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The importance of site assessment in land use planning: a re-examination of the SCS LESA model

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Abstract

The dual paradigm of the USDA Soil Conservation Service Land Evaluation and Site Assessment (LESA) system is the most striking aspect of the model design. Examination of established LESA databases and models for Douglas County, Kansas (USA) indicates the importance of the site assessment subsystem to the planning mission. This emphasis indicates a concern on the part of the US Soil Conservation Service to develop a planning model which is workable within the framework of local needs and design. Results show that the two subsystems, while distinctly separate, work together to plan the proper use of a dwindling agricultural resource base. Suggestions are made for research methodologies to improve the final grading system of LESA to reflect local objectives more adequately while responding to the national need.

Introduction

The various individuals and groups concerned with the selection of proper use of the land are frequently confronted with conflicting demands on a dwindling resource base. Models based solely on the physical constraints of the land for particular land uses are seldom implemented due to economic, social or political necessity. These pressures are most likely to determine the ultimate use of the land, particularly when there are no clear physical demarcations to land use plausibility. Additionally, even when clear physical limitations do exist, decisions for land allocation will often be made in favour of the overall plan for the community.

Any land use planning model designed to be fully operational must balance the duality of physical restrictions and socioeconomic demands. Such a model must weigh the importance of the physical constraints, stewardship and conservation of dwindling resources, against the local needs and objectives within which communities must operate. Plans which disregard the physical components will fail in the long run, since they will allow for irreversible modification of the land and destruction of sensitive and pristine environments. Conversely, those plans which neglect the political, social and economic reality of a municipality will fail in the short run since they will frequently not be implemented.

The Land Evaluation and Site Assessment (LESA) (SCS 1983) system was developed by the Soil Conservation Service (SCS) as a design construct to incorporate these competing mandates. Originating from the Important Farmlands Mapping Program, LESA was developed as an aid to planners concerned with the loss of important agricultural lands. As a result it has a strong environmental component, with its land evaluation subsystem which is designed to evaluate the land base for its physical capabilities to support agriculture. At the same time, the designers, recognizing the nature of political, social and economic factors relevant to community

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land use planning, dedicated a substantial portion of the LESA system to these factors (Steiner *et al.* 1984). This twofold nature of LESA, and its subsequent ability to strike a balance between competing forces, is by far the most striking and useful feature of the model design, perhaps ensuring its adoption and use in many communities within the United States.

Literature review

The problem of evaluating appropriate rural land uses within the framework of competing physical, socioeconomic and political demands has prompted a variety of attempts at its solution. These attempts have largely concentrated on utilizing and enhancing existing resource inventory and classification schemes. Such a merger was attempted in the Cornell System of Economic Land Classification which used a predominantly descriptive set of physical and socioeconomic factors to assess the profitability of agricultural land (Flaherty and Smit 1982). A fundamental flaw with this approach is that it does not consider the impact of land use changes in a regional or national context, whereby a change in the land use may affect nearby land uses, or reduce the national inventory of important farmlands.

This concern for the shrinking resource base has been a primary consideration in recent efforts at extensive rural land use planning. In Canada, for example, the problem of conversion of rural land to non-agricultural uses is a paramount concern of the Land Evaluation Project at the University of Guelph (Smit 1981). This uses computer programming techniques to synthesize the conditions and goals as mathematically encoded land constraints (Cocklin *et al.* 1987). The Guelph model is a three-step procedure: the first specifies the evaluation criteria and existing conditions and constraints, the second identifies appropriate methods of using the land given these constraints, and the third determines the degree of acceptability of given land uses under these conditions (Smit 1981). A fundamental improvement of the Guelph approach over that of the Cornell System is in the succinct definition of requirements and in the explicit formalism of the planning methodology.

A similar approach was being developed during the mid-1970s in Australia with the early work of SIRO-PLAN (Austin and Cocks 1978). The SIRO-PLAN project was designed specifically as a procedural theory for planning which incorporated both biophysical and social issues (Davis 1985). Once again, both the organizational aspects and the explicit definition of factors necessary for planning are its most important aspects. Additionally, SIRO-PLAN attempts 'to balance the demands of competing land use interests' based on context-dependent circumstances (Cocks *et al.* 1983). The approach to this planning methodology allows for weighting and re-weighting of those policies which are non-prohibitory, thus arriving at a group consensus opinion (Davis 1981). Like its University of Guelph counterpart, SIRO-PLAN has been automated and formalized in a series of computer programs—LUPLAN (Ive and Cocks 1983).

As a context-dependent model, SIRO-PLAN requires that certain land use issues be present, since as Davis and Ive (1985) put it, 'some particular issue or set of issues precipitated the need for a land use plan'. In their implementation of SIRO-PLAN in the Dungog Shire of New South Wales, the model was driven by demands on rural lands for non-agricultural uses, principally those demands which divided large parcels into smaller rural allotments (Davis and Ive 1985). Although not restricted to the protection of important agricultural lands, the model evaluates exclusion policies towards such lands, thereby 'excluding rural residential dwellings from areas of high agricultural capability' (Davis and Ive 1985).

The US entry into rural land planning for the protection of important agricultural lands began in 1980 when the foundation of a new technique for land planning was laid with the SCS Important Farmlands Mapping Program (Dideriksen 1980). This attempted to identify two categories of farmlands of national importance and two of statewide or local importance. In 1981 a pilot study of the new system helped systematize the procedures within which LESA might operate at the local level (Wright *et al.* 1983; Wright 1984). Since that time additional study has indicated the potential for its use (Dunford *et al.* 1983, 1984) and by January 1988, 637 counties in 29 states had completed land evaluations preparatory to LESA implementation (National Association of State Departments of Agriculture 1988).

The final system, known as the agricultural Land Evaluation and Site Assessment (LESA) system was formalized as a model for the protection of prime agricultural lands (SCS 1983). It is a two-part system: part 1 (land evaluation) emphasizes the physical potential of the land, while part 2 (site assessment) stresses the local socio-economic needs of the particular community which will implement the system.

The two-part nature of LESA is its most important feature since it formally combines the competing physical and socioeconomic factors which affect the planning process. As Steiner (1983) states, LESA 'uses traditional capability classes with agricultural productivity and importance on the one hand, while, on the other, it recognizes a range of biophysical, legal, social, and economic factors'.

As a model for planning LESA has the advantage of applicability to the long-standing tradition of map overlay analysis, either by hand-drawn techniques or within modern geographic information systems (Williams *et al.* 1983; Wiliams 1985). Its disadvantages are also numerous, especially in the manner in which factors are selected without consideration for factor similarity and subsequent convergence (Luckey 1984; Luckey and DeMers 1987) and in the assumption of factor independence (DeMers 1986). Like many other methods it also suffers from the 'single-frame' problem or static nature in which planning is based on a snapshot of the physical and cultural environment (Simpson 1987). Yet its dual physical and socio-economic nature makes it an attractive and potentially powerful model (Steiner 1983).

This paper analyses the importance of the LESA model's duality to the planning process. Implementation of the model in Douglas County, Kansas, with modifications to both the process and the factor weights, had previously provided information necessary for evaluating the suitability of LESA as a planning model in this regional context (Luckey and DeMers 1987). A further examination of the results of this study, however, also enumerates the primary importance of the duality of LESA as a model construct for land use planning, emphasizing the importance of varying LE:SA ratios on suitability outcomes.

The LESA model

LESA is a dual-character model for land use planning which incorporates the national mandate for preservation of prime agricultural lands through its land evaluation (LE) subsystem and includes factors necessary for local decision-making through its site assessment (SA) subsystem. Land evaluation assesses the physical capability of the land to support viable agricultural production. Soils are rated and placed in groups ranging from best to worst on a relative scale of 1 to 100 for agricultural use based on a selected regional indicator crop. It incorporates a series of worksheets, developed for use with the National Cooperative Soil Survey, which systematically combine evaluative criteria from land capability class, important farmland category, and existing and potential indicator crop yields, and are modified to account for the area for each category (SCS 1983).

The land capability classes are based on the limitations of the soil for production of crops and include explicit definitions of the types of limitations present, if any. Important farmland evaluation designates categories of land as 'prime', or of national importance, and 'statewide' or 'regional', indicating importance for these areal subdivisions. Existing and potential crop yields are determined based on an indicator crop (the most common cultivated crop in the area). The evaluation of indicator crop yields can be accomplished using one of two methods depending on the availability of data. Where the costs of land management are unknown these crop indices can be obtained through the application of the soil productivity rating, which assumes a high level of management and rates the relative yield of the soil under these conditions. These soil productivity ratings, stored at Iowa State University in Ames, are easily accessed by the state offices of the SCS (Wright *et al.* 1983).

Ideally, the evaluation of potential or actual crop yields should be modified to account for the costs of overcoming physical soil limitations. When these data are available the soil potential index (SPI) should be used instead of the soil productivity rating. The SPI is a numerical rating of soil quality based on the following equation:

$$SPI = P - (CM + CL)$$

where P = yield index based on established local standards
CM = index of corrective measure costs
CL = long-term costs for continuing limitations (Wright *et al.* 1983)

Compilation of these three factors is designed to produce eight or ten agricultural groups which indicate their ranked order of potential. These categories are then assigned relative values based on the adjusted yields for each group, where the highest category is assigned a value of 100 and the remainder are rated accordingly. This evaluation requires the direct supervision of the district soil conservationist, whose knowledge of the local soils will generally be the most complete (SCS 1983).

Table 1. Frequently used site assessment factors

1. Percentage area in agriculture within 1 mile
2. Land in agriculture adjacent to site
3. Size of site or farm (based on needed size unit to permit feasible farm operation)
4. Agricultural support system/services
5. Land use regulations
6. Availability of alternative site within area of consideration
7. Need for additional urban land
8. Compatibility with comprehensive plan
9. Distance to city or urban built-up area
10. Central water distribution system with available capacity
11. Central sewerage with available capacity
12. Investment for urban development
13. Transportation
14. Compatibility of proposed use with surrounding area
15. Environment factors (floodplains, wetlands, historical areas, open space, vegetation)

The site assessment subsystem includes 15 frequently used factors (Table 1) other than soils which contribute to the quality of a site for agricultural use. These factors are stratified within a 200-point-maximum scheme in accordance with local needs and objectives. The factors themselves can be modified to reflect the particular planning needs of the area and their individual point values are likewise adjustable.

The total LESA system provides a 300-point-maximum scheme for determining the quality of a site for farmland activities relative to both the physical setting (100 points maximum) and the socioeconomic setting (200 points maximum). The score for an individual site is determined by evaluating the compliance of each factor with the selected criteria. A simplified, hypothetical example from Douglas County demonstrates the LESA system for a selected site (Table 2). Once complete, the LESA value can be checked against the following selected set of criteria:

Table 2. Hypothetical example of LESA model for Douglas County

Proposed use: Housing
Soil type: Wabash silty clay loam
Land evaluation value: 84

Factor[a]	Maximum points[b]	Assigned weight[c]	Total maximum points × weight	Site No. 1 points assigned[d]	Points × weight[e]
1	10	2·1	21	8	16·8
2	10	1·5	15	9	13·5
3	10	1·1	11	7	7·7
4	10	1·8	18	9	16·2
5	10	1·3	13	8	10·4
6	10	1·7	17	10	17·0
7	10	1·7	17	10	17·0
8	10	1·5	15	10	15·0
9	10	0·2	2	10	2·0
10	10	1·3	13	9	11·7
11	10	1·0	10	10	10·0
12	10	0·8	8	5	4·0
13	10	1·1	11	9	9·9
14	10	0·6	6	10	6·0
15	10	2·3	23	10	23·0
SA subtotal			200		180·3
LE subtotal			100		84·0
Total points possible			300		300·0
Total points acrued					264·3

[a] Factors as in Table 1
[b] Maximum points per factor
[c] The relative weights are the importance factors and are adjusted to produce a maximum possible 200 points as shown in column 4
[d] A hypothetical set of points assigned to the evaluated site based on compliance with each factor
[e] This column multiplies the points assigned by the weight for each factor based on its importance to the planning mission

Protection categories
250–300 Very high protection efforts for agriculture
225–250 High protection efforts for agriculture
200–225 Moderate protection efforts for agriculture
0–200 Low protection efforts for agriculture

The ultimate decision as to whether a parcel of land should or should not be converted to non-agricultural use is determined by the decision-makers involved 'based' on the determination of the LESA values.

LESA model for Douglas County, Kansas

Research conducted by Williams *et al.* (1983) and later refined (Williams 1985) created a database of LESA factor scores and evaluative data for Douglas County, Kansas, for research in spatial modelling of the LESA system. This database was

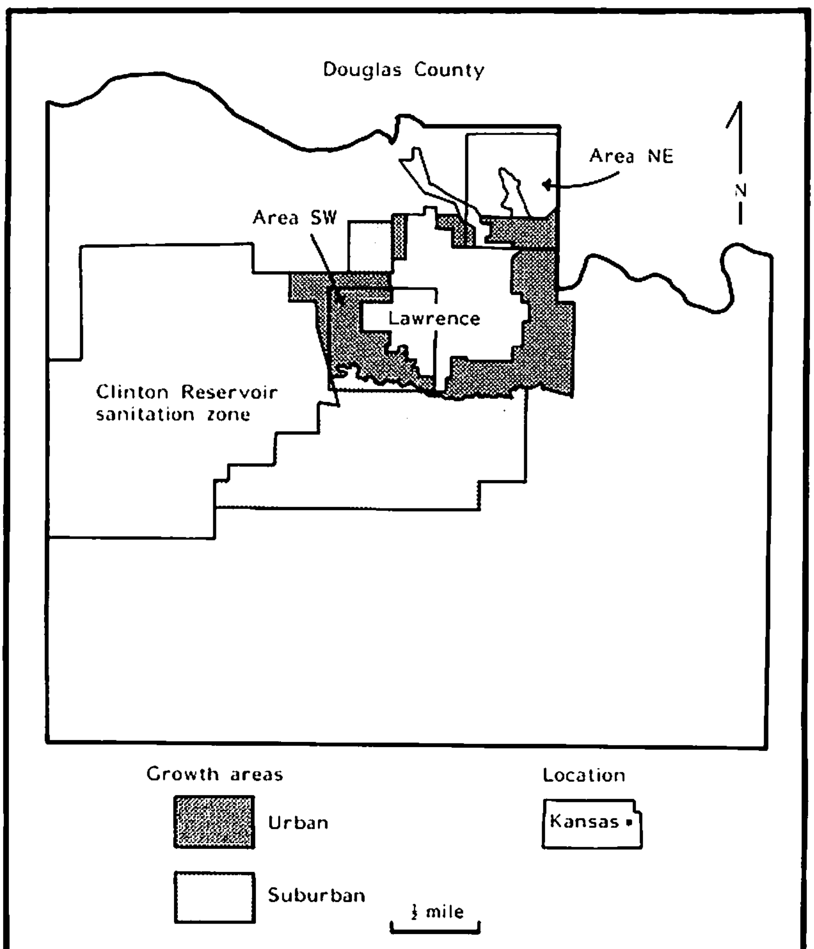

Figure 1. Douglas County study area (after Luckey 1984)

constructed from early efforts of the Lawrence-Douglas County Planning Commission to develop LESA for implementation. Their interest, plus the existence of the Williams database, provided the impetus to research the nature of the model itself in the study area (Luckey 1984; Luckey and DeMers 1987).

Efforts were undertaken to systematize the LESA factor determination procedure and to evaluate a number of modifications to the model. Two separate models were created, each representing a different view of LESA model limitations. A tree structure was created by Luckey (1984), incorporating those factors which were deemed to be redundant, while a dynamic modelling approach was created by DeMers (1986) to allow the local officials an opportunity to view the results of their decisions. Both techniques showed improvements over the existing model (Luckey and DeMers 1987). However, it remained unclear how the dual nature of LESA could potentially affect decisions when each subsystem was severely modified.

Of specific interest is the effect that severe changes in the LE:SA ratio might have on LESA values relevant to the comparative decision parameters specified by the SCS, and how these severe changes might increase the variability of scores in a given planning region. Results from previous research (Luckey and DeMers 1987) indicated the unaccountability of variation resulting from severe minimization of land evaluation in the Douglas County study region. A further analysis of the values from this research should clarify the variation and suggest appropriate LE:SA ratios for Douglas County.

Table 3. Preliminary LESA model and site assessment factors

1. Percentage area in agriculture within 1·5 miles[a]
2. Land in agriculture adjacent to site
3. Size of site or farm (based on size to permit operation)
4. Average size of land parcels within 1 mile of site[b]
5. Agricultural support system/services
6. Agrivestment in real property improvements within 2 miles[b]
7. Percentage land zoned agriculture within 1·5 miles of the site[b]
8. Zoning of site and adjacent to it[b]
9. Availability of land zoned for proposed use[b]
10. Availability of non-farmland or less-productive land as an alternative site within area of consideration[b]
11. Need for additional urban land
12. Compatibility of proposed use with surrounding area
13. Does the property have unique topographic, historic or groundcover features or unique scenic qualities?[b]
14. Is property adjacent to land with unique topographic, historic or groundcover features or scenic qualities?[b]
15. Land subject to flooding or in a drainage course[b]
16. Suitability of soils for on-site waste disposal[b]
17. Compatibility with an adopted comprehensive plan[a]
18. Within a designated growth area[b]
19. Distance from city limits[a]
20. Transportation accessibility[a]
21. Central water distribution system with available capacity (municipal system)[a]
22. Central sanitary sewerage system with available capacity (municipal or established sewer benefit district)[a]

[a] Modifications to existing factor
[b] New factor added

Existing database and values

As a result of the extensive study in the Douglas County area, both by the Lawrence-Douglas County Planning Commission and by researchers at the University of Kansas, a preliminary LESA model and list of evaluative factors was produced as a modification of the original model suggestions (Table 3). This list of factors was used

Table 4. LESA scores under differing development methods

Site	LE[a]	GIS[b]	GIS/DG[c]	DG[d]	SHNEE[e]	TREE[f]	CNTRL[g]	D1:2[h]
NE1	10	124	116·6	107·0	159·2	98·2	111·4	169·3
NE2	10	124	113·6	104·0	136·1	98·2	108·6	174·9
NE3	77	199	185·8	178·9	215·6	173·4	133·8	237·6
NE4	100	182·3	181·3	178·8	182·9	164·7	170·9	172·0
NE5	5	126	117·8	108·6	118·1	110·8	115·0	169·9
NE6	10	130·5	119·2	112·9	143·2	106·8	117·2	173·7
NE7	84	208·5	194·5	187·6	213·2	182·4	191·7	226·3
NE8	75	191	180·8	171·8	210·4	162·8	175·1	222·7
NE9	75	188	179·2	170·2	220·0	160·6	173·3	218·1
NE10	5	126	117·8	108·6	118·1	110·3	115·0	168·8
NE11	77	213·5	194·2	174·2	208·0	164·6	190·2	235·6
NE12	75	205	189·4	181·3	202·3	158·8	190·5	233·0
NE13	84	202	191·6	185·3	218·4	178·6	193·5	242·6
NE14	63	202·5	184·6	176·5	198·2	172·8	183·4	215·8
Mean	54	173·0	161·9	153·3	181·7	181·7	135·4	206·2
SW1	5	105	96·8	94·5	116·2	97·7	101·4	179·3
SW2	77	175	159·8	157·6	160·5	177·5	169·7	160·8
SW3	10	51	65·4	67·7	70·4	68·7	73·6	47·7
SW4	10	49	46·9	51·4	72·4	54·4	57·3	42·9
SW5	5	94	83·2	86·1	78·2	102·7	94·1	72·7
SW6	75	165	147·8	144·1	163·7	149·0	152·3	159·7
SW7	100	194	168·6	170·8	183·2	183·9	173·6	188·3
SW8	84	129	123·2	128·6	152·7	138·5	133·1	149·6
SW9	10	50	79·7	82·4	83·5	101·0	90·0	67·7
SW10	10	123	98·0	97·7	101·2	104·5	104·5	90·2
SW11	5	94	83·7	84·4	91·0	97·3	94·1	72·7
SW12	75	190	163·4	165·6	178·3	170·9	169·5	149·3
SW13	77	168	163·2	164·7	163·0	172·3	169·7	140·1
Mean	42	122	113·8	115·1	129·3	126·8	121·8	117·0

[a] Land evaluation portion of LESA only
[b] LESA scores for GIS implementation based on original factors and factor weights of the SCS model
[c] LESA scores for GIS implementation based on 1983 Douglas County working group factors and factor weights
[d] LESA scores based on factors from a 1982 Douglas County Planning Staff memo using the same weights as GIS/DG
[e] LESA scores based on factors and weights adopted by Shawnee County, Kansas
[f] LESA scores based on the proposed Douglas County factors whose weights are adjusted to reflect hierarchical factor relationships
[g] Control group of LESA scores based on the proposed Douglas County factors with each receiving equal weight
[h] LESA scores based on the DeMers (1985, 1986) methodology but with an LE:SA ratio of 1:2

to implement LESA in 27 selected Douglas County study sites. These sites (numbered NE1–14 and SW1–13 to correspond to northeast and southwest study regions) were selected to correspond to an historical database composed of zoning permits for non-agricultural uses (Figs 1, 2 and 3). A variety of LESA models and their associated values were then tested against these permits and against the existing LESA system values for Douglas County (Luckey and DeMers 1987) (Table 4). It should be noted that the final LESA model technique developed by DeMers (1985) is not applicable to the present analysis since the land evaluation subsystem was modified for that system. Instead, the DeMers model based on an LE:SA ratio of 1:2 is used.

Methods of analysis

It was necessary to ascertain the effectiveness of land evaluation and site assessment as predictors of LESA category determination. More importantly, this evaluation must be free of the numerical constraints of the LESA model itself. What is to be evaluated is how many of those sites which could be classified as having very high-quality soils (very high LE scores), necessitating very high conservation efforts, could be reflected in very high protection-effort LESA categories. Conversely, how many sites with a very high SA category will have equal category determination by the final LESA model?

This analysis was begun by reordering the data from Table 3 in order of descending land evaluation. Land evaluation values were compared with total LESA scores. Because LESA normally allows only one-third of the model to be determined by the land evaluation portion, a straight comparison would naturally indicate more preference toward the site assessment portion in determining final LESA scores. Because this is the case, the reordered data are further categorized as follows, indicating the protection status based entirely on land evaluation and prorated to 100 points:

Protection categories

83–100 Very high protection efforts for agriculture
75–82·9 High protection efforts for agriculture
67–74·9 Moderate protection efforts for agriculture
0–66·9 Low protection efforts for agriculture

This illustrates the same percentage score for protection status as is normally indicated by the LESA system for both portions combined. For example, LESA scores showing very high protection status would fall between 300 and 250 points on a 300-point model or, stated another way, the highest sixth of the point values would show very high protection status. Likewise, exclusively using land evaluation worth only 100 points, one-sixth of the highest point values, or those values between 100 and 83, would be classified as very high protection status. This procedure places the land evaluation subsystem on the same categorical scale, an ordinal scale, as that for an entire LESA system, thus ensuring isolation of the analysis from the numerical constraints of LESA itself.

In order to determine the degree to which site assessment alone predicts final LESA scores, the land evaluation values were subtracted from the LESA scores for the various development methodologies to obtain site assessment scores for each site. In a manner identical to that utilized for land evaluation examination, the site assessment scores were placed on the same ordinal scale as that for LESA. As such, the 200-point maximum score for site assessment is separated into identical percentage values yielding the following SA categories:

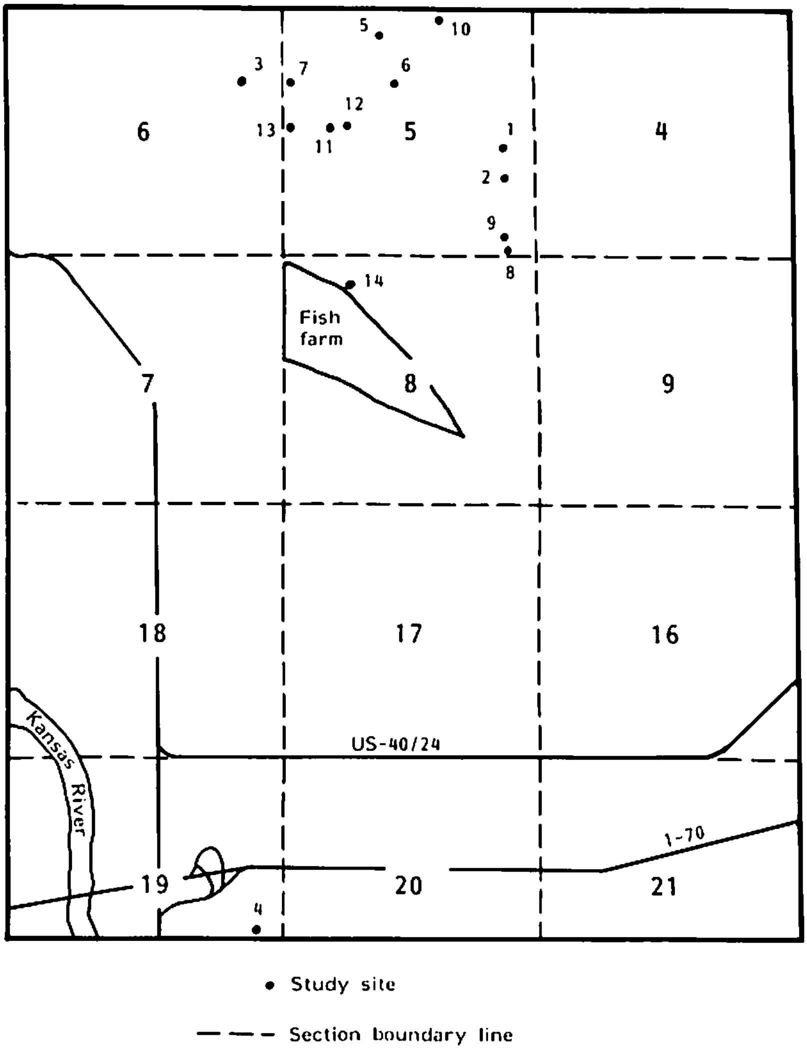

Figure 2. Northeast area study sites

Protection categories

166–200 Very high protection efforts for agriculture
150–165·9 High protection efforts for agriculture
124–149·9 Moderate protection efforts for agriculture
0–123·9 Low protection efforts for agriculture

A comparative analysis between the categorized site assessment ratings and the categorized LESA ratings was then performed.

Results

Comparison of land evaluation (LE) categories with LESA categories (*see* Tables 4 and 5) indicates little or no correspondence between the two. In fact, although there

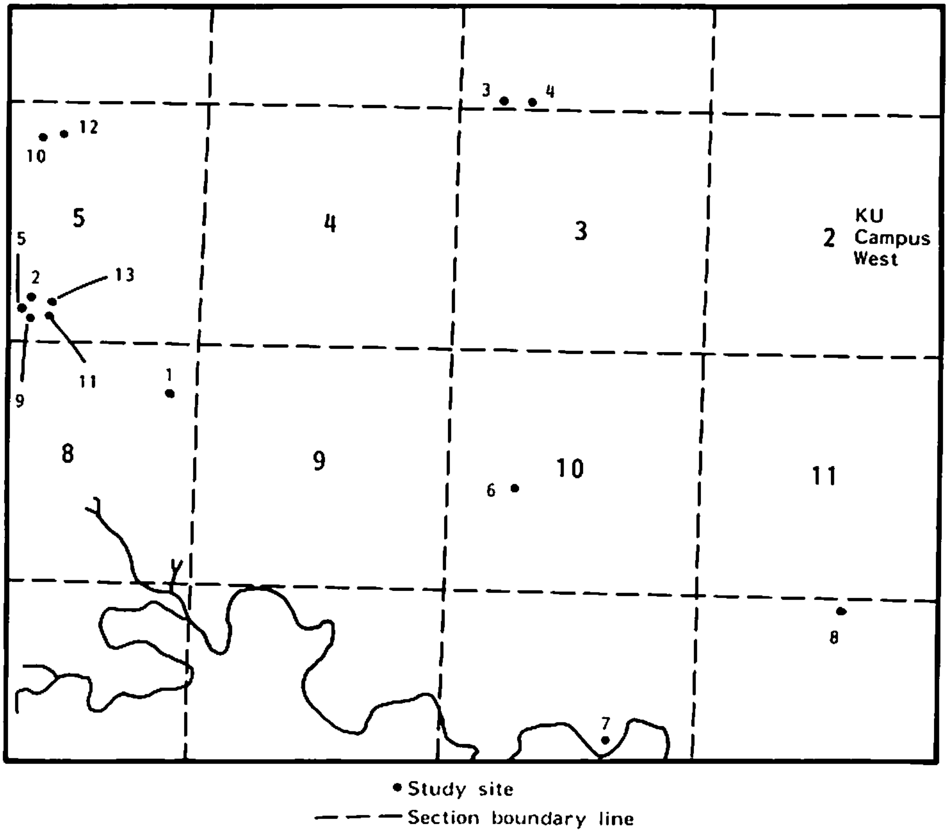

Figure 3. Southwest area study sites

were five sites with LE category very high (NE4, 7 and 13 and SW7 and 8) there was no corresponding category designation for LESA in any of the development schemes. There were, however, two sites (NE7 and 13) which did indicate high efforts for preservation of farmlands, but only in the DeMers LESA development scheme.

High LE had a very minimal correspondence with LESA categories, again within the DeMers development method, specifically for sites NE3, 11, and 12 (*see* Table 5). The GIS, Shawnee and DeMers methods also showed some categories of moderate protection efforts: sites NE11 and 12 for the GIS method, sites NE3, 8, 9, 11 and 12 for the Shawnee method, and sites NE8 and 9 for the DeMers method. The comparison between LE and LESA scores within the moderate category could not take place, since none of the LE scores fell within that category.

In all but one case (site NE14 in the GIS method) the remainder of the LE and LESA scores corresponded exactly. All of the remaining sites showed an LE category of low and all but one LESA score also showed low.

As a predictor for low LESA scores, LE seems to perform well. However, since the purpose of the LESA model is to preserve, where possible, the prime agricultural lands; and since only very high and high LESA scores will be likely to perform such a task, it is at the high end that a correspondence is essential. Such a correspondence does not exist, and therefore land evaluation as an indicator of the quality of the land

Table 5. Comparison of land evaluation and LESA categories[a]

Ranked LE	GIS	GIS/DG	DG	SHNEE	TREE	CNTRL	DI:2
NE4 (Very high)	Low	Low	Low	Low	Low	Low	Low
SW7 (Very high)	Low	Low	Low	Low	Low	Low	Low
SW8 (Very high)	Low	Low	Low	Low	Low	Low	Low
NE7 (Very high)	Mod	Low	Low	Mod	Low	Low	High
NE13 (Very high)	Mod	Low	Low	Mod	Low	Low	High
SW2 (High)	Low	Low	Low	Low	Low	Low	Low
NE3 (High)	Low	Low	Low	Mod	Low	Low	High[b]
SW13 (High)	Low	Low	Low	Low	Low	Low	Low
NE11 (High)	Mod	Low	Low	Mod	Low	Low	High[b]
NE8 (High)	Low	Low	Low	Mod	Low	Low	Mod
SW12 (High)	Low	Low	Low	Low	Low	Low	Low
NE12 (High)	Mod	Low	Low	Mod	Low	Low	High[b]
NE9 (High)	Low	Low	Low	Mod	Low	Low	Mod
SW6 (High)	Low	Low	Low	Low	Low	Low	Low
NE14 (Low)	Mod	Low	Low	Low	Low	Low	Mod
NE6 (Low)	Low	Low	Low	Low	Low	Low	Low
NE1 (Low)	Low	Low	Low	Low	Low	Low	Low
SW10 (Low)	Low	Low	Low	Low	Low	Low	Low
SW4 (Low)	Low	Low	Low	Low	Low	Low	Low
SW9 (Low)	Low	Low	Low	Low	Low	Low	Low
NE2 (Low)	Low	Low	Low	Low	Low	Low	Low
SW3 (Low)	Low	Low	Low	Low	Low	Low	Low
SW1 (Low)	Low	Low	Low	Low	Low	Low	Low
NE10 (Low)	Low	Low	Low	Low	Low	Low	Low
SW11 (Low)	Low	Low	Low	Low	Low	Low	Low
NE5 (Low)	Low	Low	Low	Low	Low	Low	Low
SW5 (Low)	Low	Low	Low	Low	Low	Low	Low

[a] See Table 4 footnotes for explanation of differing development methods
[b] Significant deviation between land evaluation and LESA scores

for agriculture does not seem to have a substantial impact on the final protection status under the existing LESA system.

What then is the relationship between the site assessment (SA) portion of LESA and the final LESA scores themselves? It is to be expected that if land evaluation is not a major influence on the final outcome of LESA, then surely the SA values must be. This is not necessarily true, since some combination of moderate to high LE scores and moderate to high SA scores might yield a resultant high or possibly even very high LESA category, depending on the admixture.

Separate comparison of SA factors developed under different methodologies (Table 6) against LESA does, however, bear out this suspicion of control by the SA subsystem of the final LESA score. Table 7 shows a very strong correspondence between the SA and LESA categories. Of the 189 possible comparison pairs (27 each for each of 7 LESA models) only 11 failed to compare exactly. Interestingly, of these 11 mismatches, only one (NE7 within the DeMers method) showed a lower site assessment category than its corresponding LESA category.

Scattergrams for each of the seven comparisons of site assessment and land evaluation substantiated the assumption of separability of the two model subsystems.

Table 6. Site assessment under differing development methods[a]

Site	GIS	GIS/DG	DG	SHNEE	TREE	CNTRL	D1:2
NE1	114	106·6	97·0	149·2	88·2	101·4	159·3
NE2	114	103·6	94·0	126·1	88·2	98·6	164·9
NE3	122	108·8	101·9	138·6	96·4	56·8	160·6
NE4	82·3	81·3	78·8	82·9	64·7	70·9	72·0
NE5	121	112·8	103·6	113·1	105·8	110·0	164·9
NE6	120·5	109·2	102·9	133·2	96·8	107·2	163·7
NE7	124·5	110·5	103·6	129·2	98·4	107·7	142·3
NE8	116	105·8	96·8	135·4	87·8	100·1	147·7
NE9	113	104·2	95·2	145·0	85·6	98·3	143·1
NE10	121	112·8	103·6	113·1	105·3	110·0	163·8
NE11	136·5	117·2	97·2	131·0	87·6	113·2	158·6
NE12	130	114·4	106·3	127·3	83·8	115·5	158·0
NE13	118	107·6	101·3	134·4	94·6	109·5	158·6
NE14	139·5	121·6	113·5	135·2	109·8	120·4	152·8
Mean	119·0	107·9	99·3	127·7	127·7	81·4	152·2
SW1	100	91·8	89·5	111·2	92·7	96·4	174·3
SW2	98	82·8	80·6	83·5	100·5	92·7	83·8
SW3	41	55·4	57·7	60·4	58·7	63·6	37·7
SW4	39	36·9	41·4	62·4	44·4	47·3	32·9
SW5	89	78·2	81·1	73·2	97·7	89·1	68·7
SW6	90	72·8	69·1	88·7	74·0	77·3	84·7
SW7	94	68·6	70·8	83·2	83·9	73·6	88·3
SW8	45	39·2	44·6	68·7	54·5	49·1	65·6
SW9	40	69·7	72·4	73·5	91·0	80·0	57·7
SW10	113	88·0	87·7	91·2	94·5	94·5	80·2
SW11	89	78·7	79·4	86·0	92·3	89·1	67·7
SW12	115	88·4	90·6	103·3	95·9	94·5	76·3
SW13	91	86·2	87·7	86·0	95·3	92·7	63·1
Mean	80	71·8	73·1	87·3	84·8	79·8	75·0

[a] See Table 4 footnotes for explanation of differing development methods

As such, changes in site assessment are not influenced by, nor are they associated with, the land evaluation subsystem. This indicates that the SA values are generally more substantially altered by changes in socioeconomic and political factors than by relationships with the physical properties of the land base.

Discussion

It has been demonstrated that LESA is a planning model with a succinctly dual nature. The land evaluation portion of the model, based as it is on the SCS Land Capability Classification, addresses planning from a viewpoint of physical land base suitability. Within Douglas County, and based on seven separate LESA models, land evaluation has little impact on the classification of land for very high or high preservation efforts; this despite four sites indicating a very high land evaluation value.

On the contrary, there is a strong relationship between site assessment categoriza-

Table 7. Comparison of site assessment and LESA scores[a]

Site	SA GIS	LESA GIS	SA GIS/DG	LESA GIS/DG	SA DG	LESA DG	SA SHNEE	LESA SHNEE
NE1	Low	Low	Low	Low	Low	Low	Mod	Low[b]
NE2	Low	Low	Low	Low	Low	Low	Mod	Low[b]
NE3	Low	Low	Low	Low	Low	Low	Mod	Mod
NE4	Low	Low	Low	Low	Low	Low	Low	Low
NE5	Low	Low	Low	Low	Low	Low	Low	Low
NE6	Low	Low	Low	Low	Low	Low	Mod	Low[b]
NE7	Mod	Mod	Low	Low	Low	Low	Mod	Mod
NE8	Low	Low	Low	Low	Low	Low	Mod	Mod
NE9	Low	Low	Low	Low	Low	Low	Mod	Mod
NE10	Low	Low	Low	Low	Low	Low	Low	Low
NE11	Mod	Mod	Low	Low	Low	Low	Mod	Mod
NE12	Mod	Mod	Low	Low	Low	Low	Mod	Mod
NE13	Low	Mod[b]	Low	Low	Low	Low	Mod	Mod
NE14	Mod	Mod	Low	Low	Low	Low	Mod	Low[b]
SW1	Low	Low	Low	Low	Low	Low	Low	Low
SW2	Low	Low	Low	Low	Low	Low	Low	Low
SW3	Low	Low	Low	Low	Low	Low	Low	Low
SW4	Low	Low	Low	Low	Low	Low	Low	Low
SW5	Low	Low	Low	Low	Low	Low	Low	Low
SW6	Low	Low	Low	Low	Low	Low	Low	Low
SW7	Low	Low	Low	Low	Low	Low	Low	Low
SW8	Low	Low	Low	Low	Low	Low	Low	Low
SW9	Low	Low	Low	Low	Low	Low	Low	Low
SW10	Low	Low	Low	Low	Low	Low	Low	Low
SW11	Low	Low	Low	Low	Low	Low	Low	Low
SW12	Low	Low	Low	Low	Low	Low	Low	Low
SW13	Low	Low	Low	Low	Low	Low	Low	Low

[a] See Table 4 footnotes for explanation of differing development methods
[b] Significant deviation between site assessment and LESA scores

tion and those of composite LESA categories, despite any potential variation in the relative LE:SA ratio. It is to be expected that this relationship would be strong if the raw SA and LESA scores are compared, since the final scores are dependent on the LE:SA ratio. Yet this correspondence is there even without this dependence.

This strong relationship between SA and LESA categories is a significant one, indicating the balance of the planning decision-making placed within the socio-economic and political arena. With this established relationship, it is important to note the lack of a single very high rating within the site assessment subsystem, indicating a decided preference of the model towards non-physical parameters. This is a substantial break from the McHarg land constraints mapping approach and shows a concern, on the part of the SCS, to put a planning model in place which is a guide and not a replacement for local decision-makers.

Certainly, the developers of the LESA system were concerned with the wise use of the land from the standpoint of conservation of prime agricultural lands within the US. Any planning system which is developed without these concerns would necessarily be unwise when considering the shrinking resource base. At the same time,

SA TREE	LESA TREE	SA CNTRL	LESA CNTRL	SA D1:2	LESA D1:2
Low	Low	Low	Low	High	Low[b]
Low	Low	Low	Low	High	Low[b]
Low	Low	Low	Low	High	High
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	High	Low[b]
Low	Low	Low	Low	High	Low[b]
Low	Low	Low	Low	Mod	High[b]
Low	Low	Low	Low	Mod	Mod
Low	Low	Low	Low	Mod	Mod
Low	Low	Low	Low	High	Low[b]
Low	Low	Low	Low	High	High
Low	Low	Low	Low	High	High
Low	Low	Low	Low	High	High
Low	Low	Low	Low	High	Mod[b]
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low
Low	Low	Low	Low	Low	Low

however, these concerns, when strictly adhered to, will not allow autonomy within the planning community. As a model, LESA has incorporated these combined concerns within a single framework.

Conclusion

Since LESA is designed to protect prime agricultural lands when possible, it may seem from the results of this research that it has failed in its mandate. To some extent this may be true, at least within the context of the Douglas County databases. More studies of this nature are needed to determine whether the indicated trends are more universal.

It is important to recognize, however, that the final categorization of LESA values as to very high, high, and so on, is an important and sensitive aspect of the model. Designs which are strictly tied to static final scores frequently fail because of a lack of correspondence between the model performance and these static figures. This is akin to determining student grades based on static percentage scores. Before this technique becomes workable, it is necessary for certain parameters to be met and for a normal distribution to be established. Neither of these has been performed on the LESA model to formalize a grading scheme.

This latter drawback is perhaps the most important aspect of future research into LESA model performance. Many questions still remain unanswered. Within a given study region what is an average LESA score? How does this average correspond to averages elsewhere? What factors, either physical or socioeconomic, contribute to any differences? Given performance of the LESA models already in place, how does the final LESA grading scheme perform to protect prime agricultural lands? And how can the grading scheme be improved to reflect the requirements of a given region more effectively?

As the model stands, care must be taken in the interpretation of LESA scores. The inclusion of site assessment, although a welcome addition to the planning process, is also a major concern since it has such a major impact on the final outcome. Planning based on this model should be performed with the aid and advice of the District Conservationist, and with a view towards the future, both locally and nationally.

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