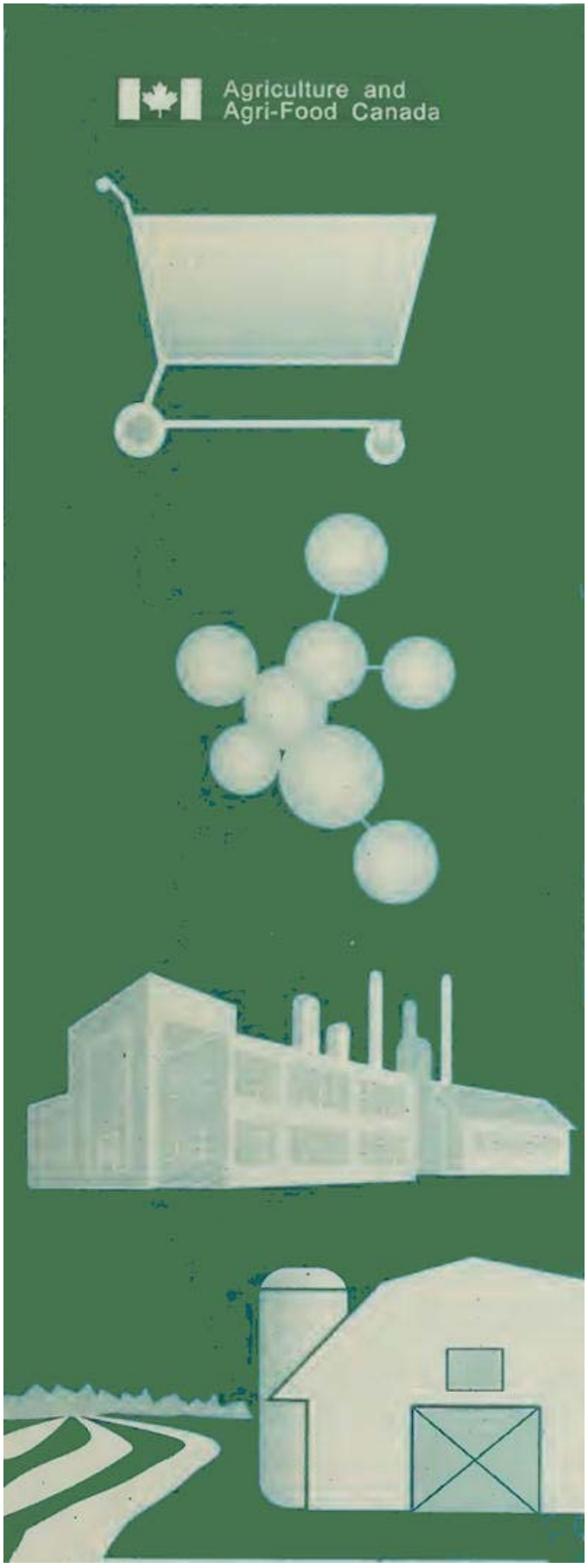

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An Assessment of the Association between Agricultural Production and Land Quality for Regional Planning

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Canada

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Summary

Several associations were documented between selected characteristics of agricultural production and the quality of the land for annual dryland crop production in two regions surrounding Edmonton, Alberta. The study, using 1986 Census of Agriculture Enumeration Area data, found that the five landscapes in the Lake Edmonton Basin (LEB) region had high quality resources for annual dryland crop production according to the Canada Land Inventory (CLI) rating system. Agricultural production in this region had higher capital investment in land and buildings and equipment, relatively more invested in these factors of production for each dollar invested in livestock, larger average total farm area, a higher proportion of cultivated area and lower livestock densities, compared to a region of lower land quality. The three landscapes in the Morainal Areas (MA) region were considered to have lower quality land resources due to less favourable agroclimate, poorer soils and greater variation in surface topography. They showed higher capital investment in livestock, smaller average total farm area, less extensive annual cultivation and higher livestock densities. These results were expected and confirmed. However, associations were not found for economic efficiency, as measured by the sales to expenses ratio, nor for total capital investment per hectare of total farm area.

Based on these results, the study reached two conclusions concerning the association between agricultural production and land quality. First, producers maintain economic efficiency by changing the distribution, not necessarily the total amount of, capital in association with the quality of land resources. Second, comparable economic efficiencies can be achieved between regions with different land quality when production decisions are adapted to the land resources characteristics. These conclusion have important implications to the representation of agricultural production in the regional planning process.

The regional planning process, as it relates to the representation of the agricultural industry, may be based on a potentially incorrect assumption. The goal of ensuring the economic viability of the agricultural industry in a region is based on the policy of conserving the highest quality lands for annual crop production. The underlying assumption is that these lands support the most efficient type of production. By extension, this type of production is, therefore, the most critical to the continued viability of the industry. This study has found, however, that economic efficiency of production, and the economic viability of the agricultural industry, are not necessarily related to land quality. Thus, planners in the future may wish to consider additional information on agricultural production, not just a single land rating system, to properly represent and assess the industry in a regional context.

Acknowledgments

This study arose from the senior author's involvement with a major review of the planning process in the Edmonton metropolitan region in the early 1990's. The review was intended, in part, to develop a new vision of the agricultural industry into the 21st century to support a more responsive regional planning process. A key issue that surfaced during the review was the adequacy of the representation of agricultural production within the planning process. This report is intended to stimulate informed debate on this issue.

Research into the association between regional agricultural production and land resource quality requires considerable cooperation and sharing of expertise amongst a diverse group of people. The following individuals are acknowledged for their patient consideration and astute observations on earlier drafts of this report: Ted Huffman, Agriculture and Agri-Food Canada; Randy Leal, Linda Saloum and Tony Tam, formerly of the Edmonton Metropolitan Regional Planning Commission; Wayne Blumstengel, formerly of Alberta Treasury; Mel Miller, Mike Pearson, Rhonda Wehrhahn and Donna Beever, Alberta Agriculture, Food and Rural Development; Rick Burroughs, Statistics Canada; and, Brenda Clarke, formerly of Statistics Canada. Thanks also to Pete Smith, Agriculture and Agri-Food Canada, for graphic support.

The publication review process, provided by Ted Huffman, Agriculture and Agri-Food Canada and Frank Liszczak, Strathcona County, produced valuable suggestions to increase the readability of this work.

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1.0 Introduction

1.1 The Agricultural Industry in the Regional Planning Process

The planning process in Alberta involves the establishment of goals, objectives and policies for major land uses in a region. The goal of the process in relation to agricultural production is to maintain the economic viability of the industry. This goal is based on the assumption that the most economically efficient[1] production occurs on the highest quality lands; thus, these lands are crucial to the industry's viability (EMRPC 1984). Objectives such as the conservation of 'better agricultural lands' and restriction on the premature conversion of these lands to non-agricultural uses are used to preserve the highest quality land for agricultural production. With similar intent, policies related to land protection and subdivision are put forward. The quality of the land resource base is represented by a land rating system that is designed to classify and show the location of areas with similar capability for annual dryland crop production.

The Canada Land Inventory - Soil Capability for Agriculture (referred to as CLI in this paper) is a 7 class system that rates land capability for annual dryland crop production based on land resource characteristics. Classes 1 to 3 indicate minor to moderate resource limitations whereas Classes 4 to 7 portray more severe conditions, such as sandy soils or very hilly land (Alberta Environment 1977). For almost 30 years, planners have used Classes 1 to 3 to define better agricultural land (i.e., lands of high quality) and, by extension, lands that should be protected for agricultural production. Non-farm developments on these lands are carefully scrutinized to ensure they are consistent with the goal, objectives and policies for the agricultural industry in a region.

A key issue in the regional planning process as it relates to the agricultural industry is the validity of the assumption that economic viability is associated with, and represented by. the quality of the land resources for annual dryland crop production. Recent discussions suggest that this assumption may be questioned and should be tested (EMRPC June, 1993a, b). These discussions identified limitations in the definition and the use of the CLI to represent agricultural production. In addition, there appears to be a lack of research to demonstrate a link between economic characteristics of agricultural production and the quality of the land resource base. Given the importance of the agricultural industry to regional economic development, and the widespread use of the assumption that economic viability of agricultural production is associated with land capability, an assessment of this issue is warranted.

1.2 Study Objective

The research objective is to determine which characteristics of agricultural production are associated with the quality of the land resource base for annual dryland crop production.

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[1] Refer to 7.0 Glossary of Terms for a definition of selected words.

2.0 Method

Two procedures were used to achieve the study objective. The first procedure was used to delineate regional landscapes and define the quality of the land resource base. The second procedure developed agricultural production profiles that were used to determine the production characteristics associated with land quality.

2.1 Definition and Description of Regional Landscapes

There were 3 steps in the procedure to define and describe regional landscapes with respect to their capability for dryland annual crop production. In the first step, the spatial distribution of four land resource characteristics that relate to land quality, namely agroclimate zone, texture of the parent material, topography and dominant soil, were noted from published soil survey and related inventories (Bowser *et al.* 1962; Lindsay *et al.* 1968). In the second step, this information, in addition to standard procedures, were used to delineate landscapes with similar resource characteristics and land quality (Brierley *et al.* 1992).

In the third step, a naming convention was applied to each landscape for ease of presentation. The name included a major physiographic feature and the compass direction from the center of the study area. As an example, a landscape termed Lake Edmonton Basin/North referred to a unit located in the glacial Lake Edmonton district, north of the City of Edmonton (Pettapiece 1986). This landscape was distinguished from Lake Edmonton Basin/South, an extension of the former glacial lake south of the city. Landscapes that had similar agroclimate and physiographic district were grouped for comparative analyses. Within a group, landscapes are ordered from largest to smallest total farm area.

2.2 Development of Regional Agricultural Production Profiles

Two steps were used in the procedure to describe agricultural production within regional landscapes. First, a map of Statistics Canada's Enumeration Areas (EA's) from 1986 were manually overlaid on a map of the regional landscapes (Alberta BSM 1987). Each EA contained about 50 farms and corresponded to approximately one township in size. The overlay procedure was used to determine those EA's that were dominantly (i.e., 70% or more) in a regional landscape. In these cases, a link file was developed that assigned the EA, and related agricultural production data, to the appropriate regional landscape.

In the second step, a profile was developed by summarizing five aspects of agricultural production from the EA data grouped by regional landscape. The profile described the major output from, and inputs to, farming in the region (Hiley *et al.* 1994). The profile included summaries of general structure (e.g., total number of farms and farm area), summary income and expenses, capital investment, land use and livestock production (Statistics Canada 1986a)[2]. Values for a group of landscapes were either totals or median values, as noted.

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[2] The data are derived from a custom request to Statistics Canada for a summary of selected 1986 Census of Agriculture variables by Enumeration Area.

3.0 Results

The results are presented in two sub-sections, the first of which contains a description of the resources and quality of landscapes in the Edmonton metropolitan region. That is followed by an analysis of the agricultural production profiles of landscapes assigned to one of two groups. The Lake Edmonton Basin (LEB) group contains landscapes with higher quality resources compared to those in the Morainal Areas (MA) group.

3.1 Regional Landscapes

Eight landscapes are identified in the Edmonton metropolitan region, five of which are in the LEB group (Figure 1). It is surrounded by the three landscapes that comprise the MA Group which encloses the glacial lake bed.

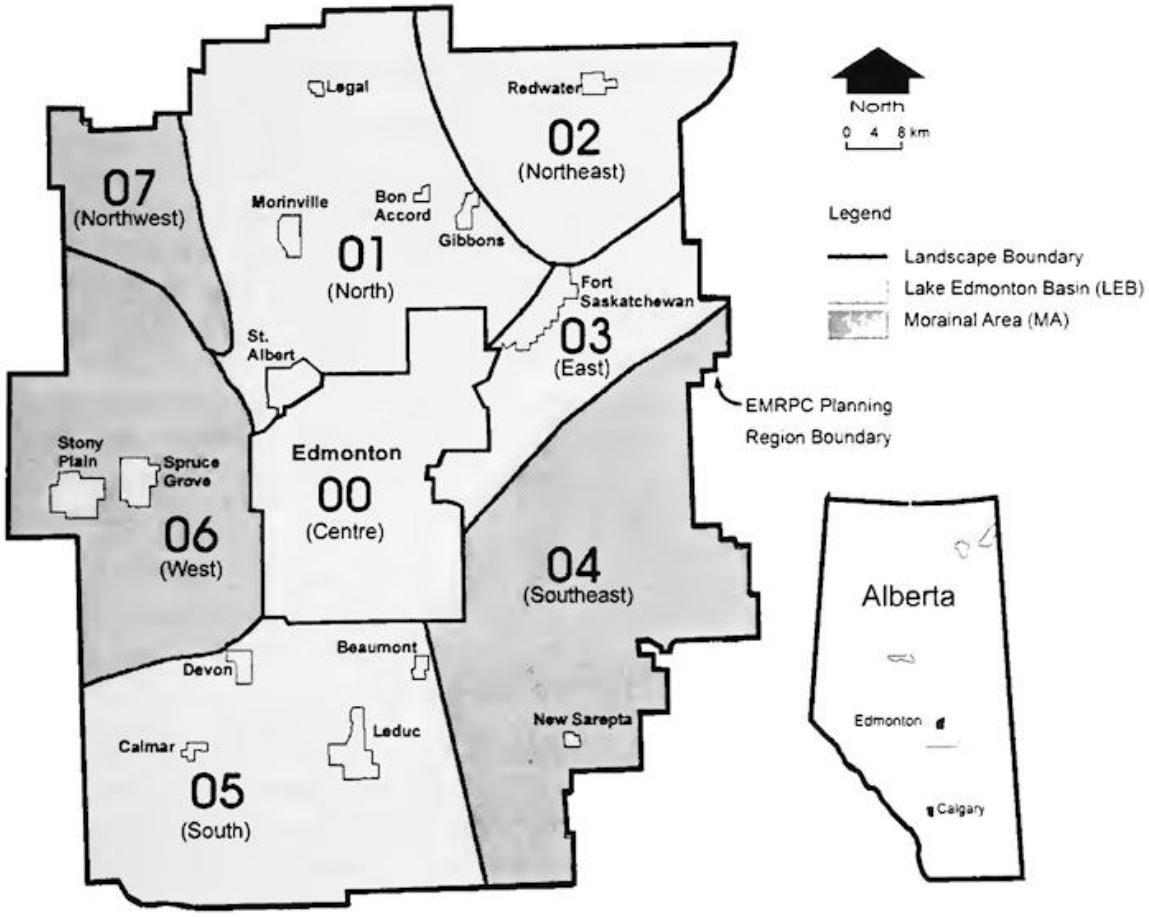

Figure 1. Study Area Location and Distribution of Regional Landscapes.

The 5 landscapes in Group 1 are essentially uniform in their land resource characteristics. They are level plains of fine textured Black Chernozemic soils with a slight limitation for cereal grain production (Table 1). The one exception is LEB/Northeast which has more variation in texture of the parent material and slightly more surface relief.

The 3 landscapes in Group 2 have differences in most land resource characteristics. MA/Southeast has Luvisolic soils developed on medium textured parent materials and variable topography (Table 1). MA/West reports Dark Gray Chernozemic soils developed on a mix of parent material textures and surface relief. MA/Northwest has predominantly Solonetzic soils and less variation in topography than the other 2 landscapes.

Table 1. Description of Landscapes within the Edmonton Metropolitan Region.

Landscape	Name	Agroclimate Zone (1)	Parent Material (2)	Topography	Soil Development (3)
00	LEB Center	2H	Fine	Level	Black Chernozemic
01	LEB North	2H	Fine	Level	Black Chernozemic
02	LEB Northeast	2H	Mix	Undulating	D. Gray Chernozemic
03	1 EB East	2H	Fine	Level	Black Chernozemic
04	M A Southeast	3H	Medium	Hummocky	Gray Luvisolic
05	LEB South	2H	Fine	Level	Black Chernozemic
06	MA West	3H	Mix	Mix	D. Gray Chernozemic
07	M A Northwest	3H	Medium	Undulating	Black Solonetzic

Notes:

1. Agroclimate Classification (Pettapiece (ed.) 1987)
   - 2H - slight limitation for cereal grain production.
   - 3H - moderate limitation for cereal grain production.

2 Parent Material (Texture) (Bowser *et al.* 1962; Lindsay *et al.* 1968)
   - mix - contains significant areas of sandy soils.

3. Soil Development (Bowser *et al.* 1962; Lindsay *et al.* 1968)
   Black Chernozemic - high quality grassland soil.
   Dark Gray Chernozemic - poorer quality grassland soil.
   Gray Luvisolic - poor quality forest soil.
   Black Solonetzic - poor quality grassland soil.

The rating of land quality, as represented by the CLI, is much higher for the landscapes in the LEB group, relative to the landscapes in the MA group. The LEB landscapes have a higher rating because they have fewer land resource constraints to the production of annual crops, including a less restrictive agroclimate, smoother topography and more naturally fertile soils (ASAC 1987). These landscapes are generally rated in CLI Classes 1 to 3 (Alberta Soil Survey 1967). Landscapes in the MA group are rated in CLI Classes 4 to 6 due to less favourable agroclimate and soil development characteristics. As discussed in the Introduction, CLI Classes 1 to 3 are defined as better agricultural land with respect to the regional planning process.

3.2 Agricultural Production Profiles

3.2.1 Lake Edmonton Basin (LEB) Group

Most of the farms and much of the farm area are located in 2 landscapes. LEB/North and South each have about 30% of the more than 2050 farms and 310,000 hectares of farm area (Appendix 1). The other 3 landscapes, LEB/East, Northeast and Center, have about equal proportions of the remaining farms and farm area.

Measures of sales and expenses show that the group values are generally representative of the 5 landscapes. Production is efficient with about $1.20 returned per dollar expended (Appendix 1, Figure 2). The ratio is based on more than $125 million (1985 dollars) in gross sales, or slightly more than $400 per hectare and over $105 million in summary expenses at nearly $350 hectare (Figure 3). In comparison to the group profile, LEB/East and Northeast both report a higher sales to expenses ratio and the lowest expenses per hectare. LEB/Center shows the lowest sales to expenses ratio as well as the highest sales and expenses per hectare.

The level and distribution of capital investment are quite variable for landscapes in the group. The group profile has almost $1 billion in total capital or more than $3200 per hectare (Appendix 1, Figure 4). Based on total farm area, it shows almost $2400 per hectare in land and buildings, about $630 in equipment has and $175 in livestock. With respect to capital distribution, almost $20 is invested in land and buildings and $5 in equipment for each dollar of livestock investment (Figure 5). Relative to the group profile, LEB/Centre reports a much higher total capital investment per hectare of total farm area. LEB/East reports a higher ratio of capital investment per hectare of total farm area and much higher investment in land and buildings per dollar invested in livestock. LEB/North has a lower total capital investment per hectare and a much lower ratio of investment in land and buildings per dollar invested in livestock.

Measures of land use are comparable amongst the 5 landscapes. The group profile shows average farm size at just over 150 hectares with 75% cultivated (Appendix 1, Figure 6). Relative to the group, LEB/North and LEB/East report slightly higher estimates of total farm area, with the former also reporting a higher proportion of cultivated area. LEB/Northeast reports a lower proportion of cultivated area.

The density of chickens is the most variable measure of livestock production. The group reports low values for the number of cattle and pigs per uncultivated hectare, at 0.3 and 0.25 respectively (Appendix 1, Figure 7). The profile shows slightly more than 2.5 chickens per uncultivated hectare. In comparison, LEB/North shows a much higher concentration of chickens whereas much lower concentrations are reported for LEB/East and Centre.

Overall, the LEB group profile suggests an emphasis on extensive annual cultivation. The profile shows a large capital investment, particularly in land, the major component of the land and buildings ratio. As well, the proportion of total area under cultivation is high whereas the concentration of livestock is low, with the exception of chickens in two cases.

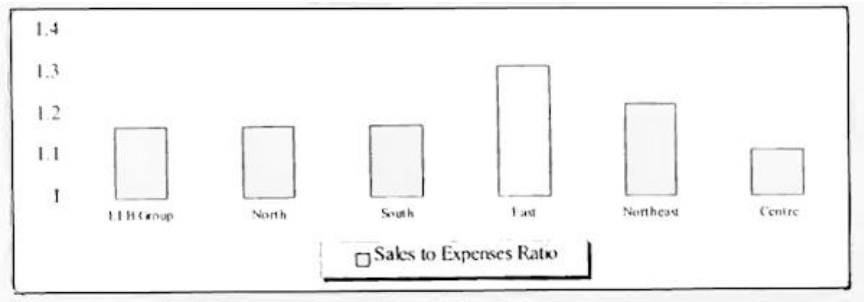

Figure 2. Lake Edmonton Basin - Sales to Expenses Ratio.

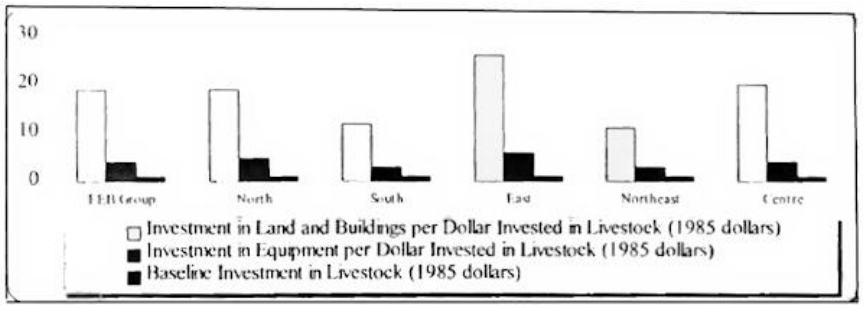

Figure 5. Lake Edmonton Basin - Capital Investment Ratios.

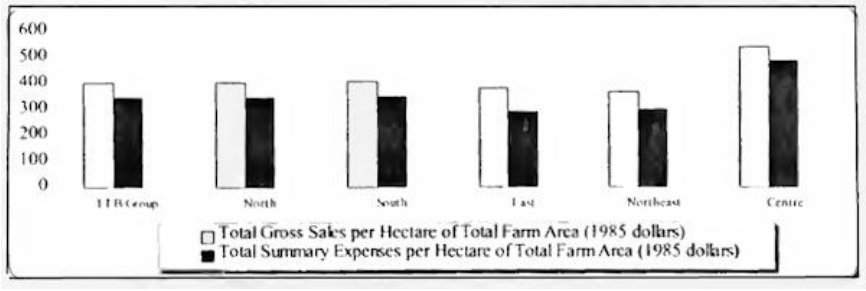

Figure 3. Lake Edmonton Basin - Sales and Expenses.

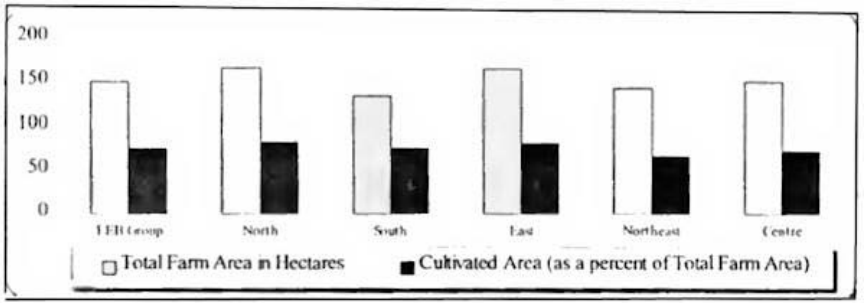

Figure 6. Lake Edmonton Basin - Average Total Farm Area and Cultivated Area.

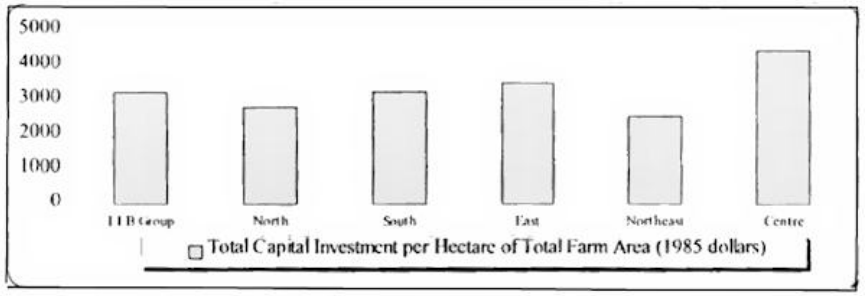

Figure 4. Lake Edmonton Basin - Total Capital Investment.

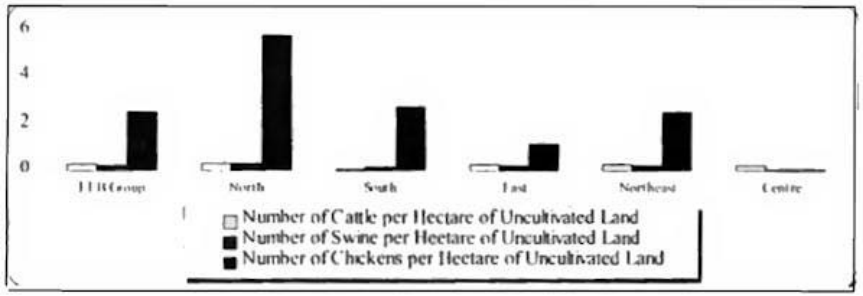

Figure 7. Lake Edmonton Basin- Livestock Production Ratios.

3.2.2 Morainal Areas (MA) Group

Two landscapes report most of the farms and total farm area for this group. MA/Southwest has about 60% of the 1500 farms and about 50% of the 190,000 hectares of total farm area (Appendix 2). MA/West shows nearly 30% of the farms and total farm area.

Sales and expenses are variable amongst the three landscapes. Sales are efficient with about $1.14 returned for each dollar of expenses (Appendix 2, Figure 8). This ratio is based on more than $77 million (1985 dollars) in gross sales, or slightly more than $400 per hectare. More than $70 million are reported in summary expenses, representing nearly $350 per hectare of total farm area (Figure 9). In relation to the group profile, MA/Southeast reports a lower sales to expenses ratio and the highest summary expenses per hectare. MA/Northwest shows the highest sales to expenses ratio as well as the lowest expenses per hectare.

The level and distribution of capital investment is large and quite variable amongst the three landscapes. The group profile shows $570 million in total capital or about $3000 per hectare (Appendix 2, Figure 10). Estimates of total capital include approximately $2250 per hectare in land and buildings, about $530 in equipment and just over $210 in livestock. In relative terms, almost $20 is invested in land and buildings and $5 in equipment for each dollar of livestock investment (Figure 11). Relative to the group profile, MA/Southeast shows a higher total capital investment per hectare of farm area. MA/West has relatively higher investment ratios in land and buildings and equipment whereas MA/Northwest shows lower values for total capital investment and investment in land and buildings.

Measures of land use vary amongst the 3 landscapes. The group profile shows an average farm size at just over 140 hectares with just under 70% cultivated (Appendix 2, Figure 12). Relative to the group, MA/Southwest reports much lower values for total farm area and percent cultivated. MA/Northwest, on the other hand, reports much higher values for these variables.

Varied concentrations of swine and chickens are noted. The group reports almost 0.4 cattle, 0.15 swine and 5.5 chickens per hectare of cultivated land (Appendix 2, Figure 13). In comparison, LEB/North shows a lower density of swine and chickens. MA/West has a much higher ratio of chickens and MA/Northwest reports a much higher ratio for swine.

Overall, the profiles for the MA group suggest an emphasis on livestock production compared to the LEB group profile. The MA profile shows a comparable value for total capital investment but relatively more investment in livestock, as evidenced by the lower ratios for land and buildings and equipment reported by this group. The average farm area is similar for the two groups however the percent cultivated is generally lower for the MA landscapes. Finally, the MA group profile shows, per hectare of uncultivated land, a higher density of cattle and a much higher density of chickens.

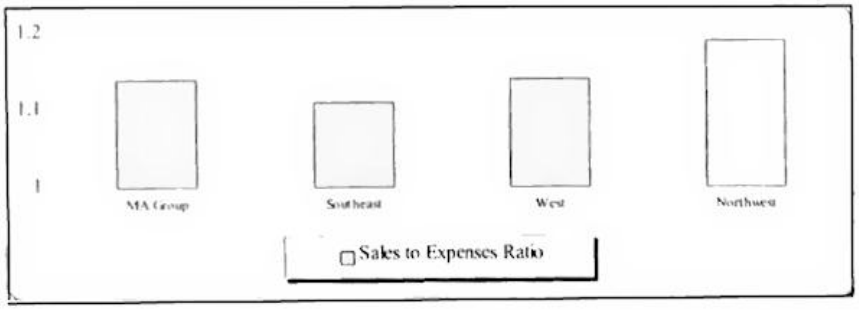

Figure 8. Morainal Areas - Sales to Expenses Ratio.

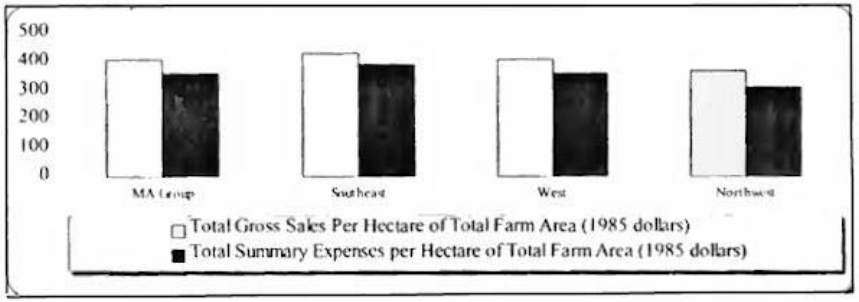

Figure 9. Morainal Areas - Sales and Expenses.

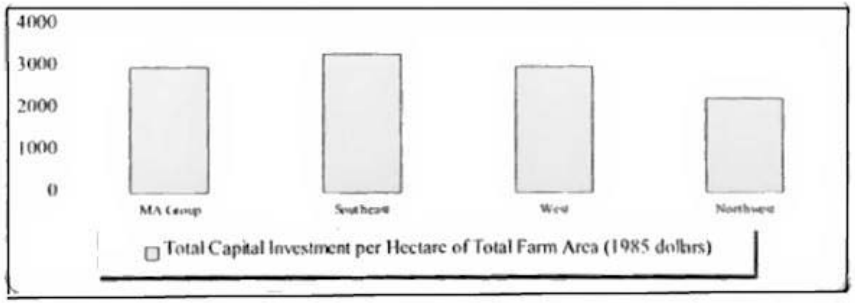

Figure 10. Morainal Areas - Total Capital Investment.

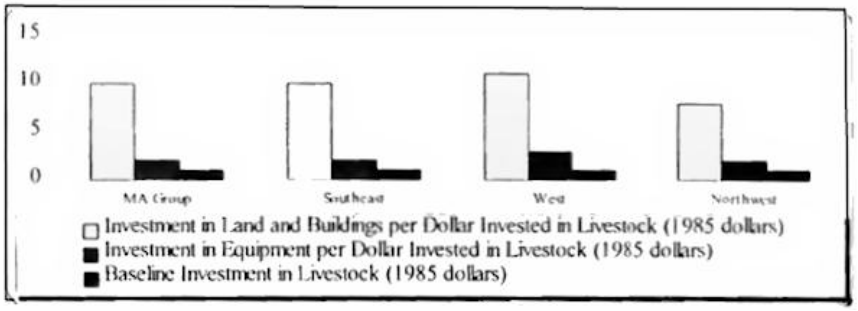

Figure 11. Morainal Areas - Capital Investment Ratios.

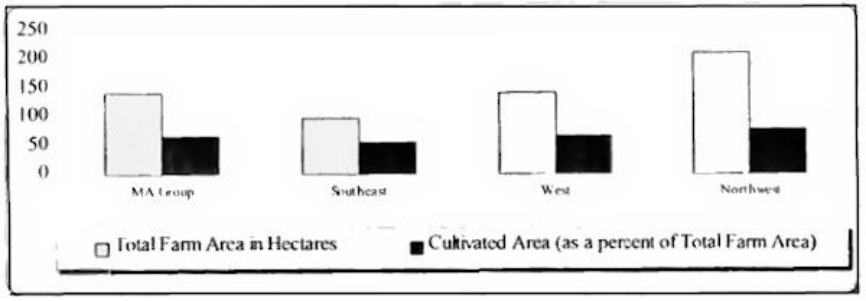

Figure 12. Morainal Areas - Average Total Farm Area and Cultivated Area.

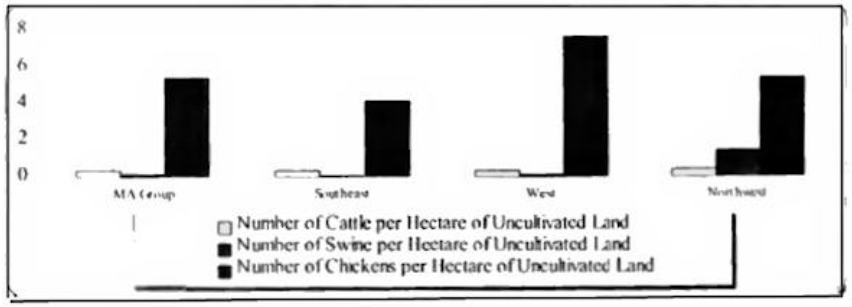

Figure 13. Morainal Areas - Livestock Production Ratios.

4.0 Discussion

The results show that several characteristics of agricultural production are associated with land quality, as represented by a rating of land capability for annual dryland crop production. The LEB group, those landscapes with land resources rated of high quality, report higher capital values in land and buildings as well as equipment in comparison to the MA group which as lower quality land resources. On a relative basis, the LEB group reports twice as much capital investment in these categories relative to the dollar value invested in livestock within the MA group. Landscapes in the LEB group generally report larger farms, a higher proportion of annually cultivated land and lower densities of livestock, such as cattle and chickens. There are, however, important characteristics that are not associated with differences in land quality.

The results also show that some characteristics, particularly economic, are not necessarily associated with variation in land quality. The study found both the gross sales per hectare and the sales to expenses ratio to be comparable between the two regions. Relatively small differences in measures of income and expenses between the two groups suggests that producers do adapt their operations to the land resources in an area. As well, total capital investment is similar for both groups, an indication that producers modify the distribution, rather than total amount, of capital in order to maintain economic efficiencies. In other words, although the land resources in the Morainal Areas are of lower quality for annual dryland production, producers in these landscapes are using other types of production systems. As a result, the land capability rating does not apply directly to their production system or to the economic efficiency associated with it.

Comparable economic performance from areas that are distinguished by differences in land quality challenges the basic assumption upon which regional planners view agriculture in the planning process. As discussed in the Introduction, the goal of the planning process in the Edmonton metropolitan region is to continue the economic viability of agriculture. It is based on the idea that the most economically efficient production occurs on the highest capability lands. The results of this study suggest that economic efficiency, as represented by the sales to expenses ratio, does not always vary with differences in land capability for annual dryland crop production. It appears that producers maintain economic efficiency by varying the distribution of capital and type of production to accommodate differences in land resource characteristics. In the case of higher capability lands, such as those found in the LEB group, producers invest more capital in land and buildings as well as equipment compared to the amount they invest in livestock. In landscapes with lower quality lands, producers invest relatively more in livestock. Of importance to regional planning is the fact that producers in both areas achieve comparable economic efficiencies.

The study may help to address two related issues concerning the representation of the agricultural industry in the regional planning process. First, an appropriate use of a land capability rating system may be to assist in the definition and delineation of areas with similar types of production. The study found that characteristics associated with land resource

capability, including the distribution of capital, land use and type of livestock production, indicate that producers are sensitive to variation in land resource characteristics. Information on land resource characteristics and the type of production can provide valuable information to the planning process on land management issues related to environmental quality. For instance, areas in extensive annual cropping tend to have less surface cover compared to lower capability lands in extensive cattle production, which tend to have more land in hay production and pasture. Lower levels of surface residue may lead to an increased risk of soil deposition into streams and rivers and decreased air, soil and water quality.

The second issue, a more complete representation of agricultural production in the planning process, may require more explicit recognition of the link between economic efficiency and the type of production. This study shows that producers' production decisions appear to be associated with the quality of the land resource base. This flexibility in the decision-making process helps to maintain the economic efficiency of agricultural production despite major differences in land quality. However, the planning process does not explicitly recognize the link between economic efficiency and the type of production nor is there regard for the differential impacts of a non-agricultural development on the type of production. For instance, it is possible that a housing subdivision may have relatively less impact in an extensively cultivated area compared to the same subdivision in a predominantly livestock production area. In the former, urban residences can virtually abut a grain or oilseed field because the dust and noise associated with field operations are limited within the growing season. With respect to the latter, there is the potential for a considerable number of nuisance complaints throughout the year from non-farm residents because of the continual noise and odours that are common to livestock operations. Restrictions on the location and size of livestock operations to reduce nuisance complaints may eventually decrease the economic efficiency of this type of production.

The need for a complete understanding and representation of the agricultural industry reinforces the role of a land capability rating system in the planning process. Land rating systems, such as the Canada Land Inventory, are useful in the identification and delineation of the quality of the resource base for a variety of uses. Problems arise, however, when they are used for purposes that were not intended. Land rating systems do not provide the planning process with a complete representation of the agricultural industry or its economic viability in a regional context.

5.0 Conclusions

The assessment shows that there is an association between agricultural production and the Canada Land Inventory (CLI) land rating system for regional landscapes in the Edmonton metropolitan region. The study identified agricultural production characteristics based on the overlay of Statistics Canada 1986 Enumeration Area centroids on regional landscapes. A comparative analysis of two groups of regional landscapes, representing differences in land capability for annual dryland crop production, found that higher capability landscapes reported:

1. higher capital investment in land and buildings and equipment;
2. nearly twice as much invested in land and buildings and equipment for each dollar of livestock investment;
3. larger average farm size;
4. higher proportion of annually cultivated area; and,
5. lower densities of livestock.

However, an association between agricultural production and land capability was not found for the following characteristics:

1. economic efficiency; and,
2. total capital investment.

It is concluded from these results that:

1. producers attempt to maintain economic efficiency by adjusting production decisions to the quality of the land resource base; and,
2. comparable economic efficiencies of agricultural production can be achieved from landscapes with very different land quality.

In our opinion, land rating systems such as the Canada Land Inventory or its equivalents provide useful information to the regional planning process. It is critical that such systems be supplemented with additional economic and social information to ensure a complete representation of the agricultural industry in the regional planning process.

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7.0 Glossary of Terms

Agroclimate zone - A classification for general agricultural assessments following a recognized system in Alberta (Alberta Soils Advisory Committee 1987). The classification is based on heat and moisture factors affecting dryland crop production.

Capital - A stock of accumulated goods rather than income received in a specific time. In this study, capital is comprised of land and buildings, machinery and livestock.

Capital Investment - The present market value of land and buildings, machinery and livestock. It is estimated by the farmer based on 1985 dollars.

Characteristic - A concept that describes one aspect of an object under study. For example, economic performance is a characteristic of agricultural production.

Chernozemic - A grassland and parkland soil developed under semi-arid conditions. See Agriculture Canada (1976) for a formal definition.

Coarse texture - The texture exhibited by sands, loamy sands and sandy loams except very fine sandy loam. See Brierley *et al.* (1992) for a formal definition.

Cropland - A variable derived from the Census that refers to the total area of: crops seeded or to be seeded in 1986, tree fruits, cultivated berries, grapes, vegetables, sod and nursery products for sale.

Cultivated Area - A variable derived from the Census equal to cropland plus summerfallow.

Economic - Relating to the production and consumption of goods and services.

Economic Efficiency - Relating to the rate of outputs produced for a given level of inputs. In this study, it is measured by the ratio of total gross sales to summary expenses.

Enumeration Area - The area covered by a Census Enumerator. In rural areas it generally contains about 50 farms. See Statistics Canada (1986) for a formal definition.

Equipment - See machinery.

Extensive - Having a wide extent. In this study, it is an adjective to describe the cultivated area as a percent of total farm area.

Fine texture - Consisting of or containing large quantities of silt and clay particles. See Brierley *et al.* (1992) for a formal definition.

Gross sales - A Census variable for total sales from all agricultural products for the 1985 calendar year. It also includes shares from tenants, cash advances for stored crops, Marketing Board or other agency payments, direct sales and income from custom work. Sales of capital items (e.g., farm machinery) or forest products are not included.

Hummocky - A complex pattern of bowl shaped depressions (or 'kettles') and irregular to conical

hills (or 'knobs'). See Agriculture Canada (1976) for a formal definition.

Input - Something added as a component of production. In this study, inputs refer to summary expenses, capital investment, land use and livestock production.

Intensity - A comparative term relating to the rate of inputs per unit area. Farming is said to be more intensive in one landscape when the amount of summary expenses or capital investment is higher per unit area, relative to another landscape.

Machinery - A Census variable for machinery and equipment. See Statistics Canada (1986) for a formal definition.

Medium texture - Intermediate class between fine and coarse texture. It includes the following textural classes: very fine sandy loam; loam silt; and, silt. See Brierley *et al.* (1992) for a formal definition.

Output - Something produced. In this study, output refers to the dollar value of farm production.

Parent material - The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of a soil is developed by pedogenic processes (Agriculture Canada 1976).

Physiographic district - A physiographic subdivision based upon the recognition of areas of similar landforms (Pettapiece 1986).

Production - Total output. In this study, it refers to total output in 1985 dollars.

Productivity - Rate of production. In this study, productivity is described in terms of total gross sales (1985 dollars) per hectare of total farm area.

Soil zone - A large geographic area with similar soil characteristics due to the influences of climate, vegetation and topography. For example, soils in the Black soil zone have more organic matter, and a darker colour, than soils in the Brown soil zone.

Solonetzic - A poor quality grassland and parkland soil. It is affected by the accumulation of sodium salts in the root zone and has poor soil structure. See Agriculture Canada (1976) for a formal definition.

Summary expenses - A variable derived from the Census that contains a partial inventory of expenses in the 1985 calendar year. It contains expenses pertaining to: rent and leasing; cash wages; interest; machinery; crops; livestock; smaller containers, twine and wire; custom work; electricity; fuel; and, all other farm business operating expenses. It does not include mortgage payments against principal and depreciation or capital cost allowance. See Statistics Canada (1986b) for a formal definition.

Total farm area - A Census variable that includes the sum of: summerfallow; improved pasture; other improved land; unimproved land for pasture, grazing or hay; woodland; and, other improved land.

8.0 Appendices

Appendix 1. Agricultural Production Profile of Landscapes in the Lake Edmonton Basin (LEB) Region.

Farm Production	Group1 Lake Edmonton Basin (LEB)	Landscapes				
		01 LEB/North	05 LEB/South	03 LEB/East	02 LEB/Northeast	00 LEB/Center
(A) General Statistics						
Number of Farms	2063*	653	793	228	242	147
Total Farm Area	310370*	108961	106941	37637	34632	22199
(B) Cash Flow						
Total Gross Sales (1985$)	126850955*	44243958	43633804	14289459	12688693	11995041
Gross Sales per Ha.	406	406	408	380	366	540
Summary Expenses	107375131	37753990	37403953	11002376	10421776	10793036
Summary Expenses per Ha.	346	346	350	292	301	486
Sales to Expenses Ratio	1.17	1.17	1.17	1.31	1.22	1.11
(C) Capital Investment						
Total Capital Value (1985$)	964052629*	302069466	346246964	13127279	86733876	97729532
Cap. Value ($)/Ha. of Total Farm Area	3238	2772	3238	3488	2504	4403
Distribution of Capital ($/Ha.)						
Land and Buildings	2396	2106	2396	2755	1878	3566
Equipment	628	554	648	628	451	660
Livestock	175	110	194	104	175	176
Capital investment Ratio (per $ of livestock)						
Land and Buildings	19	19	12	26	11	20
Equipment	4	5	3	6	3	4
Livestock	1	1	1	1	1	1
(D) Land Use						
Average Farm Size (Ha.)	15t	I-67	135	165	14-3	151
Cult. Area as % of Total Farm Area	75	82	75	81	66	72
(E) Livestock Production						
Cattle/Ha. of Uncult. Land	0.29	0.33	0.45	0.29	0.28	0.23
Pigs/Ha. of Uncult. Land	0.23	0.34	0.18	0.23	0.24	0.04
Chickens/Ha. of Uncult. Land	2.52	5.81	2.74	1.17	2.52	0.06

* - denotes total; all other group values are medians.

Appendix 2. Agricultural Production Profile of Landscapes in the Morainal Areas (MA) Region.

Farm Production	Group 2 Morainal Areas	Landscapes 04 MA/Southeast	06 MA. West	07 MA / Northwest
(A) General Statistics				
Number of Farms	1528*	935	465	128
Total Farm Area	186621*	92816	66489	27316
(B) Cash Flow				
Total Gross Sales (1985$)	77412872*	40104564	27220560	10087748
Gross Sales per Ha.	409	432	409	369
Summary Expenses	68431721	36126980	23805677	8499064
Summary Expenses per Ha.	358	389	358	311
Sales to Expenses Ratio	1.14	1.11	1.14	1.19
(C) Capital Investment				
Total Capital Value (1985$)	567873010*	305969769	200371651	61527090
Cap. Value ($)/Ha. of Total Farm Area	3014	3297	3014	2252
Distribution of Capital ($/Ha.)				
Land and Buildings	2260	2505	2260	1576
Equipment	527	527	542	472
Livestock	211	263	211	203
Capital Investment Ratio (per $ of livestock				
Land and Buildings	10	10	11	8
Equipment	2	2	3	2
Livestock	1	1	1	1
(D) Land Use				
Average Farm Size (Ha.)	143	99	143	213
Cult. Area as % of Total Farm Area	68	55	68	79
(E) Livestock Production				
Cattle / Ha. of Uncult. Land	0.38	0.34	0.38	0.41
Pigs/Ha of Uncult. Land	0.15	0.04	0.15	1.46
Chickens/Ha of Uncult. Land	5.43	4.14	7.65	5.43

* - denotes total; all other group values are medians.