
63	The error matrix (no. of pixels) from comparison of the Law of Minimum method and the Multiplication method using LUR defined by DLD	178
64	The error matrix (no. of pixels) from comparison of the Law of Minimum method and the Fuzzy land evaluation using LUR defined by DLD	179
65	The error matrix (no. of pixels) from comparison of the Multiplication method and the Fuzzy land evaluation using LUR defined by DLD	180

List of Appendix Figures

Appendix Figure	Page
1 Spatial databases of the study area as organized and stored in the harddisk	77
2 Non-spatial databases and the land evaluation program stored in the harddisk	78
3 The system shell component containing executable files, databases, and IDRISI images as stored in the harddisk	79
4 Soil series map of Prao	80
5 Slope map of Prao	81
6 Soil units map of Prao	82
7 Road map of Prao	83
8 Hydrology map of Prao	84
9 Present land use map of Prao	85
10 The starting menu of the system shell.	86
11 A menu to select the location	86
12 A menu to select thematic map, land evaluation or other	87
13 A menu to select thematic map	87
14 A menu to select land evaluation	88
15 A menu to select absolute suitability evaluation and land utilization types to be evaluated	88
16 Absolute suitability menu for selection of crop and evaluation method	89
17 Relative suitability menu for selection of evaluation method	89
18 Relative suitability for different LUT in PRAO by Fuzzy land evaluation and using the Photo Finish software to modify the title and legend in Thai language for a hard copy.	90