

THE EXURBAN CHANGE PROJECT REPORT NUMBER EX-3:

LAND COVER IN OHIO'S TOWNSHIPS:
AN ANALYSIS OF TOWNSHIP LAND COVER AND POPULATION CHANGE

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PURPOSE OF REPORT

Although land in townships accounts for 91% of Ohio's total land area, little analysis has focused on describing Ohio's township land. The purpose of this report is to investigate the land cover characteristics of Ohio township land using the National Land Cover Dataset for Ohio from the early 1990's. The report describes the general land cover characteristics of Ohio's township land, analyzes spatial patterns of township land cover and population change across the state, and examines how patterns of land cover and population change are affected by proximity to major urban areas. Selected conclusions based on these analyses are that agricultural land in Ohio is much more vulnerable to current and future population growth than forest lands and that, to effectively protect open space in Ohio, policies should focus on protecting farmland located within approximately 20-40 miles of major cities.

The information contained in this report is intended for policymakers, planners, community development professionals, applied researchers, and citizens with an interest in land cover and population change in Ohio. The data and analysis presented here are intended to inform community decision making regarding land use issues, including farmland preservation, growth management, and comprehensive planning. This report is the first of a two-part series on land cover trends in Ohio and is part of a larger body of research focused on Ohio's townships and exurban-rural areas, conducted by The Exurban Change Project at The Ohio State University. Individual township land cover data is available for all of Ohio's 1,309 townships at The Exurban Change web site: <http://aede.ag.ohio-state.edu/programs/exurbs/>.

SELECTED HIGHLIGHTS FROM EARLY 1990'S LAND COVER ANALYSIS:

Ohio's townships account for 91% of the total land area in Ohio.

- Townships in Ohio cover over 37,000 square miles of land in Ohio, which is 91% of Ohio's total land area. Large cities (over 50,000 population) account for 2%; small cities and villages make up the remaining 7%.

Agricultural land cover is the single largest land cover in Ohio.

- Agricultural land covers 60% of land in Ohio, accounting for over 24,000 square miles of land area. Row crops are the dominant agricultural land cover in the state, covering 38% of Ohio's land and measuring 15,000 square miles in area.
- Agricultural land covers 62.9% of township land area, of which row crops are the dominant agricultural land cover (40% of all township land). Forestlands are also a prominent land cover in townships, covering over 12,000 square miles and 32.4% of township land area.
- Over half of Ohio's townships have two-thirds or more of their land in agricultural land cover and a fourth of all townships have almost 90% of their

land cover in agriculture. Townships with two-thirds or more of their land cover in agriculture are generally located in the western and north central regions of the state.

- Low levels of higher density urban land are recorded in Ohio's townships. Higher density urban land totals 764 square miles within townships, which is 2% of township land area. Out of Ohio's 1,309 townships, three-fourths of them contained less than 1.7% higher density urban land and more than half of Ohio's townships contained less than 0.5% higher density urban land. The townships that contain the highest proportion of urban land are primarily located adjacent to existing urban areas or near transportation corridors.

While the majority of Ohio's township population and township population growth between 1990-2000 occurred in the most urbanized townships, a large proportion of the growth also occurred in townships with significant amounts of agricultural land.

- Ohio's township population is highly concentrated in townships that have relatively large amounts of higher density urban land. Only 25% of townships have more than 1.7% urban land cover, but they contain over 2.3 million residents (61% of total township population in Ohio).
- Townships that had already started to urbanize prior to 1990 were the ones to urbanize the fastest in the 1990's. The top 25% of urbanized townships increased in population by 194,000 residents (an increase of 9%) between 1990 and 2000, accounting for 58% of all township population growth during this period.
- Significant township growth also occurred in townships that have moderate to large proportions of agricultural land cover, which includes some of the most urbanized townships. 84% of the population growth in townships between 1990-2000 occurred in townships that have over a third of the total land in an agricultural land cover.

Townships located within metropolitan areas contain a significant amount of agricultural land, but are also witnessing the highest population growth rates among townships.

- Townships located within metropolitan areas contain higher levels of higher density urban land (613 square miles) than townships outside metropolitan areas (151 square miles).
- Despite the large amounts of urban land within metropolitan areas, only 4% of the township land inside metropolitan areas is urban.
- Over 9,400 square miles of metropolitan township land is agricultural land (61% of the total land cover within metropolitan townships).
- Townships in the Cincinnati-Hamilton metropolitan area contain the most urban land. Over 10% of the township land in the Cincinnati-Hamilton metro area is identified as higher density urban land cover. In the 1990's, township

population in this metropolitan area increased by 92,000 people (13.4% of the 1990 population).

- At least 40% of total township land in seven of the nine metropolitan areas analyzed in this study is agricultural land cover. Columbus's metropolitan townships contain a high proportion of agricultural land (metropolitan townships have an average of 76.2% of their total land as agricultural land cover), but at the same time are experiencing significant population pressure. Townships in the Columbus metropolitan area recorded a population increase of 10.2% in the last decade.

Agricultural land remains a significant portion of the total land cover in townships located within close proximity to Ohio's major cities, but is threatened by high rates of population growth in these townships.

- 73% of township land in the urban-rural fringe of Ohio's major urban areas is in agricultural land cover.
- Townships located within 40 miles of Ohio's major cities accounted for 80% of total township population growth in the 1990's, but only 60% of the total township land in Ohio. 67% of the State's total agricultural land cover is contained within this area.
- Township population growth is the highest 10-20 miles outside of Ohio's major cities, suggesting that some growth has "leapfrogged" over township areas that are adjacent to the major cities (**Figure 3**).

SELECTED CONCLUSIONS AND POLICY IMPLICATIONS:

- Some areas of Ohio's landscape are not likely to be impacted by urbanization in the near future. In particular, the highly agricultural northwestern Ohio townships and the forested townships of southeastern Ohio have had little growth in the past decade and are not likely to experience significant growth levels in the foreseeable future.
- Townships located in the rural-urban interface of Ohio's major urban areas have grown significantly in the past decade and are likely to continue doing so in the future. To the extent that population growth continues to leapfrog out from urban areas, the area under urban influence will increase at a faster rate than population.
- Because of the spatial distribution of agricultural land cover relative to Ohio's major cities, agricultural land in Ohio is much more vulnerable to current and future population growth than forest lands.
- Open space protection policies in Ohio should focus on protecting farmland located within approximately 40 miles of major cities. Within these areas, land that is further away from major cities (e.g. 20-40 miles) is likely to be the best opportunity for preservation because larger contiguous tracts of agricultural land are still in existence and land prices are generally lower.

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INTRODUCTION

Located at the interface between the Corn Belt and Appalachian regions and interspersed with many urban centers, Ohio's land cover is a diverse patchwork of agricultural, forested, urban, and other types of lands. This patchwork of land cover is contained within another diverse patchwork—that of local government, which is comprised of cities, villages, and townships.¹ Whereas cities and villages are incorporated areas, townships are unincorporated local governments.² Ohio's 1,309 townships cover over 37,000 square miles of land in Ohio, accounting for 91% of the land in the state. Although townships account for much of Ohio's landscape, little land cover analysis has focused on describing Ohio's township land.

The purpose of this report is to investigate the land cover characteristics of Ohio township land using the National Land Cover Dataset for Ohio from the early 1990's. The report describes the general land cover characteristics of Ohio's township land, analyzes spatial patterns of township land cover and population change across the state, and examines how patterns of land cover and population change are affected by proximity to major urban areas.

The land cover data used in this report are from the National Land Cover Dataset that was produced by the Multi-Resolution Land Characteristics (MRLC) Consortium. These data were compiled from Landsat satellite TM imagery (circa 1992) with a spatial resolution of 30 meters and supplemented by various ancillary data, including agricultural and census statistics, land cover maps, soil characteristics and wetland data. These data are from the early 1990's and, although changes have certainly occurred in many areas of Ohio since then, they provide a snapshot of recent land cover trends.

There are some important limitations of the accuracy of these data that are summarized in Appendix C. An important consideration when reviewing this report is that the data reported here are **land cover** and not land use data. Generally, land cover is the physical material covering a given land area, whereas land use is the way in which humans utilize the landscape.³ Land cover is generally determined by using satellite images while land use has to be determined in more exhausting methods such as aerial photographs and "ground truthing."

While many times land cover also indicates land use, it often times does not. For example, the land cover of a plot of land may be forest, but the actual land use may be a natural preserve, a commercial forest that is managed for timber, or a low-density

¹ Three types of general-purpose local governments exist in the state of Ohio: counties, townships, and municipalities. Counties are the major local government subdivision of the state, with all of the state's territory and population contained within one of Ohio's 88 counties. Municipalities in the state are classified as either a village (population less than 5,000) or city (population 5,000 or greater). Municipalities may adopt laws that are not forbidden or in direct conflict with state law. In contrast, townships are administrative units of state government limited to functions specified by state law. See OSU Extension Bulletin 835-98 (online at: ohioline.ag.ohio-state.edu) for additional background information about local governments in Ohio.

² The township data reported in this study represents all unincorporated land in the state and does not account for land located in cities and villages.

³ Meyer, William (1995). *Past and Present Land Use and Land Cover in the USA*. Consequences Vol. 1, Number 1

residential development with a full tree canopy. Thus, data that reports land cover gives only a general interpretation of what biophysical matter covers the landscape and does not accurately assess land use.

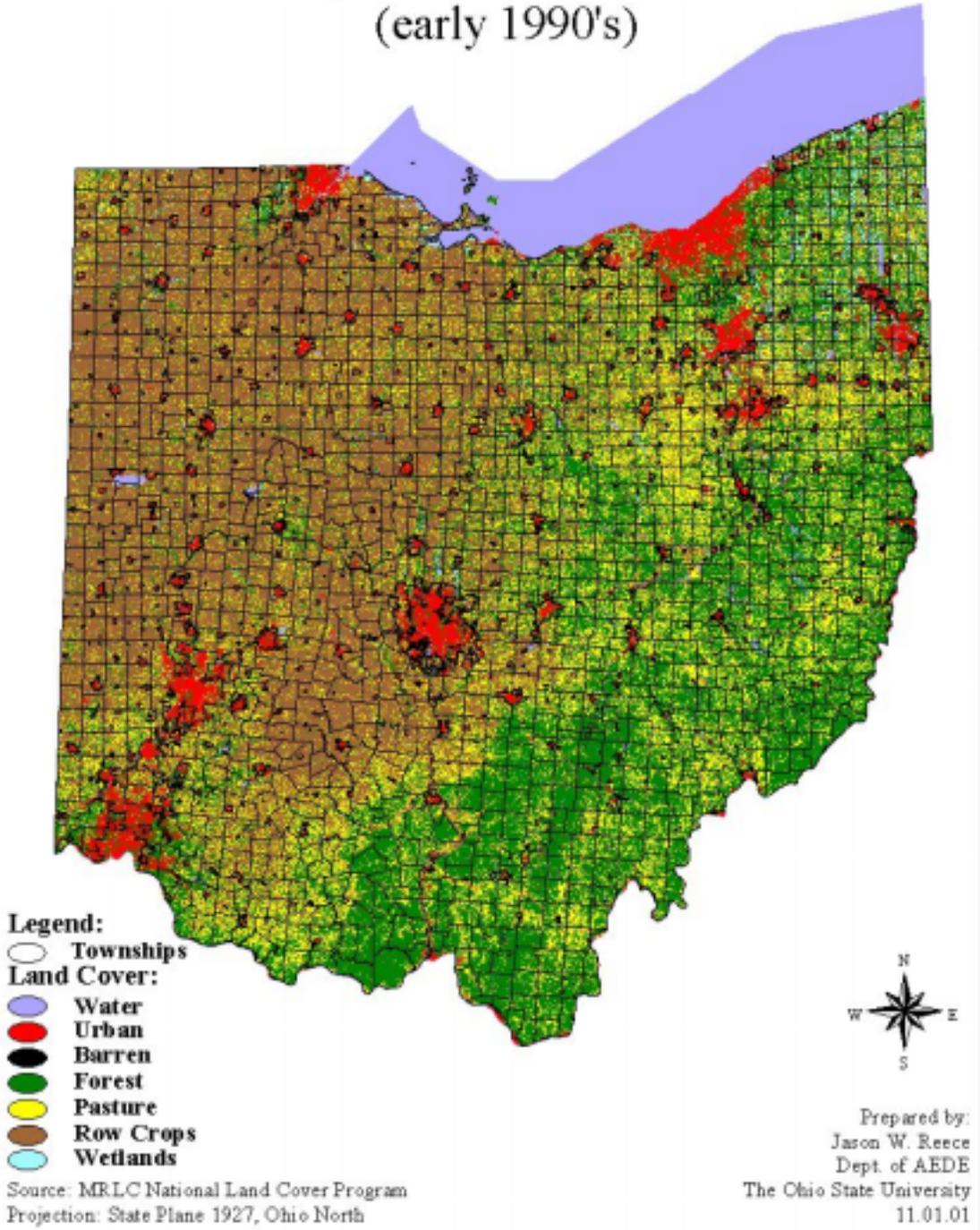
This fact is critical for interpreting the contents of this study. The land cover statistics reported here cannot be interpreted as the land use of a given area. Most importantly, **urban land cover as reported here does not represent all urban land uses, but instead represents only highly built-up urban land uses**—i.e. land that is sufficiently built-up so that it is visible from a satellite as urban land. For this reason, we refer to this category as “higher density urban land.” Conversely, agricultural land cover should not be interpreted as containing only agricultural land use. **Because non-urban uses dominate rural housing and development at the rural-urban fringe, this land will be categorized as agricultural or forestland and therefore the measure of urban land reported here is only a partial measure of the total urban land use area. Likewise, the amount of agricultural and forestland reported here overstates the amount of non-urban land in an agricultural or forested land use.**

The amount of urban land reported here corresponds most closely with the amount of urban land in areas that are almost fully built-up (e.g. major cities). This measure is significantly less than the amount of urban land in rural-urban fringe areas that contain a large amount of low-density urban development. The difficulties related to identifying low density or exurban development is one motivation for integrating population change from the U.S. Census Bureau with the township land use analysis. *(See Section 3 of this report for analysis of population change by township land cover category.)*

In summary, land cover data (such as the MRLC data used in this report) represent the physical material covering the landscape. Land cover data provides a general interpretation of a given landscape and should not be confused with land use. The following report presents land cover data and the differences between land cover and land use should be considered when interpreting the results of this study.

For a more detailed explanation of how urban land and all other land covers are identified see Appendix C: Notes on Data.

Map 1: Ohio Land Cover (early 1990's)



SECTION 1: OHIO'S LAND COVER (EARLY 1990'S)

Map 1 illustrates Ohio's diverse patchwork of land cover across the state. Ohio's land cover consists of high concentrations of urban land as well as pasture, row crop and forest lands. The following section of this report describes early 1990's land cover characteristics for the State of Ohio, Ohio's townships, and incorporated places (cities and villages).

Forests and row crops dominate the Ohio landscape. Of Ohio's total 27,720 square mile land area, forest land covers almost 13,000 square miles and row crops cover 15,800 square miles of Ohio's land mass (**Table 1**). Forest and crop land account for 31.5% and 38.2% of Ohio's total land area respectively. The third most prominent land cover is pastureland, which consists of 8,900 square miles of land and accounts for 21.7% of Ohio's total land area. Total agricultural land (the sum of all pasture and row crops) in Ohio comprises 59.9% of Ohio's total land area.

Urban land cover, which represents higher density urban land uses, consists of 2,413 square miles, covering 5.8% of the State's land (**Table 1**).

Land cover in Ohio townships, cities and villages-

Township land cover characteristics mirror the state's land cover. Total agricultural land covers 62.9% of township land area; row crops are the dominant agricultural land cover (40% of all township land) and pasture land is 23% of all township land. Forestlands were also a prominent land cover in townships, covering 32.4% of township land area. Urban land was extremely low in township areas, accounting for 2% of township land area (**Table 1 and Figure 1**).

Ohio's cities and villages contain significantly higher concentrations of urban land. According to the MRLC data, 68% of all urban land in Ohio is located in Ohio's cities and villages. Approximately 1,649 square miles of urban land are found within Ohio's cities and villages and urban land amounts to 45% of all land area in cities and villages. Agricultural (row, crop and pasture lands) and forest land cover also account for a significant portions of the land area within cities and villages, comprising 29% and 21% of the total land area within cities and villages respectively (**Table 1 and Figure 1**).

Summary-

In summary, satellite data from the early 1990's indicates that Ohio has a diverse landscape with specific concentrations of row crop, pasture, forest and urban land cover. Generally, agricultural land cover dominates Ohio's landscape. Nearly two-thirds of Ohio's township land is agricultural land cover. Conversely, higher density urban land is not prevalent in Ohio's township areas and is concentrated in the state's cities and villages. Although the MRLC data indicates low levels of urbanization in Ohio's townships, the inability of the satellite data to identify low density or exurban development significantly underestimates the levels of urban land in Ohio. Thus, agricultural lands discussed in this report should be considered inclusive of rural housing as well as crop and pasture land.

Table 1: Land cover for the state of Ohio (Early 1990's)

Land Cover:	<u>State of Ohio</u>		<u>Ohio Townships</u>		<u>Ohio Cities & Villages</u>	
	Square Miles	% of Total Land Cover	Square Miles	% of Total Land Cover	Square Miles	% of Total Land Cover
Water	473.8	1.1%	406.9	1.1%	66.8	1.8%
Urban	2,413.5	5.8%	764.2	2.0%	1,649.4	45.2%
Barren	100.6	0.2%	87.4	0.2%	13.2	0.4%
Forest	12,986.9	31.5%	12,201.5	32.4%	785.4	21.5%
Pasture	8,945.9	21.7%	8,502.4	22.6%	443.5	12.2%
Row Crops	15,774.6	38.2%	15,163.2	40.3%	611.3	16.7%
Wetland	579.2	1.4%	499.0	1.3%	80.2	2.2%
Total Land	41,274.4	n/a	37,624.6	n/a	3,649.8	n/a
Total Agriculture*	24,720.5	59.9%	23,665.6	62.9%	1,054.9	28.9%

Source: Multi-Resolution Land Characteristics Consortium

** Total Agriculture represents the sum of all row crop and pasture land cover*

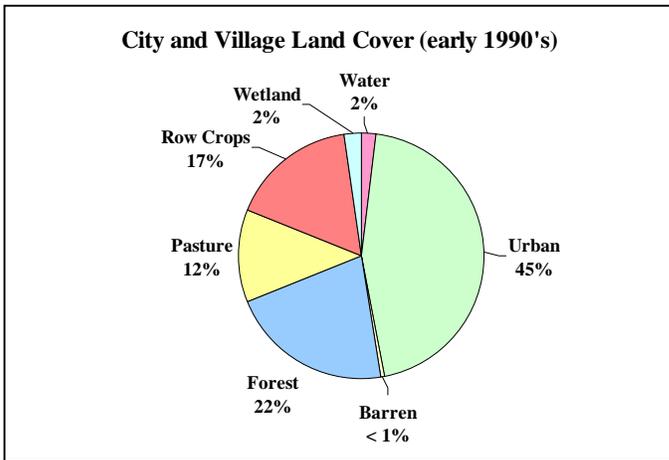
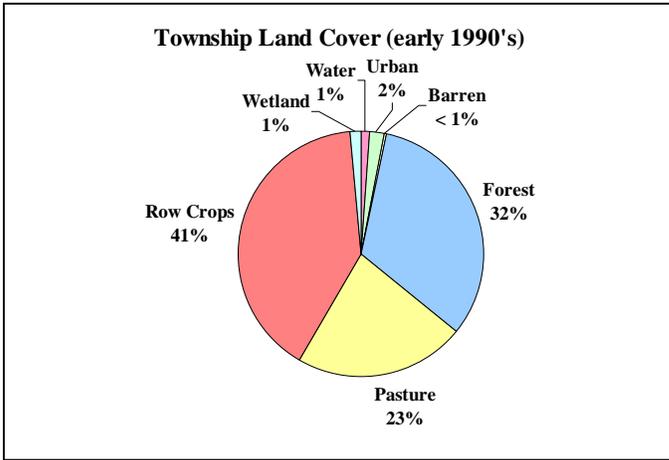
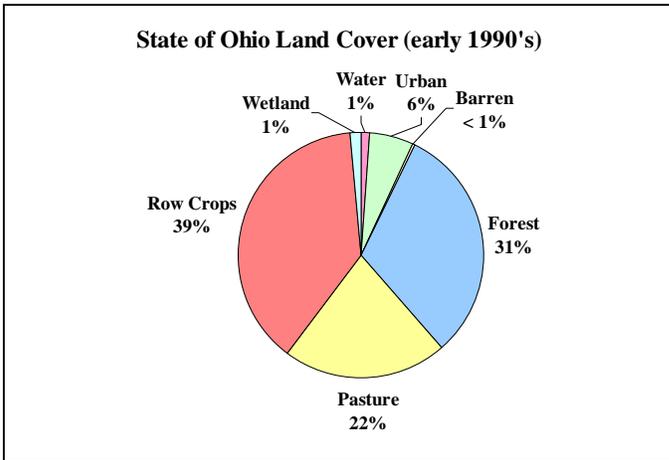


Figure 1: Land Cover distribution for The State of Ohio, Ohio Townships and Ohio Cities and Villages (early 1990's)

Source: Multi-Resolution Land Characteristics Consortium National Land Cover Data Program

Section 2: Township Land Cover Attributes

Significant geographic diversity in land cover exists in Ohio's townships. The following section of this report describes the land cover distribution within townships and the spatial patterns of land cover for urban, forest, row crop and pasture land across townships.

Urban Land Cover-

Generally low levels of higher density urban land are recorded in Ohio's townships. According to the MRLC data, out of Ohio's 1,309 townships, 996 contain less than 1.7% urban land cover and more than half contain less than 0.5% urban land cover (**Table 2**). The 313 townships with more than 1.7% urban land cover are primarily located adjacent to existing urban areas or along transportation corridors (**Map 2**). Seventy-three percent of all higher density urban land (1,763 sq. miles) is located within 5 miles of an existing interstate highway and 65% of all urban township land (495 sq. miles) is located within 5 miles of an interstate in Ohio.

Forest Land Cover-

Moderate amounts of forest land cover can be seen in Ohio's townships. Approximately half of Ohio's townships contain greater than 27% forest land cover (**Table 2**). One fourth of Ohio's townships (327 townships) contain greater than 53% forest land cover. These highly forested townships are generally located in the southeastern portion of the state (**Map 3**). This concentration of forest land cover in southeastern Ohio largely corresponds with the Appalachian region of the State (see Appendix A). The topographical characteristics of the Appalachian region have hindered the development of row crops in the region.⁴ Higher concentrations of forested lands are also found in townships in the Northeast, adjacent to the Cleveland and Akron metropolitan areas.

Row Crop Land Cover-

Substantial row crop land cover is found throughout Ohio's townships. Over half of Ohio's townships contain greater than 29% row crop land cover and 325 townships have more than 72% of their land cover in row crops (**Table 2**). Townships where row crops are the dominant land cover are spatially concentrated in western and northwestern Ohio (**Map 4**). This region of Ohio is the eastern border of the Midwest "Corn Belt" that stretches across the Plains and Midwestern states. (See Appendix A) Additional townships with large concentrations of row crops are located around the peripheries of the Columbus, Dayton-Springfield and Cincinnati-Hamilton metropolitan areas (**Map 4**).

Pasture Land Cover-

Modest amounts of pasture land cover exist in many Ohio's townships. Approximately half of Ohio's townships (653 townships) have between 13 and 29% pasture land cover (**Table 2**). One quarter of townships contain more than 29% pasture land cover. These are primarily concentrated at the foothills of the Appalachian region and around the peripheries of the Cincinnati-Hamilton, Columbus and Cleveland-Akron metropolitan areas (**Map 5**).

⁴ Peacefull, Leonard ed. (1996) *A Geography of Ohio*. The Kent State University Press, Kent OH (pg. 236)

Total Agricultural Land Cover-

When analyzing total agricultural land cover (the sum of all pasture and row crop land), it becomes apparent that agricultural land cover dominates the township landscape. Over half of Ohio’s townships contain more than 66% agricultural land cover and approximately one-fourth of the townships have more than 88% of their land cover in agriculture (**Table 2**). As displayed in **Map 6**, townships with more than 66% of their land cover in agriculture are located in the western and north central regions of the state. Although agricultural land is predominately found in traditionally rural northwest Ohio, many of the townships with the highest proportions of agricultural land are located in the urban-rural fringe of Ohio’s major urban areas (**Map 6**).

Summary-

Distinct spatial trends of land cover are observed in Ohio’s townships. Generally, townships contain very low levels of higher density urban land. Townships with relatively higher amounts of this urban land are located around the peripheries of Ohio’s urban areas and transportation corridors. Forest cover is found in moderate levels in most townships and is concentrated in townships located in the Appalachian region and portions of northeastern Ohio. Row crop land cover is very prevalent in Ohio townships, but is most dominant in western and northwestern Ohio townships. Pasture land cover is found in modest levels in many Ohio townships, with concentrations in townships located around the peripheries of several metropolitan areas and in the foothills of the Appalachian region. Agricultural land cover dominates land cover in Ohio’s townships.

Table 2: Number of Townships by Land Cover Quartiles

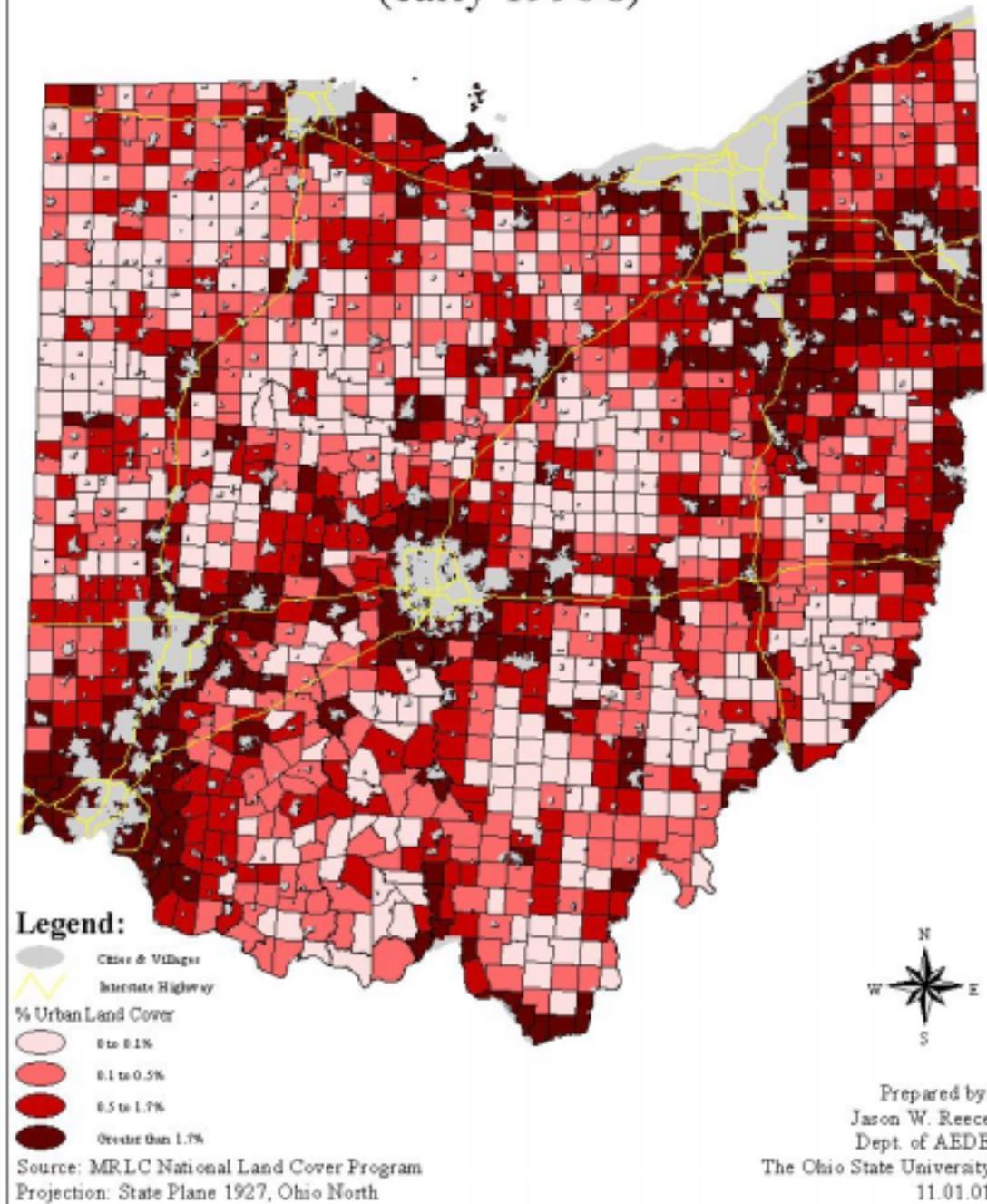
Quartile	Urban Land Cover		Forest Land Cover	
	% of Land Cover	Number of Townships	% of Land Cover	Number of Townships
1	< than 0.1%	342	< than 8.8%	327
2	0.1 to 0.5%	330	8.8 to 27%	328
3	0.5 to 1.7%	324	27 to 53%	327
4	> than 1.7%	313	> than 53%	327

Quartile	Row Crops Land Cover		Pasture Land Cover		Total Agricultural Land Cover*	
	% of Land Cover	Number of Townships	% of Land Cover	Number of Townships	% of Land Cover	Number of Townships
1	< than 8.9%	327	< than 13%	332	< than 37.5%	326
2	8.9 to 29.4%	329	13 to 21%	328	37.5 to 66.3%	328
3	29.4 to 72.3%	328	21 to 29.9%	325	66.3 to 88.2%	328
4	> than 72.3%	325	> than 29.9%	324	> than 88.2%	327

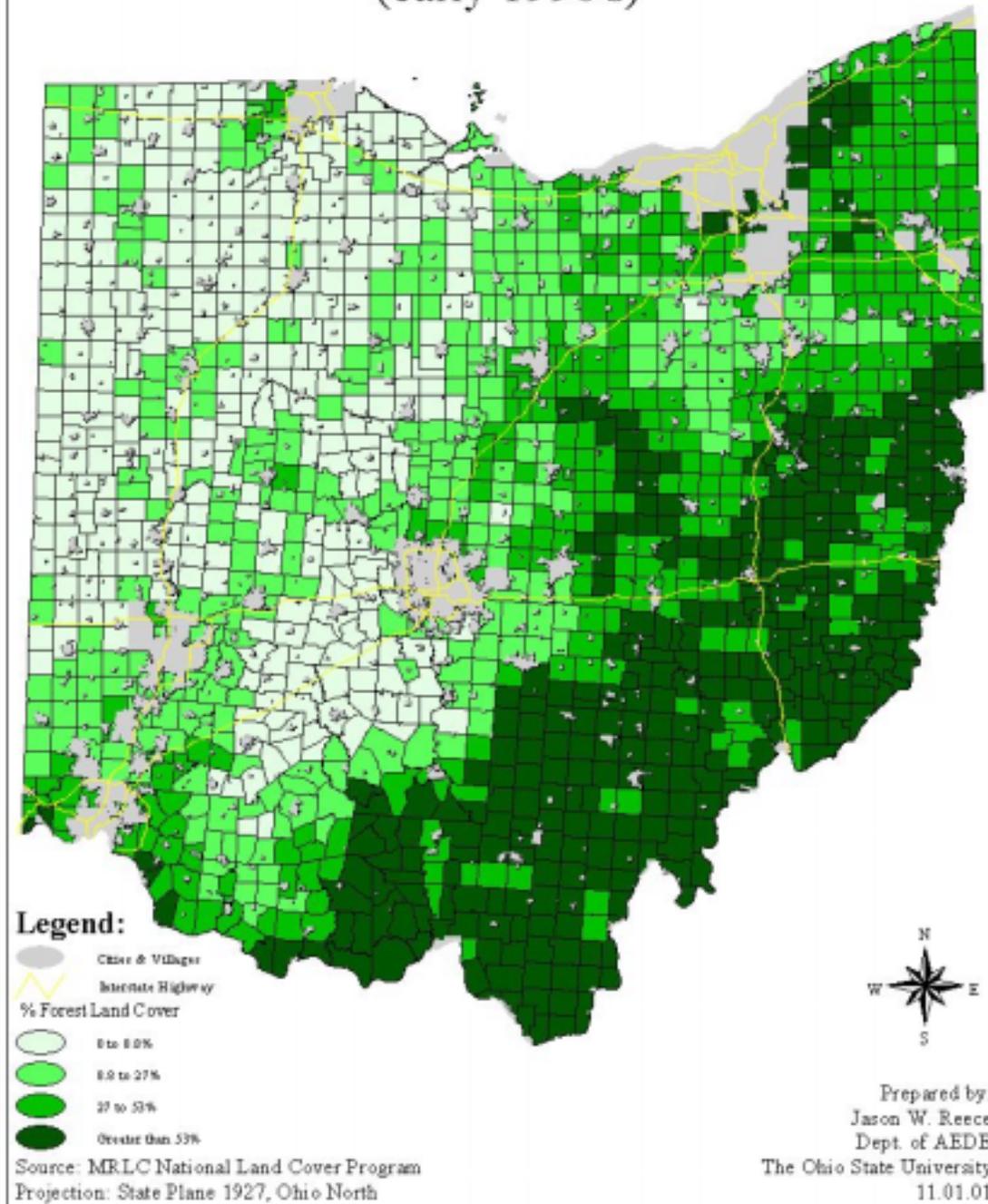
Source: Multi-Resolution Land Characteristics Consortium

* Total Agriculture represents the sum of all row crop and pasture land cover

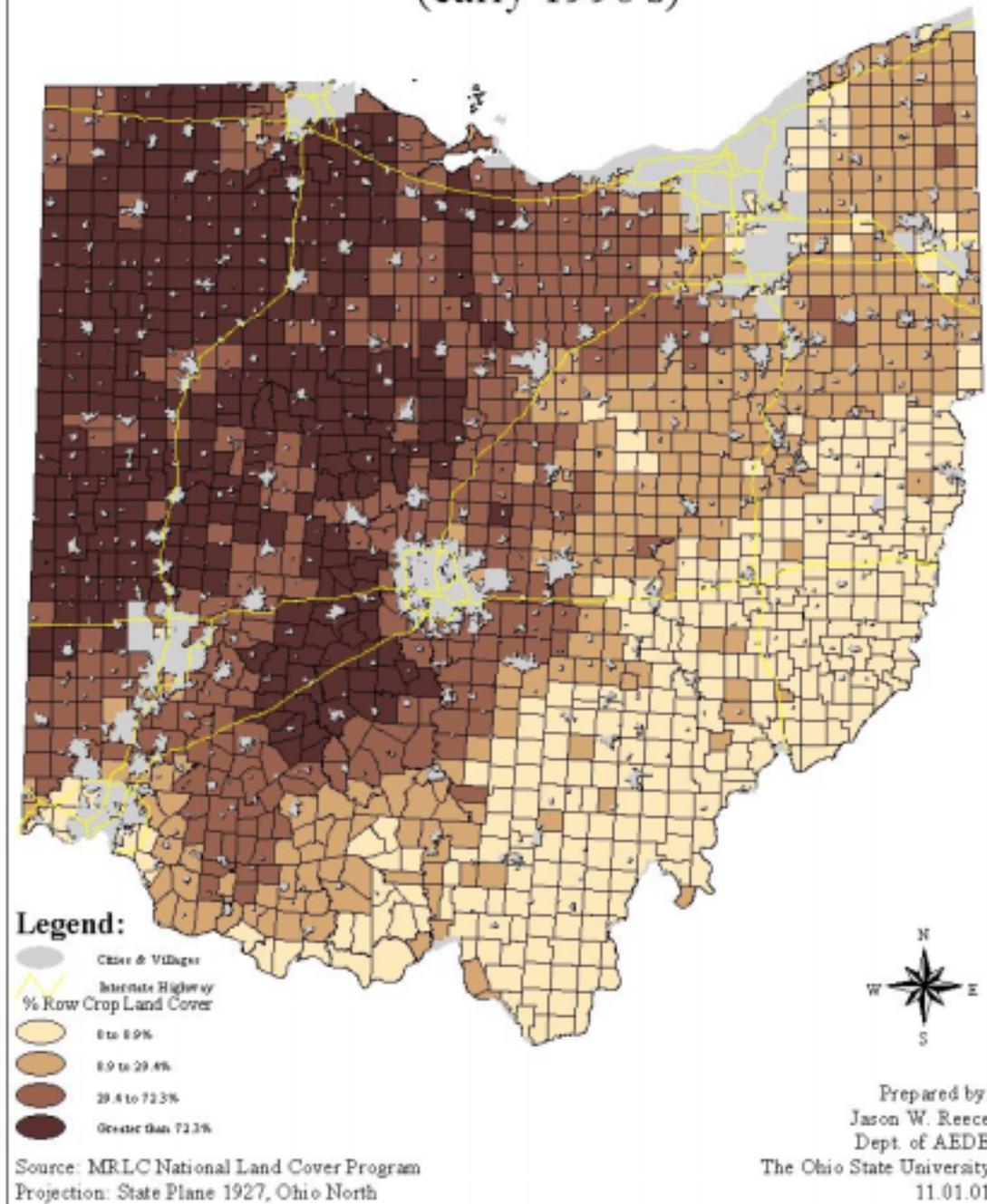
Map 2: Urban Land Cover by Township
(early 1990's)



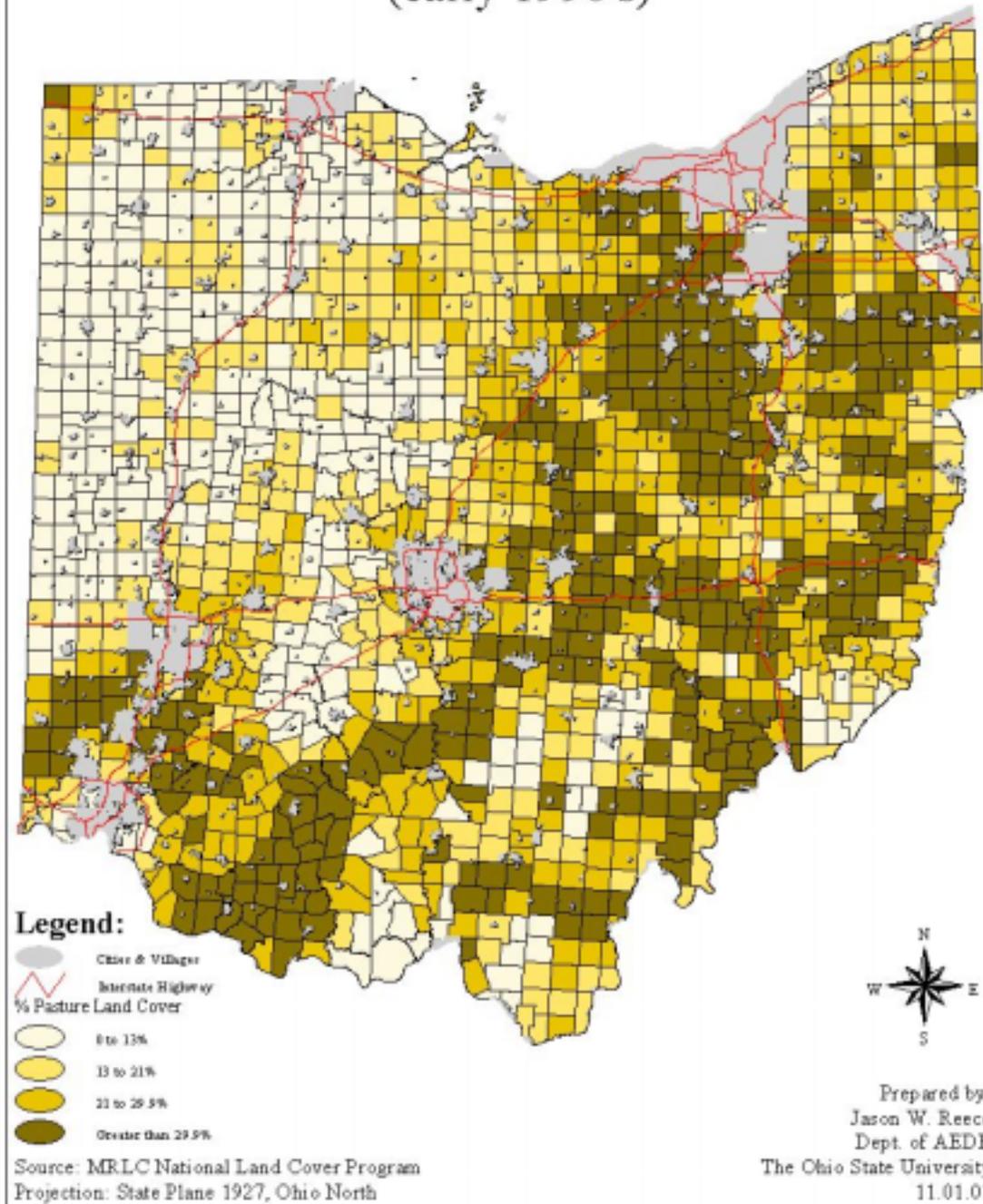
Map 3: Forest Land Cover by Township (early 1990's)



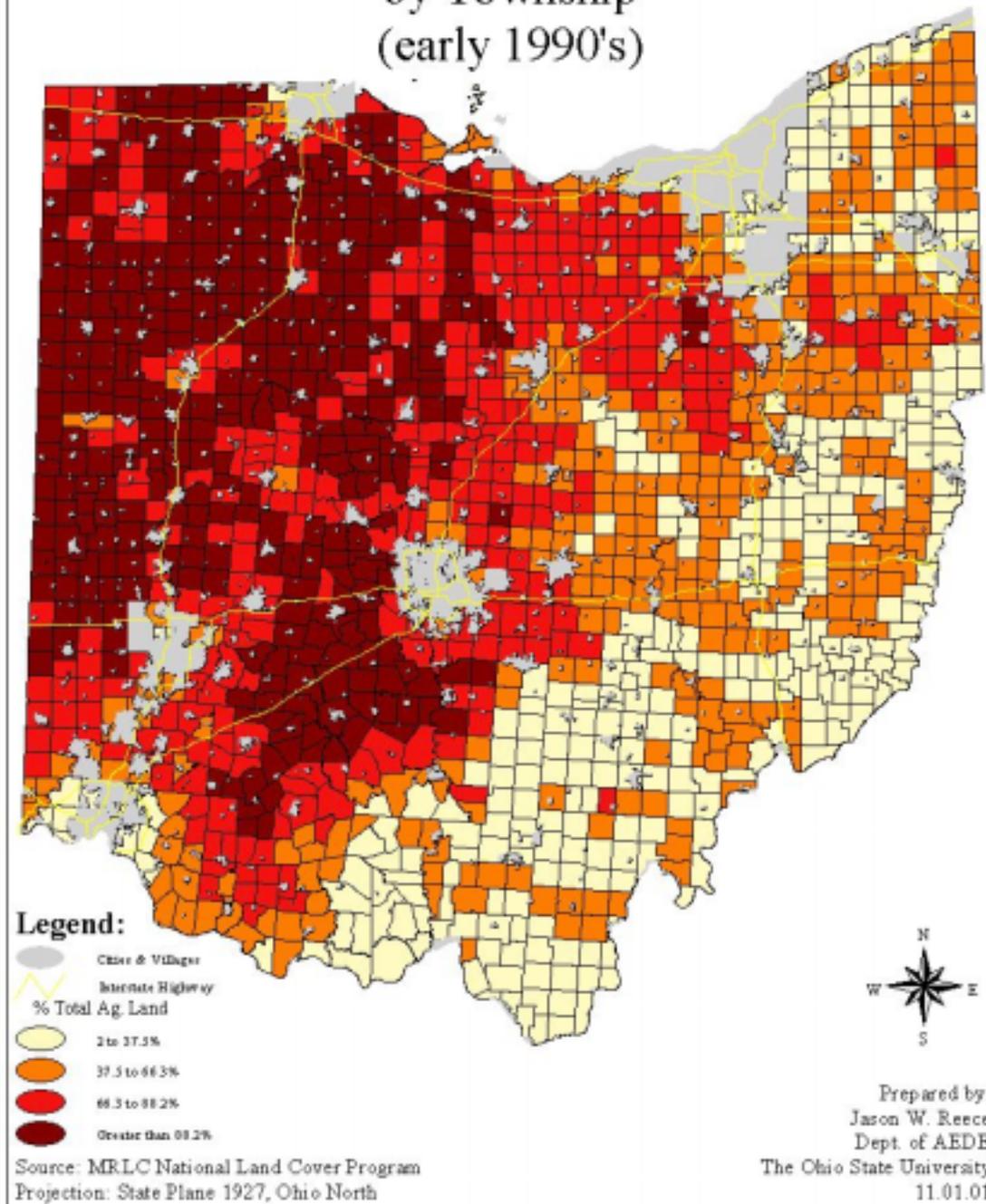
Map 4: Row Crop Land Cover by Township
(early 1990's)



Map 5: Pasture Land Cover by Township (early 1990's)



Map 6: Total Agricultural Land Cover
by Township
(early 1990's)



Section 3: Population Dynamics (1990-2000)

The land cover data used for this analysis provides land cover information from the early 1990's. Between 1990 and 2000, population in Ohio's 1,309 existing townships increased by approximately 336,000 persons.⁵ This growth has not been equally distributed throughout the state (**Map 7**). The following section of this analysis considers how townships with different land cover characteristics have grown in the past decade.

In this analysis, townships are categorized according to the relative amounts of land cover that they contain and population is compared across these land cover categories. For example, to analyze population change for townships with different amounts of agricultural land cover, all 1,309 townships were divided into four equally sized categories (low, low to moderate, moderate to high, high) based on the proportion of agricultural land cover within each township. Next, population change is summed across all townships within each category to compare township population trends across the different land cover categories. This comparison between land cover and population growth was done for urban, forest, row crop, pasture, and total agricultural land cover (**Table 3**).

Population change by amount of urban land cover-

Ohio's township population and population growth is highly concentrated in the small number of townships with relatively large amounts of higher density urban land cover. A total of 313 townships (25% of all townships) have more than 1.7% urban land cover, but they contain over 2.3 million residents (61% of total township population in Ohio). These townships also grew the most during the 1990's. These townships increased in population by 194,000 between 1990 and 2000, accounting for 58% of all township population growth during this period.

Population change by amount of forest land cover-

Population and population growth are concentrated in townships with moderate levels of forest land cover. Half of Ohio's townships have between 9% and 53% forest land cover. Approximately 2.3 million township residents (71% of total Ohio township population) are found in townships with these moderate amounts of forest land cover. These townships also experienced greater growth during the 1990's than townships with either very low or high amounts of forest land cover, increasing by 275,000 persons and accounting for 81% of all township growth during this time period.

Population change by amount of row crop land cover-

88% of township population is found in the 75% of townships that contain relatively moderate or low amounts of row crop land cover (those with less than 72% row crop land cover) and 79% of the population growth in the 1990's occurred in townships with moderate levels of row crop land (those with 9% to 72% row crop land cover). In contrast, population growth increased by a modest 4.4% during the 1990's in townships with the highest proportions of row crop land cover (those with 72% or more).

⁵ Since population and land cover was analyzed for the 1,309 townships existing in 2000, this figure excludes the loss of population in townships from the seven townships abolished since 1990. Thus, this population total is greater by 91,157 persons than population change cited in other reports.

Population change by amount of pasture land cover-

Township population was equally distributed across townships of varying levels of pasture land. All categories of pasture land cover contained between 900,000 to 1.1 million residents. Population growth during the 1990's was somewhat more concentrated in townships with the largest amounts of pasture land (those with more than 30% pasture land cover). Population increased by 104,059 in these townships during the 1990's, an increase of 12.9% and accounting for approximately 31% of all Ohio township population growth.

Population change by amount of total agricultural land cover-

Significant differences in population are observed in townships with varying amounts of total agricultural land cover (row crop and pasture land cover). Approximately 25% of the townships have more than 88% agricultural land cover and contain 435,998 residents, which is 11.3% of Ohio's total township population. These townships grew by 2.8% (11,677 residents) between 1990 and 2000, which accounts for 3.5% of total township population growth during this decade. In contrast, townships with moderate levels of agricultural land (38% to 88%) grew by 245,065 residents and accounted for 73% of all township population growth in the 1990's.

Summary-

In summary, township population growth is not equally distributed across townships with varying land cover characteristics. Townships with large amounts of urban land cover and moderate amounts of forest and agricultural land cover grew faster during the 1990's. Conversely, townships with low amounts of urban and forest land cover and high amounts of row crop land cover experienced little growth during the 1990's. This analysis suggests that those townships that had already started to urbanize prior to 1990 were the ones that grew the fastest in the 1990's.

Map 7: Township Population Change 1990-2000 (Percent Change)

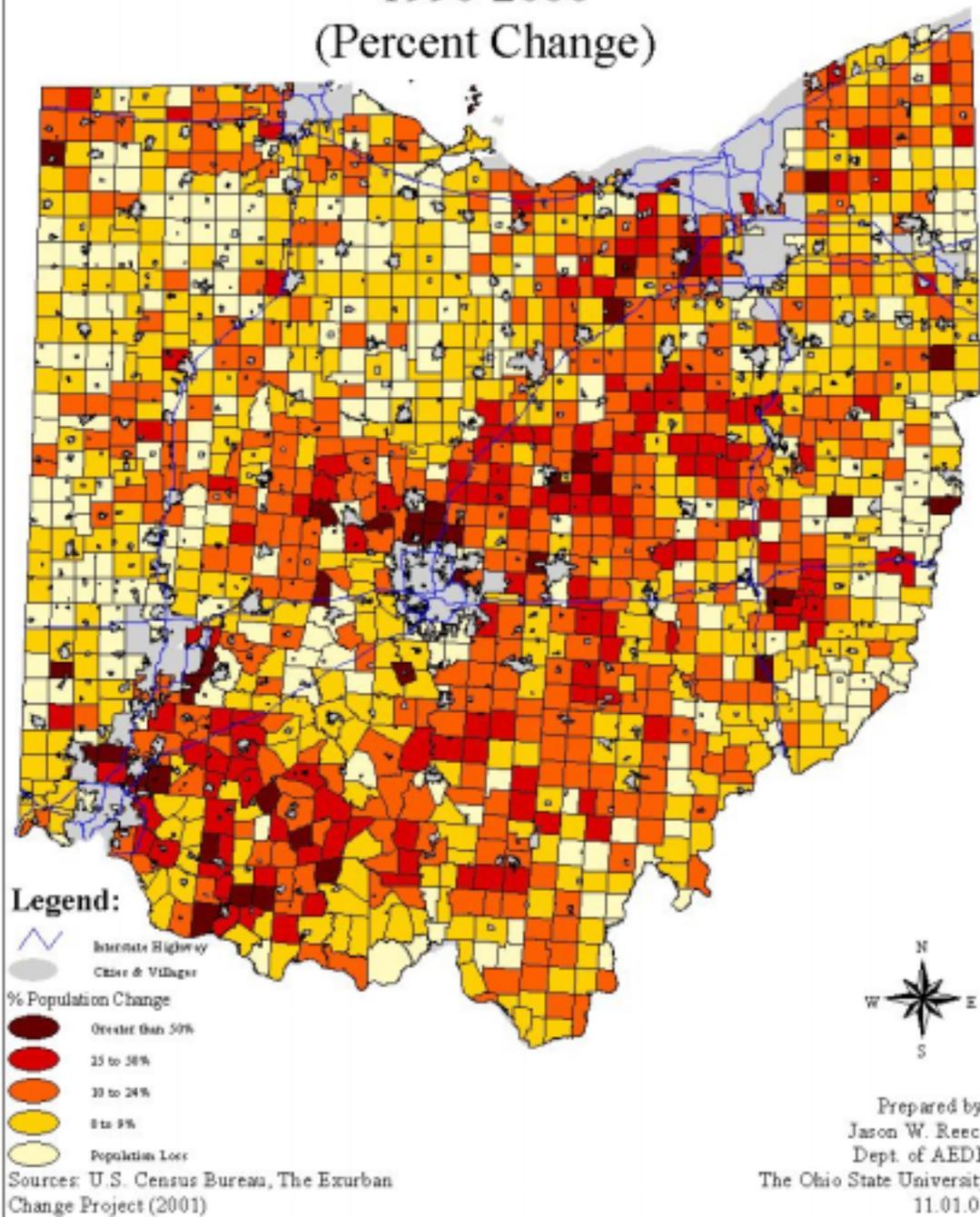


Table 3: Township Population and Population Change by Land Cover Quartiles

Land Cover	Quartile	% of Total Land Cover	Relative Amount of Land Cover	Number of Townships	2000 Population	% of Total Township Population	Population Change 1990 to 2000	% of Total Township Pop. Change in the 1990's
Urban	1	< than 0.1%	Low	342	327,339	8.5%	30,096	8.9%
	2	0.1 to 0.5%	Low to Moderate	330	478,776	12.4%	46,114	13.7%
	3	0.5 to 1.7%	Moderate to High	324	709,317	18.4%	66,028	19.6%
	4	> than 1.7%	High	313	2,345,331	60.7%	194,507	57.8%
Forest	1	< than 8.8%	Low	327	526,773	13.6%	14,102	4.2%
	2	8.8 to 27%	Low to Moderate	328	1,304,067	33.8%	133,013	39.5%
	3	27 to 53%	Moderate to High	327	1,440,329	37.3%	142,879	42.4%
	4	> than 53%	High	327	589,594	15.3%	46,751	13.9%
Row Crops	1	< than 8.9%	Low	327	1,106,825	28.7%	54,845	16.3%
	2	8.9 to 29.4%	Low to Moderate	329	1,289,583	33.4%	154,297	45.8%
	3	29.4 to 72.3%	Moderate to High	328	1,008,837	26.1%	112,624	33.4%
	4	> than 72.3%	High	325	455,518	11.8%	14,979	4.4%
Pasture	1	< than 13%	Low	332	945,878	24.5%	43,553	12.9%
	2	13 to 21%	Low to Moderate	328	930,688	24.1%	101,858	30.2%
	3	21 to 29.9%	Moderate to High	325	1,075,639	27.9%	87,275	25.9%
	4	> than 29.9%	High	324	908,558	23.5%	104,059	30.9%
Total Agriculture	1	< than 37.5%	Low	326	1,282,501	33.2%	80,003	23.8%
	2	37.5 to 66.3%	Low to Moderate	328	1,172,697	30.4%	130,249	38.7%
	3	66.3 to 88.2%	Moderate to High	328	969,567	25.1%	114,816	34.1%
	4	> than 88.2%	High	327	435,998	11.3%	11,677	3.5%

Sources: Multi-Resolution Land Characteristics Consortium, U.S. Census Bureau

Notes: Total Agriculture represents the sum of all row crop and pasture land cover.

This analysis excludes townships that were dissolved or abolished in the 1990's; thus population is tracked for those townships that existing in 2000. Due to this fact, total township population change from 1990 to 2000 was 336,745; this figure is larger than previous reports of township population by 91,157 persons. The difference is township population lost from the abolishment of seven townships

Section 4: Spatial Analysis

To identify spatial trends in township land cover attributes, this section describes the distribution of land cover characteristics between metropolitan and non-metropolitan areas and the distribution of land cover characteristics with respect to proximity to Ohio's major cities.

4.1 Township Land Cover by Metropolitan Status

Metropolitan areas are economic regions designated by the U.S. Office of Budget and Management. Metropolitan areas contain a core urban center with a dense concentration of population that is surrounded by a region of adjoining communities that are economically and socially integrated with the core.⁶ Generally, areas outside of the metropolitan areas are considered to be largely economically independent of a metropolitan area. Based on the 1990 Metropolitan Area definitions, Ohio contains two large consolidated metropolitan areas⁷ (Cleveland-Akron and Cincinnati-Hamilton) and eleven smaller metropolitan areas⁸ (**Map 8**). Based on these boundaries, Ohio metropolitan areas contain over 15,400 square miles of township land (85% of total metropolitan land area) and non-metropolitan areas contain approximately 22,000 square miles of township land (94% of total non-metropolitan land area).

Metropolitan vs. non-metropolitan townships-

Township land cover characteristics were analyzed for the thirty-nine counties inside and forty-nine counties outside of these metropolitan areas. Township land within metropolitan areas contains higher amounts of urban land (613 sq. miles) than township land outside metropolitan areas (151 sq. miles) (**Table 4**). Conversely, township land in non-metropolitan areas contains a larger concentration of agricultural land (over 14,000 sq. miles) than township land within metropolitan areas (9,400 sq. miles). Although the data supports generalizations of more urban townships within metropolitan areas and highly agricultural townships outside urbanized areas, this generalization should not be overstated. The amount of urban land inside metropolitan townships is relatively low (only 4% of the total land cover within metropolitan townships) and a significantly amount of agricultural land (over 9,400 square miles or 61%) is found within metropolitan townships.

Township land cover by metropolitan area

Land cover characteristics were also analyzed for townships in nine of Ohio's metropolitan areas.⁹ The amounts of urban land, agricultural land and forestland and population change between 1990-2000 were calculated for the proportion of these

⁶ U.S. Census Bureau (2001) Metropolitan Area Definitions. Found at: <http://www.census.gov/population/www/estimates/metroarea.html>

⁷ Consolidated Metropolitan Statistical Areas (CMSA's) must have over one million inhabitants and contain separate component areas (smaller MSA's) that meet statistical criteria set by the U.S. Office of Management and Budget.

⁸ Office of Budget and Management, Statistical Policy Office (1999) Metropolitan Areas 1999 Lists I-IV. Attachment to OMB Bulletin No. 99-04

⁹ Metropolitan areas with central counties outside the State of Ohio were excluded from this analysis. Excluded metropolitan areas included Steubenville-Weirton, Wheeling, Parkersburg-Marietta and Huntington-Ashland.

metropolitan areas within townships. Since the relative land area of each metropolitan area differs significantly, land cover is compared as a percentage of total land cover for the metropolitan area. (Please refer to **Table 5** for the results of this analysis)

Urbanized metropolitan township land-

The Cincinnati-Hamilton metropolitan area contains the most urban township land (**Table 5**). Over 10% of the township land in the Cincinnati-Hamilton metro area is higher density urban land. This metropolitan area also experienced the largest increase in township population during the 1990's, with an increase in township population of approximately 92,000 or 13.4%. In comparison, the remaining metropolitan township areas have less than 6% urban land and over half of these contain less than 3% higher density urban land.

Agricultural metropolitan township land-

Agriculture is a prominent land cover in metropolitan townships. The total township land area of four metropolitan areas (Dayton-Springfield, Canton-Massillon, Cleveland-Akron and Columbus) is 75% or more agricultural land cover and seven of the nine metropolitan areas are at least 40% agricultural land cover. Columbus' townships have 76.2% agricultural land cover, but are also experiencing significant population pressure. Townships in the Columbus metropolitan area recorded a population increase of 10.2% in the last decade.

Forested metropolitan township land-

The amount of forest land cover in metropolitan townships varies significantly by metropolitan area. Metropolitan township forest land cover accounts for less than 8.5% of township land in the Canton-Massillon and Dayton-Springfield metro areas. In contrast, the Toledo and Youngstown-Warren metro areas contain relatively high amounts of township forest land cover (56% and 80% respectively). The relatively urbanized Cincinnati-Hamilton metropolitan area contains 32.3% township forest land cover.

Summary-

Significant differences in township land cover exist when comparing metropolitan and non-metropolitan township land. Generally, metropolitan townships contain higher levels of urban land cover and lower amounts of agricultural land cover. However, relatively low levels of urban land cover and significant amounts of agricultural land cover are present in metropolitan townships.

The Cincinnati-Hamilton metropolitan area contains the largest amount of higher density urban township land. Agricultural land is the most prevalent land cover in Ohio's metropolitan townships; four metropolitan areas have agricultural land cover accounting for at least 75% of all township land cover. Of these highly agricultural metropolitan areas, the townships in the Columbus metropolitan area witnessed the most significant population change in the 1990's.

Table 4: Township Land Cover Characteristics by County Metropolitan Status

METRO VS. NON METRO TOWNSHIPS					
Land Cover:	Metropolitan Areas (39 Counties)		Non-Metropolitan Areas (49 Counties)		
	Square Miles	% of Total Land	Square Miles	% of Total Land	
Water	198.2	1.3%	208.6	0.9%	
Urban	613.0	4.0%	151.4	0.7%	
Barren	31.9	0.2%	55.5	0.3%	
Forest	4,817.9	31.1%	7,383.6	33.3%	
Pasture	3,719.5	24.0%	4,782.7	21.6%	
Row Crops	5,721.5	37.0%	9,441.9	42.6%	
Wetlands	366.4	2.4%	132.6	0.6%	
Total	15,468.4	n/a	22,156.2	n/a	
Total Agriculture*	9,441.0	61.0%	14,224.6	64.2%	

Source: Multi-Resolution Land Characteristics Consortium

*Total agricultural land is the sum of total pasture land and total row crop land

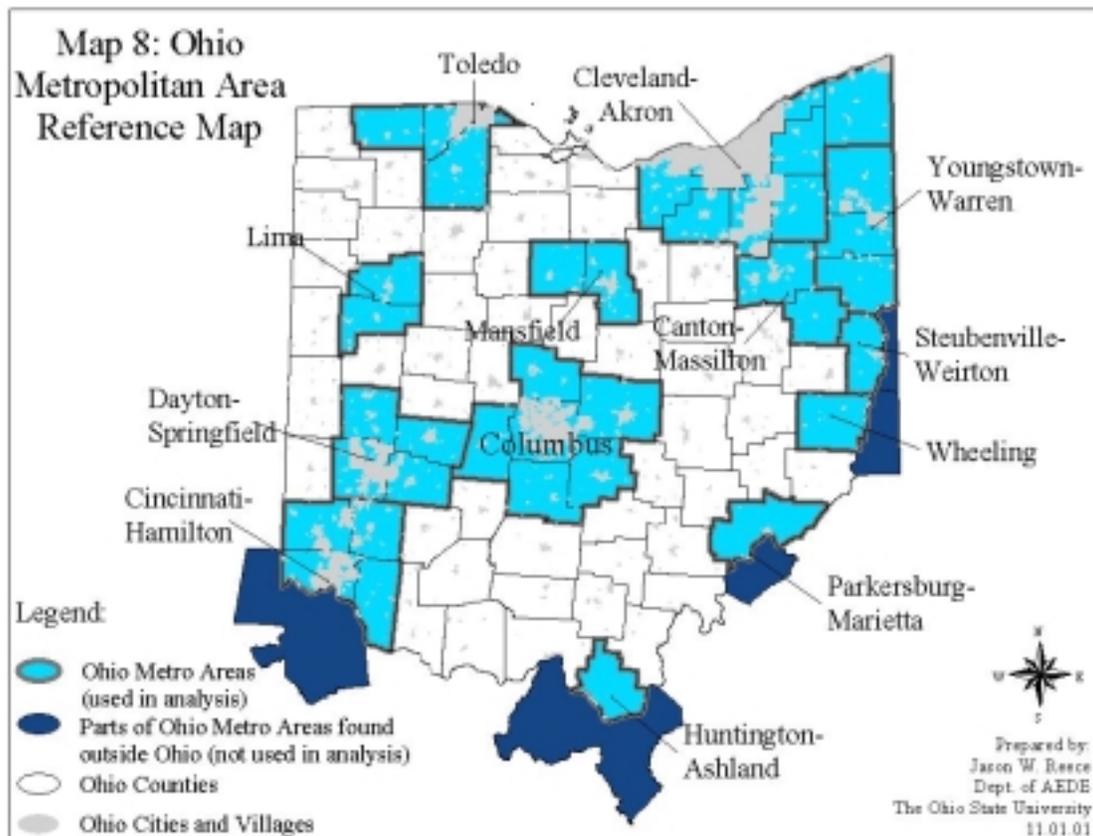


Table 5: Township Land Cover (early 1990's) and Population Change (1990-2000) for Ohio Metropolitan Areas

Metropolitan Area:	Urban Land		Agricultural Land*		Forest Land		Township Pop. Change 1990-2000	
	Sq. Miles	% of Land	Sq. Miles	% of Land	Sq. Miles	% of Land	Abs. Chg.	% Change
Cincinnati-Hamilton**	144.2	10.3%	775.5	55.7%	448.3	32.2%	92,705	13.4%
Cleveland-Akron	70.6	5.2%	1,124.8	83.6%	136.8	10.2%	19,878	4.2%
Columbus	74.4	2.8%	2,037.1	76.2%	520.7	19.5%	33,327	10.2%
Canton-Massillon	15.3	2.0%	674.0	88.2%	65.2	8.5%	12,627	5.9%
Dayton-Springfield***	23.4	2.0%	1,023.6	87.9%	81.4	7.0%	-45,940	-18.6%
Lima	92.8	3.7%	1,138.7	45.7%	992.8	39.9%	5,246	7.5%
Mansfield	84.9	5.9%	639.2	44.4%	597.8	41.6%	2,200	3.1%
Toledo	9.1	1.7%	207.1	39.4%	296.6	56.4%	12,626	9.1%
Youngstown-Warren	8.0	1.8%	73.0	16.4%	358.3	80.3%	11,316	3.6%

Source: Multi-Resolution Land Characteristics Consortium

*Total agricultural land is the sum of total pasture land and total row crop land

**Data excludes portion of MSA outside the State of Ohio

***The Dayton-Springfield township population declined dramatically during the 1990's due to annexation and dissolution of townships

Note: Metropolitan areas with central counties outside of the State of Ohio were excluded from this analysis.

4.2 Township Land Cover and Population Change by Proximity to Ohio's Major Cities

To identify how township land cover and population growth change with proximity to major cities, the following analysis identifies cities with at least 100,000 residents that are within or in close proximity to Ohio.¹⁰ A Geographic Information System (GIS) was used to create distance zones around each city in ten-mile increments. A total of six distance zones were created: less than 10 miles, 10-20 miles, 20-30 miles, 30-40 miles, 40-50 miles, and greater than 50 miles (**Map 9**). After creating the distance zones, township land cover and population data were aggregated within each distance zone. The land cover and population change characteristics for the six distance zones were then compared.

Spatial land cover trends-

In comparing land cover characteristics across zones, the percent of urban land cover in townships decreases significantly with distance from major cities (**Tables 6 and 7**). Over 10% of township land cover within ten miles of major cities is urban. This drops to 2.7% in townships located within 10 to 20 miles of cities and averages around 1% of township land cover for townships beyond twenty miles of major cities.

Conversely, the percent of forest land cover in townships increases significantly as distance increases from major cities. Forest land cover constitutes less than 22% of land cover in townships located within 30 miles of major cities; this figure increases to 58% of the total land cover for townships located more than 50 miles from major cities (**Figure 2**). A major factor explaining this phenomenon is that many townships located more than 50 miles from major cities are in the Appalachian region of the state, which contains much higher amounts of forestland than the remainder of the state¹¹ (**Appendix A**).

The percent of agricultural land cover increases with distance from major cities up until approximately 20 miles, but then steadily declines with distances of 30 miles and greater from major cities. Agricultural land makes up 64% of township land within ten miles of major cities. This figure increases to over 76% of land for townships located within 10 to 30 miles of major cities, but then declines after distance to major cities increases beyond 30 miles. For townships located more than 50 miles from major urban centers, agricultural land cover accounts for only 38% of total land cover (**Figure 2**).

The change in agricultural land cover as distance increases to major urban centers is primarily due to changes in cropland and not due to changes in pasture land cover. The proportion of pasture land cover remains relatively constant as distance to major cities increases, accounting for 20-25% of township land on average. The proportion of row crop land cover does not follow this pattern; it is a relatively large component of total land for townships within 10 to 30 miles of major cities (accounting for over 50% of total

¹⁰ Using this criterion, Ohio's major cities include (with 2000 population): Akron (217,074), Cincinnati (331,285), Cleveland (478,403), Columbus (711,470), Dayton (166,179), Toledo (313,619) and Fort Wayne, Indiana (205,727). Because of its impact on northwest Ohio, Fort Wayne, Indiana was included in the analysis. *Population figures from 2000 Census of Population and Housing*

¹¹ The counties, which constitute the twenty-nine county Appalachian region in Ohio, have 57% of their total land identified as forestland. In contrast the remaining 59 counties in Ohio have only 17.7% of their land in forest land cover.

township land); this percentage then declines significantly for township land beyond 30 miles of major cities. (**Figure 2**)

Spatial population dynamics-

Township population change also varies with proximity to major cities. Absolute population change in the 1990's was the greatest in townships located within 10-20 miles outside of the seven major cities considered here. Of the total township population change between 1990-2000, 26% of this growth occurred in township areas located 10-20 miles outside of major cities and 24% of the growth occurred in township areas located less than 10 miles from these cities. As distance from these major cities increases beyond 20 miles, township population growth declines steadily. Approximately 50% of Ohio's township population change in the 1990's occurred within twenty miles of these cities and 80% of township population change occurred within 40 miles of these cities¹² (**Figure 3**). In terms of population density, the townships located within 10 miles of the major urban cities grew the most, adding 29 persons per square mile. In comparison, townships located within 10-20 miles added 16.3 persons per square mile and townships located between 20-30 miles added 8.3 persons per square mile (**Table 8**).

Integrating township land cover characteristics with absolute population change shows that townships located between 10-20 miles from the outer boundaries of major cities experienced the largest increase in total population between 1990 and 2000 and have the highest proportion of agricultural land—with over 76% of the total land area in agricultural land cover (**Figure 3**). Given the urbanization pressures exerted by this level of population growth, these data suggest that townships located within 10-20 miles of urban centers are experiencing the greatest pressures to convert non-urban land to residential uses and can expect the most significant changes in the future composition of their land use. In addition, over 80% of the total township population growth that occurred between 1990 and 2000 took place within 40 miles of the major urban centers, an area that is comprised of 70% agricultural land cover overall.

Summary-

To summarize, definite spatial trends appear when analyzing land cover and population change for townships with respect to their distance from major cities. Urban land decreases and forestland increases with distance to major cities. Agricultural land remains very prominent in areas within forty miles of major cities, peaking at a distance of 10-30 miles, and declines significantly beyond forty miles from major cities. Township population change also is concentrated within forty miles from major cities, primarily in townships within twenty miles from major cities and greatest for townships located 10-20 miles from major cities. As a result, conflict between development pressures and agricultural land are more likely to surface in these townships that are within twenty miles of major cities and that have a high proportion of agricultural land.

¹² Excluding the townships abolished since 1990, total township population change between 1990 and 2000 was 336,745. Since population and land cover was analyzed for the 1,309 townships existing in 2000, this figure excludes the loss of population in townships from the seven townships abolished since 1990. Thus, this population total is greater by 91,157 persons than population change cited in other reports.

Map 9: Buffers from Ohio's Major Cities*

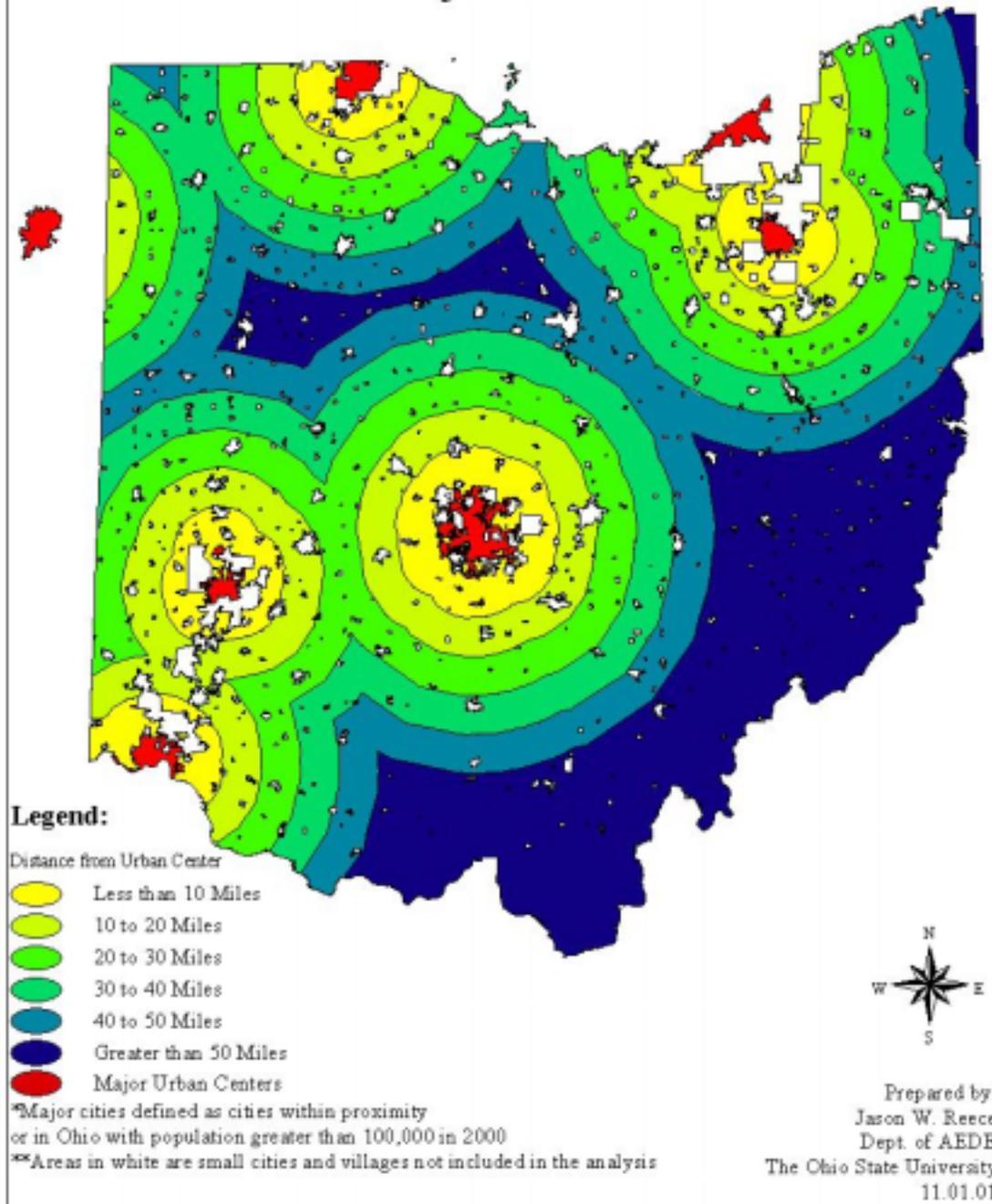


Table 6: Land Cover by Distance from Major Cities

Land Cover	Distance From Major Cities**					
	< than 10	10 to 20	20 to 30	30 to 40	40 to 50	50 to 100
	Square Miles of Land Cover					
Water	39.7	59.4	58.4	65.3	89.3	94.4
Urban	293.0	147.0	68.1	94.4	75.2	84.6
Barren	7.0	7.6	7.0	11.6	12.0	42.1
Forest	617.9	999.4	1,442.6	1,876.8	2,383.4	4,878.5
Pasture	598.9	1,235.8	1,540.0	1,594.7	1,456.0	2,076.2
Row Crops	1,198.8	2,915.1	3,803.9	3,566.9	2,548.9	1,129.6
Wetlands	48.4	69.1	97.5	137.3	104.1	42.5
Total Land	2,803.7	5,433.4	7,017.4	7,347.0	6,668.9	8,348.0
Total Ag. Land*	1,797.7	4,150.9	5,343.9	5,161.6	4,004.8	3,205.7

Table 7: Percentage of Land Cover by Distance from Major Cities

Land Cover	Distance From Major Cities**					
	< than 10	10 to 20	20 to 30	30 to 40	40 to 50	50 to 100
	Percentage of Total Land Cover					
Water	1.4%	1.1%	0.8%	0.9%	1.3%	1.1%
Urban	10.4%	2.7%	1.0%	1.3%	1.1%	1.0%
Barren	0.3%	0.1%	0.1%	0.2%	0.2%	0.5%
Forest	22.0%	18.4%	20.6%	25.5%	35.7%	58.4%
Pasture	21.4%	22.7%	21.9%	21.7%	21.8%	24.9%
Row Crops	42.8%	53.7%	54.2%	48.5%	38.2%	13.5%
Wetlands	1.7%	1.3%	1.4%	1.9%	1.6%	0.5%
Total Land	n/a	n/a	n/a	n/a	n/a	n/a
Total Ag. Land*	64.1%	76.4%	76.2%	70.3%	60.1%	38.4%

*Total Ag. Land is the sum of all Pasture land and Row Crop land

** Major Urban Centers are defined as cities in proximity to Ohio with population greater than 100,000 in 2000

Table 8: Township Population Change by Distance from Major Cities 1990-2000

Population	Distance From Major Cities**					
	< than 10	10 to 20	20 to 30	30 to 40	40 to 50	50 to 100
Change	81,349	88,644	58,150	46,828	33,842	27,933
Change in Pop. Density*	29.0	16.3	8.3	6.4	5.1	3.3

*Population Density Change is change in number of persons per square mile

Notes: This analysis excludes townships that were dissolved or abolished in the 1990's; thus population is tracked for those townships that existing in 2000. Due to this fact, total township population change from 1990 to 2000 was 336,745; this figure is larger than previous reports of township population by 91,157 persons. The difference is township population lost from the abolishment of seven townships in the 1990's.

Figure 2: Township Land Cover by Distance to Major Cities

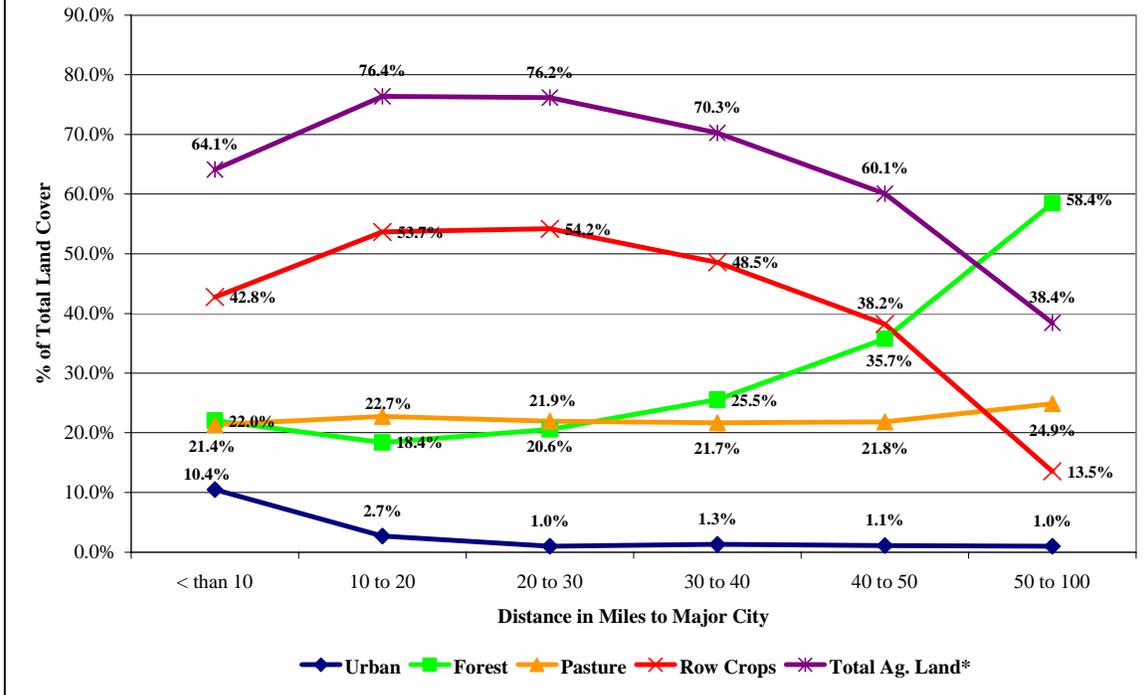
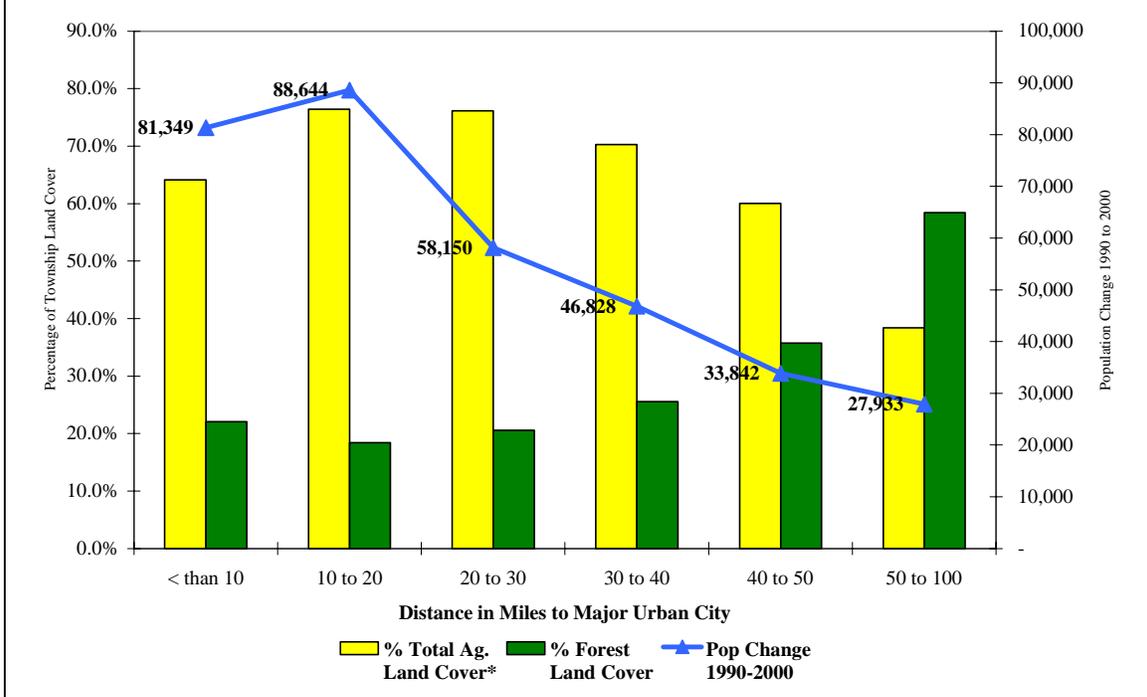


Figure 3: Township Land Cover and Population Change by Distance to Major Cities



Section 5: Concluding Observations

Ohio's unique geography has produced significant diversity and distinct spatial patterns of land cover across its townships. In addition, population change and metropolitan growth have significantly impacted township land cover and will continue to do so in the future.

Township land cover-

The MRLC satellite imagery land cover data from the early 1990's suggest that Ohio's townships contain relatively small amounts of dense urban land cover. Townships with larger amounts of urban land cover are concentrated along Ohio's transportation corridors and around the periphery of metropolitan areas. Due to the problems with identifying low-density development, the low levels of urban land cover in townships reported in this study should not be overstated. Additional analysis with other sources of data (i.e. population and land use data) is necessary to more accurately assess urbanization patterns in townships.

The distribution of other land cover characteristics across Ohio's townships reveals a spatial pattern that corresponds to Ohio's physical geography. Row crop land cover dominates the township lands in northwest and western Ohio where the topography is flat and large concentrations of forest land cover encompasses most of the southeastern Ohio townships that comprise the hilly Appalachian region. Pasture land cover in townships also displays a particular spatial pattern, located primarily at the foothills of Appalachian Ohio and around the peripheries of the Cincinnati-Hamilton, Columbus and Cleveland-Akron metropolitan areas.

Population and spatial analysis-

Integrating population change data with land cover illustrates how population is changing in townships with varying land cover characteristics. Population change in Ohio's townships is occurring primarily in townships with a relatively large proportion of urban land and in townships with moderate amounts of forest and crop land cover. Townships that were more highly urbanized prior to 1990 were the ones that grew the fastest in the 1990's. On the other hand, townships with extremely high levels of crop land cover and low levels of forest and urban land cover have low population levels and are experiencing only modest population growth.

While townships located within metropolitan areas have more urban land cover, they still retain considerable amounts of agricultural land cover. The Cincinnati-Hamilton metropolitan area contains the largest amount of urban township land and compared to other Ohio metropolitan areas experienced the largest township population growth in the 1990's. Townships within the Columbus metropolitan area are generally dominated by agricultural land cover and were the second fastest growing metropolitan townships in the last decade.

The amount of urban township land increases with proximity to major cities within or near Ohio. In contrast, forest land cover in townships increases substantially as distance to major cities increases. Agricultural land cover in townships comprises the highest proportions of township land in areas 10-40 miles outside of major cities, and this proportion declines steadily in townships located more than 40 miles from major cities.

The largest increases in population were experienced in townships located 10-20 miles outside major cities. The amount of population growth in townships then declines as distance from major cities increases beyond 20 miles. Together, these population and land use trends suggest that agricultural land in Ohio is much more vulnerable to current and future population growth than forest lands and that predominately agricultural townships within 40 miles of urban centers appear to be experiencing the majority of population growth. As land closer to the cities is converted, development pressures in the outer rural-urban fringe areas (e.g. those located 20-40 miles outside major cities) are likely to intensify in the future.

Conclusions and Policy Implications-

While the pattern of land cover across Ohio's townships is largely influenced by Ohio's physical geography, future changes in the pattern of land cover across Ohio's townships will primarily be impacted by metropolitan expansion and urbanization. Spatial analysis of land cover and population change indicates significant growth is occurring in townships that are close to major Ohio cities. Land cover analysis of these townships indicates that these townships are currently dominated by agricultural land cover and that the proportion of land in agricultural land cover is greatest in townships that are located about 40 miles outside of the major urban centers. Given that 80% of the population growth in the 1990's occurred within 40 miles of the major cities, these townships that are dominated by agricultural land cover and located along the urban-rural interface will be at the forefront of urban development in the future.

In addition, the spatial analysis of population change revealed that population growth relative to major cities has exhibited a moderate pattern of "leapfrog" development. Population growth was found to be slightly higher in townships located 10-20 miles from major urban areas vs. townships located within 10 miles of the major cities. Continuation of this leapfrog growth pattern implies that the greatest growth pressures in the future will be in townships that are even further outside the boundaries of major cities.

The results of this analysis have implications for future policies in Ohio regarding open space protection and urban growth management. Based on our analysis, we conclude that large areas of Ohio's landscape are not likely be impacted by urbanization in the near future. In particular, the highly agricultural northwestern Ohio townships and the forested townships of southeastern Ohio have had little growth in the past decade and are not likely to experience significant growth levels in the foreseeable future.

In contrast, townships located in the rural-urban interface of Ohio's major urban areas have grown significantly in the past decade and are likely to continue doing so in the future. As urban areas continue to spread outward, the amount of area located in the rural-urban zone will increase and therefore some townships that are not currently experiencing significant growth are likely to start growing significantly in the near future. In addition, to the extent that population growth continues to leapfrog out from urban areas, the areas under urban influence will increase even more. Because of the spatial distribution of agricultural land cover relative to Ohio's major cities, these trends have much more severe implications for potential farmland loss than for potential forest loss.

We conclude that open space protection policies in Ohio should focus on farmland protection and should target farmland located in areas that are the most likely to

experience high population growth in the future. Our analysis implies that farmland preservation efforts will be the most effective if they target agricultural land located within approximately 40 miles of the major cities in and around Ohio. Within these areas, land that is further away from the major cities (20-40 miles) is likely to be the best opportunity for preservation because large contiguous tracts of agricultural land exist and land prices are lower since competition for land for urban uses will be somewhat less.

Likewise, urban growth policies should target those areas that are the most likely to urbanize the fastest in the future. For example, our analysis shows a clear linkage between the amount of urban land cover and the location of transportation corridors in Ohio. Growth management policies should recognize this strong linkage and incorporate transportation planning into growth management policies that seek to guide the location of urban growth in the future.

Appendix A: Supplementary Data Tables and Maps

The “Corn Belt” and “Appalachian” region are referred to in the preceding report. The following map (See **Map A1**) displays the Corn Belt¹³ and Appalachian¹⁴ regions in Ohio. The following table (See **Table A1**) displays land cover data for both regions.

Table A1: Land cover in the Corn Belt and Appalachian Regions (Early 1990's)

Land Cover:	<u>The Corn Belt Region</u>		<u>The Appalachian Region</u>	
	Square Miles	% of Total Land Cover	Square Miles	% of Total Land Cover
Water	153.9	0.9%	169.0	1.2%
Urban	951.5	5.7%	288.5	2.0%
Barren	20.0	0.1%	59.5	0.4%
Forest	1,551.3	9.2%	8,222.7	57.2%
Pasture	2,425.1	14.4%	4,032.2	28.0%
Row Crops	11,579.0	68.9%	1,565.8	10.9%
Wetland	128.5	0.8%	47.0	0.3%
Total Agriculture*	14,004.1	83.3%	5,598.0	38.9%

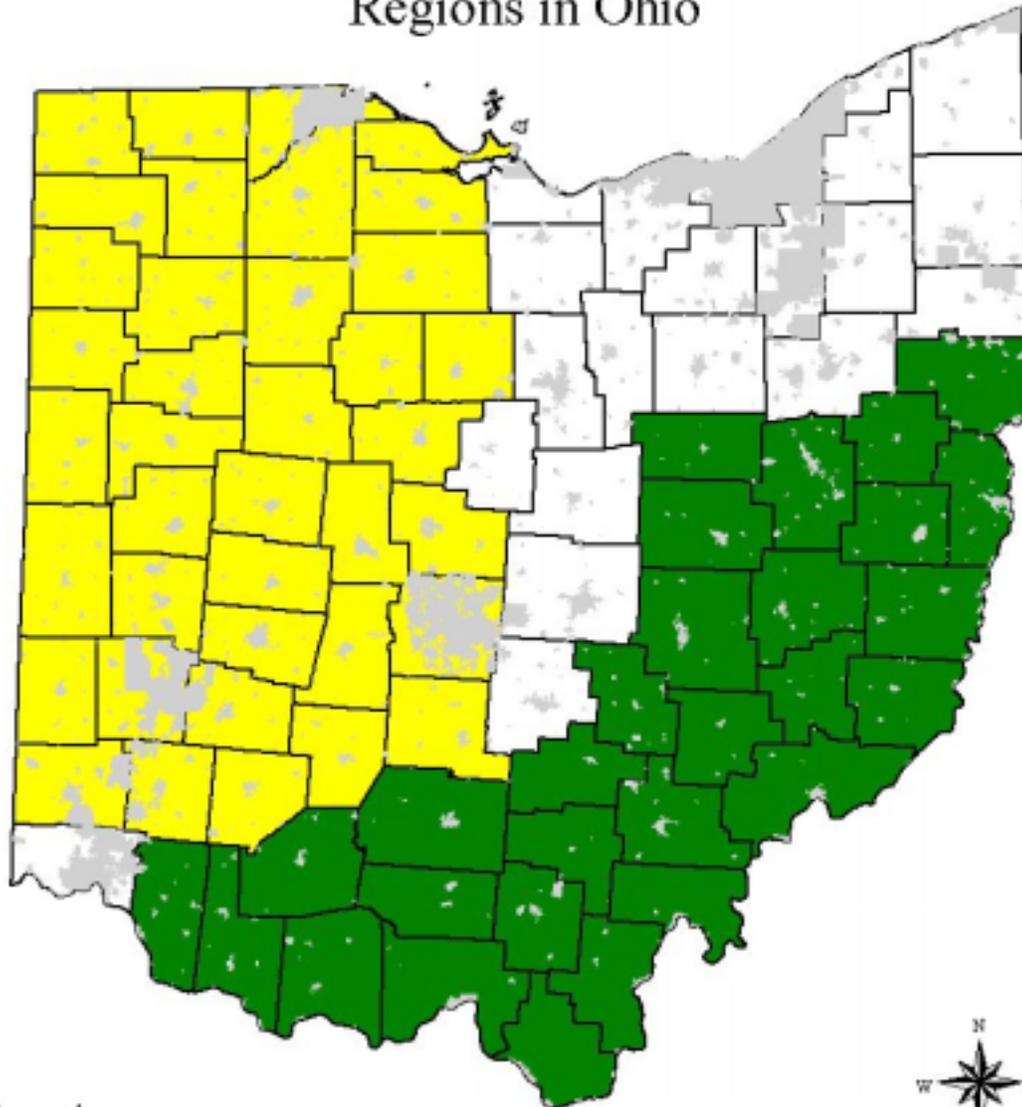
Source: Multi-Resolution Land Characteristics Consortium

** Total Agriculture represents the sum of all row crop and pasture land cover*

¹³ Boundary for the Corn Belt in Ohio was taken from “The North Center (Corn Belt) Region” in: Bouge, D. & Beale C. (1961) Economic Areas of the United States. The Free Press of Glencoe, Inc. NY, NY. (pg. 130)

¹⁴ Boundary for Appalachian counties in Ohio was dependent on county membership in the Appalachian Regional Commission, list of ARC counties found at: <http://www.arc.gov/aboutarc/region/counties.htm>

Map A1: The Corn Belt and Appalachian Regions in Ohio



Legend:

-  Cities and Villages
-  Counties
-  Appalachian Region in Ohio
-  Corn Belt Region in Ohio

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Appendix B: Sources of Data

Land Cover Data:

Early 1990's land cover data is from the National Land Cover Dataset (NLCD) produced by the Multi-Resolution Land Characteristics (MRLC) Consortium.¹⁵ These data are made freely available to the public. See Appendix C for a more detailed description of these data.

Township Population Data:

To analyze township population characteristics, sub-county level data was gathered and aggregated from the 1990 and 2000 decennial censuses.¹⁶ Data was summarized into a township database that included all townships existing in 2000 and their 100% population counts. The township data reported in this study represents all persons residing in the unincorporated land in the state and does not account for the population residing in villages or cities.

Township Land Areas:

Township land area in 2000 was calculated utilizing a Geographic Information System and the 2000 Census Tiger Files.¹⁷ Townships areas were created by overlaying minor civil division boundaries with place boundaries. After overlaying place boundaries, all residual minor civil division land was identified as township area. Area calculations were performed after creating township boundaries.

¹⁵ USGS EROS Data Center (2000) *MRLC Regional Land Cover Characterization Project –Land Cover Data for Ohio early 1990's* (Version 2000-03). Multi-Resolution Land Characteristics Consortium National Land Cover Data Program

¹⁶ Office of Strategic Research. The Ohio Department of Development (2001) 2000 Census of Population by age, race and Hispanic origin for Ohio's governmental units

¹⁷ 2000 Tiger files of places and minor civil divisions downloaded from ESRI's geography network at: <http://www.geographynetwork.com/data/tiger2000/>

Appendix C: Additional Notes on Data

The following are additional notes helpful in understanding and analyzing land cover data from the Multi-Resolution Land Characteristics (MRLC) National Land Cover Dataset (NLCD). These data are made freely available to the public. For further information, see the NLCD website: <http://www.epa.gov/mrlc/nlcd.html>.

General Information-

To create the MRLC data set, scenes from land-sat Thematic Mapper satellite images were taken over a period of time in the early 1990's and labeled by land cover type into twenty one land cover classes. Land cover classification was identified at a 30-meter resolution, meaning that land cover was identified at a scale of 30 square meters. The corresponding land cover data set uses a 30 square meter pixel size as the smallest area of identification. Along with satellite data, agricultural and census statistics, land cover maps, soil characteristics and wetland data were used to check the accuracy of the data set. More recent land sat satellite images are being collected and analyzed and will soon provide a 2000 MRLC land cover image for the United States that will enable a time series analysis of land cover change.

Temporal data problems-

The data sets used to create the MRLC land cover for Ohio were taken from land sat satellites over a period of several years. Land-sat Thematic Mapper (TM) scenes were shot between 1987 and 1994, with the majority of scenes taken between 1990 and 1992. As a result, the temporal range of the images used to create the land cover may not have captured some changes that may have occurred during this time period. This may prove problematic for some land covers which may change rapidly, for example land converted quickly to an urban use or agricultural land changing from pasture or grasses to row crops between seasons.

Data limitations-

The land cover data from Ohio used in this report have not been checked for accuracy, meaning that there may be some statistical inaccuracies that will be refined when these data undergo accuracy assessment. Readers are cautioned to keep these limitations in mind when interpreting the data and analysis reported here. In addition, readers should remember that the NLCD represents conditions in the early 1990s. For more information on the accuracy assessment process, see <http://landcover.usgs.gov/accuracy/>.

Aggregation of land covers-

The 21 categories of land cover were too detailed to use effectively for this report. Eight land cover categories were created from the original 21 land cover categories for this analysis. The following describes what land cover components were aggregated into each of the seven land cover categories used in this report.¹⁸

¹⁸ The original land cover definitions listed here are taken from the Documentation file for the early 1990's MRLC data set version 03-16-2000

Land Cover: Water

Components: (11) Open Water and (12) Perennial Ice and Snow

- Open Water - All areas of open water; typically 25 percent or greater cover of water (per pixel).
- Perennial Ice/Snow - All areas characterized by year-long cover of ice and/or snow.

Land Cover: Urban

Components: (21) Low Intensity Residential, (22) High Intensity Residential, (23) Commercial/Industrial/Transportation and (85) Urban/ Recreational Grasses

- Developed Land - Areas characterized by a high percentage (30 percent or greater) of constructed materials (e.g. asphalt, concrete, buildings, etc).
 - Low Intensity Residential - Includes areas with a mixture of constructed materials and vegetation. Constructed materials account for 30-80 percent of the cover. Vegetation may account for 20 to 70 percent of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high intensity residential areas.
 - High Intensity Residential - Includes highly developed areas where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20 percent of the cover. Constructed materials account for 80 to 100 percent of the cover.
- Urban/Recreational Grasses - Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.

Land Cover: Barren

Components: (31) Bare Rock/Sand/Clay, (32) Quarries/Strip Mines/Gravel Pits and (33) Transitional

- Barren - Areas characterized by bare rock, gravel, sand, silt, clay, or other earthen material, with little or no "green" vegetation present regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the "green" vegetated categories; lichen cover may be extensive.
 - Bare Rock/Sand/Clay - Perennially barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, beaches, and other accumulations of earthen material.
 - Quarries/Strip Mines/Gravel Pits - Areas of extractive mining activities with significant surface expression.
 - Transitional - Areas of sparse vegetative cover (less than 25 percent of cover) that are dynamically changing from one land cover to another, often because of land use activities. Examples include forest clear cuts, a transition phase between forest and agricultural land, the temporary

clearing of vegetation, and changes due to natural causes (e.g. fire, flood, etc.).

Land Cover: Forest

Components: (41) Deciduous Forest, (42) Evergreen Forest and (43) Mixed Forest

- Forested Upland - Areas characterized by tree cover (natural or semi natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25-100 percent of the cover.
 - Deciduous Forest - Areas dominated by trees where 75 percent or more of the tree species shed foliage simultaneously in response to seasonal change.
 - Evergreen Forest - Areas dominated by trees where 75 percent or more of the tree species maintain their leaves all year. Canopy is never without green foliage.
 - Mixed Forest - Areas dominated by trees where neither deciduous nor evergreen species represent more than 75 percent of the cover present.

Land Cover: Pasture

Components: (71) Grasslands/Herbaceous and (81) Pasture Hay

- Grasslands/Herbaceous - Areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25 percent, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.
- Pasture/Hay - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.

Land Cover: Row Crops

Components: (82) Row Crops

- Planted/Cultivated - Areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation accounts for 75-100 percent of the cover.
 - Row Crops - Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.

Land Cover: Total Agricultural Land

Components: Sum of all pasture land cover and all row crop land cover

Land Cover: Wetland

Components: (91) Woody Wetlands and (92) Emergent Herbaceous Wetlands

- Wetlands - Areas where the soil or substrate is periodically saturated with or covered with water as defined by Cowardin et al.¹⁹
 - Woody Wetlands - Areas where forest or shrubland vegetation accounts for 25-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.
 - Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.

¹⁹ Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe, (1979). *Classification of Wetlands and Deepwater Habitats of the United States*, Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C.