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Cahiers de géographie du Québec, vol. 22, n° 57, 1978, p. 329-348.

CAHIERS DE GÉOGRAPHIE DU QUÉBEC,
Vol. 22, no 57, décembre 1978, 329-348

THE IMPORTANCE OF REGIONAL VARIATION IN THE ANALYSIS OF URBANISATION—AGRICULTURE INTERACTIONS

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ABSTRACT

Research into agriculture in metropolitan regions has concentrated on urban-induced agricultural land use changes. Other processes of change and factors related to variations in the regional environment have been neglected. Some recent research is reported here which points to the importance of the regional environment at a variety of scale levels. First, a typology of regions based on Census Metropolitan Areas in Canada is developed. Some groups of regions experienced significant agricultural changes quite unrelated to metropolitan development pressures. Regional differences in the agricultural environment are suggested as partial explanations. Second, for the Montréal region, a series of agricultural variables (1961 to 1971) are analysed using factor analysis. Results are interpreted in the light of a) urbanisation forces and b) internal variation in the regional environment. Finally, for a township near Toronto, an investigation is made of the distribution of severances. Once more, relationships appear with certain physical characteristics. The paper concludes that agricultural change is not uniform either between regions or within regions, and that part of the variation is related to differences in the "regional" environment and part to metropolitan forces.

KEY WORDS: Urbanisation-agriculture interactions in Canada, regional differences, regional typology, national framework, scale, agricultural change, urban fringe agriculture, land severances, Montréal region, Toronto Region.

RÉSUMÉ

L'importance des différences régionales pour l'analyse des liens entre l'urbanisation et l'agriculture

La recherche géographique sur l'agriculture dans les régions métropolitaines a été orientée vers l'étude des changements agricoles influencés par l'urbanisation. D'autres processus d'évolution et les facteurs liés aux variations de l'environnement régional ont été négligés. Certaines recherches récentes faisant apparaître l'importance de l'environnement régional à des échelles géographiques différentes sont décrites. Premièrement, une typologie de régions basées sur les régions métropolitaines de recensement du Canada est présentée. Certains groupes de la typologie ont connu des changements agricoles importants qui ne s'expliquent pas par les pressions du développement métropolitain. Des différences régionales dans l'environnement agricole apportent des explications partielles. Deuxièmement, pour la région de Montréal des variables agricoles (de 1961 à 1971) sont analysées avec une analyse factorielle. Les résultats sont interprétés en termes a) de l'urbanisation et b) des variations dans l'environnement à l'intérieur de la région. En dernier lieu, pour une municipalité située près de Toronto, une analyse est faite de la répartition géographique du morcellement des parcelles cadastrales. Une fois encore, des liens sont apparents avec certaines caractéristiques de l'environnement. La conclusion est que les changements agricoles ne sont pas homogènes, soit entre régions, soit à l'intérieur d'une même région, et que l'explication devrait être formulée aussi bien en termes de la variation de l'environnement régional qu'en termes des influences métropolitaines.

MOTS-CLÉS : Liens entre l'urbanisation et l'agriculture au Canada, différences régionales, typologie régionale, schéma national, échelle, évolution agricole, agriculture périurbaine, morcellement des parcelles cadastrales, région de Montréal, région de Toronto.

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Importance of the "regional" environment in any treatment of the interaction between urbanisation and agriculture represents the theme of this paper. After an initial discussion based on a literature appraisal, consideration is given to recent research activities that a) shed light on the importance of the "regional" environment in dealing with urbanisation-agriculture interactions, and b) investigate urbanisation-agriculture interactions at a variety of scale levels—national, regional, local—in the Canadian context.

THE TREATMENT OF "REGIONAL VARIATION" IN THE LITERATURE

A significant body of literature on urbanisation-agriculture interrelationships has developed over the past four decades. Many facets are involved ranging from the obvious direct impact of agricultural land losses (Wibberley, 1954; Best, 1976; Coleman, 1976), to more indirect and less tangible impacts such as the environment of uncertainty and speculation in areas of imminent urban expansion (Sinclair, 1967; Bryant, 1973), the development of inequities in property taxation (Krueger, 1957; Walrath, 1957) and theft and vandalism (Rawson, 1976). A review of this literature suggests two principal conclusions : a) that agricultural land use changes in metropolitan areas are viewed essentially as urban-induced, and b) that such impacts are viewed as basically negative in direction. Consequently, the existence of other processes of change, such as technological change in agriculture (Munton, 1974), and of important variations in the general regional environments within which the processes of urbanisation and agricultural change are taking place, have often been neglected. It is suggested that the regional environment "factor" is important because it may influence the nature of agricultural forces of change and may modify the nature of the relationship between agricultural change and urbanisation. By regional environment factor is meant those elements of the total environment that might be considered as having an influence on agricultural change. It includes both physical, economic, socio-cultural and political factors; in this paper, it is mainly the physical attributes in so far as they have influenced agricultural structure that are emphasized. The relationship between physical environment and agriculture provides one simple example of how the combined physical and existing agricultural structure might operate. A particular physical environment may be better suited to certain agricultural types than others; if regional specialisation in agriculture follows, then the agricultural forces of change such as technological change and commodity price movements will be differentiated regionally to the extent that different agricultural sectors experience different forms of technological progress and face different market structures.

The neglect of these factors in the literature seems to have arisen for a number of reasons. First, some researchers have attempted modelling the process, or part of it (Sinclair, 1967; Bryant, 1973). While valuable, subsequent work has often accepted as proven fact these partial models, which have only received limited verification; much subsequent work has ignored the existence of other variables, eliminated in these model-building exercises for quite valid reasons. Second, an overly simplistic view of agriculture has been common in which the emphasis has been placed on the land resource alone; data on farm acreage in metropolitan zones have therefore assumed great importance in urbanisation-agriculture interaction studies (Bogue, 1956; Howard, 1972). But it is not valid to interpret decreases in farm land acreage as resulting solely from non-farm development. Aban-

donment of land occurs in some regions for purely agricultural reasons; to gain an appreciation of this, we must use data on farm structure including perhaps indicators of farm viability to try to identify whether such areas are competitive or marginal agriculturally. Third, not only have studies of agriculture around urban areas been focussed often entirely within the rural-urban fringe so that little comparison can be made with non-fringe areas, but our attention, and even the research itself, has been based upon a limited number of regions, which may not be characteristic of all metropolitan regions. In Canada, for instance, attention has been focussed primarily on the Niagara Fruit Belt (Krueger, 1959 and 1973; Reeds, 1972) and Southern Ontario generally (Howard, 1972; Patterson, 1968), the Vancouver (British Columbia, 1956 and 1972; Rawson, 1976) and, to a lesser extent, Montréal regions (I.N.R.S., 1973). Only more recently has work been published that hints of the tremendous regional variation across the nation (Russwurm, 1977; Bryant, 1976). Finally, census-based research has used a very coarse spatial filter which has precluded detailed investigation of geographic variation within regions.

The implications are first, that a lack of comparative frameworks exist within which comparisons can be made, and second, that inadequate account has been taken of variation in the regional environment factor. The rural-urban fringe which usually has represented the arena for research on urbanisation-agriculture interactions, has often been treated in like manner; again the same point must be made, i.e. that instead of talking about *the* rural-urban fringe, we must be prepared to recognise considerable variation in types of rural-urban *fringes*, both between regions *and* within the same metropolitan region. It is therefore the purpose of this paper to make a first step towards remedying the lack of a comparative framework and the neglect of the regional environment. First, a national framework is constructed for broad regions based on the Census Metropolitan Areas of Canada to provide one such comparative framework. Second, in constructing this framework and in the subsequent analysis of the Montréal region and the municipality of Albion near Toronto, variables are selected to represent key aspects of the regional environment and the interpretations are also couched in similar terms. The interpretation of the research findings provided in this paper represent a reinterpretation of the original research documents (Bryant, 1976; Greaves, 1975).

A NATIONAL FRAMEWORK FOR CANADA

Canada contains marked internal geographic differences. While many cities developed in areas of good agricultural land resources, there are numerous cases where this was not so. Regional variations in agriculture must be considered in any analysis of urbanisation-agriculture interactions. Furthermore, different regional physical environments might play some part in modifying the urban growth process. Recently, the acreage in different agricultural land capability categories was estimated (Manning and McCuaig, 1977) for areas within 50 miles of most Canadian Census Metropolitan Areas (CMA's). For example, classes 1, 2 and 3 accounted for 29 percent of this zone around Halifax, Nova Scotia, and 86 per cent around London, Ontario. It is no surprise then to discover (Gierman, 1977) that these same three classes accounted for 24,9 per cent and 99,8 per cent of the rural land converted to urban uses around Halifax and London respectively over the 1966 to 1971 period. Given such regional variation, it is naive to begin with the assumption that agricultural land uses and structural change in metropolitan regions are essentially only urban-induced. Some agricultural change has little to do with metropolitan forces. Other forces exist such as technological change in agriculture and price movements of agricultural produce and inputs; and to the extent that regional resource base variations are reflected in regional agricultural specialisation, then these forces must act differentially on a regional basis.

Consequently, recent research (Bryant, 1976) has focussed upon such regional variation. First, regions based upon the 22 CMA's of the Canadian 1971 Census of Population were delimited to include all Census Divisions that fall wholly or in part within 25 miles of the centre of the principal CMA city for CMA's less than 1 million in population in 1971, and within 35 miles from the edge of the principal city area for CMA's over 1 million; thus, each region so defined includes both rural-urban fringe and rural hinterland, so that geographic variation within each region can be highlighted. Then, thirteen variables were identified to represent the regional environment; these variables represent aspects of the regional environment considered significant in affecting type of agricultural change, viz. urban size and growth, the nature of the physical environment particularly in relation to urban development, and a set of variables representing the type of agriculture including the importance of "improved" agricultural land which is a crude surrogate for the land quality for agriculture (see table 1 for list of variables). Using these variables a typology was created to identify broad types of regional environment. Owing to the limited number of observations and in order to focus upon regional conditions significantly different to the "average" national picture, those variables that were not already in a binary form were dichotomised (see table 1 for interpretation of the resulting variables) and the resulting binary data matrix submitted to a Dissimilarity Analysis (MacNaughton-Smith, 1965; Bryant, 1974), a hierarchical, divisive and polythetic classificatory technique.

The resulting typology comprises four principal groups of regions (see table 1 for their attribute-profiles and figure 1 for the dendrogram upon which the groups are based). Group 1, with four regions, is characterised by regions which are part of relatively complex systems and have a lack of physical barriers to development, much diversity agriculturally, a relative importance of fruit and vegetable farms and a good to medium agricultural land resource. The regions in Group 2 are characterised by relatively simple urban systems, few physical barriers to development, medium urban-size, high population increase, a lack of intensive agriculture and good to medium agricultural land resources. Group 3 is again characterised by regions with relatively simple urban systems, but which have significant physical barriers to development, large proportions of part-time and small-scale agricultural holdings and a poor agricultural land base. Finally, St. Catharines and Vancouver comprise the fourth group, sharing in common a lack of agricultural diversity, high values on dimensions of agricultural intensity, the importance of part-time and small-scale agricultural holdings and a good to medium quality land resource.

The relevance of such a typology is evident upon examination of land use and structural changes in agriculture by the groups so produced. Change in farm acreage represents one of the major aspects of urbanisation-agriculture interactions frequently studied. It is clear (table 2) that the typology bears a strong relationship to the relative rates of change in farm acreage from 1961 to 1971. The largest rates of loss are found in Group 3, largely city-regions in the Atlantic provinces, and Northern Ontario and Quebec; these regions experienced the smallest increases in CMA populations. Obviously, the rapid decrease in the agricultural land resource must be explained in terms of the "uncompetitive" nature of farmland in these regions (Nowland, 1975), rather than urban development pressures. Farm acreage in Group 2 regions has either decreased by small amounts, or even increased, the exceptions being the Ottawa-Hull and Quebec City regions. The latter two regions have, in this respect, more in common with the Group 3 regions; indeed, both regions contain large areas of very poor agricultural land. Groups 1 and 4 experienced quite large increases in CMA population but, interestingly enough, lower relative decreases in farm acreage than the Group 3 regions, although this does not mean we can be complacent about agricultural land losses in these regions, for there is a quality dimension involved. Change in farm numbers exibits a similar pattern of change by group. Indeed, farm num-

bers appear relatively stable in those regions with large CMA population growth and/or high levels of rural non-farm development. This can be explained partially by the importance of part-time farm operators and the unwillingness of farmers to sell land to other farmers under conditions of high potential for non-agricultural land use development.

Table 1

Attribute Profiles of Major CMA-based Region Groups

		Attribute Identification[3]												
Group[1]	*Number of regions in group*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
1	4	3[2]	0	0	2	1	2	3	2	4	0	0	3	0
2	9	2	0	0	0	5	3	3	0	0	0	0	5	1
3	7	0	4	5	0	0	1	2	4	1	7	7	0	7
4	2	1	1	1	1	1	0	0	2	2	2	2	1	0

Notes:

[1] See Figure 1 for each group's membership.

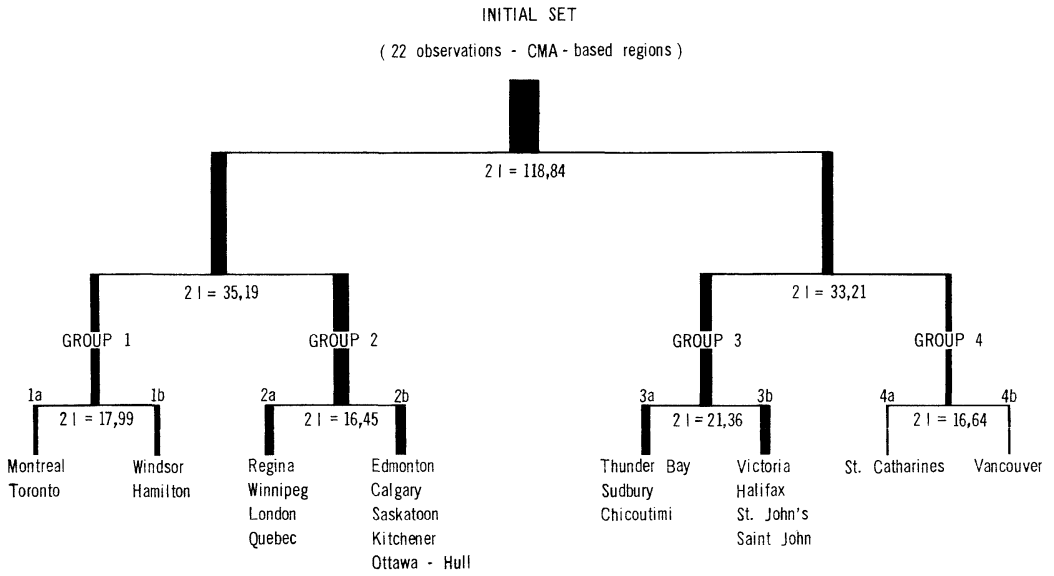
[2] Numbers in the body of the table indicate the number of observations (CMA-based regions) in each group that possess each of the respective attributes.

[3] Criteria for assigning binary values, and attribute interpretation:
Variable No.
1 : being part of, or consisting of, a complex urban system
2 : the presence of absolute barriers that have significantly constrained urban development into specific directions
3 : the presence of rugged topography presenting difficulties for urban development
4 : CMA populations (1971) greater than 1 million
5 : the largest CMA population growths, 1961-1971 (more than 30%)
6 : the greatest positive changes in the share of rural population classed as non-farm, 1961-1971 (more than 20%)
7 : the largest degrees of agricultural diversity in 1961 (based on an index of diversification of the structure of commercial farms)
8 : the highest values of machinery and equipment per improved acre in 1961 (greater than $ 60)
9 : the highest percentages of fruit and vegetable farms out of all commercial farms, 1961 (greater than 7%)
10 : the highest percentages of small-scale farms in 1961 (greater than 35%)
11 : the highest percentages of farm operators reporting any off-farm work in 1961 (greater than 40%)
12 : the highest percentages of farmland classes as "improved" (greater than 75%)
13 : the lowest percentages of farmland classed as "improved" in 1961 (less than 55%).

This relative stability in farm numbers, and hence in farm size, in these metropolitan regions, has been partly compensated for by greater intensification; for instance, the value of machinery and equipment per improved acre increased by 63,8 per cent for all these CMA-regions, 1961 to 1971, compared with 45,6 per cent for all Canada. There appears little overall pattern of change on this variable associated with the typology, except at the extremes; Groups 1a and 4 have consistently high increases on this variable, testifying to the strong forces encouraging intensification within highly urbanised metropolitan regions. Conversely, Thunder Bay, a region characterised by a poor agricultural resource base, exhibits little intensification. Change in the value of land and buildings per improved acre is more closely related to the typology; groups 1 and 4 show consistently high increases, whereas group 3 exhibits generally smaller increases, excepting Sudbury and Victoria. Interesting differences also appear for certain intensive crops; considering the area under orchards, vegetables, horticultural activities (cut flowers, dry bulbs and nurseries) and mushrooms/greenhouses, the one consistent feature is the relative increase in importance of these intensive enterprises (at least three out of the four enterprises in each case) in the highly urbanised regions of Toronto, Montréal, Windsor, Hamilton, St. Catharines and Vancouver. Of any other region with any significant area under each of these enterprises initially, only London exibits the same degree of change in those enterprises. Other changes also bear witness to the existence of certain urban forces affecting land use of farms;

Figure 1

DENDROGRAM OF THE SUCCESSIVE DIVISIONS FORMED BY THE DISSIMILARITY ANALYSIS



The value, 2 I, is the value of the Dissimilarity Index multiplied by 2.0 at a particular spit, and this is compared to the critical value of X^2 at the appropriate level of significance and degrees of freedom. Here, major groups are identified using $X^2_{0.01}$ 27.688, and sub - groups using $X^2_{0.05}$ 22.362

Source : based on Bryant, 1976, op. cit., p. 40.

Table 2

Selected Population Characteristics and Changes in Selected Indicators of Farm Structure and Land Use, for the 22 CMA-based Regions, 1961-1971.

	CMA-based Region and Group	% change in CMA population	% rural population classed as non-farm	% change in: improved farm acreage	farm numbers	average farm size	$ value of land/buildings	$ value of machinery/ equipment	acres rented	#cattle	#horses	acres of grain corn	acres of tame hay
			1971				per improved acre						
1a	Toronto	36,9	82,0	−19,5	−22,0	3,9	182,0	99,6	40,1	−15,5	65,5	1484,3	−20,3
	Montréal	23,8	73,8	−14,7	−27,6	14,3	76,7	80,4	31,7	163,0	38,6	3225,2	−20,0
1b	Windsor	19,1	76,7	− 4,2	−22,5	20,5	79,5	52,9	28,9	−48,5	21,4	4,2	−54,3
	Hamilton	24,3	78,7	− 5,7	−19,5	14,4	106,7	59,3	50,5	−12,0	− 6,1	455,3	−26,9
2a	Regina	23,7	51,7	5,6	−15,0	17,5	90,0	43,8	−12,2	5,2	−42,7	*−100,0*	79,3
	Winnipeg	13,4	58,4	0,7	−20,3	22,5	67,9	42,3	9,9	6,8	−20,8	− 23,2	2,3
	London	26,2	64,6	0,4	−17,0	15,3	94,0	74,4	33,1	− 3,4	2,7	230,6	−30,2
	Québec	26,7	80,2	−25,4	−36,5	5,8	81,4	90,5	60,2	− 9,1	−64,5	88,3	−22,1
2b	Edmonton	37,8	49,6	14,3	−11,2	19,2	87,0	45,2	6,3	33,0	−10,4	*1900,0*	36,9
	Calgary	44,5	48,3	2,2	−11,3	5,9	106,5	63,6	7,7	23,1	− 6,3	−100,0	7,1
	Saskatoon	32,2	46,4	4,1	−19,1	23,9	85,1	35,3	− 5,5	23,2	−42,7	− 45,5	76,5
	Kitchener	46,4	63,0	− 9,6	−16,8	7,6	158,8	73,8	63,4	6,8	− 9,9	1004,5	−16,0
	Ottawa-Hull	31,8	80,5	−18,9	−31,4	14,8	103,8	71,6	19,6	− 8,7	−41,8	1595,3	−18,8
3a	Thunder Bay	9,8	91,7	−18,9	−50,7	33,5	47,4	18,3	29,6	− 7,6	− 9,9	—	−16,3
	Sudbury	22,0	96,0	−37,9	−50,5	21,6	110,7	69,5	−21,2	−33,5	−25,2	− 9,1	−37,4
	Chicoutimi	4,8	83,9	−23,7	−40,0	21,5	16,6	46,3	49,3	− 5,2	−73,3	*581,8*	−20,0
3b	Victoria	25,7	92,6	−22,7	−25,9	2,6	162,5	105,2	22,9	− 5,3	35,0	*−100,0*	−13,4
	Halifax	15,1	95,5	−14,7	−43,0	15,8	87,2	63,1	136,2	− 8,6	−38,7	*1780,0*	−24,2
	St. John's	23,5	96,8	−14,4	−43,0	204,5	46,3	58,9	54,2	− 0,4	−44,5	—	−35,2
	Saint John	8,8	85,5	−28,3	−42,5	17,4	62,7	90,7	10,0	−20,0	−53,1	−73,3	−32,7
4a	St. Catharines	17,7	62,2	−12,3	−16,5	3,7	135,1	79,1	39,9	−12,5	26,9	243,2	−19,7
4b	Vancouver	30,9	83,6	− 4,6	− 9,8	0,0	162,5	93,8	− 0,0	11,1	208,4	− 76,5	−11,7

Source: compiled from Bryant, 1976, op.cit., Tables 3.2, 3.5, 3.10, 3.14 and 3.16, in turn compiled from the Census of Canada, 1961 and 1971.
Note: italicised values indicate regions whose 1961 acreage of grain corn was less than 100 acres.

hence, contrary to the national picture, substantial increases in the horse population occured in the most highly urbanised regions (Toronto, St. Catharine's, Vancouver and Montréal) while small increases or very small decreases occured in some other urbanised regions. Conversely, elsewhere the decline of the horse population is in evidence. The difference suggests the existence of certain types of urban influence, e.g. "hobby" farming and riding stables, in the more urbanised regions.

This analysis highlights, then, a difference between the Maritime, Northern Ontario and Quebec regions (and, we might add, the Ottawa-Hull and Quebec city regions) on the one hand, and the Prairies, Southern Ontario, Vancouver and Montréal regions on the other. In the former set of regions, the large removal of land and farms from agriculture is related to the uncompetitiveness of agriculture in such regions. The latter set, containing the more highly urbanised and urbanising regions, is characterised by a smaller *rate* of removal of land and farms from agriculture, often smaller increases in farm size and high increases in the value of land and buildings per improved acre. Other regional differences also appear, especially within Group 2, between the Prairie regions on the one hand (Edmonton, Calgary, Regina, Saskatoon and Winnipeg) and the remaining Ontario and Quebec regions. The Prairie regions are characterised by smaller increases in rented land, and in the value of both machinery and equipment and land and buildings per improved acre; generally larger increases in cattle numbers; greater decreases in horse numbers; and smaller increases in grain corn acreage associated with larger increases in hay acreage. Such features relate to broad differences in the regional agricultural economy of the Prairie areas compared to other areas of Canada.

Even the cursory evidence presented above demonstrates two major points in relation to our review of the literature and our objective of emphasizing the importance of variations in the regional environment. First, there is no unambiguous indicator of decline in agriculture within these metropolitan regions that is clearly and universally associated with urban development; indeed, some indicators such as change in intensity and in intensively cultivated enterprises, bear witness to the strong market forces even in the most highly urbanised regions. Second, there is considerable variation in the regional environments within which urbanisation-agriculture interactions are taking place; the different profiles of change by regional group are evidence of this. We may further infer that the very nature of the agricultural land use problems in such metropolitan regions must also differ significantly as a result of these different environments.

These generalisations are supported by recent US work (Zeimetz and *al*, 1976) in which considerable regional variation in the effects of urbanisation on rural land uses and the supply of agricultural land was found to exist. In Florida, for example, urbanising counties identified by the study experienced a net *increase* in cropland due to continuing improvements applied to the land, and in the Piedmont region, significant portions of cropland removal involved conversion to forest, while elsewhere the major portion of cropland decrease often involved movement of cropland into the "open idle" category. Much of the cropland decline was attributed to the impact of changing technology and increased productivity in other areas resulting in "economic obsolesence" of part of the cropland base, rather than urban impact.

URBANISATION-AGRICULTURE INTERACTIONS AT THE REGIONAL LEVEL : THE MONTRÉAL REGION

The purpose of this section is to demonstrate that variation in the environment cannot be ignored within any particular urban region. The Montréal region is chosen as an example; some general comments are made on the environment within which urbanisation-

agriculture interactions are taking place, and then a synthesis of agricultural change is made. This is undertaken using principal components analysis (Nie and *al*, 1975) and an orthogonal (varimax) rotation. Concluding comments to this section make reference to similar studies carried out in other regions.

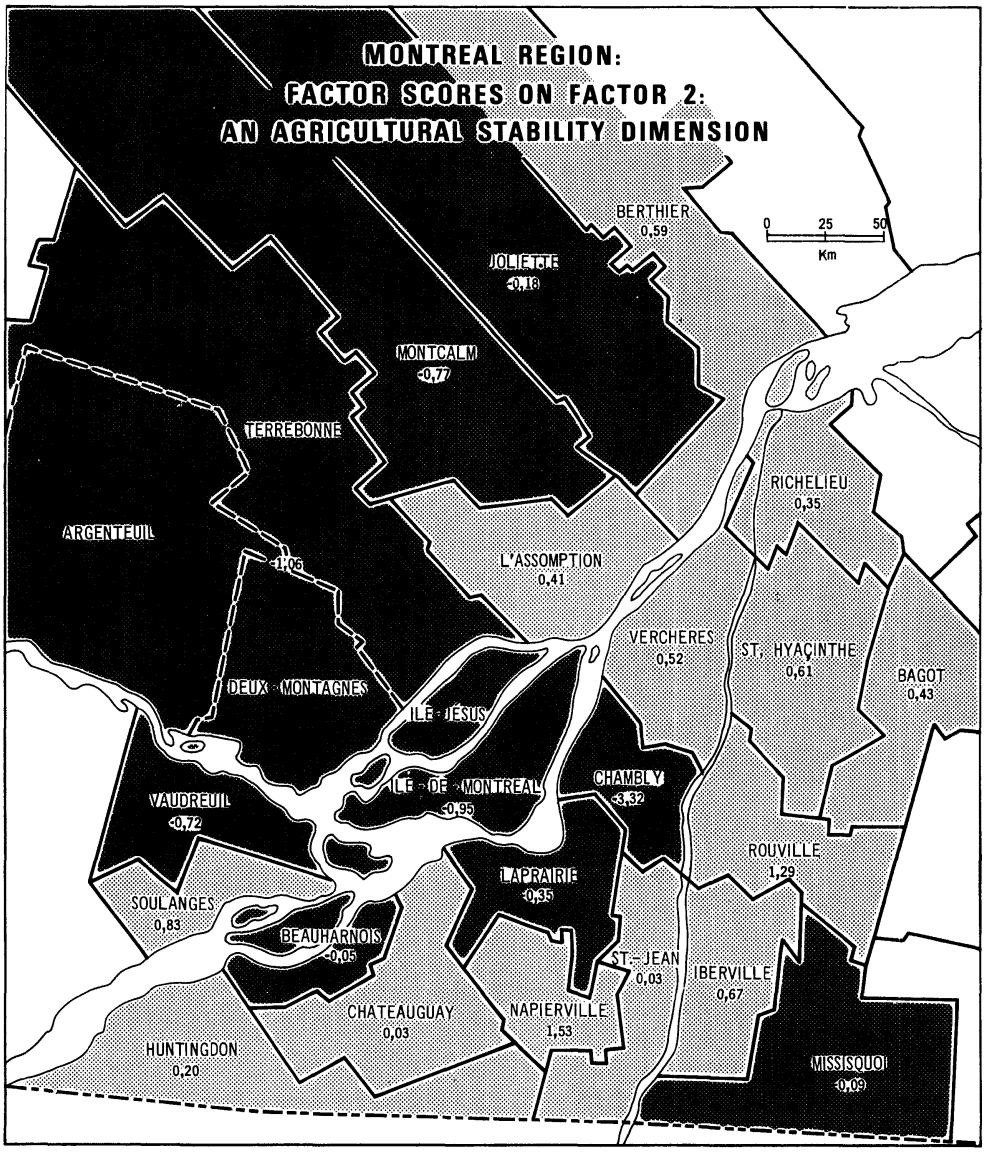
The Montréal Region

The region defined here comprises 22 Census Divisions (figure 2). The region has a reasonably good agricultural resource base, and 74 per cent of the census farmland was classed as "improved" in 1961, although Manning and McCuaig's figures (1977) show only 50 per cent of the land within a 50 mile radius of the city as being in the top three agricultural capability classes. Considerable variation within the region exists, however, with the percentage in "improved" farmland in 1961 ranging from 61,4 per cent in Argenteuil, Deux Montagnes and Terrebonne, and 56,5 per cent in Huntingdon to 92,2 per cent in Laprairie. These internal differences reflect the presence of two distinctive agricultural regions, the Plaine de Montréal and the western and central Laurentides (Morrisette, 1972). The Plaine de Montréal is most extensive on the South Bank of the St. Lawrence. Agricultural conditions are particularly good (I.N.R.S., 1973) with the favourable physical conditions being reinforced by proximity to the Montréal market. A varied and intensive agriculture has developed, including orchards, vegetables and milk production. Market influences have also been felt in the Laurentides, witness the poultry production at Joliette and Berthier, although the range in farm viability is large.

Concern regarding the impact of urbanisation upon agriculture has been expressed, especially for the South Bank area. (The Montréal CMA was the largest in Canada in 1971, with a population of 2743200, and the CMA population grew by 23,8 per cent from 1961 to 1971 (compared to 27,8 per cent for all Canadian CMA's)). The development of idle or unused farmland in the urban fringe of Montreal has been documented early on (Montréal, 1966) and attributed to both land speculation and the attractive pull of non-farm employment to the farming population. In a more recent study of the South Bank area (I.N.R.S., 1973), a major zone of "degeneration in farm structure" was identified, in which agriculture was suffering from the forces of urbanisation.

A synthesis of agricultural structure and structural change, from 1961 to 1971, is provided by a principal components analysis of the 13 variables identified in table 3a, in which the varimax rotated factor matrix is also given; a brief description of the meaning of the range of factor scores on each factor is provided in the notes to table 3b. The first five initial factors possessed eigenvalues of more than 1,0, together accounting for 84,3 per cent of variation in the data set. Factors 1 and 2 both involve dimensions of general agricultural stability. Factor 1 is defined mainly by variables 1, 2 and 3 and by variables 7, 8, 9, 12 and 13. At one extreme of this scale would be found a situation where large decreases in farm acreage occur in areas of high agricultural intensity and are associated with small increases (or decreases) in farm size, relative stability of small-scale farms, older operators and part-time operators—in short, a situation which could be labelled "degeneration" of the farm structure. Inspection of the factor scores (table 3b) showed such areas occuring on the Iles and on the north shore from Assomption into the Laurentides. Nowhere are such areas associated with large relative increases in population, although for the Iles and Assomption urbanisation forces might play some role given the easy access to urban areas. However, the "degeneration" evident in the central Laurentide zone must be explained largely by the low initial degree of farm viability there. Conversely, the South Bank area is characterised by small decreases in farm area, large decreases in

Figure 2



Negative scores

BAGOT Census Divisions. Note that Census Divisions Terrebonne, Argenteuil and Deux-Montagnes are amalgamated owing to boundary changes between 1961 and 1971.

NOTE: High positive scores indicate stability in farm area, farm numbers, older operators and part-time operators.

High negative scores indicate large decreases in all of these variables.

older operators and part-time operators, and generally larger increases in farm size than the North Bank, indicating continued agricultural modernisation.

Factor 2 also describes an agricultural stability dimension, but this time one which is defined maily by variables 1, 2, 5, 8 and 9. The extreme of the scale describing greatest instability is represented by a situation with large decreases in farm area, farm numbers, older operators and part-time operators—in other words, simple absolute decline in agriculture. The geographic distribution of scores on this factor (figure 2) identifies the North Bank, excepting Assomption and Berthier, as an area of decline as well as the highly urbanised areas of the Iles and Vaudreuil. On the South Bank, both Laprairie and Chambly appear as areas of significant decline as well; interestly enough, both Laprairie and Chambly are identified elsewhere (Montréal, 1966) as having considerable areas of abandoned farmland in the early 1960's and they also experienced among the highest proportionate increases in population over the 1961 to 1971 period. Furthermore, they both fall in the area where the Institut National de la Recherche Scientifique (1973) found a significant "degeneration" in farm structure, aging of the farm operators, low investment in agriculture, and, on the basis of land sales *for agriculture*, low market values per acre.

Table 3a

Varimax Rotated Factor Matrix, Montréal Region

Variable						
Identification	*No.*	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 4*	*Factor 5*
% change in farm area, 1961-1971	1	−0,47	0,80	−0,23	−0,09	0,09
% change in improved farm area, 1961-1971	2	−0,40	0,82	−0,07	0,26	0,25
% change in average farm size, 1961-1971	3	−0,85	0,14	−0,32	−0,06	0,04
% change in acres rented, 1961-1971 .	4	0,02	0,24	0,07	0,94	−0,03
% change in census farm numbers, 1961-1971	5	0,04	0,95	−0,01	0,17	0,08
% of 1961 census farms classed as small-scale (less than $5,000 gross sales per year)	6	−0,10	−0,06	0,90	−0,02	0,07
% change in number of these small farms, 1961-1971	7	0,62	−0,05	0,36	−0,57	−0,04
% change in number of farm operators over 45 years old, 1961-1971	8	0,34	0,84	0,08	−0,02	−0,06
% change in number of operators reporting off-farm work, 1961-1971 ...	9	0,70	0,32	−0,02	0,22	0,03
% change in the value of land and buildings per improved acre, 1961-1971 .	10	0,00	−0,26	0,16	0,16	−0,78
$ value of machinery and equipment per improved acre, 1961	11	0,08	−0,08	0,37	0,18	0,71
% change in vegetable acreage, 1961-1971	12	0,83	−0,09	−0,38	−0,13	−0,02
$ value of land and buildings per improved acre, 1961	13	0,85	−0,15	−0,31	−0,23	0,17

Table 3b

Factor Scores on Census Divisions, Montréal Region

Census Division[1]		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
North Bank						
1	Argenteuil					
22	Terrebonne	−0,19	−1,06	0,82	0,88	−3,13
7	Deux-Montagnes					
15	Montcalm	0,65	−0,77	1,07	1,46	2,92
13	L'Assomption	0,74	0,41	0,28	0,61	0,26
11	Joliette	0,34	−0,18	0,47	1,10	−0,38
4	Berthier	0,43	0,59	1,44	0,59	−0,17
23	Vaudreuil	−0,64	−0,72	0,68	−0,42	−0,15
21	Soulanges	−0,02	0,83	2,05	−1,36	0,45
Iles						
10	Ile-de-Montréal and Ile-Jésus	3,71	−0,95	−0,88	−1,13	−0,14
South Bank						
3	Beauharnois	−1,39	−0,05	−1,06	−0,30	1,16
5	Chambly	−0,58	−3,32	−0,48	−0,21	0,05
6	Châteauguay	−0,46	0,03	−0,96	−0,42	0,40
8	Huntingdon	−0,47	0,20	0,22	−1,08	0,06
12	Laprairie	−0,53	−0,35	0,62	−1,02	0,05
16	Napierville	0,46	1,53	0,59	−0,29	−0,60
20	St-Jean	−0,50	0,03	−0,11	−0,37	0,45
24	Verchères	−0,10	0,52	−0,29	−0,84	−0,18
17	Richelieu	−0,30	0,35	1,03	0,18	−0.11
19	St-Hyacinthe	0,11	0,61	−1,37	2,45	−0.02
2	Bagot	−0,59	0,43	−0,23	1,54	−0.27
18	Rouville	0,74	1,29	−1,60	−0,15	−0,25
9	Iberville	−0,79	0,67	−1,33	−0,91	−0,12
14	Missisquoi	−0,63	−0,09	−0,94	−0,29	−0,21

Notes:
Interpretation of factor scores: high positive values indicate the following.
Factor 1 : a large decrease in farm area, stability of small farms, ...; Factor 2 : stability of farm numbers, farm area, etc.; Factor 3 : relative importance of small units, low intensity, etc.; Factor 4 : a large increase in farmland renting and a large decrease in small farms; Factor 5 : small increases in the value of land and buildings and large increases in vegetable acreages. Low negative values indicate the converse.
[1] Identification numbers of Census Divisions refer to those on Figure 2.

The remaining areas on the South Bank show up as areas of relatively low change in all of the variables in Factor 2, especially the areas east of the Richelieu River, such as Rouville and St. Hyacinthe, confirming the contention of the Institut National de la Recherche Scientifique (1973) that the Richelieu has somehow acted as a barrier to the spread of negative urbanisation impacts.

Factor 3 is defined mainly by variables 3, 6, 7, 11, 12 and 13 and involves a dimension of relative stability in small-scale agriculture. The scores on this factor (table 3b) indicate again a contrast between North and South Banks. The North Bank shows up as an area where small-scale agriculture is important and vegetable production increasing (e.g. Montcalm), reflecting the influence, no doubt, of market forces. Factor 4 is linked to variables 4 and 7; at one extreme on this scale is a situation where increases in farmland renting are associated with large decreases in small-scale farms, a relationship which is not surprising. The scores on factor 4 (table 3b) indicate that the areas experiencing the greatest increases in renting (and thus decreases in small farms) on this dimension are

the Laurentide zones and the eastern portion of the South Bank, especially St. Hyacinthe. Again, this confirms the relative dynamism of the area east of the Richelieu River. St. Hyacinthe also has seen one of the largest increases in corn acreage, and this apparent relationship between renting of farmland and expansion of corn acreage was observed also for the Kitchener region (Bryant, 1976).

Finally, factor 5 is defined by variables 10 and 11, indicating that where a high increase in the value of land and buildings has been experienced, decreases in vegetable acreage have occurred, and the converse. Factor scores (table 3b) show that the areas with the largest increases in vegetables (and therefore the lowest increases in the value of land and buildings per improved acre) have occurred to some extent in the Laurentide zone, but are mostly concentrated on the South Bank on the outskirts of the Montréal region.

By way of concluding this section then, it is possible to visualize three types of area in terms of agricultural change. First, there is a zone characterised by high levels of urbanisation (e.g. Chambly and Laprairie) where increases in the value of land and buildings are substantial and where farm area and farm numbers are decreasing significantly. Farm size tends to be relatively stable, as are small-scale farms; one might surmise the existence of part-time farming as a factor is maintaining a relatively high level of small-scale farms here. This represents the classic situation where urbanisation-agriculture interactions clearly involve a negative impact on agriculture. Second, there is a zone on the southern and south-eastern borders of the region away from the principal concentrations of population where change in agricultural structure appears to be following a more "normal" pattern, i.e. land losses from agriculture are relatively small, and average farm size increases have been substantial, as have increases in farmland renting. The existence of a physical barrier (the Richelieu River) may have contributed to this overall situation in the eastern part of the South Bank area. Third, the Laurentide area stands out generally as a zone where agriculture is declining substantially, even though the more spectacular components of urbanisation (large population increases) are not in evidence. It is suggested that this is most likely related to the marginality of much of the agriculture in this area, in turn related to the physical environment of agriculture in this zone. Certainly, one cannot discount urbanisation effects here, but they are more likely to exist in terms of the pull of the metropolitan zone for labour and this pull might be felt more strongly in an area of low farm viability.

The Montréal region thus provides evidence of the importance of variations in the farm structure and the physical environment in accounting for different patterns of agricultural change across the region. Similar studies within the context of the larger project (Bryant, 1976) were undertaken for other regions, viz. the Kitchener, Vancouver and Winnipeg regions. All these analyses demonstrated that variation in agricultural change within each region was partly related to differences in initial farm structure and environment generally. Furthermore, differences between the regions appeared. The Vancouver region was similar to the Montréal region in that a significant area of degeneration in farm structure was identified, closely related to accessibility to the main urban centers, and the same was true, but to a much lesser extent, of the Winnipeg region. These three regions are all characterised by relatively large urban populations. In the Kitchener region, on the other hand, a zone around the cities of Waterloo and Kitchener was identified where a potentially beneficial interaction between agriculture and urbanisation was present. Specifically, this zone was characterised by a very large increase in farm business size, attributable to the great increase in the rental of farmland from non-farm owners many of whom had acquired land in this zone far in advance of development. The increased farmland rented was also intimately associated with increase in the acreage of grain corn planted. Cer-

tainly, such interaction can have negative effects too, but indicators of farm structure such as farm size and investment do not suggest this as yet. Finally, within the Winnipeg region, strong internal variation in terms of agricultural land use and structural change was found, relating largely to the internal differentiation of the region with respect to agricultural systems rather than any metropolitan forces.

AN EXAMPLE OF URBANISATION—AGRICULTURE INTERACTIONS AT THE LOCAL LEVEL

To illustrate the importance of environmental variation even at the local level, brief reference is made to recent research dealing with severances in Albion Township, a township lying within the commutershed of Metropolitan Toronto[1]. Severance development, an aspect of urbanisation, is often viewed as representing the beginning of non-farm development in an area, since many severances have found their way ultimately into rural residential use (Ontario, 1973). It is therefore interesting, given our current objectives, to inspect their locational distribution and to examine some factors which may influence that distribution, particularly in relation to agricultural land.

The data sources include the Minutes of Albion's Committee of Adjustment from June 17th, 1965 to Dec. 31, 1973 which provide a) the locations of the 936 severances granted during that time and b) the 352 *successful* Applications for Consent filed with the township's Committee of Adjustment between November, 1970 and November, 1973, which provide consistent information on size of severance.

Variability in the local environment was hypothesized explicitly as being important in influencing the intensity of severance development. After undertaking initial screening of "independent" variables by inspecting their simple associational relationships with the incidence of severances on a survey lot basis, the following factors were retained: capability for recreation, aesthetic appeal, the Official Plan designations, and land capability for agriculture. These factors are represented in the analysis by seven variables measured on a binary scale[2]. Groupings of the survey lots representing in some sense different "regional environments" were delimited by submitting these data to a Dissimilarity Analysis, alluded to earlier. The analysis produced eleven significantly different groups of survey lots, each group characterised by a particular set of attributes (see table 4 and figure 3). Clearly, it is the various combinations of three Official Plan designations (rural, agricultural, and residential and industrial) and three sets of natural environmental factors (good capability for recreation and aesthetic appeal, good aesthetic appeal and good capability for agriculture) that define nine of the eleven situations.

This stratification has an obvious relationship to the incidence of severance development (table 5), the lowest frequencies being associated with good capability for recreation, good aesthetic appeal and the rural Official Plan designation (cf. situation IV) and the higher frequencies mainly with good capability for agriculture and the agricultural Official Plan designation (cf. situation IX). In view of initial expectations that scenically attractive areas would be in greater demand for rural residential development, the results are somewhat surprising. However, the fact that the better quality agricultural areas—which might be considered less attractive for rural residential development given the lack of visual relief on the landscape—received a greater incidence of severance development may be related to yet another factor. These areas lie in the south of Albion, that part of the township which is closest to Toronto and which has better quality roads. Thus, accessibility may well be the overriding factor here.

Figure 3

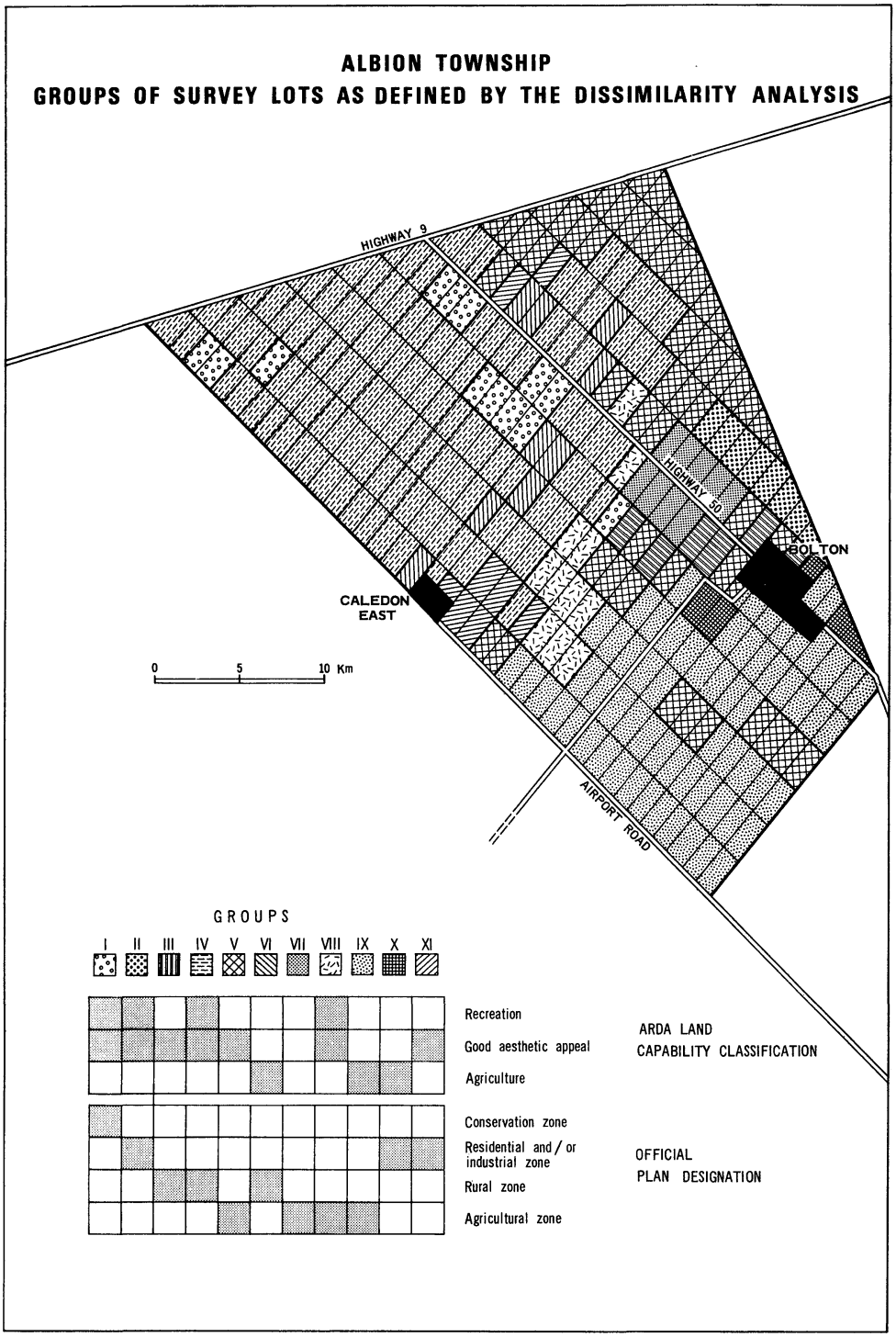

ALBION TOWNSHIP
GROUPS OF SURVEY LOTS AS DEFINED BY THE DISSIMILARITY ANALYSIS
HIGHWAY 9
HIGHWAY 50
BOLTON
CALEDON EAST
0 5 10 Km
AIRPORT ROAD
GROUPS
I II III IV V VI VII VIII IX X XI
Recreation
Good aesthetic appeal
Agriculture
Conservation zone
Residential and / or industrial zone
Rural zone
Agricultural zone
ARDA LAND CAPABILITY CLASSIFICATION
OFFICIAL PLAN DESIGNATION

Table 4

Attribute Profiles for the Groups of Survey Lots, Albion Township

Group[2]	Attributes[1]			In Official Plan categories:				Number of sample survey lots
	Recreation capability	High aesthetic appeal	Good agricultural soils	agricul-ture	conser-vation	residential and industrial	rural	
I	5[3]	5	0	0	5	0	0	5
II	29	36	4	0	0	0	37	37
III	4	4	3	4	0	0	0	4
IV	2	3	0	0	1	2	0	3
V	2	1	5	0	0	0	5	5
VI	0	0	21	21	0	0	0	21
VII	0	0	2	0	0	2	0	2
VIII	0	19	6	22	0	0	0	22
IX	2	3	1	0	0	4	0	4
X	0	2	0	0	0	0	3	3
XI	0	0	0	2	0	0	0	3

Notes :

[1] See text for explanation of attributes.

[2] The classification was produced for a 35% sample of the total 311 survey lots, the sample being choosen so that every combination of attributes actually present in the data set was represented proportionately in the sample as closely as possible.

[3] The numbers in the body of the table indicate the number of lots in the sample in that group which possess each respective attribute. Note that the remaining survey lots were assigned (figure 3) to one of the eleven groups by identical matching of individual attribute profiles.

Table 5

Average Severance Frequency and Size of Severance by Survey Lot Group, Albion Township

Group[1]	Average severance frequency (average number of severances per survey lot)[2]	Average size of severances (acres)[3]	Spatial domination, if any
I	0,4		
II	0,8		
III	1,9		
IV	2,8	13,1	north
V	2,9	6,2	east
VI	3,3	11,9	
VII	3,4	1,6	
VIII	3,8	3,9	
IX	4,0	6,3	south
X	4,2		
XI	6,6	10,9	
Average	3,1	8,3	

Notes:

[1] See table 4 for the characteristics of each group.

[2] Derived from the minutes of the Albion Committee of Adjustment (June 17, 1965 to December 31, 1973). Average severance frequency was calculated as the total number of severances in a group divided by the total number of survey lots falling into that group.

[3] Derived from the successful Applications for Consent filed with the Committee of Adjustment, November, 1970 to November, 1973. Average severance size was calculated by summing the sizes of all severances in a group and dividing by the number of severances. Not all groups have a value associated with them owing to the limited number of applications in some groups over this shorter time period.

The unexpected results noted above suggest as well that there may be different types of severances. Indeed, an inspection of average severance size in acres (table 5) for those situations where a sufficient number of observations existed from the 1970 to 1973 data set further supports this idea. The smaller sizes occur in situations having the agricultural Official Plan designation as a characterisitic, while the larger ones are associated with the rural Official Plan designation. It seems that severance development in the agricultural areas is more "dormitory" in nature (Greaves, 1975), while development in the "rural" areas concerns more expensive rural estate-type developments.

This cursory view of the above analysis is sufficient to illustrate, once again, that there are variations in the environment even at the local level and that the incidence and form of an element of non-farm development are related to these variations. This, in turn, indicates that variation in the nature of the urbanisation-agriculture interactions can be expected.

CONCLUSION

The preceding discussion has reviewed a number of studies dealing with some aspect(s) of urbanisation-agriculture interactions at a variety of scale levels. At each level —national, regional or local—significant variation in the environment within which this interaction occurs has been documented. The evidence presented on agricultural change, especially at the national and regional scales, shows that agricultural change does not assume the same form in all regional environments or indeed within the same metropolitan region, and that the relationship with urbanisation is not consistently of the same form, and is certainly not unambiguously negative. Furthermore, although the evidence presented above is not extensive, even the form of the urbanisation forces may vary with variations in the regional environment, e.g. the tentative suggestions made following the analysis of Albion Township with respect to different types of non-farm residential development. This does not mean, of course, that previous model-building exercises or conceptualisations are invalid, but only that because of the simplifying nature of such exercises, only one major set of forces of change has been dealt with. We must simply recognize the existence of other processes, and, in the final analysis, be prepared to relax the initial assumptions concerning the environment within which a process operates. Indeed, when we move from a purely investigative endeavour to one oriented to land use problems and problem-solving, it is even more significant to recognize such variation, for the very nature of the land use problems themselves may be affected.

The evidence presented above is based primarily upon the interpretation of statisical associations. Having demonstrated the significance of regional variation in agricultural changes between and within metropolitan regions, the next logical step in research would be to undertake detailed studies, inevitably involving interviewing and field work, within the context of the sort of comparative framework outlined earlier in order to obtain a better understanding of the actual processes and mechanisms of change and the impacts of change and how they are modified by urbanisation forces in different regional environments.

NOTES

[1] GREAVES, S. (1975) *Severance Development: a Micro-Study of Albion Township*. Waterloo, University of Waterloo, Department of Geography, unpublished M.A. thesis. The severance procedure is that process by which properties are legally divided into smaller units and has often involved the splitting off of a relatively small parcel from an initially much larger parcel. The smaller parcel is commonly called a consent, a severance or a severance lot. In the absence of broader regional bodies, the Committee of Adjustment is that body of the local municipal government empowered to

approve or reject applications for severance. Once a severance has been approved, its ownership can be held or transferred as with any other piece of property.

[2] The seven attributes were defined as follows: whether survey lots possessed "good capability for recreation" (class 4 of the ARDA Capability for Recreation Classification since no higher capability classes are present in Albion); whether survey lots possessed "good aesthetic appeal" (subclass Q (i.e. features contributing to aesthetic appreciation of the landscape) of the ARDA Capability for Recreation Classification); whether survey lots possessed "good capability for agriculture" (classes 1 and 2 of the ARDA (Canada Land Inventory) Land Capability for Agriculture Classification); and whether a survey lot fell into the following Official Plan designations: the Rural zone (agricultural uses with large residential lots of no less than 25 acres permitted); the Agricultural Zone (strict severance control intended); the Residential and/or Industrial zone; and, finally, the Conservation zone (no provisions for severances at all).

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