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U.S. AGRICULTURAL TILLAGE PRACTICES IN THE GREAT LAKES BASIN, 1988

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Agricultural runoff has long been recognized as a major source of nutrients as well as other agricultural chemicals to the Great Lakes. The International Joint Commission's Water Quality Board[1] reported in 1989 that monitored and unmonitored tributaries are the largest remaining sources of phosphorus loads to the Great Lakes. Whereas point sources of nutrients have been largely controlled through the building of waste treatment facilities and the NPDES permit program for regulation of dischargers to surface water, non-point sources of contamination remain an environmental problem. This problem can be solved, however, by implementation of Best Management Practices that preserve topsoil, increase yields, and reduce cropland runoff.

CONSERVATION TILLAGE PRACTICES

Tillage and planting practices which reduce soil erosion by wind or water are known collectively as conservation tillage. Conservation tillage practices which reduce soil erosion by water are defined as those which maintain a minimum of 30% of the soil surface covered with residue after planting. For areas subject to wind erosion, conservation tillage practices, by definition, reduce wind erosion during the critical erosion period by maintaining at least 1,000 pounds per acre of flat small-grain residue equivalent on the soil surface.

There are four main types of conservation tillage practices: No-Till, Mulch-Till, Ridge-Till, and Strip-Till. In addition, Reduced Till is defined as any other tillage and planting system not covered above that meets the residue requirement. These tillage practices differ in the level of soil disturbance and method of cultivation. The No-Till practice is recognized as providing maximum reduction of the amount of erosion. Other methods which do not attain the minimum of 30% residue on the soil surface, or 1,000 pounds residue per acre are known as conventional tillage practices. The tillage system selected by the farmer is dependent on both his circumstances (i.e. location, soil type, crop and other site-specific factors) and on his understanding of productive and prudent farming practices.

The Conservation Technology Information Center (CTIC) has compiled agricultural and tillage data for counties nationwide. CTIC, located in West Lafayette, Indiana, compiles agricultural and tillage data provided by the Soil Conservation Service on a county level nationwide. CTIC is part of the National Association of Conservation Districts. U.S. EPA 's Great Lakes National Program Office has analyzed data

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[1] Great Lakes Water Quality Board Report on Great Lakes Water Quality (1989)

from CTIC's Seventh National Survey of Conservation Tillage Practices for 1988 for counties of the Great Lakes basin[2] to show tillage trends in the Great Lakes area:

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CROPLAND IN GREAT LAKES BASIN COUNTIES

Cropland accounts for 18,540,298 acres or 18% of the total area of the Great Lakes basin counties (101,733,263 acres) (Figure 1, Great Lakes Basin Acreage). The major cropland areas of the basin are located in northwest Ohio, the Saginaw River and Bay area, and west-central Wisconsin. Figure 5 (Percentage Cropland to Total County Area) shows the distribution of cropland in the Great Lakes Basin counties. Corn is the largest crop in the basin with a total of 7,784,348 acres (42%), followed by soybeans with 4,519,231 acres (24%) and small grains with 3,139,986 acres (17%) (Figure 2).[3] Figure 6, Figure 7, and Figure 8 show the distribution of corn, soybeans and small grains production in the Great Lakes basin counties. Major corn growing areas are located in east-central Michigan, south-east Michigan and northwest Ohio, and in central Wisconsin. Soybean growing is based in norhtwestern Ohio and south of Saginaw Bay in Michigan. Small grains are grown largely east of Saginaw Bay in Michigan, and in south easten Wisconsin. Grain sorghum, other crops, pasture, forage crops, and fallow land account for the remaining 3,096,733 acres (17%) of cropland.[4]

GREAT LAKES TILLAGE PRACTICES

Conventional tillage practices are used far more than conservation tillage for all crops. Conservation tillage practices are used in 27% of the cropland. Mulch-Till is the most frequently used conservation tillage practice, accounting for 68% of all conservation tillage acres. No-Till is used in 24% of all conservation tillage acres. Ridge-Till and Strip-Till have only minor application in the Great Lakes basin (Figure 3). Comparison of Figures 5, 6, 7, and 8 (distributions of crop production) with Figures 9, 10, 11, and 12 (distribution of conservation tillage practices) shows graphically that Conservation Tillage practices are generally lowest in the areas of the greatest production for any particular crop.

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[2] Great Lakes counties were selected using ARC/INFO based upon 1:2,000,000 scale digital hydrography files (Table: Great Lakes counties). This list of counties includes counties not wholly within the Great Lakes Basin.

[3] Small grains includes crops such as wheat, oats, barley, rye, rice and others.

[4] Forage crops are grasses and/or legumes planted as part of crop rotation. Other crops are those not specifically listed as vegetable and truck crops, peanuts, tobacco, etc.

The corn crop is grown with a greater percentage of conservation tillage than any other crop. For example, conservation tillage is used for 38% of the total corn crop, but only 25% of the soybean crop and 20 percent of small grains (Figure 4). Conservation tillage practices account for less than 10% of all other crops grown.

Conservation tillage practices are most prevalent in corn production areas in northwest Indiana, central Wisconsin, and central Michigan (Figure 10). LaPorte and Porter counties in northwest Indiana have the two highest rates of conservation tillage use for corn production in the basin, 95.2% and 89%. On the other hand, the top eleven counties having the highest proportion of cropland to their acreage (79.7% - 68.2%) had very low rates of conservation tillage use. These counties, all in northwest Ohio, have rates of conservation tillage application ranging from 12.8% up to a high of 45.2% and averaging around 23.7%.

Kathy, work on this paragraph a bit. ..... These varying rates of conservation tillage are partly attributable to differences in soil types. Some soils with a high clay content cannot support conservation tillage practices, since the soil may become too hard to permit drainage, thereby drowning seed or denying sufficient moisture to near surface soil. During the early 1980's, USEPA-GLNPO helped to support demonstrations of conservation tillage in the Black Creek Indiana watershed, itself part of the Maumee River basin. One outcome of these studies was to show that high farm yields were obtainable in certain high clay soils, given sufficient drainage systems. Construction of such systems (e.g., parallel tile outlet terraces) is expensive and the drainage systems require the availability of outlet streams. Figure 2 does not adjust for soil types and thus does not indicate one likely reason for varying rates of conservation tillage. However, it is useful for displaying the absolute rates of conservation tillage adoption among counties.

IMPACT OF CONSERVATION TILLAGE PRACTICES UPON GREAT LAKES WATER QUALITY

The effectiveness of conservation-tillage practices upon nutrient and other agricultural chemical runoff is difficult to judge on a regional or lake-wide scale. However, recent research supported by U.S. EPA in the Lake Erie basin found no significant differences in runoff, tile flow, and pesticide losses between No-Till and fall plowing on test plots[5]. Corn-producing areas which may benefit from greater use of conservation tillage practices include northwest Ohio and east-central Michigan.

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5 Logan et al., 1989

From 1987 through 1989, USEPA-GLNPO helped to sponsor comprehensive visual surveys by the Soil and Conservation Service of conservation tillage in counties in Ohio, Indiana, and Michigan that drain to Saginaw Bay and Lake Erie. These have tended to essentially confirm traditional Soil and Conservation District "best professional judgment" estimates regarding "no till" prevalence, but indicate less adoption of other conservation tillage practices than previously estimated for these areas.

Comparison of overall crop production to conservation tillage practices use for the states of the Great Lakes basin show the following trends: .....

The states of ..., ..., ... need to play stronger roles in implementing ....

RECOMMENDATIONS

Several universities are pursuing development of remote, satellite monitoring of tillage practices that hold promise of obtaining more precise estimates in the future. However, differing estimation methods over time and around the Great Lakes basin tend to make district-by-district comparisons and historical trends somewhat problematic. Support appcication of remote sensing technologies to secure up to date information on crops, and tillage practices employed. This would help to

Continue to support CTIC, and continuosly monitor agricultural trends in the Great Lakes basin.

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Figure 1.

GREAT LAKES BASIN ACREAGE

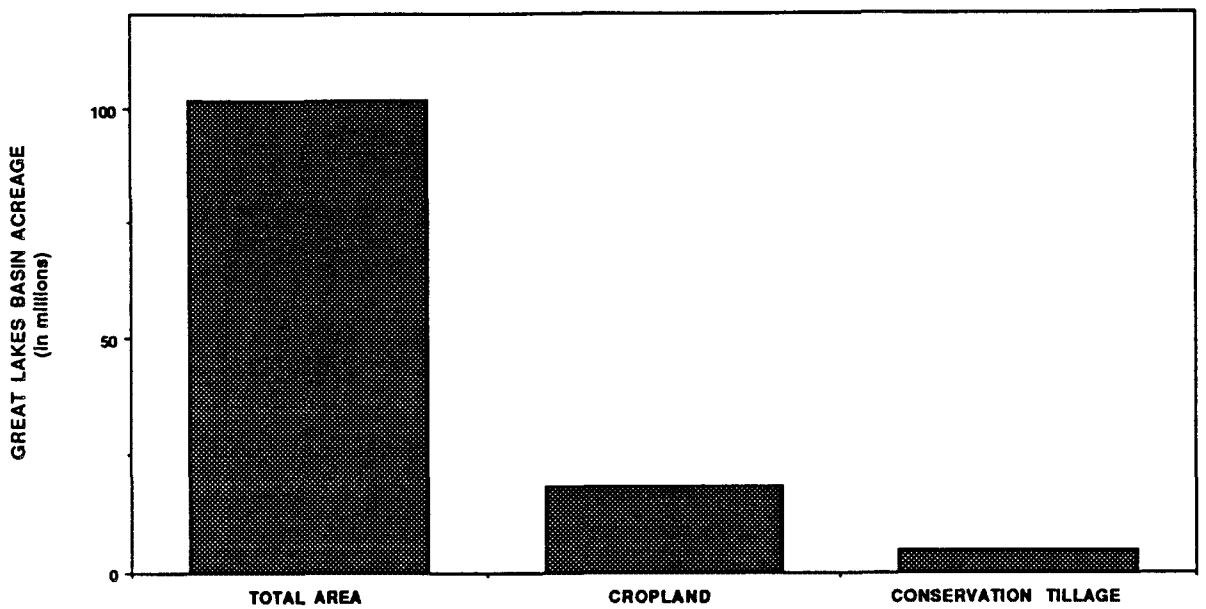

Figure 2.

CROPLAND IN GREAT LAKES BASIN COUNTIES

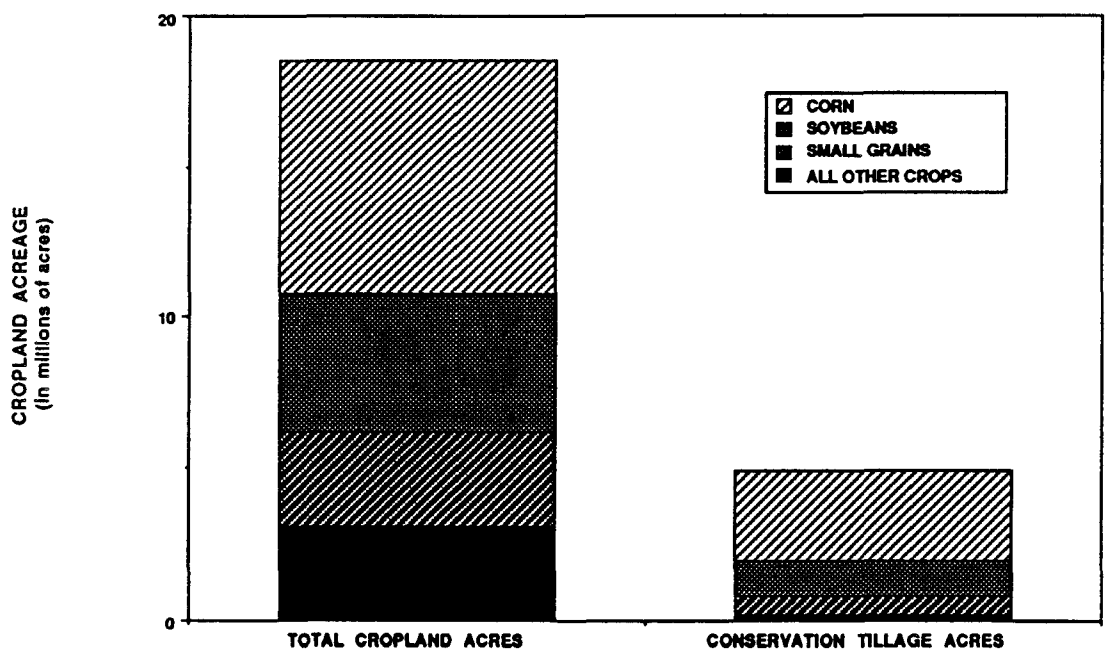

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Figure 3.

CONSERVATION TILLAGE PRACTICES IN GREAT LAKES BASIN COUNTIES

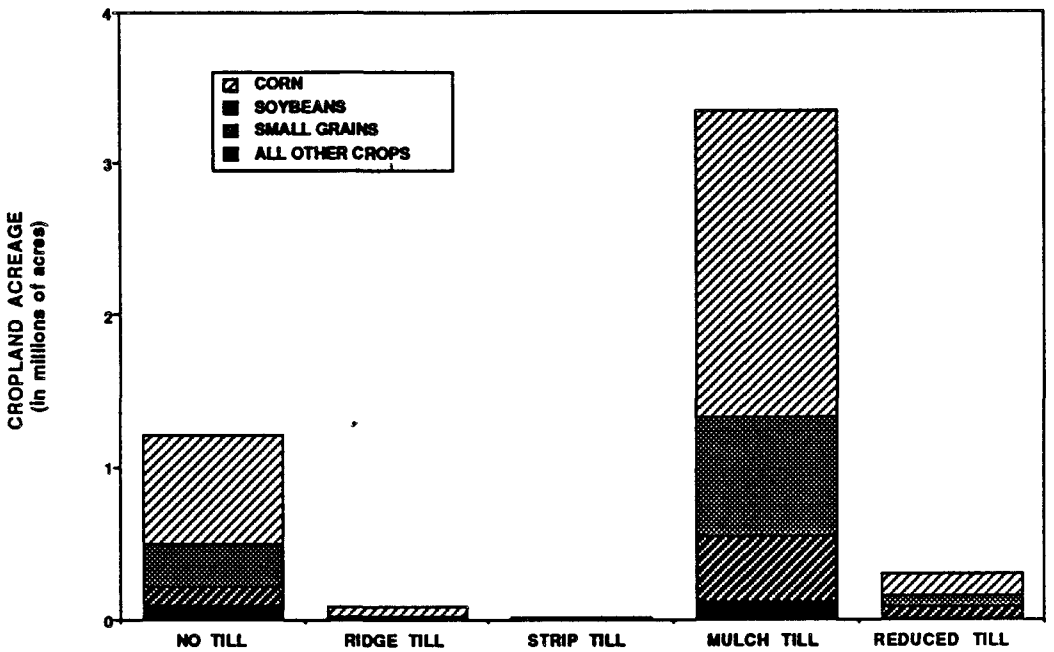
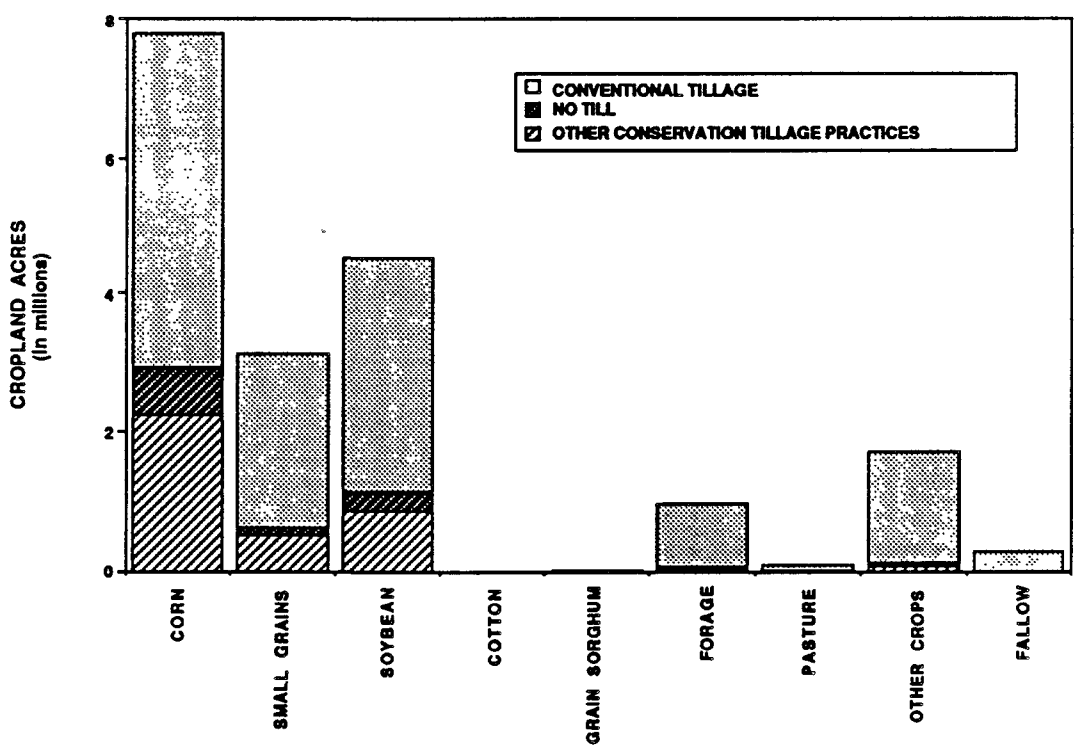


Figure 4.

TILLAGE PRACTICES IN GREAT LAKES BASIN COUNTIES (by crop)



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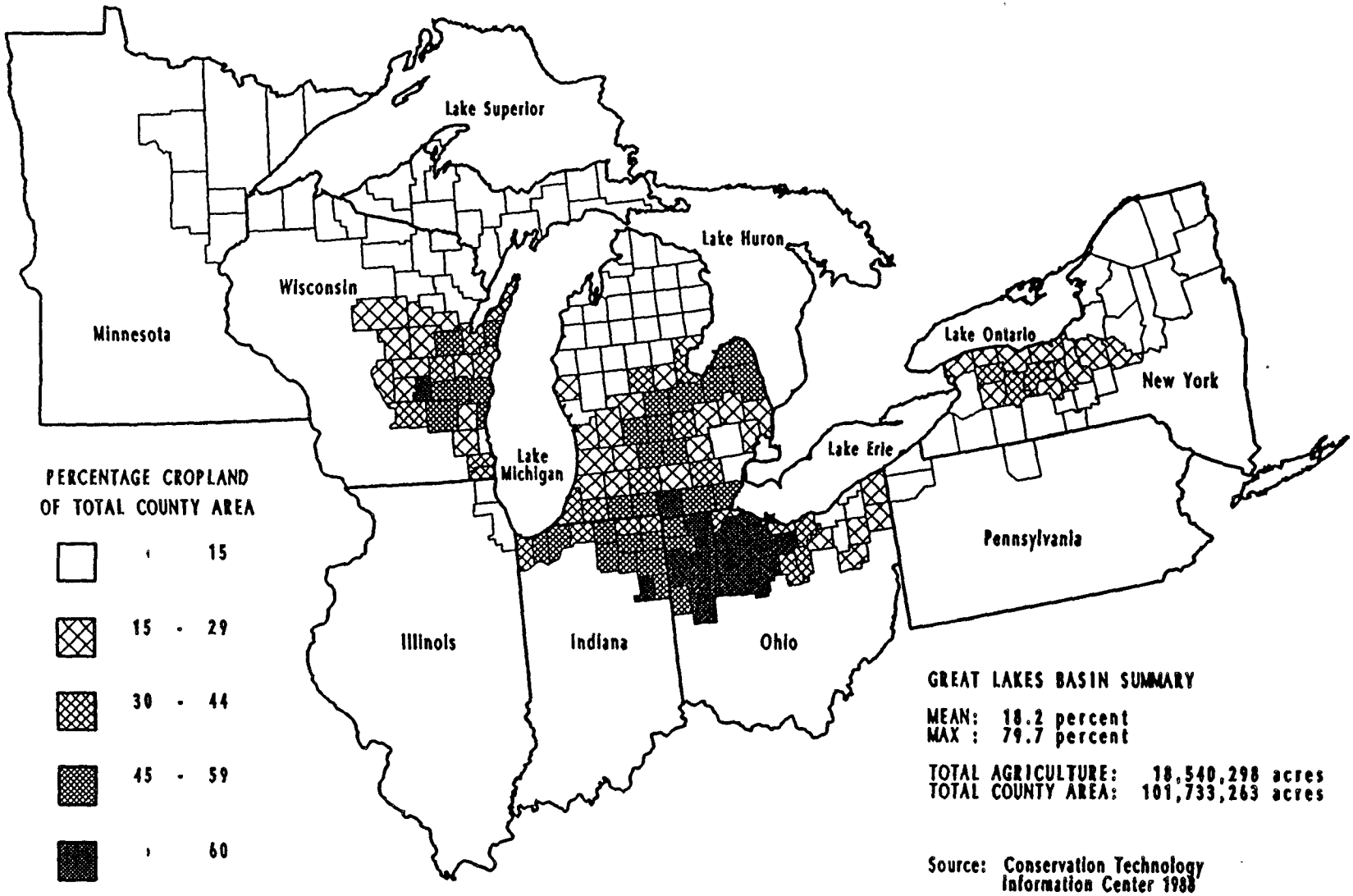

GREAT LAKES BASIN SUMMARY

MEAN: 18.2 percent
MAX : 79.7 percent

TOTAL AGRICULTURE: 18,540,298 acres
TOTAL COUNTY AREA: 101,733,263 acres

Source: Conservation Technology Information Center 1988

Figure 6

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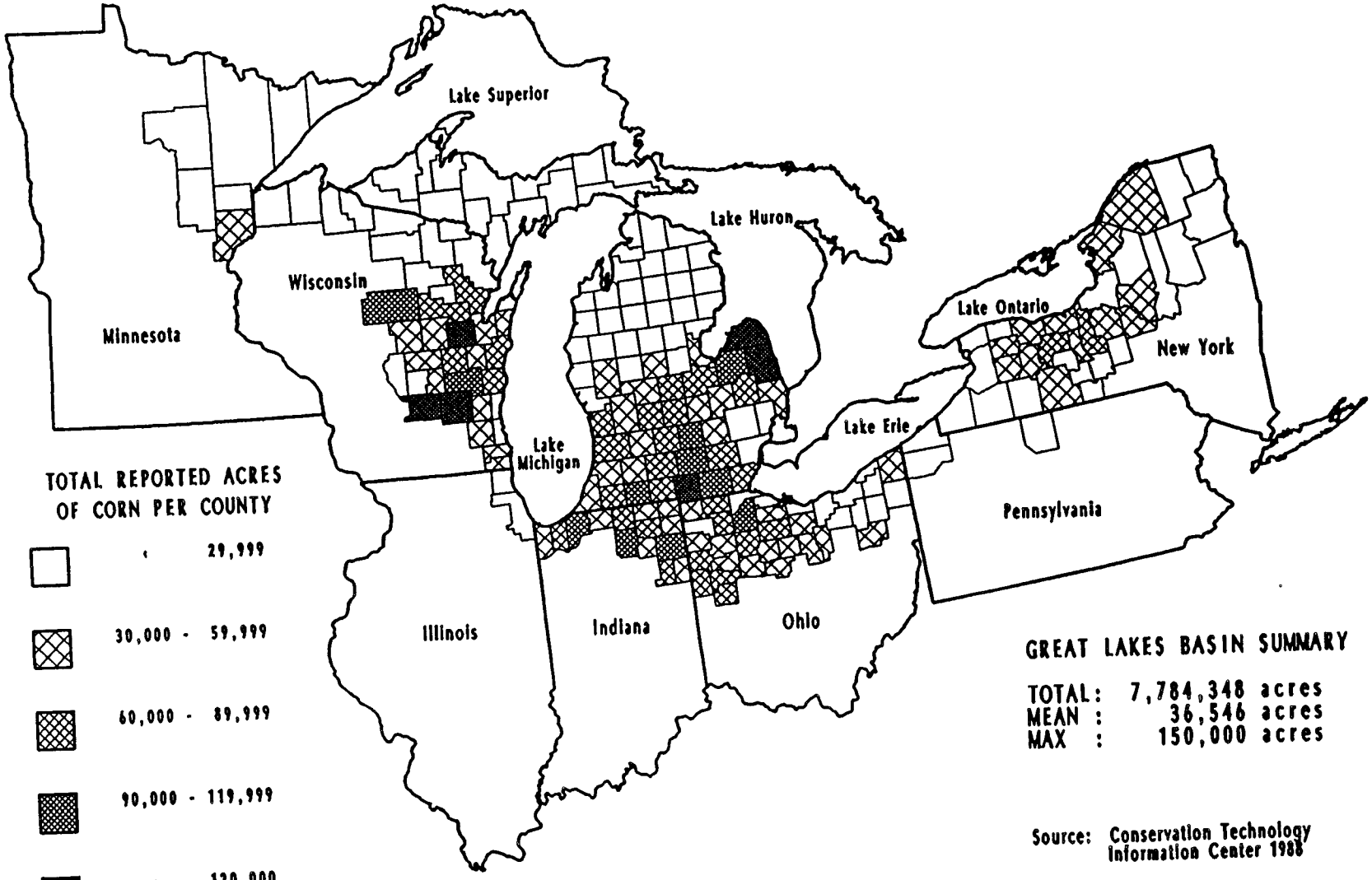

GREAT LAKES BASIN SUMMARY

TOTAL: 7,784,348 acres
MEAN : 36,546 acres
MAX : 150,000 acres

Source: Conservation Technology Information Center 1988

Figure 2

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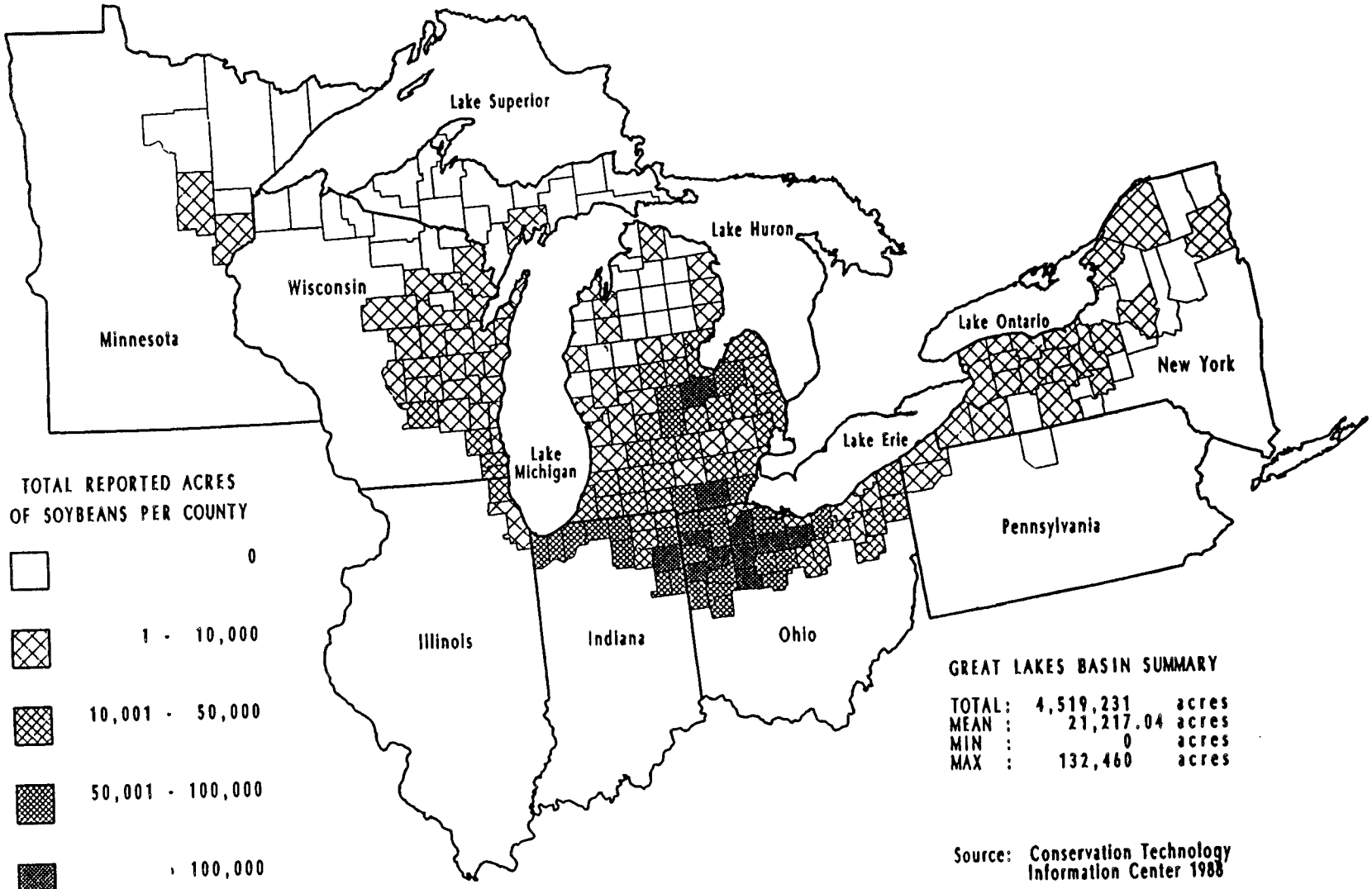

GREAT LAKES BASIN SUMMARY

TOTAL:	4,519,231	acres
MEAN :	21,217.04	acres
MIN :	0	acres
MAX :	132,460	acres

Source: Conservation Technology Information Center 1988

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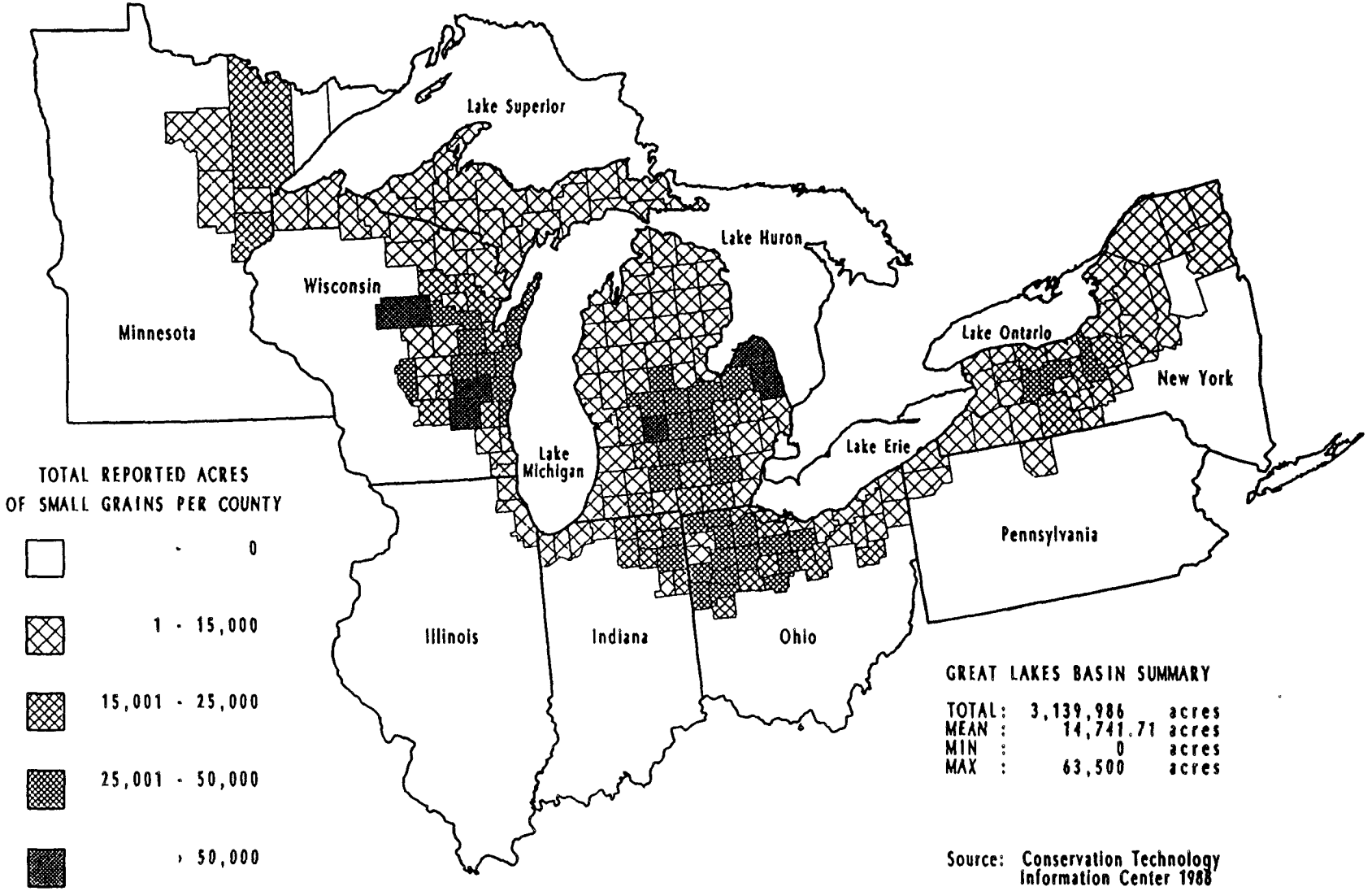

GREAT LAKES BASIN SUMMARY

TOTAL:	3,139,986	acres
MEAN :	14,741.71	acres
MIN :	0	acres
MAX :	63,500	acres

Source: Conservation Technology Information Center 1988

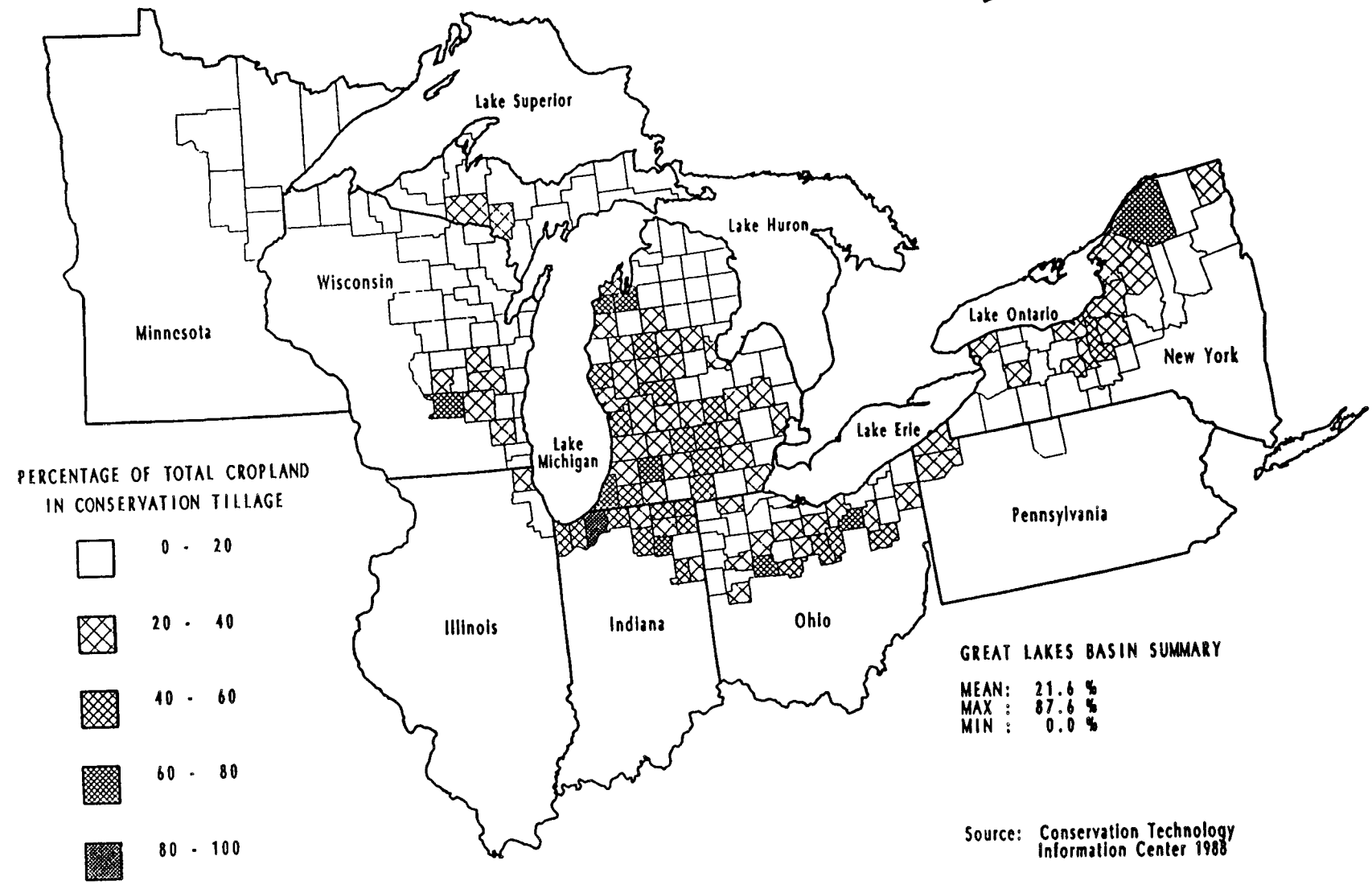
Lake Superior
Lake Huron
Wisconsin
Minnesota
Lake Ontario
New York
Lake Erie
Lake Michigan
Pennsylvania
Illinois
Indiana
Ohio
PERCENTAGE OF TOTAL CROPLAND IN CONSERVATION TILLAGE
0 - 20
20 - 40
40 - 60
60 - 80
80 - 100
GREAT LAKES BASIN SUMMARY
MEAN: 21.6 %
MAX : 87.6 %
MIN : 0.0 %
Source: Conservation Technology Information Center 1988

Figure 4-6

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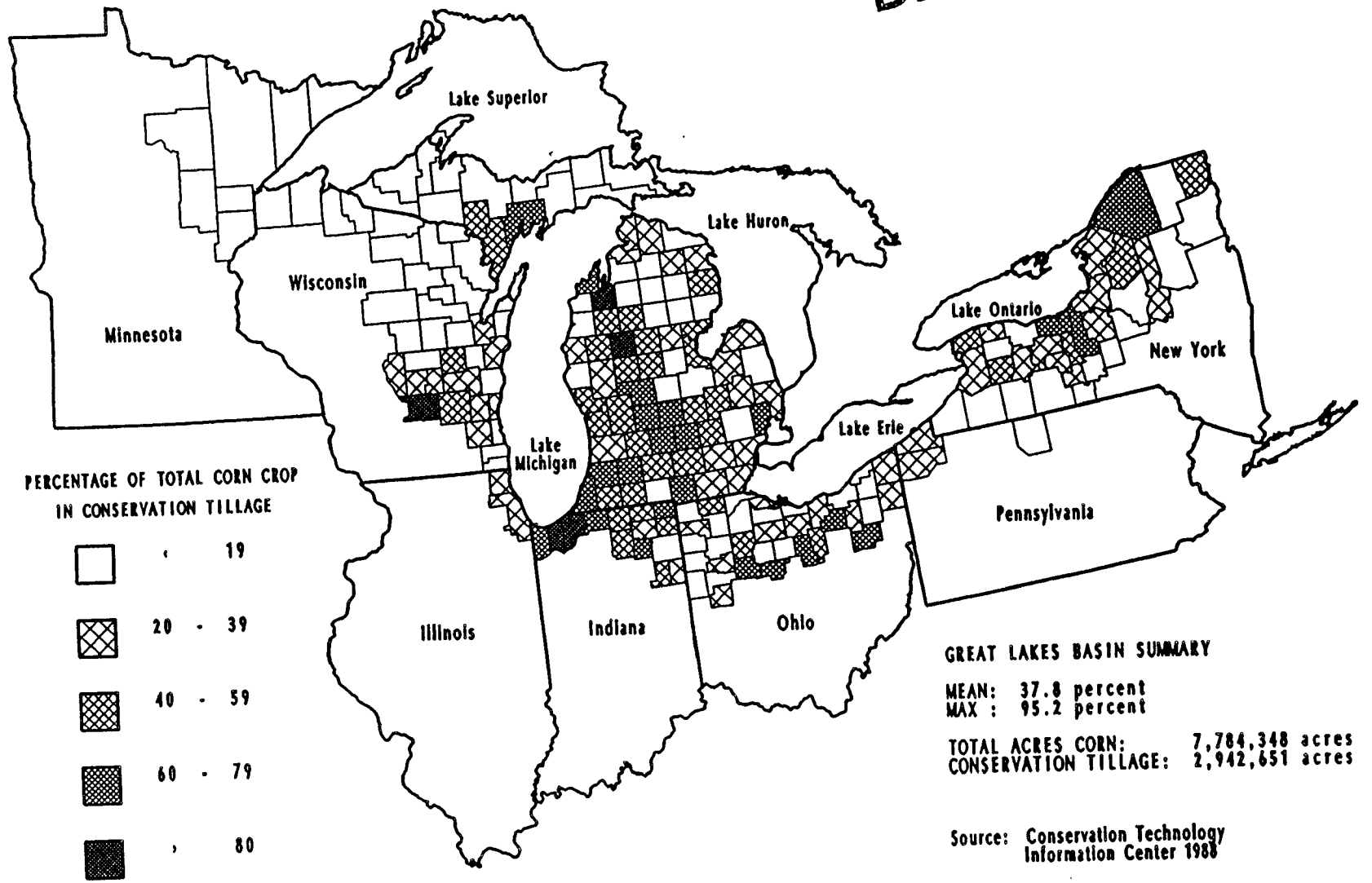

GREAT LAKES BASIN SUMMARY

MEAN: 37.8 percent
MAX : 95.2 percent

TOTAL ACRES CORN: 7,784,348 acres
CONSERVATION TILLAGE: 2,942,651 acres

Source: Conservation Technology Information Center 1988

Figure 11

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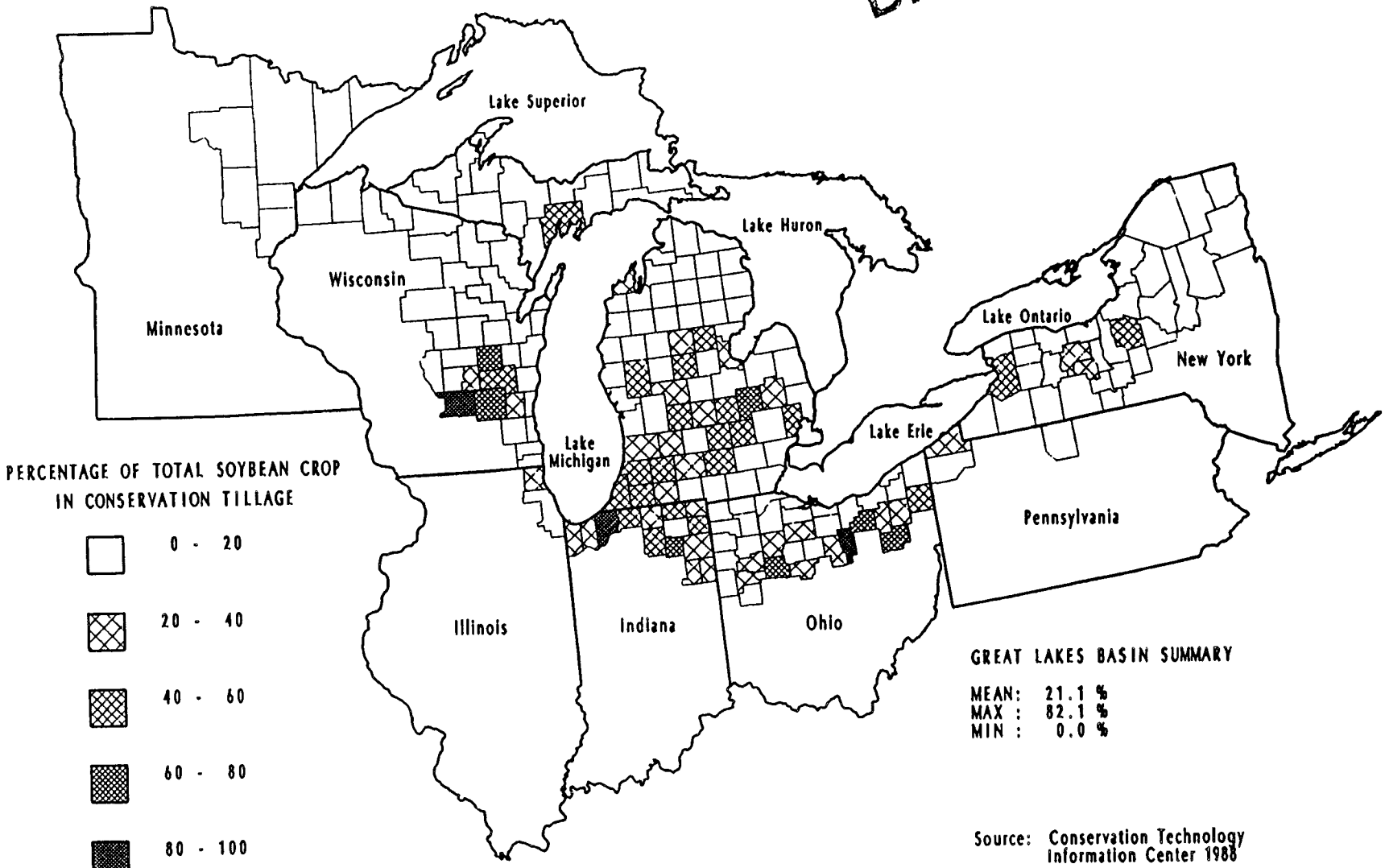

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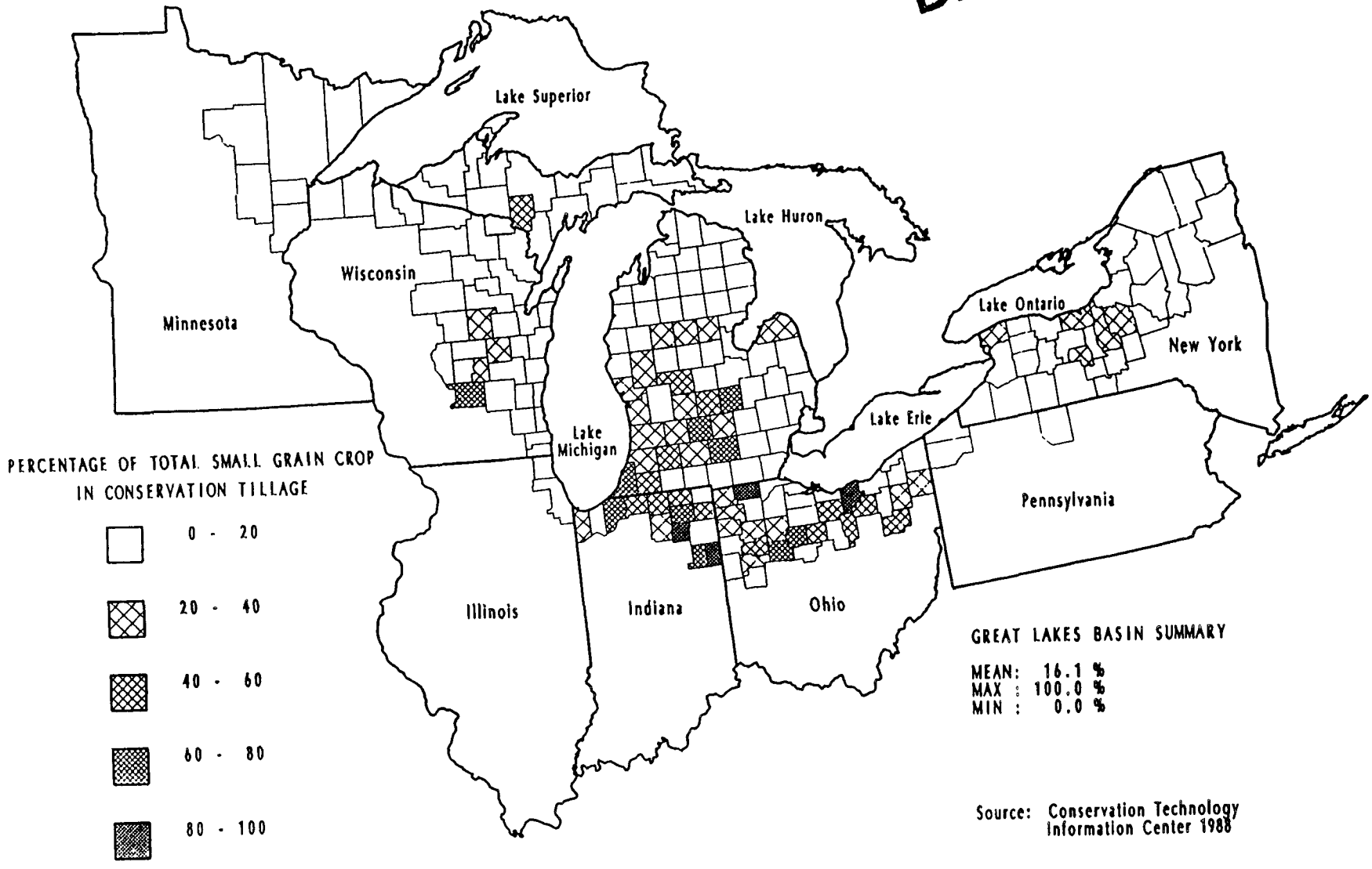
Lake Superior
Lake Huron
Wisconsin
Minnesota
Lake Ontario
New York
Lake Michigan
Lake Erie
Pennsylvania
Illinois
Indiana
Ohio
PERCENTAGE OF TOTAL SMALL GRAIN CROP IN CONSERVATION TILLAGE
0 - 20
20 - 40
40 - 60
60 - 80
80 - 100
GREAT LAKES BASIN SUMMARY
MEAN: 16.1 %
MAX : 100.0 %
MIN : 0.0 %
Source: Conservation Technology Information Center 1988