

4. RESULTS

4.1 Database Design

4.1.1 Spatial Database

All spatial data were digitized by using the PC ARC/INFO package at the map scale of 1:50,000 . The digital map was stored separately as a coverage and information contained in each map depends on the type of entities. The spatial data for the entire Prao district were contained in 8 mapsheets (Appendix Table 8). The harddisk space used to store the spatial data for Prao district in PC ARC/INFO are;

Soil series	=	175.436	Kbyte
Soil units	=	216.084	Kbyte
Landuse	=	380.517	Kbyte
Administrative boundary	=	28.165	Kbyte
Contour	=	534.715	Kbyte
Slope	=	835.899	Kbyte
Road	=	116.843	Kbyte
Hydrology	=	423.092	Kbyte
Total	=	2,710.751	Kbyte

The soil series, administrative boundary, and slope coverages from PC ARC/INFO were overlaid to produce small polygons. This coverage was converted to IDRISI format and the soil information were stored in the database format or attribute tables. The space required to store these data in IDRISI was twice as much as those stored in PC ARC/INFO. The type of data in raster format of IDRISI and the space required for Prao district were described as follows;

Soil series, administrative boundary, contour	=	4,297.794	Kbyte
Soil units	=	60.912	Kbyte
Road	=	118.777	Kbyte
Hydrology	=	271.958	Kbyte
Land use map	=	93.561	Kbyte
Total	=	4,842.902	Kbyte

The soil series, slope, soil units, road, hydrology, and Land use maps of Prao are shown in Appendix Figure 4 - 9 in IDRISI format respectively.

4.1.2 Non-Spatial Database

The attribute data of LUT, LUR, LMU, and the resulting suitability classes of this study were stored in the .DBF format. These data were used as the lookup tables of coverage in PC ARC/INFO or the attribute value files in IDRISI format. The space required to store these data are;

LUT	=	0.297	Kbyte
LUR	=	52.474	Kbyte
LMU	=	103.556	Kbyte
Suitability by Fuzzy land evaluation	=	622.350	Kbyte
Suitability by Law of Minimum	=	363.048	Kbyte
Suitability by Multiplication method	=	355.264	Kbyte
Suitability by Modified Multiplication method	=	355.264	Kbyte
Land use	=	21.108	Kbyte
Total	=	1,873.361	Kbyte

4.2 Land Evaluation Models

4.2.1 Land Mapping Units

The land mapping units were derived from overlaying slope map with soil series map. The total of 973 units were created by this process and stored in a database named LMU.DBF. These LMU were subjected to suitability evaluation by different methods. Land characteristics of each LMU can be retrieved from the database and can be directed to the screen or printer as required. Table 1 illustrates the values of land characteristics for five selected LMU retrieved from LMU.DBF.

Table 1. Characteristics of some LMU in Prao for evaluation.

AREA_ID	Temp	Rain	Drainage ^{1/}	Texture ^{2/}	Root_dep	CEC	pH	P	K	Slope
77	25.5	1090	SP	SALO	70	H	6.0	VH	H	2
91	25.5	1090	W	SALO	70	L	6.0	M	M	3
112	25.5	1090	W	SALO	70	L	6.0	L	H	4
140	25.5	1090	SP	CLLO	70	H	6.0	VH	H	1
153	25.5	1090	MW	SALO	70	L	5.8	M	L	2

^{1/} SP=Somewhat poor; W=Well; MW=moderately well

^{2/} SALO=Sandy loam; CLLO=Clay loam; VH=Very high; H=High; M=Medium; L=Low; VL=Very low.

4.2.2 Fuzzy Land Evaluation by Wang's Method

Equation (6) and (7) were used to calculate absolute suitability class of each LMU in Prao. Five LMU shown in Table 1 are selected for illustration. The characteristics of these LMU are shown in Table 1, these were converted to land quality values for wetland-rice (Table 2) using LUR from FAO. The results of the calculation of membership grades for the selected LMU in each suitability class i.e., S1, S2, S3 and N for Wetland-rice are listed in Table 3. The maximum values of membership grades are used to represent the hardened class of each LMU. For example, 0.2801 of wetland-rice is the highest grades of Area_ID 77 therefore absolute suitability class for wetland-rice is S1, designated as highly suitable for wetland-rice. To illustrate the relative suitability evaluation, the membership grades class S1 for each LUT of seven crops area shown in Table 4. These values were used to calculate relative suitability according to equation (8), the results are shown in Table 5. The crop (LUT) whose relative suitability value (R_i) is the highest for each LMU is considered to be the most suitable LUT for that LMU. For example,

Area_ID 77 has R_i of 0.2489 for Wetland-rice which is the highest value among other R_i values for Area_ID 77, therefore wetland-rice is the most suitable LUT for Area_ID 77 (Table 5 and 6).

The results of absolute and relative suitability evaluation using Fuzzy land evaluation for Prao district displaying as thematic maps are shown in Figure 6 and Figure 7. The process in calculating fuzzy membership took 13 minutes on PC 80486-DX machine running at 33 MHz. with the harddisk speed of 16 ms.

Table 2. Land quality values for wetland-rice converted from land characteristics of LMU in Table 1.

AREA_ID	Temp	Rain	Drainage	Texture	Root_dep	CEC	pH	P	K	Slope
77	6.4	2.7	8.0	6.0	2.3	8.0	4.3	10	7.5	0.4
91	6.4	2.7	4.0	6.0	2.3	4.0	4.3	5.0	5.0	0.6
112	6.4	2.7	4.0	6.0	2.3	4.0	4.3	2.5	7.5	0.8
140	6.4	2.7	8.0	8.0	2.3	8.0	4.3	10	7.5	0.2
153	6.4	2.7	8.0	6.0	2.3	4.0	4.3	2.5	7.5	0.4

Table 3. Membership grades of the selected LMU for wetland-rice as evaluated by Fuzzy land evaluation.

AREA_ID	S1	S2	S3	N	Maximum grade	Hardened class
77	<u>0.2801</u>	0.1482	0.0856	0.0680	0.2801	S1
91	0.1391	<u>0.2077</u>	0.1543	0.0884	0.2077	S2
112	0.1089	<u>0.1341</u>	0.1202	0.0921	0.1341	S2
140	<u>0.2901</u>	0.1479	0.0854	0.0678	0.2901	S1
153	0.1459	<u>0.2029</u>	0.1425	0.0789	0.2029	S2

Table 4. Membership grades of seven LUT in the selected areas as evaluated by Fuzzy land evaluation.

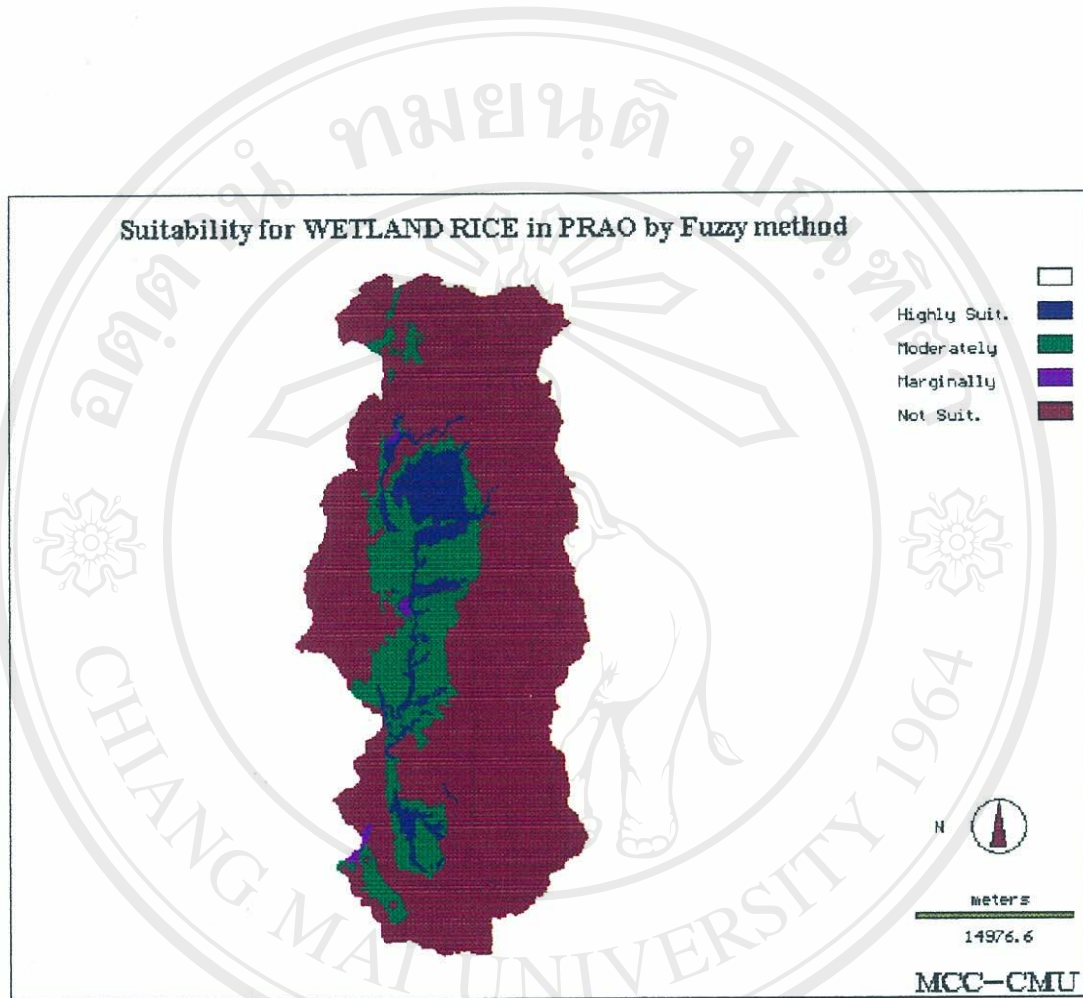
AREA_ID	Wetland-rice	Upland-rice	Maize	Soybean	Peanut	Mungbean	Sugarcane	Total
77	0.2801	0.1455	0.1849	0.1301	0.1211	0.0912	0.2025	1.1554
91	0.1391	0.1170	0.1429	0.1931	0.2508	0.1893	0.1291	1.1613
112	0.1089	0.0973	0.1107	0.1200	0.1436	0.1572	0.1040	0.8417
140	0.2901	0.1519	0.1277	0.1347	0.1090	0.0912	0.2017	1.1063
153	0.1459	0.1619	0.1287	0.2345	0.2980	0.2278	0.1183	1.3151

Table 5. Relative suitability values (R_j) for selected LUT based on Fuzzy land evaluation.

AREA_ID	Wetland-rice	Upland-rice	Maize	Soybean	Peanut	Mungbean	Sugarcane
77	0.2489	0.1248	0.1587	0.1116	0.1039	0.0783	0.1738
91	0.1198	0.1007	0.1231	0.1663	0.2160	0.1630	0.1112
112	0.1294	0.1156	0.1315	0.1426	0.1706	0.1868	0.1236
140	0.2622	0.1373	0.1154	0.1218	0.0985	0.0824	0.1823
153	0.1109	0.1231	0.0979	0.1783	0.2266	0.1732	0.0900

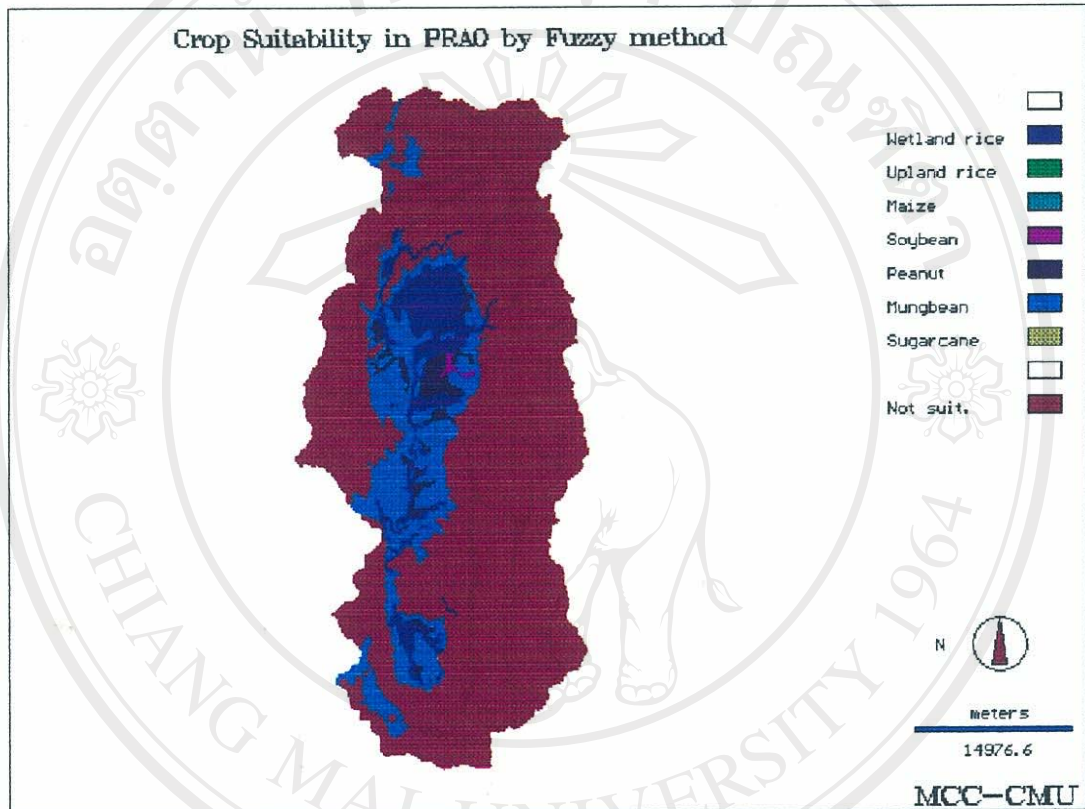
Table 6. The maximum relative suitability values and their associate LUT for selected LMU.

AREA_ID	Maximum value	Crop name
77	0.2489	Wetland-rice
91	0.2160	Peanut
112	0.1868	Mungbean
140	0.2622	Wetland-rice
153	0.2266	Peanut



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Figure 6. Absolute suitability for wetland-rice in Prao by Fuzzy land evaluation.



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Figure 7. Relative suitability for different land utilization types (LUT) in Prao by Fuzzy land evaluation.

4.2.3 Law of Minimum

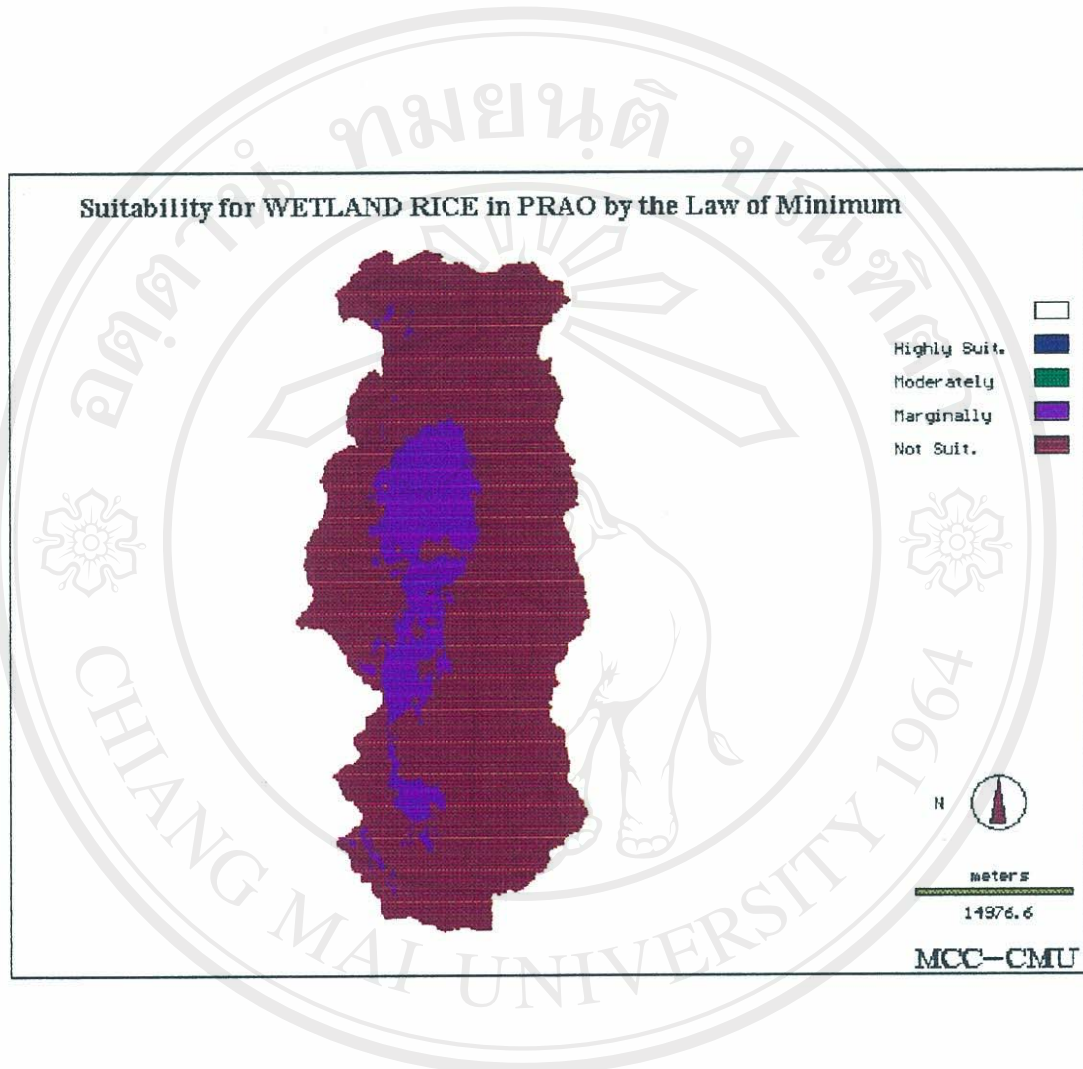
The LMU of Prao were evaluated by using the Law of Minimum. The same selected areas were used to illustrate the technique. The first step in this method is to convert soil characteristics to land quality rating according to FAO framework, the results are shown in Table 7. These values were used to select the minimum value to represent the suitability classes, the results are shown in Table 8. The results of the Law of Minimum method is shown as thematic maps in Figure 8. The process in calculating suitability class lasted 1 minutes on PC 80486-DX machine running at 33 MHz. with the harddisk access speed 16 ms.

Table 7. Land quality values for wetland-rice converted from data in Table 1 according to LUR from FAO.

AREA_ID	Temp	Rain	Drainage	Texture	Root_dep	CEC	pH	P	K	Slope
77	1.0	0.5	1.0	0.8	1.0	1.0	1.0	1.0	1.0	1.0
91	1.0	0.5	0.5	0.8	1.0	1.0	1.0	0.5	1.0	0.8
112	1.0	0.5	0.5	0.8	1.0	1.0	1.0	0.5	1.0	0.8
140	1.0	0.5	1.0	1.0	1.0	1.0	1.0	0.5	1.0	1.0
153	1.0	0.5	1.0	0.8	1.0	1.0	1.0	0.5	0.8	1.0

Table 8. Suitability classes for Wetland-rice as defined by the Law of Minimum.

AREA_ID	Value	Suitability Class
77	0.5	S3
91	0.5	S3
112	0.5	S3
140	0.5	S3
153	0.5	S3



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Figure 8. Absolute suitability for wetland-rice in Prao by the Law of Minimum Method

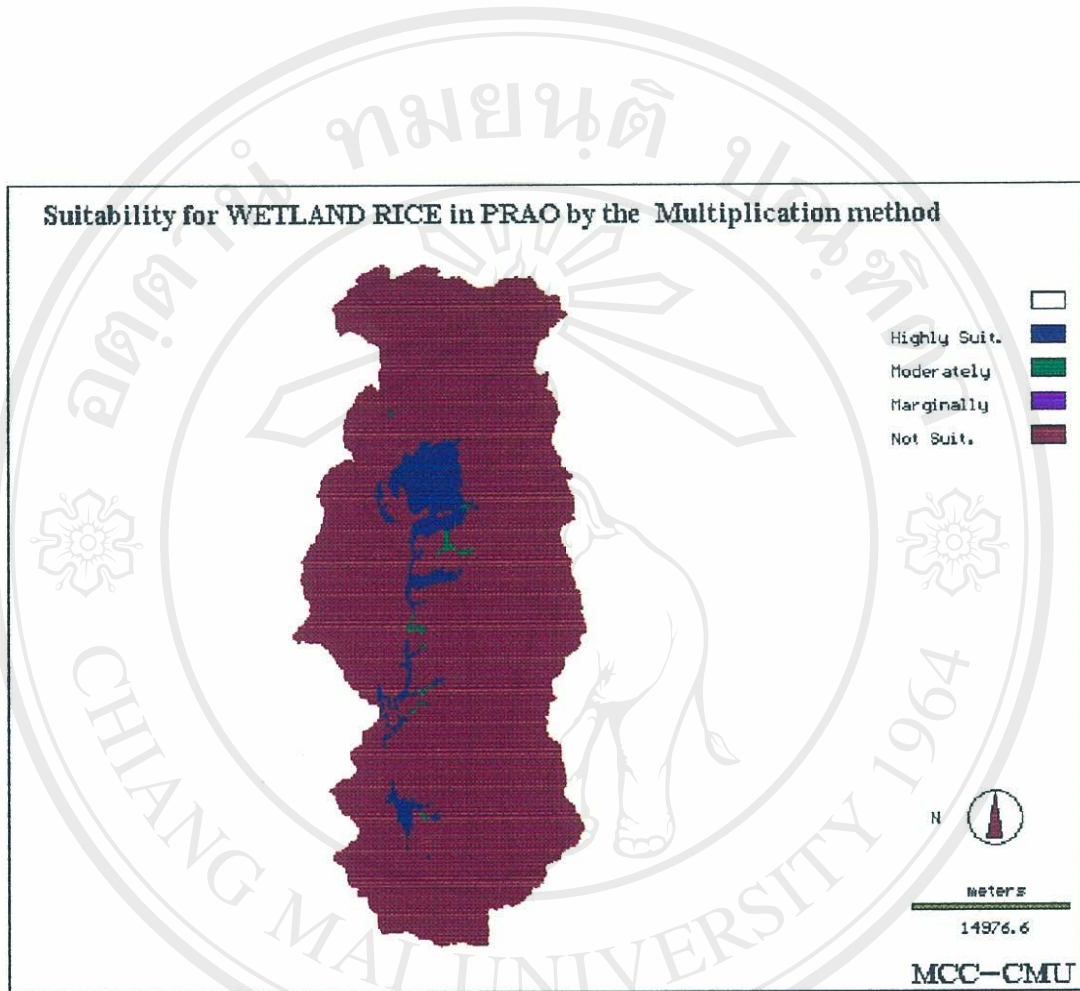
4.2.4 Multiplication Method

Equations (7) was used to evaluate the LMU of Prao. The same selected areas were used to illustrate the technique. The LQ values in Table 7 were multiplied together for all land qualities for wetland-rice and the values were converted back to suitability classes, the results are shown in Table 9.

The results of the Multiplication method is shown as a thematic map in Figure 9. The process in calculating suitability class lasted 2 minutes on a PC 80486-DX machine running at 33 MHz. with the harddisk access speed of 16 ms.

Table 9. Absolute suitability classes for wetland-rice as calculated by equation (1) according to the Multiplication method.

AREA_ID	Value	Suitability Class
77	0.40	S2
91	0.08	N
112	0.08	N
140	0.25	S3
153	0.16	N



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Figure 9. Absolute suitability for wetland-rice in Prao by the Multiplication Method

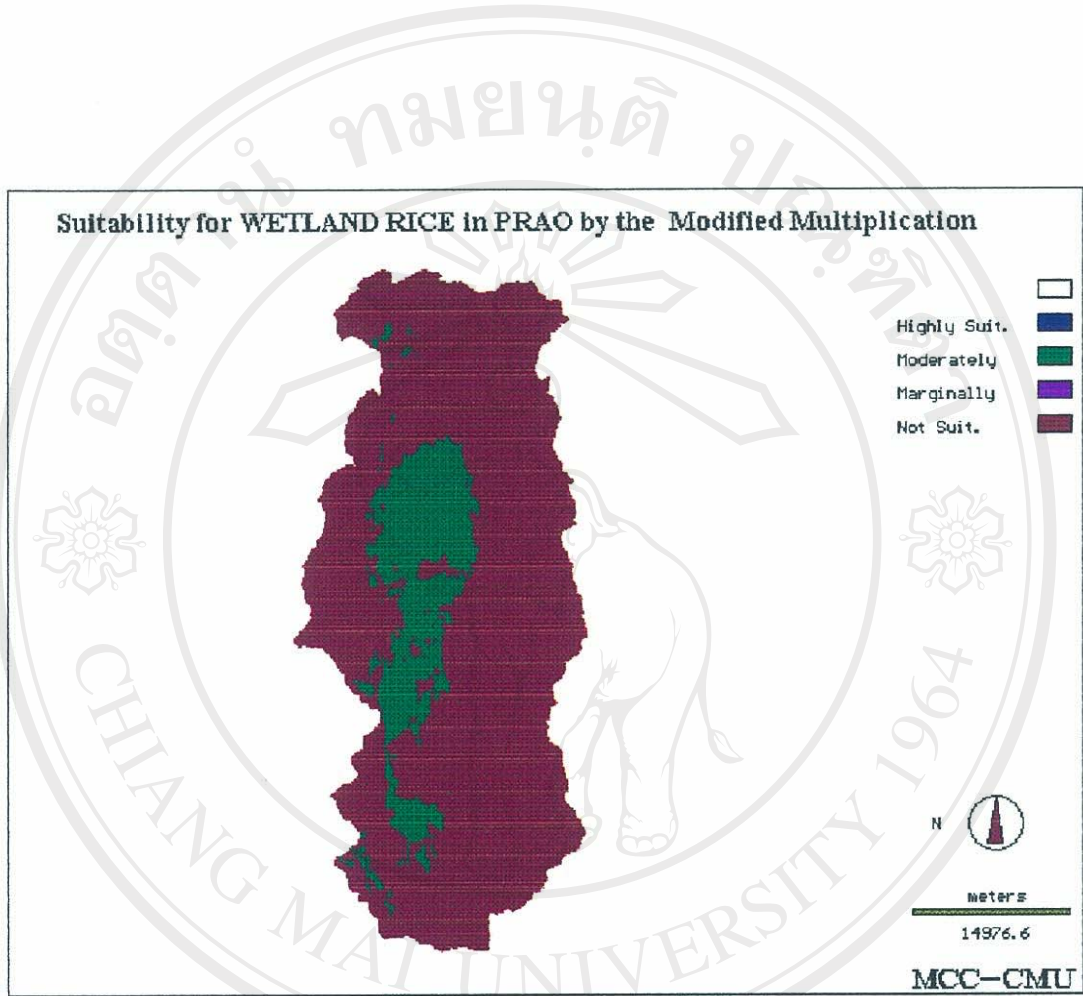
4.2.5 Modified Multiplication Method

The step in this method is to convert soil characteristics to land quality rating as the above method according to FAO framework, the results are shown in Table 7. Calculation of LQ suitability value for each LMU were done according to equation (2) and the values were converted back to suitability classes, the results are shown in Table 10.

The results of the Modified Multiplication method is shown as a thematic map in Figure 10. The process in calculating suitability class lasted 2 minutes on PC 80486-DX machine running at 33 MHz. with the harddisk access speed of 16 ms.

Table 10. Absolute suitability classes for wetland-rice as calculated by equation (2) according to the Modified Multiplication method.

AREA_ID	Value	Suitability Class
77	0.48	S2
91	0.36	S3
112	0.32	S3
140	0.50	S2
153	0.42	S2



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Figure 10. Absolute suitability for wetland-rice in Prao by the Modified Multiplication method

4.3 System's Shell

4.3.1 Main Menu

The system shell consists of a pull-down menu which was created by FoxPro software is hierarchical in nature. It allows the user to select a location for displaying various kinds of thematic maps and evaluate land by different methods and reselect new locations for those operations. This system shell starts with the menu bar and windows as shown in Figure 11. The program will wait for the user to select the location in the next menu by pressing [Alt] and [Enter]. This system shell required at least running on PC 80386 machine with color monitor and harddisk space 15 Mbyte.

4.3.2 Area Selection Menu

The area menu shows the Northern Region with the names of provinces to be selected for evaluation. Once the province had been selected, any district and subdistrict within that province can be subsequently chosen. For example if the user selects Chiang Mai province, the program will display all districts of Chiang Mai in the next pulldown menu for further selection. If the user choose Prao district the next pulldown menu for selecting subdistrict within Prao district will be displayed on the screen (Fig. 12). The shell will also allow the user to select specific project areas which do not coincide with the administrative boundaries. The watershed areas and irrigated areas are examples of such project areas. This thesis focuses on Chiang Mai at the provincial level and every subdistrict in Prao in particular.

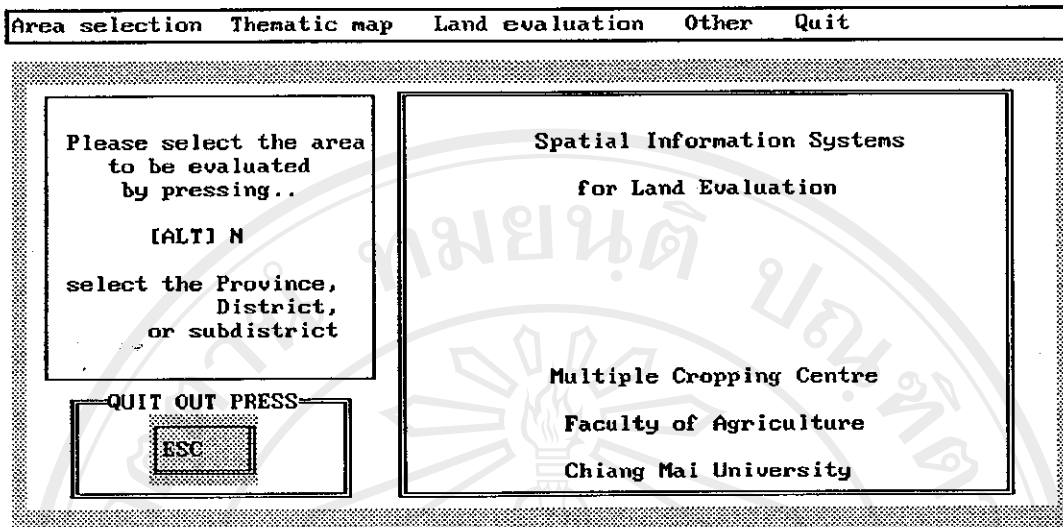


Figure 11. The starting menu of the system shell.

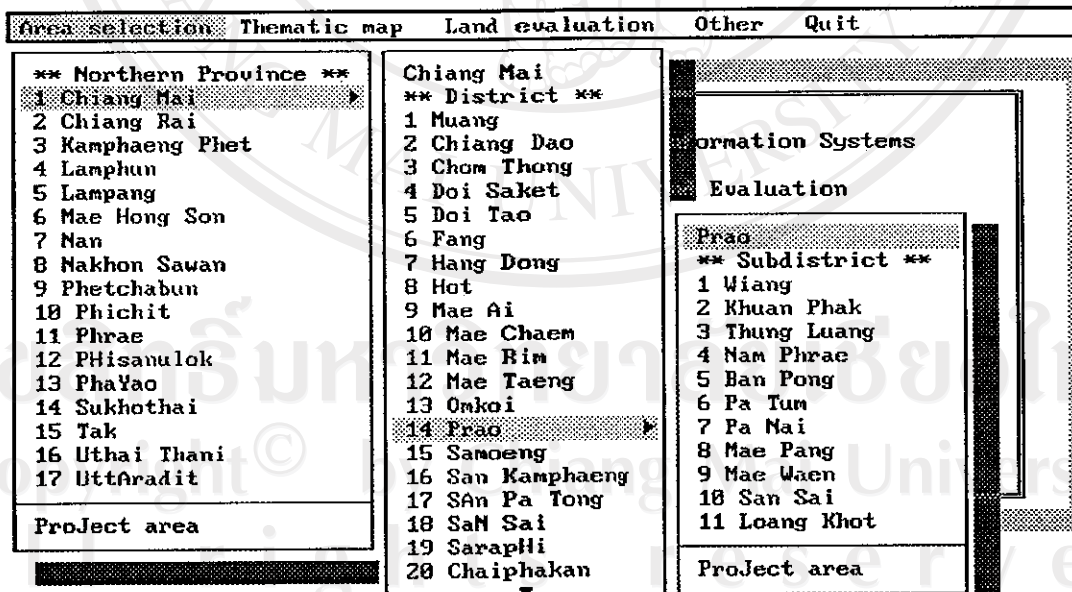


Figure 12. A menu to select the location.

4.3.3 Thematic Map Menu

After selecting the location, the system shell will display the menu to select a Thematic map, Land evaluation and Other (Fig. 13). The thematic map menu has a pulldown menu for selecting the display of areas boundary, soil map, slope map, present landuse, hydrology, and road (Fig. 14). All the map data were stored as the images in IDRISI format. Thematic map menu will invoke the commands that link FoxPro to IDRISI and produce appropriate maps of the selected area which have been saved as IDRISI images. Figure 15 shows administrative boundaries of Prao and its subdistricts.

4.3.4 Land Evaluation Menu

Land evaluation menu facilitates the evaluation of each map unit for its absolute suitability and relative suitability (Fig. 16) by the Fuzzy methods according to Wang. Land suitability rating is also included in the menu. The Absolute suitability submenu provides the user to select a specific crop to be evaluated (Fig. 17). Then the user should select Fuzzy, Modified Multiplication method, or DLD suitability rating to create the desired suitability map (Fig. 18). However, the relative suitability submenu will allow only Fuzzy method for evaluation (Fig. 19). The results of the absolute or relative suitability evaluation will be displayed as thematic maps through IDRISI commands invoked from within FoxPro. The source codes of this system shell are shown in Appendix Table 43-49.

As mentioned earlier that the system can be selected to display the shell in either Thai or English. The examples of the display of Thai Shell are illustrated in Appendix Figure 1-8.

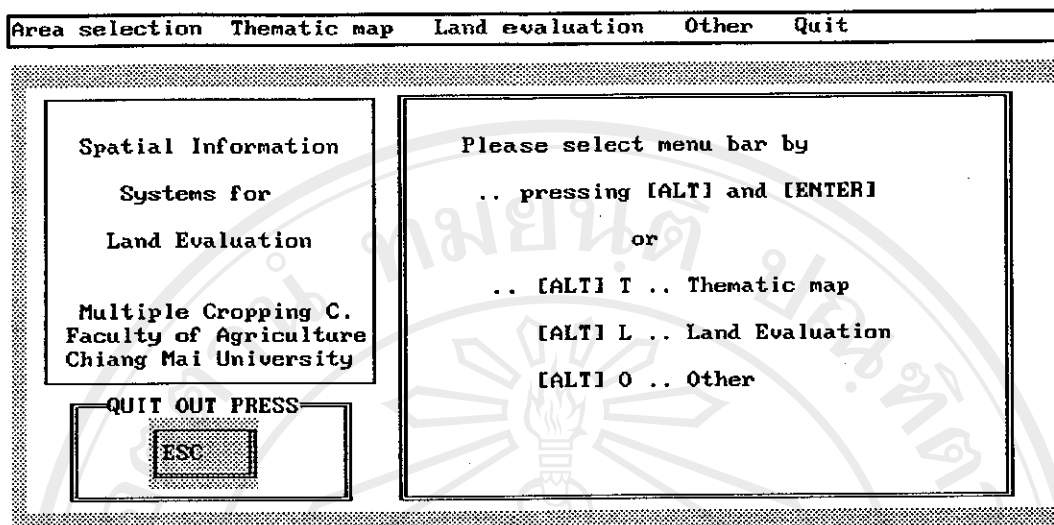


Figure 13. A menu to select thematic map, land evaluation or other.

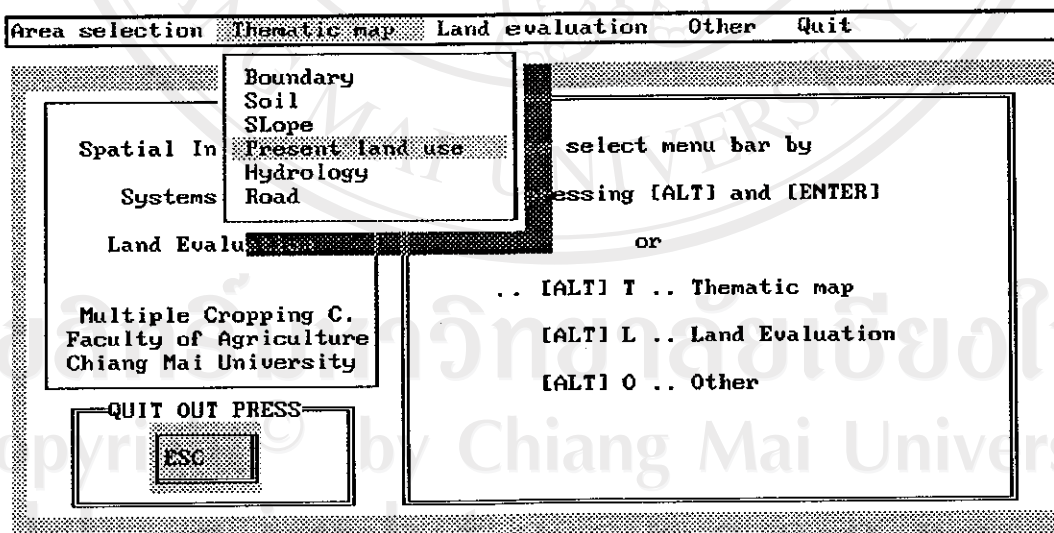
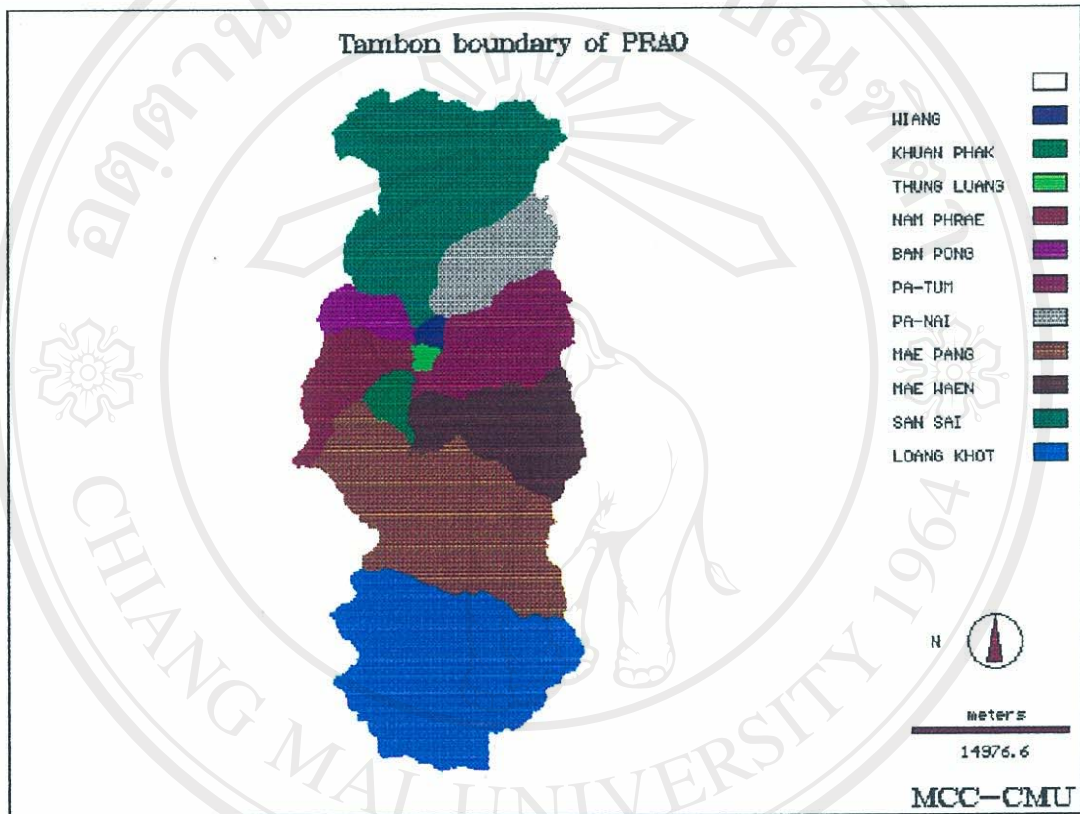


Figure 14. A menu to select a thematic map.



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Figure 15. Prao district and subdistricts.

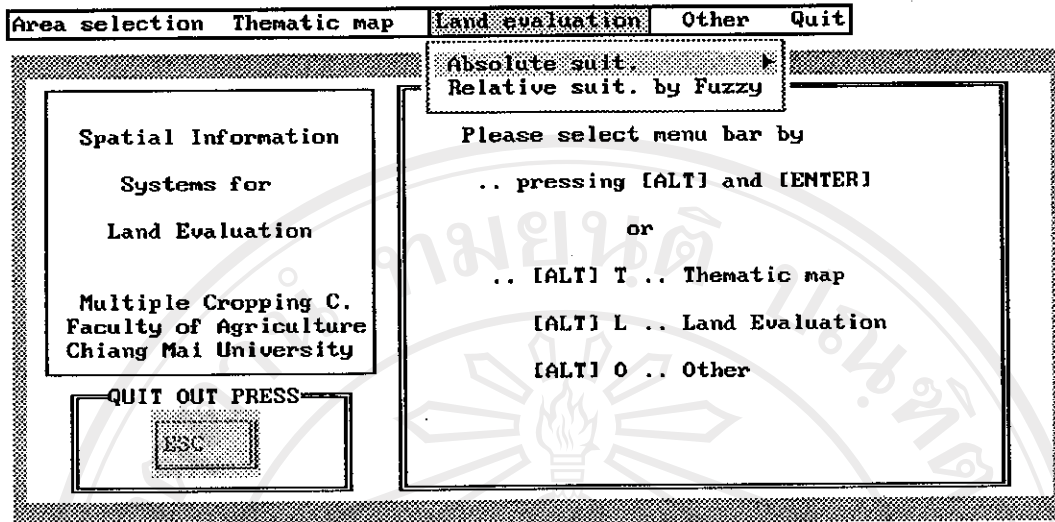


Figure 16. A menu to select land evaluation.

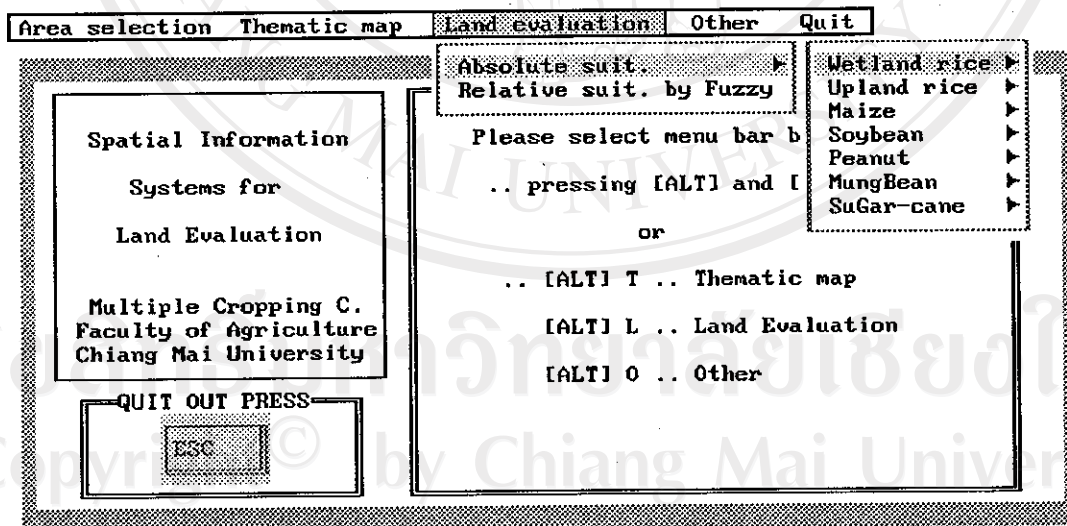


Figure 17. A menu to select absolute suitability evaluation and land utilization types to be evaluated.

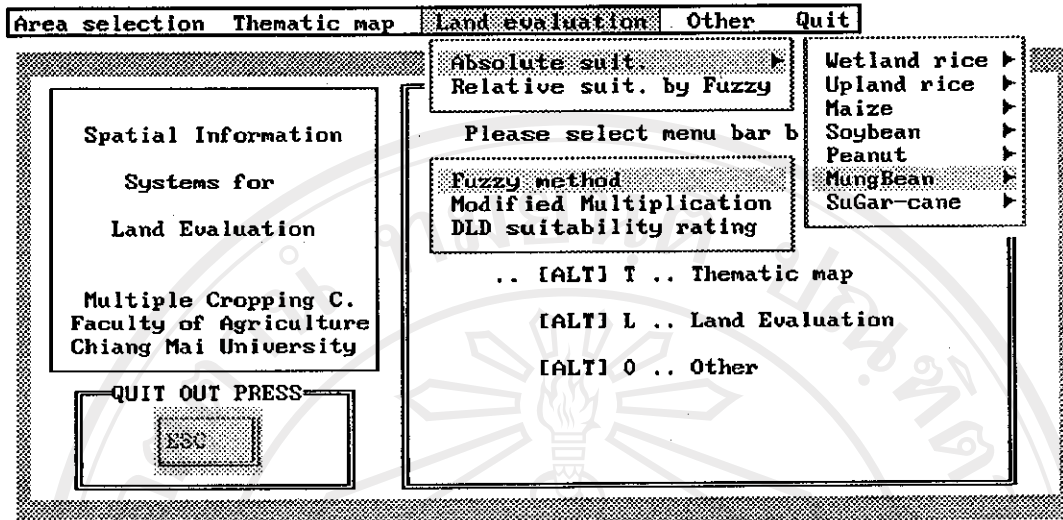


Figure 18. Absolute suitability menu for selection of crop and evaluation method.

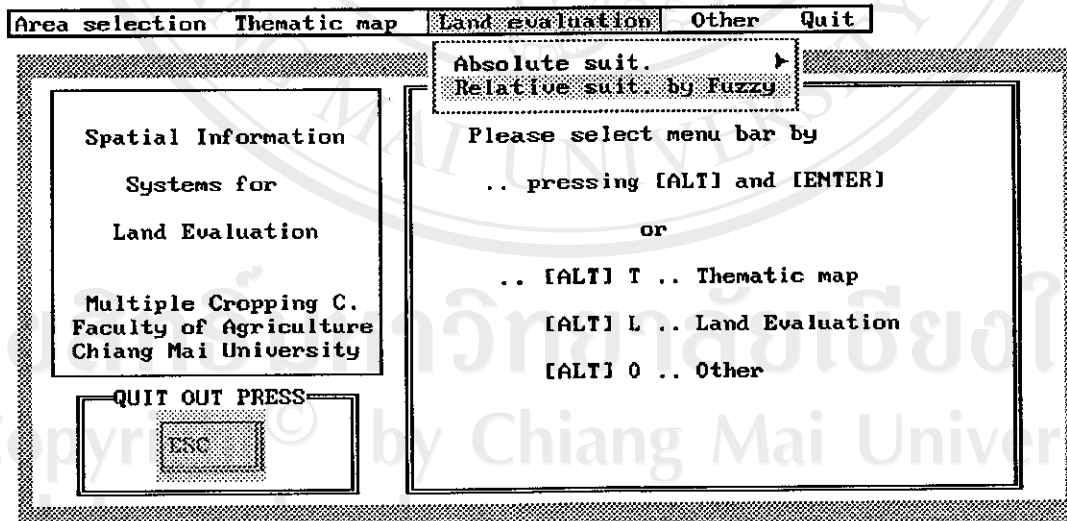


Figure 19. Relative suitability menu for selection of evaluation method.

4.4 Outputs of Evaluation

Figure 20 and Figure 21 show the absolute suitability of peanut and relative suitability in Prao district evaluated by Fuzzy land evaluation method in IDRISI format as the output of the system shell. The absolute suitability of peanut by the Modified Multiplication method is also shown in Figure 22 in IDRISI format. Figure 23 shows the absolute suitability of peanut defined by the DLD suitability class. An example of the output in PC ARC/INFO format is illustrated by using absolute suitability of peanut in Prao district by Fuzzy land evaluation (Figure 24).

The area of each suitability class could be determined by AREA command in IDRISI. Table 11 shows the area of each suitability class using Fuzzy land evaluation method and two sources of LUR, CSR/FAO (1983) and DLD (1992). When evaluation was based on CSR/FAO, the resulting suitability classes of the examined LUTs ranged from S1 to N. However, the evaluation which was based on LUR as defined by DLD resulted in the narrower distribution of the suitability classes, only S1 and S2 were assigned to the land in Prao for all examined LUTs.

The results from the Law of Minimum indicated that the lands were assigned to the lower suitability, class mostly in S3 class (Table 12). The output from the Multiplication method shows that more lands were assigned to the better suitability classes (S1 and S2) comparing to those evaluated by the Law of Minimum. However, it also rated more lands to non-suitable (N) class (Table 13). The Modified Multiplication method shifted land quality towards better suitability comparing to the results obtained from the Multiplication and the Law of Minimum methods (Table 14).

Table 11. Area (%) in each suitability class for various LUTs using Fuzzy land evaluation method and LUR as defined by FAO and DLD.

Fuzzy method	LUR from FAO				LUR from DLD			
	S1	S2	S3	N	S1	S2	S3	N
Wetland-rice	28.63	66.99	3.22	1.16	14.82	85.18	0.00	0.00
Upland-rice	28.63	13.27	58.10	0.00	65.21	34.79	0.00	0.00
Maize	27.70	69.23	2.73	0.34	15.96	84.04	0.00	0.00
Soybean	0.77	96.49	2.64	0.10	15.18	84.82	0.00	0.00
Peanut	25.24	72.90	1.78	0.08	33.84	66.16	0.00	0.00
Mungbean	0.00	98.22	1.78	0.00	76.97	23.03	0.00	0.00
Sugarcane	28.50	67.95	3.54	0.00	0.00	100.00	0.00	0.00

* Total area = 28,925 hectare

Table 12. Area (%) in each suitability class for various LUTs using the Law of Minimum method and LUR as defined by FAO and DLD.

Law of Minimum	LUR from FAO				LUR from DLD			
	S1	S2	S3	N	S1	S2	S3	N
Wetland-rice	0.00	0.00	68.81	31.19	0.00	0.00	95.61	4.39
Upland-rice	0.00	36.47	59.33	4.19	0.00	0.00	75.35	24.65
Maize	0.00	29.20	66.34	4.47	0.00	0.00	75.35	24.65
Soybean	0.63	7.39	87.54	4.44	0.00	13.32	62.03	24.65
Peanut	0.00	60.85	30.73	8.42	0.00	62.52	12.83	24.65
Mungbean	4.04	57.58	36.18	2.20	0.64	63.81	10.90	24.65
Sugarcane	0.00	0.00	95.06	4.94	0.00	0.00	98.64	1.36

* Total area = 28,925 hectare

Table 13. Area (%) in each suitability class for various LUTs using the Multiplication method and LUR as defined by FAO and DLD.

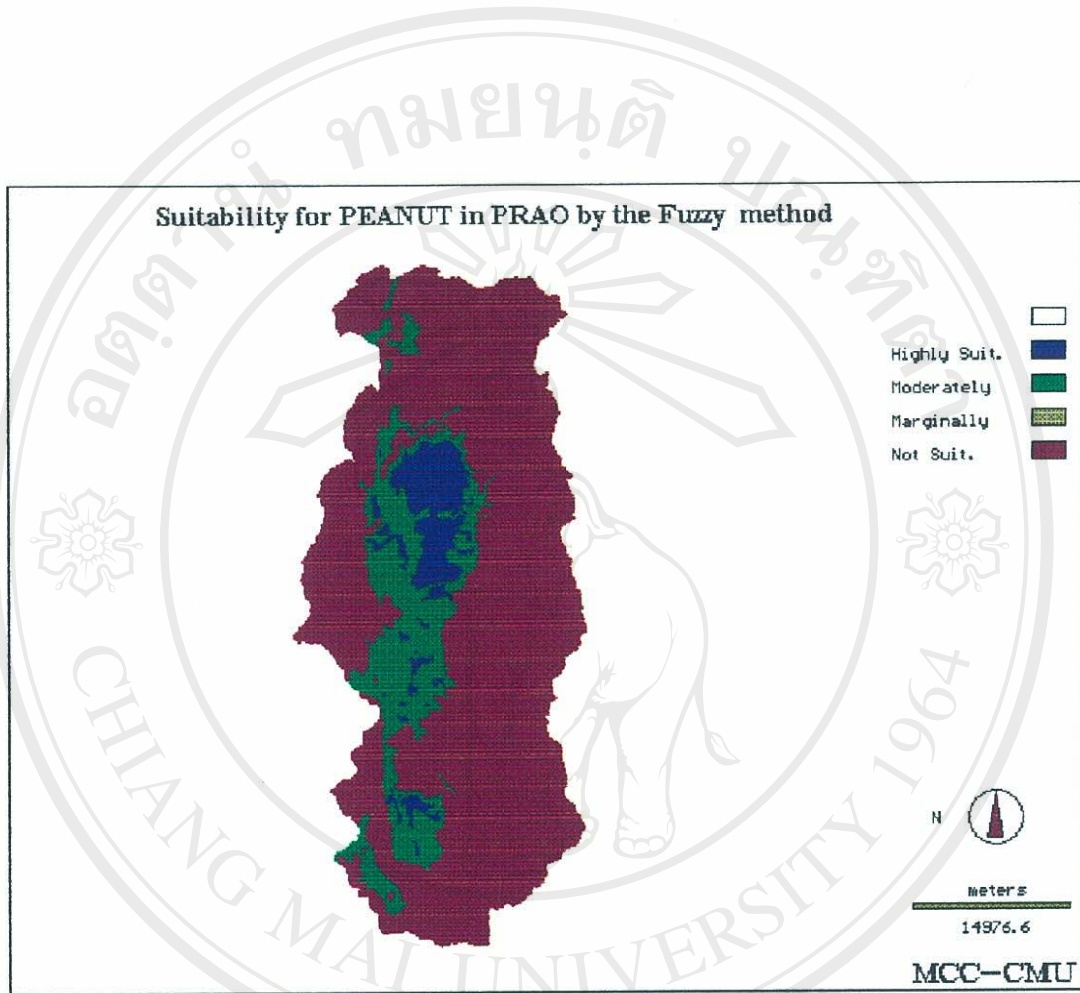
Multiplication	LUR from FAO				LUR from DLD			
	S1	S2	S3	N	S1	S2	S3	N
Wetland-rice	23.82	1.76	0.00	74.42	0.00	2.47	0.00	97.53
Upland-rice	36.25	55.20	0.00	8.55	2.21	0.85	0.00	96.94
Maize	41.11	45.79	0.00	13.09	2.21	0.85	0.00	96.94
Soybean	48.39	46.79	0.00	4.81	3.06	34.17	0.00	62.77
Peanut	80.90	10.16	0.00	8.94	23.75	45.24	0.00	31.01
Mungbean	94.75	2.72	0.00	2.52	26.01	42.98	0.00	31.01
Sugarcane	0.00	41.43	0.00	58.57	2.21	0.85	0.00	96.94

* Total area = 28,925 hectare

Table 14. Area (%) in each suitability class for various LUTs using the Modified Multiplication method and LUR as defined by FAO and DLD.

Modified-Multiplication	LUR from FAO				LUR from DLD			
	S1	S2	S3	N	S1	S2	S3	N
Wetland-rice	68.81	0.00	0.00	31.19	0.00	99.94	0.00	0.06
Upland-rice	36.47	59.33	0.00	4.19	0.00	76.65	0.00	23.35
Maize	29.20	66.34	0.00	4.47	0.00	76.65	0.00	23.35
Soybean	8.02	87.54	0.00	4.12	13.65	63.00	0.00	23.03
Peanut	60.85	30.73	0.00	8.42	65.25	11.40	0.00	23.35
Mungbean	61.62	36.18	0.00	2.20	67.36	9.29	0.00	23.35
Sugarcane	0.00	95.06	0.00	4.94	0.00	99.94	0.00	0.06

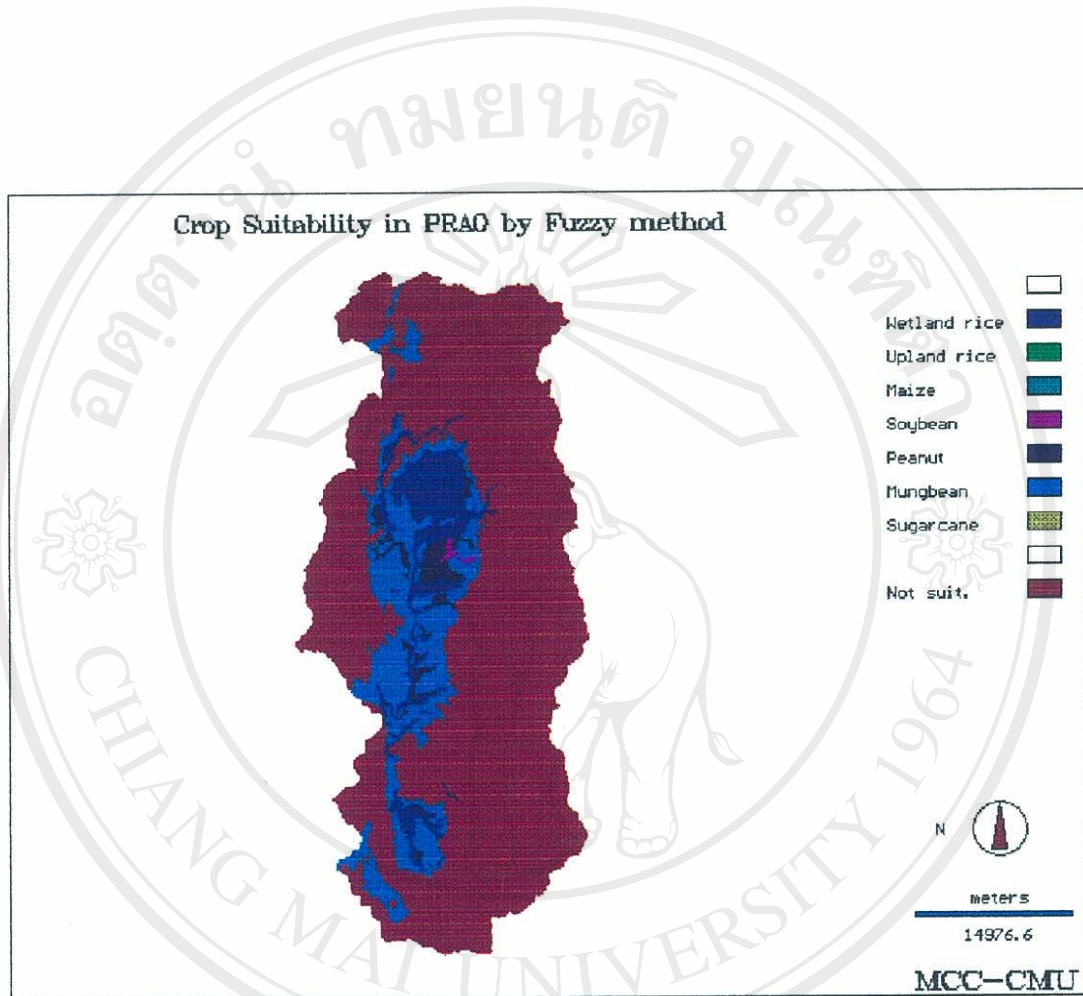
* Total area = 28,925 hectare



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Figure 20. Absolute suitability of peanut in Prao district by Fuzzy land evaluation

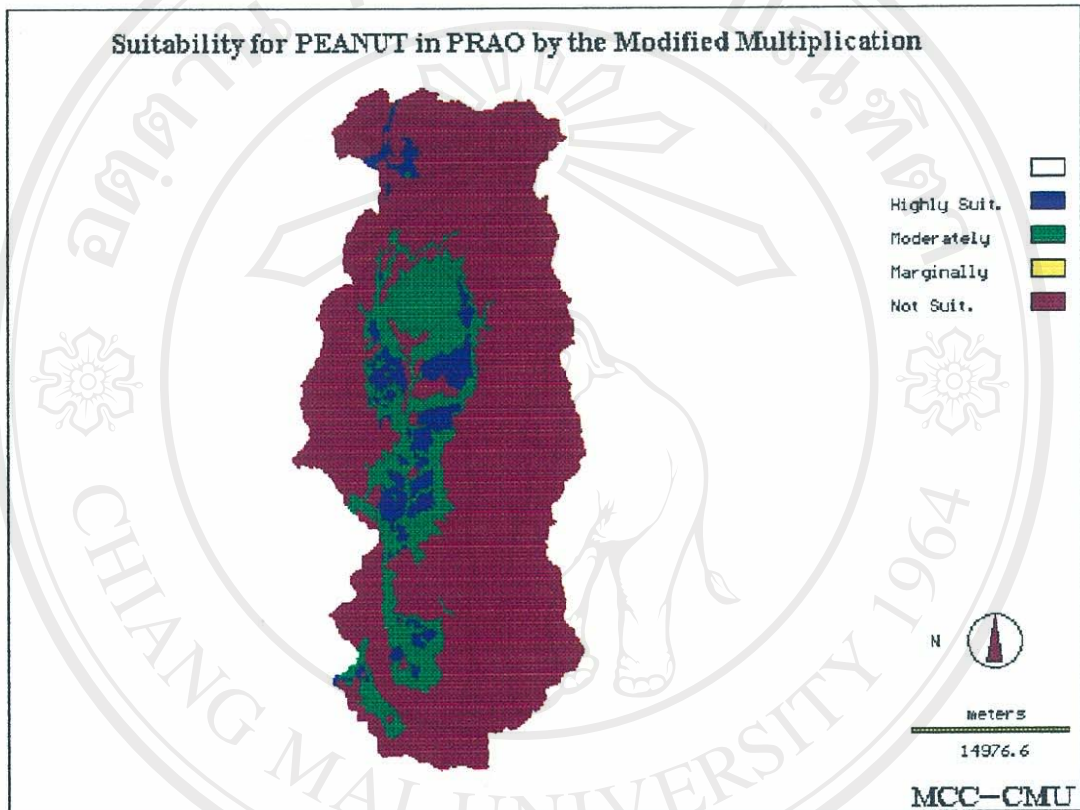
method in IDRISI format



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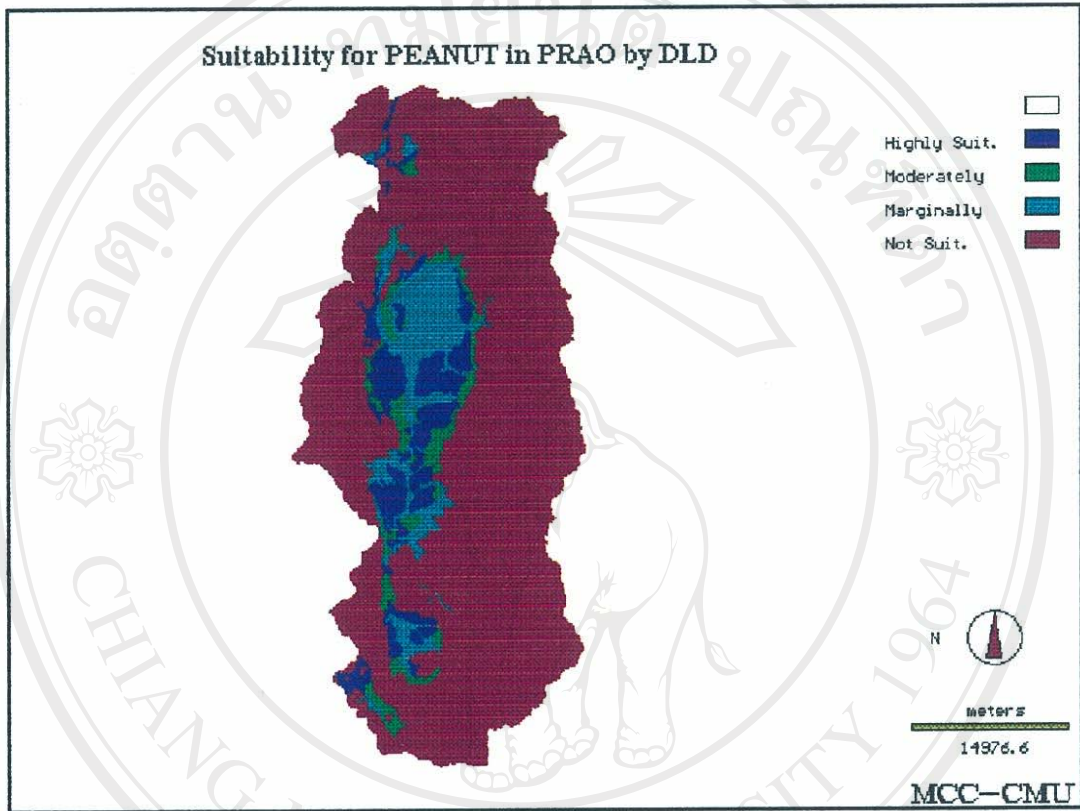
Figure 21. Relative suitability in Prao district by Fuzzy land evaluation method in

IDRISI format



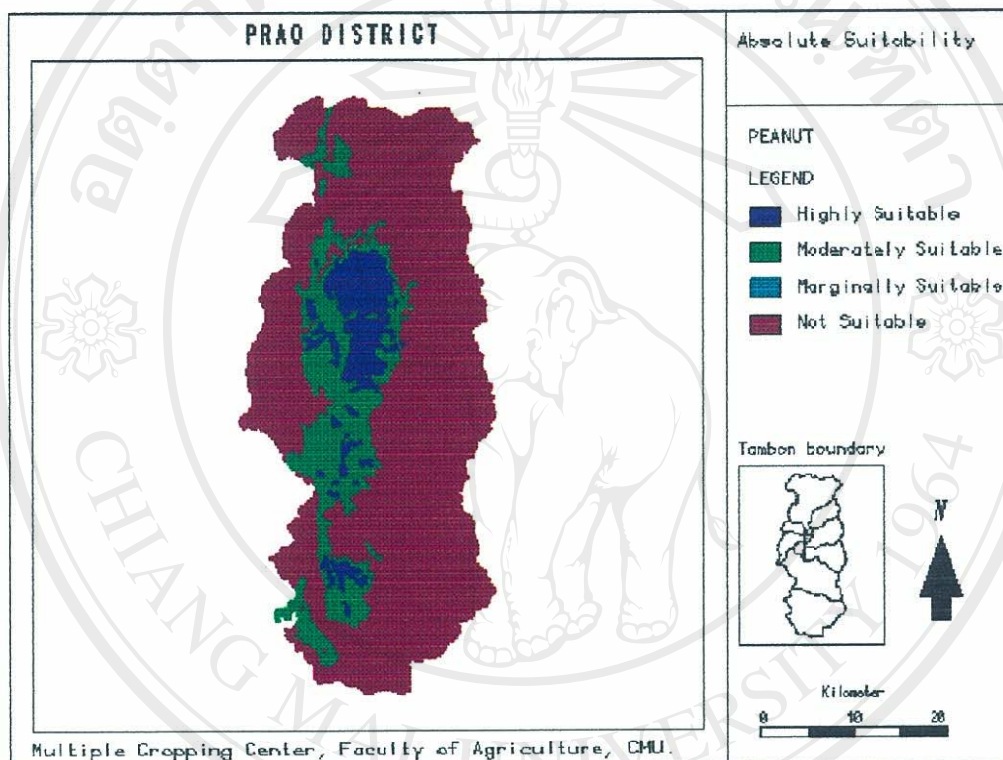
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Figure 22. Absolute suitability of peanut in Prao district by the Modified Multiplication method in IDRISI format



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Figure 23. Absolute suitability of peanut in Prao district by DLD suitability rating in IDRISI format



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Figure 24. Absolute suitability of peanut in Prao district by Fuzzy land evaluation

method in PC ARC/INFO format

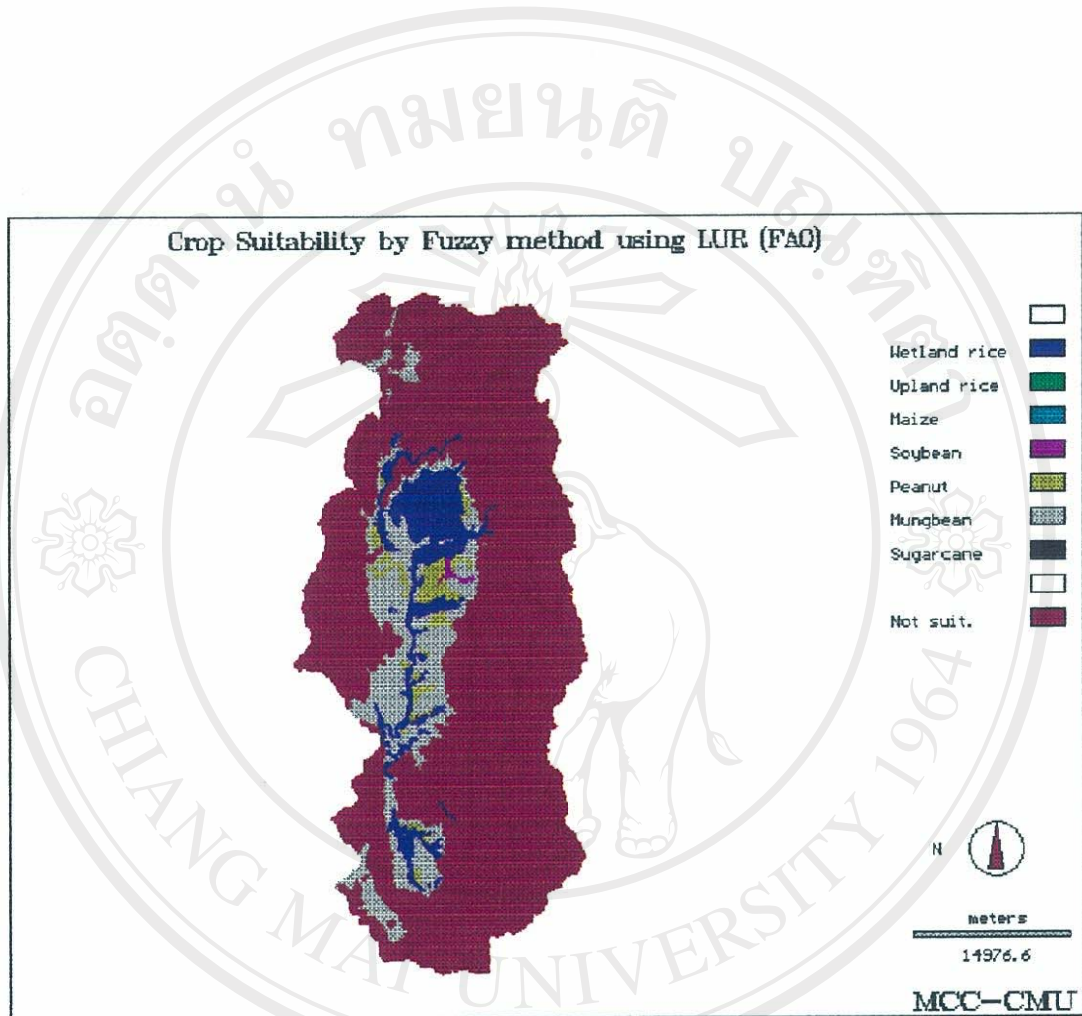
When relative suitability is considered, the land could be automatically evaluated only by the Fuzzy method. The results of the evaluation based on different sources of LUR are shown in Figure 25 and 26.

4.5 Comparison Among Different Methods.

The CONFUSE command in IDRISI was used to compute variance-covariance matrix and KHAT statistics according to equation (9). Appendix Table 50-53 show the matrix of map comparison between LUR defined by DLD and FAO and among different methods of suitability rating i.e., Fuzzy, Law of Minimum, Multiplication, and Modified Multiplication methods for each LUT. Table 15 shows the result of KHAT statistics of 4 methods of suitability rating with two sources of LUR as defined by DLD and FAO. The results indicate that the suitability maps are not similar among different methods and different sources of LUR. The KHAT value exceeding 0.80 indicates the map are satisfactorily similar.

Table 15. The overall KHAT statistics as a result of comparison between LUR defined by DLD and FAO in each method of suitability rating.

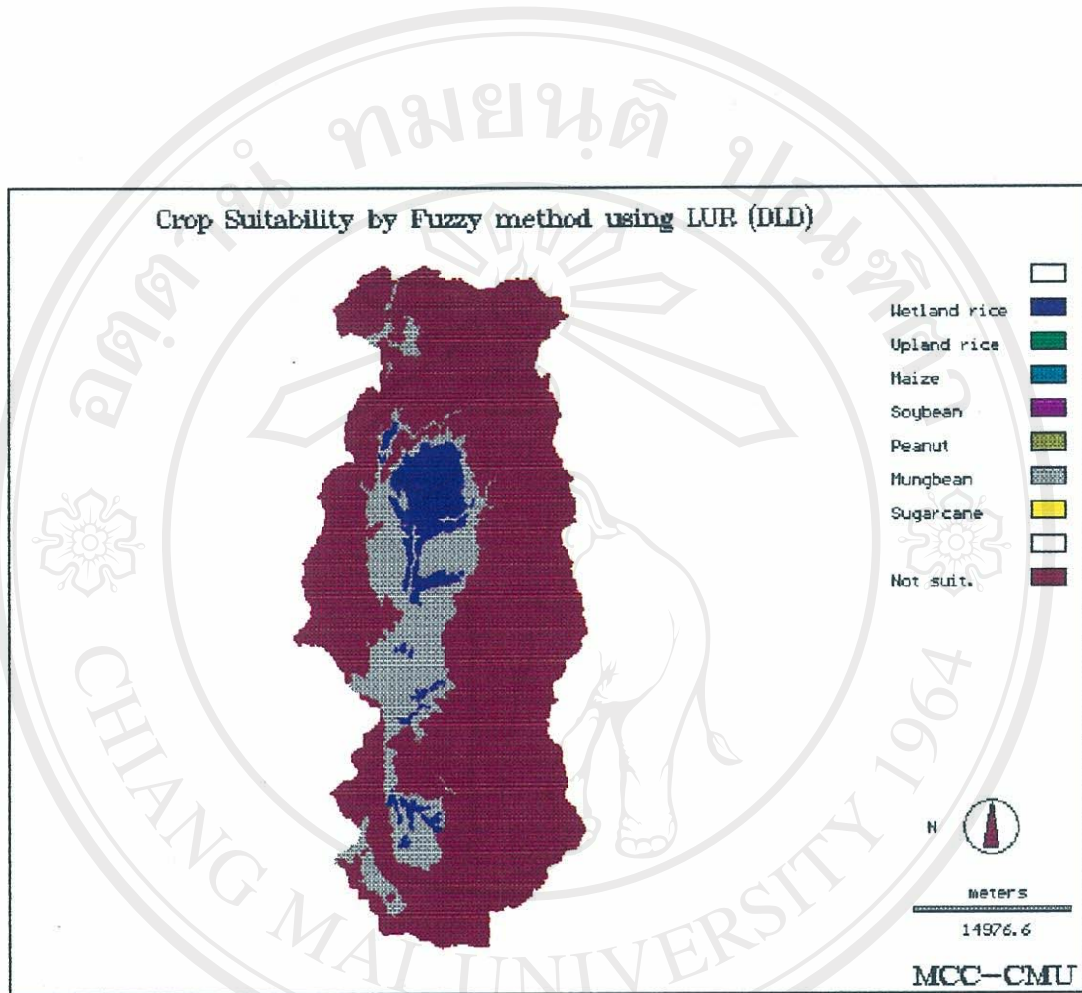
FAO X DLD	Wetland- rice	Upland- rice	Maize	Soybean	Groundnut	Mungbean	Sugarcane
Fuzzy method	-0.18	-0.22	0.30	0.07	-0.01	0.00	0.00
Law of Minimum	0.18	0.18	0.25	-0.06	0.22	0.17	0.41
Multiplication	-0.02	-0.02	0.00	-0.07	0.12	-0.03	0.01
Modify Multi.	0.00	0.16	0.21	-0.13	0.19	0.17	0.02



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Figure 25. Relative suitability in Prao district by Fuzzy land evaluation using LUR

defined by FAO



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Figure 26. Relative suitability in Prao district by Fuzzy land evaluation using LUR

defined by DLD

Different methods of suitability rating were compared using LUR as defined by FAO. The results of KHAT statistics (Table 16) indicate that the map output were not similar among different methods except those between the Modified Multiplication method and the Multiplication method particularly for the upland rice and maize whose KHAT values were 0.91 and 0.64 respectively. The details of error matrix can be seen in Appendix Table 57-59.

Table 16. The overall KHAT statistics values to compare different methods of suitability ratings of various LUTs using LUR defined by FAO

	Wetland- rice	Upland- rice	Maize	Soybean	Groundnut	Mungbean	Sugarcane
Modi. Multi. X Law of Min	0.24	-0.23	-0.19	-0.02	-0.14	-0.22	0.05
Modi. Multi. X Multi.	0.11	0.91	0.64	0.26	0.56	0.18	0.07
Modi. Multi. X Fuzzy	-0.03	0.19	0.46	0.22	-0.30	-0.02	0.04
Law of Min. X Multi.	0.10	-0.20	-0.11	0.01	0.02	0.01	0.02
Law of Min. X Fuzzy	-0.01	0.38	-0.13	-0.01	0.17	0.05	-0.03
Multi. X Fuzzy	0.19	0.19	0.54	0.03	0.11	-0.02	-0.21

The disagreement among different suitability rating methods were also detected when LUR defined by DLD was used as a basis of matching between LQ and LUR. This can be clearly seen from KHAT values of most error matrices in Appendix Table 60-65 and overall KHAT values as summarized in Table 17.

Table 17. The overall KHAT statistics values to compare different methods of suitability ratings of various LUTs using LUR defined by DLD

	Wetland- rice	Upland- rice	Maize	Soybean	Groundnut	Mungbean	Sugarcane
Modi. Multi. X Law of Min	0.00	0.19	0.19	0.11	0.12	0.14	0.00
Modi. Multi. X Multi.	0.00	0.01	0.01	0.26	0.32	0.31	0.00
Modi. Multi. X Fuzzy	0.00	-0.21	-0.10	-0.04	0.00	0.29	1.00
Law of Min. X Multi.	0.00	0.01	0.01	0.18	0.42	0.44	0.00
Law of Min. X Fuzzy	0.00	0.00	0.00	-0.01	-0.07	-0.17	0.00
Multi. X Fuzzy	-0.02	0.00	0.01	-0.06	0.18	-0.06	0.00

Table 18 shows the error matrix of suitability classification between LUR defined by FAO and DLD when fuzzy evaluation was used to assess relative land suitability. The result of KHAT statistic was 0.34. Table 19 and 20 show matrix of comparison between present land use with relative suitability evaluated by the Fuzzy method with LUR from FAO and relative suitability by Fuzzy method with LUR as defined by DLD. The KHAT statistics in Table 21 and 22 were 0.20 and 0.25 respectively indicating that these maps are not similar.

Table 18. The error matrix (expressed in number of pixels) of relative suitability by Fuzzy land evaluation method using LUR defined by FAO and DLD.

DLDxFAO	Wetland-rice	Upland-rice	Maize	Soybean	Groundnut	Mungbean	Sugar-cane	KHAT
Wetland-rice	2145	0	0	0	0	550	0	
Upland-rice	0	0	0	0	0	0	0	
Maize	0	0	0	0	0	0	0	
Soybean	0	0	0	0	0	0	0	
Groundnut	0	0	0	0	0	0	0	
Mungbean	2352	0	0	89	846	5588	0	
Sugarcane	0	0	0	0	0	0	0	
								0.34

Table 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.

Fuzzylanduse	Wetland-rice	Field crops	Other	KHAT
Wetland-rice	2450	787	862	
Field crops	1006	2618	3025	
Other	0	0	0	
				0.22

Table 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.

Fuzzylanduse	Wetland-rice	Field crops	Other	KHAT
Wetland-rice	2196	119	21	
Field crops	1260	3286	3866	
Other	0	0	0	
				0.28