Some Effects of Glaciation Upon Agricultural Productivity in Morgan County

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Introduction

Crossed by both the Wisconsin and the Illinoian Glacial Boundaries, Morgan County serves well as a political unit in which to study some of the significant influences of glaciation upon agriculture. No other Indiana county has such diverse soils as does Morgan, for six of the State's major soil regions are represented. The County also has considerable diversity in physiography and topography. Portions of two major physiographic regions, the Central Lowlands Province and the Interior Low Plateaus Province, are represented. Malott[1] places parts of Morgan County in three of Indiana's physiographic regions. The diverse soils, physiography, and topography have had a profound effect upon the production pattern. Average and high corn yields, apple production, and land assessment values have been studied to determine significant glacial influences.

Glacial Influences upon Topography and Soils

Approximately one-half of the County belongs to the Norman Upland, the other half to the Tipton Till Plain; two small areas are a part of the Mitchell Plain (in the west central and southwest). Several topographic contrasts closely related to glaciation are evident in the Norman Upland and Till Plain sections. From the air it is easy to distinguish the three major physiographic subdivisions. The northern and eastern parts are level to rolling. The central and southern sections are rough, dissected upland with considerable forest cover on the slopes, ridges, and hills, together with the creek and especially the White River Bottoms, which have much cropland. The Mitchell Plain is indicated by karst or sinkhole features which suggest to one who has flown over the war zones, an area that has been subject to aerial bombing. Several commercial apple orchards border some of the rougher areas, while one of the State's important forestry projects (Morgan-Monroe State Forest) occupies the south-central rough section. While these rough areas are low in productivity, they afford good examples of relatively profitable use of rough land.

The small steep-sided streams, the larger creeks, and White River have made an intricate drainage pattern. Partly because of the diagonal

[1] Logan, W. N., Cumings, E. R., Malott, C. A., Visher, S. S., et al—Handbook of Indiana Geology, Department of Conservation, No. 21 (1922) (pp. 66-256).

course of White River, the County has about 10% of its area in fertile first and second river bottoms. This valley is broader than the present river implies. Its breadth reflects the position of White River in relation to the melting Wisconsin ice sheets. Of the tremendous volume of melt water flowing away from this glacier, White River was so located in Morgan County that it received most of it. Looking at the Morgan County portion of the White River Valley and its relation to the Wisconsin Glacial Boundary (Fig. 1), the sudden widening of the valley below the boundary gives considerable support to the conclusion that melting ice was most significant in the formation of a broad fertile valley in much of the County. However, the fact that from 50 to 100 feet

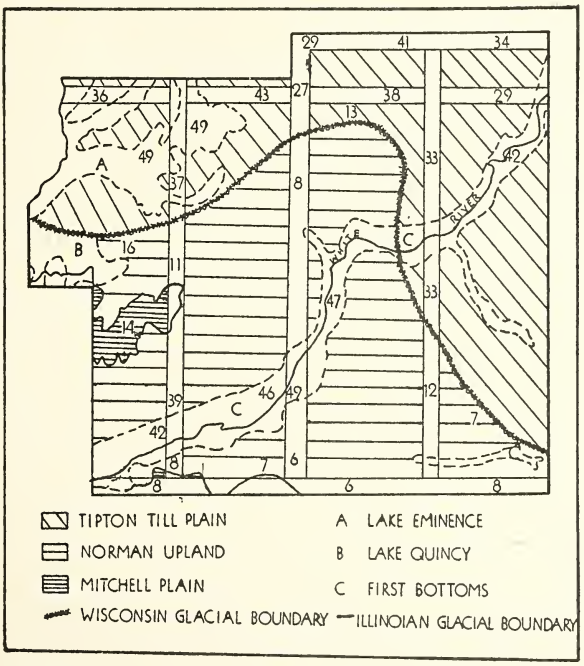

Fig. 1. Relationship between land assessment values and glaciation in Morgan County. Average dollar values per acre are based on samples of approximately 1000 acres for each location. Boundaries of the Mitchell Plain after H. P. Ulrich.

of the rock material through which White River has cut its course is easily eroded shale is of major significance.[2]

The till plain in Morgan County is more rolling than in counties immediately to the north as might be expected near the glacial margin. Likewise the thinner layer of till near the boundary means somewhat less fertile soils than those of the more deeply covered portions further

[2] Brown, R. T., 1883. Geology of Morgan County. Ann. Rept. Indiana Dept. Geol. and Nat. Hist. **13**:80.

north. Yet this glacial till has been of great importance, and underlies much of the County's best cropland. Particularly fertile is the Lake Eminence area, shown in figure 1. This former glacial lake has poor natural drainage; but artificial drainage soon opened up the area for farming. Another lacustrine flat, Lake Quincy, only a small part of which lies in Morgan County, has also benefited from the deposition of silts and clays. It is of Illinoian age, whereas Lake Eminence is within the outer Shelbyville Wisconsin Moraine. The Lake Quincy area does not have such fertile soils as does Lake Eminence because greater leaching has taken place there (12 to 15 feet). Lake Eminence deposits are leached only about five to six feet. This lake bed, with an area of some 30 square miles, is one of two fertile areas; the other is the White River Bottoms.[3]

Land assessment values reflect local contrasts in the potentiality for production of various crops. In figure 1 some of the relationships between physiography, topography, and land values are shown. The value per acre of farms sampled in making this map are from the land assessment values of 1932 (the last official land assessment); consequently these values are very low compared with value per acre for which land now usually sells. However, there is little reason to believe that the relative values have changed drastically, although the hilly areas (because of more rapid loss of fertility) have become somewhat relatively less valuable than the more level parts of the County. The north-south land assessment value profiles clearly indicate where the more fertile level land lies in comparison with the less fertile rough parts. In north-south profiles the abruptness is evident in every instance, indicating sudden rather than gradual transitions between hilly, less fertile areas and rolling to level, more fertile sections. For example, the average value of land for several farms situated just south of the Wisconsin Glacial Boundary in one section was $10 per acre, while for farms immediately to the north, it was $36 per acre. In the eastern part of the County the north-south contrast in land assessment values is not so great as in the central and western parts. This is due to the presence of some Indian Creek bottom land lying just south of the glacial boundary. In the eastern north-south profile, there is a steady northward increase in land values reflecting increased penetration of the glaciated region, and deeper till. The lack of abrupt changes for the White River Valley in this eastern profile indicates that the typical rolling Till Plain on both sides of the river grades into the bottom land. A greater difference exists in the north-south profiles than in those running east-west. This illustrates the fundamental role of glaciation upon the local physiography.

The diverse soils of Morgan County are especially significant in explaining the contrasts in crop yields. Most of the soils are of glacial origin. As all the soils were formed under similar forest conditions, they are normally light in color and low in nitrogen and organic materials; rainfall conditions have led to considerable leaching, particularly of lime; the soils are practically all low in nitrogen, phosphorus, and

[3] Thornbury, W. D., 1940. Glacial Lakes Quincy and Eminence. Proc. Ind. Acad. Sci., 49:131-144.

available potash. All of the soils except a few acres of muck are derived mainly from rock materials. Fine texture is a common characteristic, 85% being silt loam, 10% silty clay loams, and 5% relatively sandy.[4] The diversity is due to extent, depth, and characteristics of glacial deposits; time that leaching and stream dissection has been in progress; and difference in parent materials and drainage conditions during soil formation.

Four soils, comprising about 17% of the total acreage, are especially productive. The fertile Brookston and Cope series are situated in the northwestern part of the County adjacent to the productive and compact Toledo soils of Lake Eminence. This area of some 5,000 acres (Toledo) is equalled in fertility by most of the Genesee soils, although the latter have some less fertile phases. Some 20,000 acres of bottom land, principally along White River are very productive. In contrast to these fertile soils, which are among the most productive in the State, Morgan County has large areas of poor soils. The Muskingum and Cincinnati soils, which comprise 21% of the County's soils, are relatively infertile. Between these highly fertile and infertile soils are the remaining soils. The Russell, Fincastle, and Miami soils of the Till Plain comprise 28% of the soil area and are above average in productivity, but are not so fertile as the Toledo, Genesee, Brookston, and Cope soils.[5] The considerable acreage of relatively infertile Cincinnati and Muskingum soils aids in explaining the middle-of-the road position of the County in most phases of agriculture.

Glacial Influences and Corn Yields

Average yields: Morgan County ranks among Indiana's 92 Counties, 54th in total corn acreage and 46th in production (1934-43 average); the principal limitations are soils and topography. Corn occupies one-fifth of the total acreage of the County, but over one-half of the cropland. Only one other County (Pike) has a greater proportion of its cropland in corn. The wide White River bottoms and glacial Lake Eminence are largely responsible; there the natural fertility is sufficient to permit a short rotation with corn as the major crop. The relatively high rank (28th, see Fig. 2) of Morgan among Indiana counties in average corn yields is due to the natural productivity of these two areas. Of the 27 counties outranking Morgan in average yields, 22 have more of their area within the Till Plain than does Morgan—a telling point for the highly beneficial effects of glaciation in central Indiana.

Average corn yields correlate with soil and topography. The highest yields are in the Lake Eminence area with an average yield of 65 bushels per acre in 1945. Next in rank was the County's northern margin where the Till Plain commences to take on the characteristics typical of

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[4] Ulrich, H. P. and Assistants, 1937. Soil Survey of Morgan County, Purdue University, p. 95. To be published by the U. S. Dept. of Agriculture.

[5] Ulrich, *op. cit.* This summary discussion has been largely based on a soil map and acreage table prepared by Ulrich.

central Indiana. Here yields averaged 57 bushels per acre. The central portion of the Till Plain (not including the White River Valley) and the 2nd bottoms of White River have average yields of about 51 bushels, showing a progressive decline from north to south which correlates with the decrease in the depth of the Wisconsin drift. The overflow bottoms of White River have a "spotty" distribution of yields, which can be attributed to soil contrasts. The average was 53 bushels in 1945.

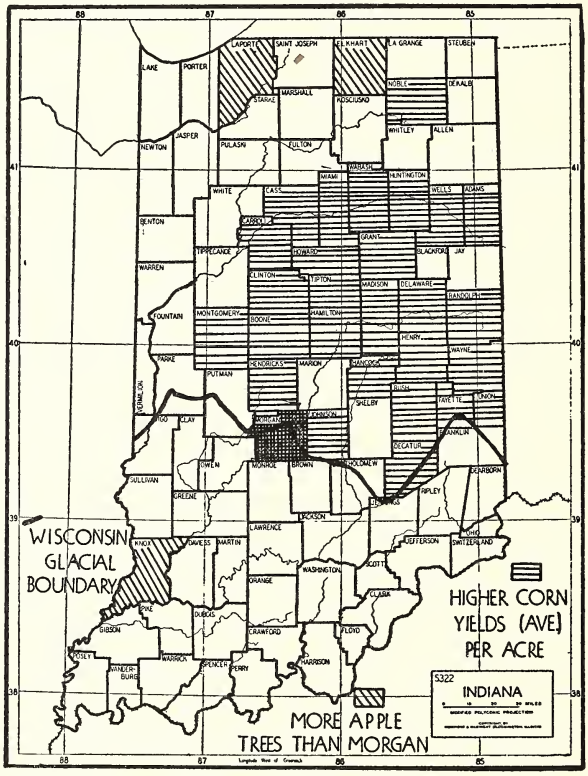

Fig. 2. Morgan County's rank in corn yields (1934-43 average) and number of apple trees (1940 census). Corn yields compiled from Annual Crop Summaries prepared by Department of Agricultural Statistics, Purdue University.

For the rough southern part of the County, average yields were comparatively low (44 bushels); the corn acreage there is small.

High yields: A study of corn yields of 100 bushels or more from 1934-1944 made by farmers who have entered the five-acre contests of the Indiana Corn Grower's Association reveals further notable influences of glaciation upon agricultural production. Within Morgan County climatic contrasts are almost absent; therefore the distribution of high yields are explained by other factors. Figure 3, showing the

distribution of high yields, shows a concentration in two areas: (1) glacial Lakes Eminence and Quincy and (2) the first and second White River Bottoms. Five-sixths of the high yields were made on soils that make up only one-sixth of the total area. Most of the remaining high yields were made on creek bottom soils. Approximately one-half of the soil area having exceptional yields are subject to overflow, which strongly suggests that Morgan County would rank much lower but for the alluvial materials transported from Wisconsin till areas. For 1934-44 Morgan ranks in the upper one-third among Indiana counties in high yields but has a slightly lower position than for average yields (Fig. 2). That Morgan County is surpassed by such counties as Martin, Davies,

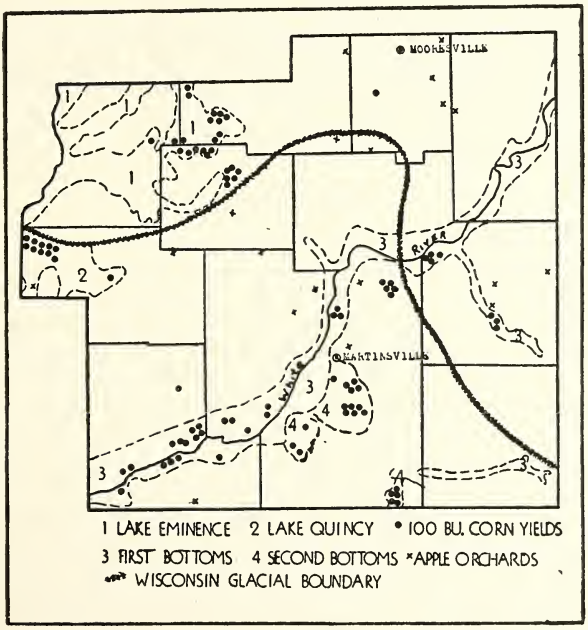

Fig. 3. Location of high corn yields (1934-44) and commercial apple orchards in Morgan County.

Green, and Clay in the number of 100 bushel yields, but that these counties have considerably lower average yields, further illustrates the production capabilitis of alluvial soils.

About one-half of the high yields were produced on the Genesee, Eel, Toledo, and Fulton soils. The Martinsville, Philo, Russell, and Crosby soils have also produced exceptionally high yields. All of these soils are better than average, and no 100 bushel yields were obtained on soils below the average in productivity. These more productive soils are all directly or indirectly related to glaciation. The lacustrine deposits in the northwestern part of the County have made especially fertile soils once they were drained. Some of this area is subject to overflow which

has aided in maintaining fertility. The White River bottom soils have been transported from the fertile Wisconsin drift area, which largely explains their fertility. The upland soils formed from Illinoian drift are less fertile than those in the Wisconsin drift area; however some of the bottom soils formed mainly from transported Illinoian drift materials have contributed high yields.

As most of Morgan County's soils lack sufficient natural fertility for 100 bushel yields, considerable commercial fertilizer and lime are used. Questionnaire returns reveal that commercial fertilizer was used in producing three-fourths of the 100 bushel yields, and lime had been applied to one-half of the fields. Significant contrasts in the use of fertilizers are apparent. In the First White River bottoms only one-eighth of the high yields were grown on fertilized fields. On the Second bottoms, beyond the range of floods, practically all of the high yields were produced on fertilized fields. Similarly, the 100 bushel yields on upland soils and on the lacustrine soils are commonly fertilized. Hence the distribution of high yields in Mogran County correlates closely with glaciation.

Apple Orchards

Morgan County's high rank in apple production has an interesting relation to geographic factors. Only three Indiana counties surpass Morgan in the number of apple trees of bearing age (Fig. 2). Three factors have been especially significant in promoting orchards: (1) sufficient slopes to permit air drainage, (2) soils of adequate fertility on slopes and ridges, and (3) good location in respect to markets and shipping facilities. Figure 3 shows the location of the principal apple orchards. Most of the orchards are located on the more rolling parts of the Till Plain or near the Wisconsin Glacial Boundary. This distribution suggests that soils above average in fertility found in conjunction with slopes sufficient to provide air drainage are an important requirement for good orchard sites in a region having considerable frost hazard. Morgan County has numerous locations wth favorable air drainage, but many of these lack fertile soils. The orchards are concentrated on the Russell, Crosby, Miami, and the better phases of the Cincinnati soils, all of which are relatively good upland soils.

An exceptionally favorable orchard site is situated in the north central part of the County just south of the glacial boundary. Here an upland area is bordered on the north by a steep slope which was once the shore of Lake Eminence. Other good orchard sites are on the rolling uplands to the southeast, west, and southwest of Mooresville. The County's largest orchard is located west of Mooresville where rolling uplands grade into the almost level Till Plain to the north and into the rough morainic area to the south. While differences in elevation are not great, there are sufficient contrasts to lessen appreciably the hazards of late spring frosts. Glaciation has been largely responsible for the topography which permits good air drainage and soils.

Conclusions

Four conclusions are: (1) Land assesment values in Morgan County correspond closely to differences in topography and soils. Location is a secondary factor. (2) Land values and average corn yields increase northward with increase in amounts of glacial till. (3) High corn yields are heavily concentrated in the glacial lakebeds and river bottoms; both of which have especially benefited from glaciation. (4) The combination of above average soils and favorable air drainage, and proximity to Indianapolis with its large market largely explains Morgan County's high rank in apple production; again the glacial influence is highly significant.