

Land Use Change in Edmonton 1966-1976

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Executive Summary

Through the growing population, an increased need for urbanization has arisen in recent years. Between 1966 and 1976, urban areas have increased, encroaching on agricultural and natural land areas. Finding the balance between the different land uses is the key to sustainable development. As an urban planner, the best locations must be found for future expansions that will maximize agricultural, natural and urban development for economic benefits. With the given results, most of the land use that was turned into urban areas by 1976 was originally unimproved pasture and range land as well as non-productive woodland in 1966. The expansion of urban areas given the results is focused on areas that were previously unproductive, thus, repurposing the land. As more land is developed it is important to note the fragmentation of the different class level metrics of the land and try to decrease it to improve accessibility and convenience.

Introduction

As we move into further into modernization, ever growing populations have increased the demand for urban areas. Edmonton, Alberta, is no exception. Urbanization has become a driving force in land use changes. In his work, Hansen (1984) has found that in Canadian provinces, urban areas have increased between 1966 and 1976. He refers to this trend of population growth as “rural revival” (Hansen, 1984, p. 74). This rapid urbanization has led to flourishing cities around the world. Best, Jones and Rogers (1979) explain the expansion with the reasoning that there is a set density per area that is ideal, beyond which, people feel uncomfortable with the amount of overcrowding. Thus, cities continue to expand to reduce population density and increase standards of living.

As an urban planner looking particularly at Edmonton, land use changes can be used to predict the best areas to repurpose for urban growth and development. Land use in the region conflicts between urban, agricultural and natural uses which means that when looking at urban planning, these three areas must be taken into account (Muller & Middleton, 1994). Also when urban planning large plots of land must be converted into outdoor recreation areas for people to enjoy. By looking at the land use changes as they pertain to these different fields, one can ascertain where each of the components are coming from and how much/ what is being converted into each class.

Results and Discussion

The analysis performed was completed using Canada Land Use Monitoring (CLUMP) data from the Geogratis website. The data that was taken is at a 100 meter resolution, which is what it was kept at for the remainder of the analysis process. Then using FragStats, a spatial

statistics program, and ArcMap, we were able to visualize the land use changes that have taken place in the Niagara region from 1966 to 1976.

When looking urban areas, from 1966 to 1976, there is a general trend of expansion. It is important to note which areas have been deemed the most appropriate for expansion. Looking at the map (Figure 2), the initial impression that one notices is that the majority of urban expansion that occurred in the decade was converted from unimproved pasture and range land as well as non-productive woodland. This this means that areas that were not productive in 1966 were repurposed and improved by 1976. While areas that have are useful to the inhabitants of the area such as improved pastures and crops, remained fairly unchanged. Development in urban areas also comes with an increase in outdoor recreation areas. A large portion of unproductive land (12.50 percent) have been converted for recreational purposes (see Table 4). Table 4 shows that 94.40 percent of improved pasture areas remained the same. This is because agriculture remains a large industry in Edmonton (Muller & Middleton, 1994). One can note the large amounts of croplands (51.70 percent in 1966) which remained as the highest category of land use and further increased in 1976 to 55.86 percent (see Table 4). The changes of these classes can also be observed and compared in Table 2 and 3.

Furthermore, while the urban sprawl is growing, the new urban areas that were developed by 1976 are smaller and more fragmented than the urban areas in 1966 (see Table 2 and 3). This means that areas that are further from the city core will be harder to service given that they are not as easily accessible compared to if the developed urban areas were more compact.

Comparing Table 2 with Table 3, the total edge of urban built-up areas increases from 555400 meters to 2373000 meters as a result of this fragmentation coupled with the increase in urban area. In addition, while urban land area increased about 7 percent (see Table 4) the number of

patches increased threefold from 133 to 417 (see Table 2 and 3). This reflects back on the fragmented distribution sprawl of the urbanized land.

Looking at the landscape level metrics, can further show how the area has changed between the two time periods. The Shannon's Diversity Index increased from 1.4914 to 1.5855 showing that there is a higher variety of land use types over time and that they are growing more equitably distributed. This means that different forms of land use are slowly mixing together as time progresses which is good in terms of diversifying land use. This is further validated by Shannon's Evenness Index which increased from 0.5814 to 0.6182 showing that there is an increase in land use diversity (see Table 1). The landscape level metrics also show a decrease in patch density from 1.3186 to 1.287 which indicates that as development occurs, some patches are gradually blending into other patches of the same class level metric.

Recommendations

Looking at Figure 1, one can note where most of the land is currently devoted to cropland at the moment and which means that if urban development is to continue, it would be most likely that the land being developed will come from this class. This further plays into the agriculture versus urbanization conflict that Muller & Middleton (1994) mentioned. There is already a decrease in croplands and an increase in urban areas between 1966 and 1976 (see Figure 1). As a result, future plans of urban expansion should be wary of developing over good croplands which are an economic staple for the population in the region (Bryant & Russwurm, 1979) (Gierman, 1977). Future urban development must also look at decreasing these fragmented areas to improve access to urban resources such as medical care, fire and rescue and food supplies for people living in these locations. Another key to reduce land conflict as urban development continues is

to ensure that all stakeholders have adequate say in the development process and key economic and environmental areas are protected from urban encroachment.

References

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Appendix A: Key Terms

<u>Terms</u>	<u>Definitions</u>
<i>Class Metrics</i>	Metrics that are calculated for each type of land on the landscape (ex. Croplands, urban areas, mines)
Total Area	Area of each class in hectares
Percentage of Landscape	Percentage of each class on the landscape
Number of Patches	Number of each patch type
Total Edge	The sum of the length (in meters) of the edge segments (cells that boarder other classes) for each patch type
Mean Shape Index	The average patch perimeter divided by the square root of patch area, adjusted by a constant to adjust for a square standard
Total Core Area	A buffer of 100m was set to the core area that was
Core Area Percentage of Landscape	The percentage of the landscape that is the core area for each class type
Number of Disjunct Core Areas	The number of disjunct core areas contained within each patch in the landscape
<i>Landscape Metrics</i>	Metrics that are calculated for the entire landscape
Number of Patches	Number of patches on a landscape
Patch Density	Number of patches on a landscape over the entire landscape area
Shannon's Diversity Index	An indicator of the diversity in different patch types on a given landscape and how equitably they are distributed
Shannon's Evenness Index	An indicator of patch diversity on a given landscape ranging from 0 (low diversity) to 1 (high diversity).

Appendix B: Data Tables

Table 1: Changes in landscape level metrics for land use in Edmonton, Alberta from 1966-1976

Year	Number of Patches	Patch Density	Total Edge	Shannon's Diversity Index	Shannon's Evenness Index
1966	8496	1.3186	17331000	1.4914	0.5814
1976	8287	1.287	15929100	1.5855	0.6182

Table 2: 1966 class level metrics in Edmonton, Alberta

	Total Area (hectares)	Percentage of Landscape	Number of Patches	Total Edge (meters)	Coefficient of Variation of Patch Area	Mean Shape Index	Total Core Area (meters)	Core Area Percent of Landscape	Number of Disjunct Core Areas
Water areas	19861	3.0825	337	1000600	599.7003	1.3198	13003	2.0181	238
Cropland	284664	44.1805	579	11817300	1498.1967	1.6392	196305	30.467	1349
Unimproved pasture and range land	75934	11.7851	2597	8727000	525.5473	1.4701	24261	3.7654	1922
Improved pasture and forage crops	46750	7.2557	2132	5502800	186.3394	1.3557	11720	1.819	1547
Productive woodland	28450	4.4155	843	2871600	263.1711	1.4933	10701	1.6608	670
Swamp, marsh or bog	11340	1.76	1144	1867200	218.2349	1.2831	1951	0.3028	365
Non-productive woodland	19086	2.9622	517	1861000	339.773	1.5178	7816	1.2131	413
Mines quarries sand pits	1681	0.2609	99	199400	154.1402	1.2398	508	0.0788	47
Urban built-up area	19596	3.0413	133	555400	604.8148	1.2798	15708	2.4379	88
Outdoor recreation	1735	0.2693	80	204400	132.3644	1.3764	563	0.0874	47
Horticulture	23	0.0036	5	4200	89.7381	1.0286	0	0	0
Unproductive land (sand)	36	0.0056	16	10800	83.887	1.1083	0	0	0
Unproductive land (rock)	208	0.0323	14	40300	65.4976	1.7833	5	0.0008	2

Table 3: 1976 class level metrics in Edmonton, Alberta

	Total Area (hectares)	Percentage of Landscape	Number of Patches	Total Edge (meters)	Coefficient of Variation of Patch Area	Mean Shape Index	Total Core Area (meters)	Core Area Percent of Landscape	Number of Disjunct Core Areas
Water areas	19875	3.0866	340	1003800	602.0022	1.3189	13003	2.0194	238
Cropland	263105	40.8601	709	9696500	1121.912	1.5205	190266	29.5482	928
Productive woodland	59439	9.2308	1718	6029300	414.5431	1.4841	22774	3.5368	1291
Unimproved pasture and range land	45154	7.0124	1715	4865600	281.4969	1.405	15687	2.4362	1183
Non-productive woodland	7316	1.1362	403	905700	219.4666	1.374	2236	0.3472	203
Swamp, marsh or bog	6228	0.9672	551	926500	197.1752	1.2636	1375	0.2135	219
Improved pasture and forage crops	44358	6.8888	2170	5327500	169.2857	1.3403	10710	1.6633	1489
Mines quarries sand pits	3116	0.4839	84	262400	342.119	1.3176	1405	0.2182	61
Urban built-up area	54995	8.5407	417	2373000	703.7032	1.4787	38268	5.943	384
Horticulture	750	0.1165	44	77800	131.8307	1.1377	255	0.0396	22
Outdoor recreation	4582	0.7116	126	378900	249.2571	1.3274	2152	0.3342	79
Unproductive land (sand)	18	0.0028	6	4800	81.6497	1.1667	0	0	0
Unproductive land (rock)	31	0.0048	4	6400	136.0587	1.2955	0	0	0

Table 4: Changes in land use between different class types in Edmonton between 1966 and 1976

		1966		1976									
		1966	1976	1966	1976								
Cropland	82.34%	0.22%	0.02%	0.70%	0.26%	0.22%	1.69%	0.38%	6.65%		7.52%		55.86%
Horticulture	34.78%	52.17%				4.35%					8.70%		0.00%
Improved pasture and forage crops	0.98%	0.01%	94.40%	0.13%	0.28%	0.09%	0.77%	0.16%	2.15%		1.02%	0.00%	9.19%
Mines quarries sand and gravel pits	4.34%		0.12%	42.59%	3.81%	5.35%	9.10%	0.18%	13.44%		21.06%		0.33%
Non-productive woodland	12.57%	0.05%	0.05%	0.27%	8.53%	2.30%	51.62%	0.46%	13.32%		10.85%		3.75%
Outdoor recreation	0.17%				85.42%				0.29%		14.12%		0.34%
Productive woodland	14.92%	0.04%	0.11%	0.39%	1.44%	2.07%	63.76%	0.27%	7.33%		9.67%		5.59%
Swamp, marsh or bog	17.67%	0.04%	0.12%	0.07%	7.82%	1.04%	12.86%	28.17%	26.08%		6.06%	0.08%	2.23%
Unimproved pasture and range land	26.08%	0.09%	0.14%	0.25%	4.55%	1.55%	32.34%	2.27%	22.95%		9.78%	0.00%	14.91%
Unproductive land (rock)	6.73%				0.96%	12.50%	60.10%				14.90%		0.04%
Urban built-up area	0.02%		0.01%	0.01%			0.01%				99.96%		3.85%
Water areas											100.00%		3.90%
Grand Total	51.70%	0.15%	8.72%	0.61%	1.44%	0.90%	11.68%	1.22%	8.87%	0.01%	10.80%	3.91%	100.00%

Appendix C: Figures

Figure 1: Changes in total area (ha) of class level metrics from 1966 to 1976

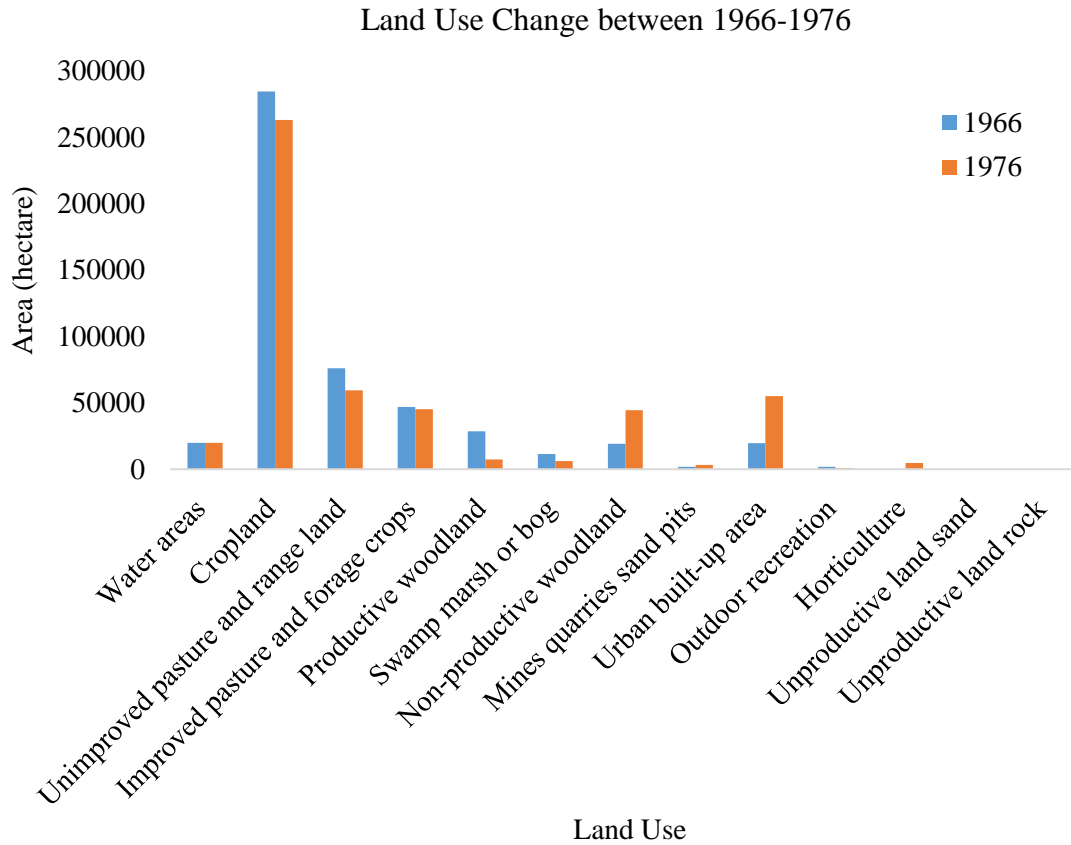


Figure 2: Comparison map of the land use allocation changes in Edmonton from 1966 to 1976

(see page 13)