Some Comparisons of Population Distribution in the Middle West in 1950

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Although variations in population density are among the most fundamental aspects of human geography, geographers have been surprisingly slow in coming to grips with the problem of describing these variations objectively and quantitatively. We have prepared accurate maps of the distribution of population in many parts of the world, but in seeking to describe and explain these maps we have often taken recourse to such subjective generalities as "densely populated" or "sparsely populated" for the description of broad areas, and within these areas we have tended to ignore considerable local variations in density.

This paper is a report of progress to date, and of questions for future investigation, in an attempt at description and partial explanation of the distribution of population in a block of nine States in the Middle West. This area was chosen primarily for its convenience, however, and the basic goal of the project is the formulation of generic principles relating to pop-

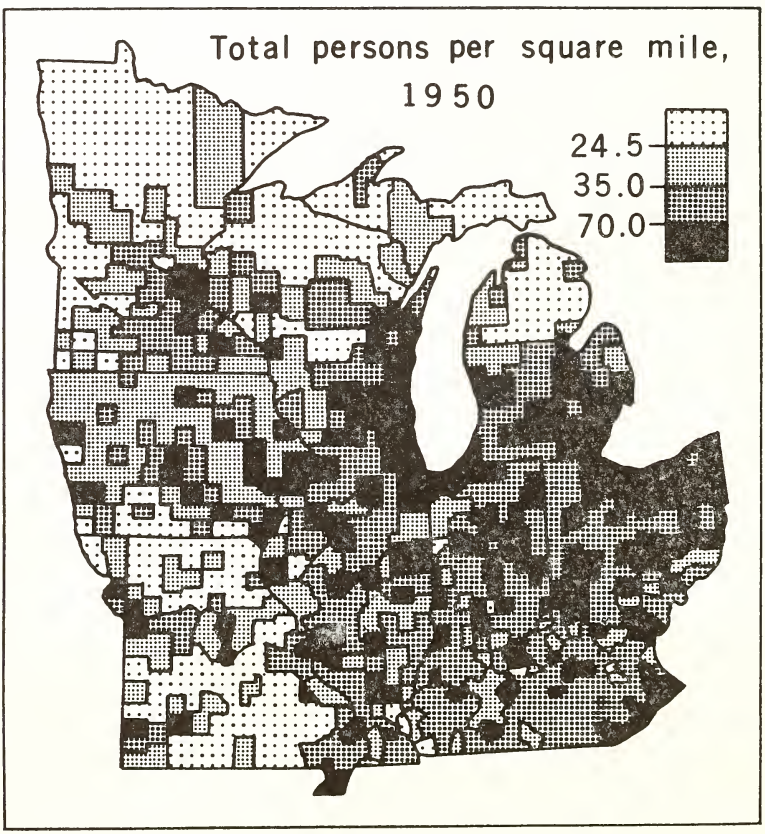

Fig. 1

ulation distribution in the entire United States, and perhaps in other areas as well. Nevertheless, those phases of the project which were based upon the data of the *1950 Census of Population* (1) were halted in view of the imminent availability of 1960 data, and this paper must be considered simply as a progress report.

The map of total population density has such a complicated—almost kaleidoscopic—pattern of high, intermediate, and low densities that it virtually defies simple description (Fig. 1). But is it not possible that the complex variations of this pattern, like the pattern of the kaleidoscope, are simply the product of variations in a number of simpler patterns superimposed one upon another? And if so, is it not possible that we might better be able to describe the complex pattern if we resolve it into its simpler components? If, for example, we understand the factors which influence the spatial variations of any one component of the population, we thereby approach a better understanding of spatial variations in total population density.

A fundamental problem in preparing and describing a map of total population density is the extremely wide range of actual densities, from virtually uninhabited areas to densely populated urban districts. Twenty-nine of the 856 counties in this area had fewer than ten persons per square mile in 1950, yet ten counties had more than 1,000; Cook County, Illinois, had 4,726 persons per square mile, but Cook County, Minnesota, had only 2.1!

This tremendous range is partially the product, I suggest, of the superimposition of two quite different patterns of population distribution. One pattern is essentially clustered, point-oriented, and highly concentrated in space, with large empty areas between points—or small areas—of extremely dense population. The other pattern of distribution is more uniform, with far less areal variation. For want of better terms I refer to the first pattern as "urban" and to the second as "rural," but I must emphasize that I use these terms with specific reference to different patterns of population distribution, and not in the official Census sense.

But we must rely on Census data in order to resolve these patterns; that is, to determine the actual numbers and the precise location of those people who are distributed in a point-oriented pattern, and those who are distributed in a pattern of regional uniformity. How can we best use Census data for this purpose?

For most of the point-oriented population the solution is comparatively simple, for the Census publishes data on the number of persons in all places of 1,000 or more persons, and for all incorporated places, no matter how small they may be. Certainly *these* places should be mapped separately, with point symbols. The explanation of their distribution, I suggest, might well be one of the products of research in central place theory. Admittedly some of these "points" are of considerable size—the Chicago Urbanized Area in 1950 covered almost 650 square miles—but I suggest that they nonetheless be considered points in the formulation of a theory of population distribution.

In 1950 just over twelve percent of the total point-oriented population of this nine State area was classified in the rural nonfarm category by the Bureau of the Census. These are the people who lived in large villages,

TABLE 1

Population by Place of Residence, 1950, in Nine Middle Western States

	Total	Urban	Rural Nonfarm			Farm Rural
			Places of 1,000 to 2,500 Persons	Incorporated Places of Less Than 1,000 Persons	Unagglomerated	
Minnesota	2,982,483	1,624,914	197,003	205,271	215,496	739,799
Iowa	2,621,073	1,250,938	190,887	272,453	124,145	782,650
Missouri	3,954,653	2,432,715	169,579	187,007	301,856	863,496
Wisconsin	3,434,575	1,987,888	184,476	151,239	385,738	725,234
Illinois	8,712,176	6,759,271	319,066	304,314	566,329	763,196
Michigan	6,371,766	4,503,084	248,713	112,649	812,578	694,742
Indiana	3,934,224	2,357,196	177,111	142,601	590,162	667,154
Ohio	7,946,627	5,578,274	292,311	229,290	993,664	853,088
Kentucky	2,944,806	1,084,070	155,316	75,659	655,591	974,170
TOTAL	42,902,383	27,578,350	1,934,462	1,680,483	4,645,559	7,063,529

Source: U. S. Census of Population: 1950. Vol. II, Characteristics of the Population.

of 1,000 to 2,500 persons, and in *incorporated* small villages of less than 1,000 persons (Table I). I suggest that these smaller clusters of population, although officially classified as rural, are just as much a part of the point-oriented population as is the population which is officially classified as urban, and should be so treated.

I apply the term "unagglomerated" to the remainder of the rural nonfarm people, who cannot be assigned to specific locations within their respective counties on the basis of published Census data (Fig. 2). We have ample reason to suspect, however, that they also form part of a point-oriented distribution. For example, more than one third of these people—comprising more than a fifth of the total rural nonfarm population—live in counties which are included in Standard Metropolitan Areas (Table II).

Whitney's study of 20 years of change at the national level (2), Solly's study in Minnesota (3), and my own work in Georgia (4) and in Indiana (5) have all shown that a considerable proportion of the unagglomerated rural nonfarm population is concentratetd in the vicinity of urban places, but unfortunately we have little information as to the distribution of the remainder. In Indiana, however, where stringent laws control incorporation of small places, preliminary investigation indicates that a sizable percentage—perhaps as much as half—of the unagglomerated rural nonfarm people live in unincorporated small villages for which Census data are not available. Conversely, in Iowa and Missouri, where incorporation of small villages is relatively easy, most of the rural nonfarm people live in villages for which data are published, and the distribution of the unagglomerated rural nonfarm population is closely related to the distribution of urban centers (Fig. 2). Furthermore, the traditional reluctance of coal mining communities to incorporate is apparently related to the dense unagglomerated rural nonfarm population of mining areas in south-

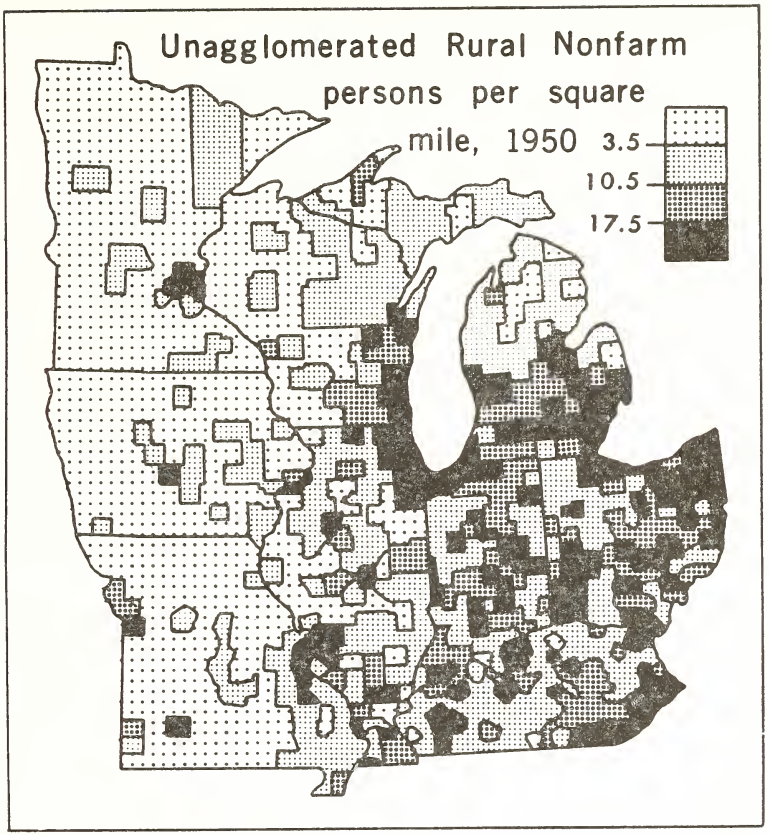

Fig. 2

eastern Kentucky, southern Illinois, southwestern Indiana, and southeastern Ohio (Table II).

In summary, then, the rural nonfarm population, like the Census urban population has a point-oriented or "urban" pattern of distribution. A considerable percentage of the rural nonfarm people are clustered in villages, and most of the rest live on the fringes of urban centers of varying sizes. The distribution of these people around urban centers reminds one of a number of conical tents of varying height and diameter, with the diameter of each tent proportional to the height of its central pole; in the same fashion, the density and extent of the rural nonfarm population around a city would appear crudely proportional to the size of the city's population.

Therefore, I suggest that if research in central place theory can provide us with a theoretical explanation of the size and distribution of urban centers, this theory should go far toward describing and perhaps explaining the distribution of one major component of population—the point-oriented population—which includes both the urban and rural nonfarm groups as defined by the Bureau of the Census.

TABLE II

Unagglomerated Rural Nonfarm Population in Counties of Standard Metropolitan Areas and in Mining Counties in Nine Middle Western States, 1950

	Total		Standard Metropolitan Areas			Mining Counties*		
	Population	No. of Counties	Population	No. of Counties	%	Population	No. of Counties	%
Minnesota	215,496	87	89,058	5	41.4	6,821	1	3.2
Iowa	124,145	99	30,783	6	24.8	.....	..	...
Missouri	301,856	115	98,771	6	32.7	10,107	1	3.4
Wisconsin	385,738	71	94,335	6	24.4	2,700	1	0.7
Michigan	812,578	83	346,261	10	42.5	41,612	5	5.1
Illinois	566,329	102	265,047	13	46.8	81,971	20	14.4
Indiana	590,162	92	171,963	9	29.0	58,634	10	9.9
Ohio	993,664	88	494,154	18	49.6	79,184	11	8.0
Kentucky	655,591	120	89,800	5	13.7	269,009	26	41.0
TOTAL	4,645,559	856	1,680,172	78	36.1	538,002	75	11.6

* Mining counties are defined as those which had at least one male-employed-in-mining per square mile, and at least five percent of the employed-male-labor-force employed in mining, in 1950.

In contrast to the point-oriented population, the distribution of the rural farm population exhibits a striking degree of regional uniformity (Fig. 3). Although there are some local variations, this regional uni-

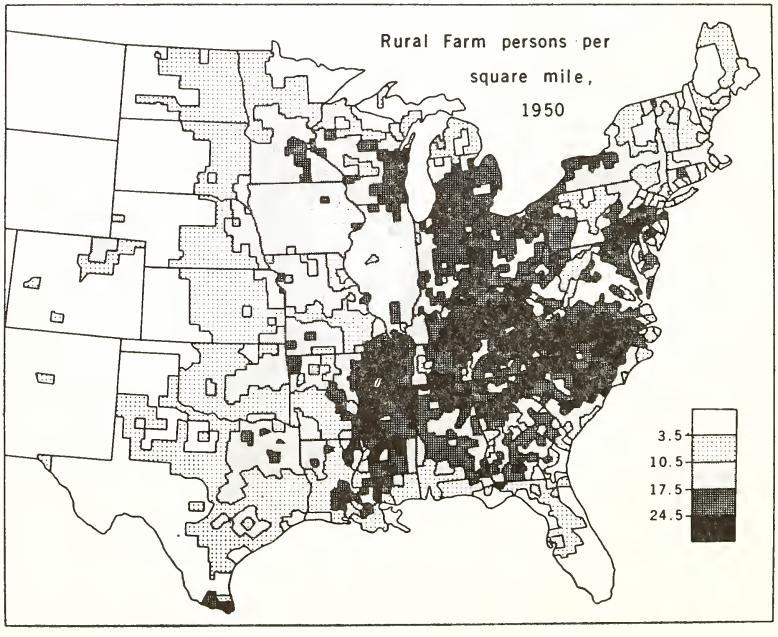

Fig. 3

formity tempts one to think of the farm population as being distributed in a series of levels, or plateaus. The lowest plateau is in northern Minnesota and Michigan, with a fairly steep rise to the next, centered in Iowa and Illinois with extensions into adjacent States. In western Indiana this second plateau rises to a third and higher plateau centered along the Indiana-Ohio line, and the third plateau rises to a fourth—still higher—in southern Kentucky.

One might hypothesize that variations in the density of the farm population are the product of variations in farm size and variations in

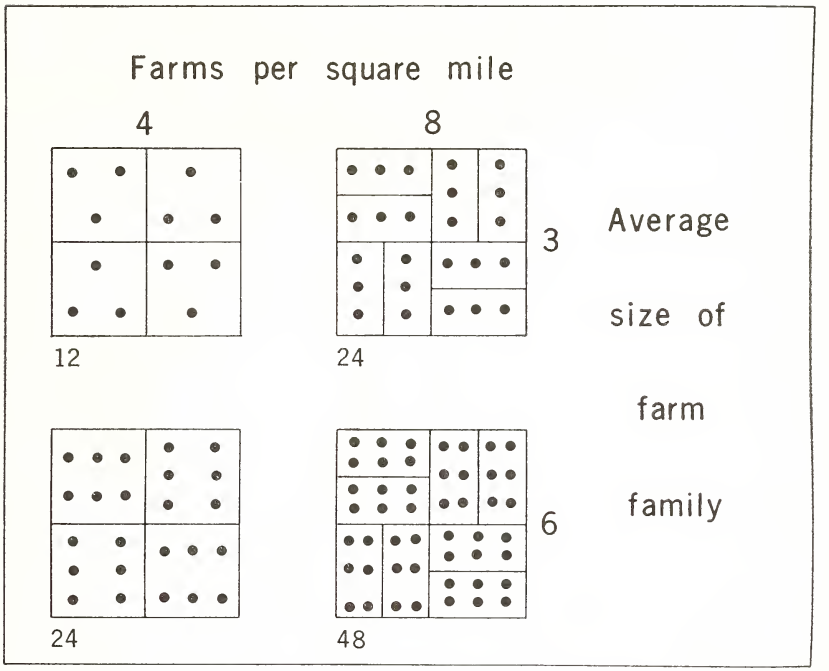

Fig. 4

the size of farm families (Fig. 4). It might even be argued that the number of farm persons per square mile could be determined by multiplying the number of persons per farm family by the number of farms per square mile, and that variations in either factor will influence the density of farm population. A farm population density of 24 persons per square mile will result, for example, *either* if there are 8 farms per square mile and 3 persons in the average family, *or* if there are only 4 farms per square mile but 6 persons in the average farm family. In short, we should be able to express variations in farm population density in terms of variations in farm size and in size of farm family.

Actually, variations in farm population density in the Middle West appear to be so closely related to variations in farm size that the two sets of data were subjected to regression analysis. The coefficient of correla-

tion for the 856 counties proved to be an impressive +0.94, with a standard error of estimate of 2.4, and a regression line with the formula:

$$y = 4.4x - 1.1$$

This means that one can estimate the farm population density of any county by multiplying the number of farms per square mile by 4.4, and then subtracting 1.1.

Residuals from regression were computed and mapped by comparing the actual farm population density, D, as taken from the *1950 Census of Population*, and the computed density, D_c, as computed by multiplying the number of farms per square mile, F, by 4.4, and then subtracting 1.1 (6).

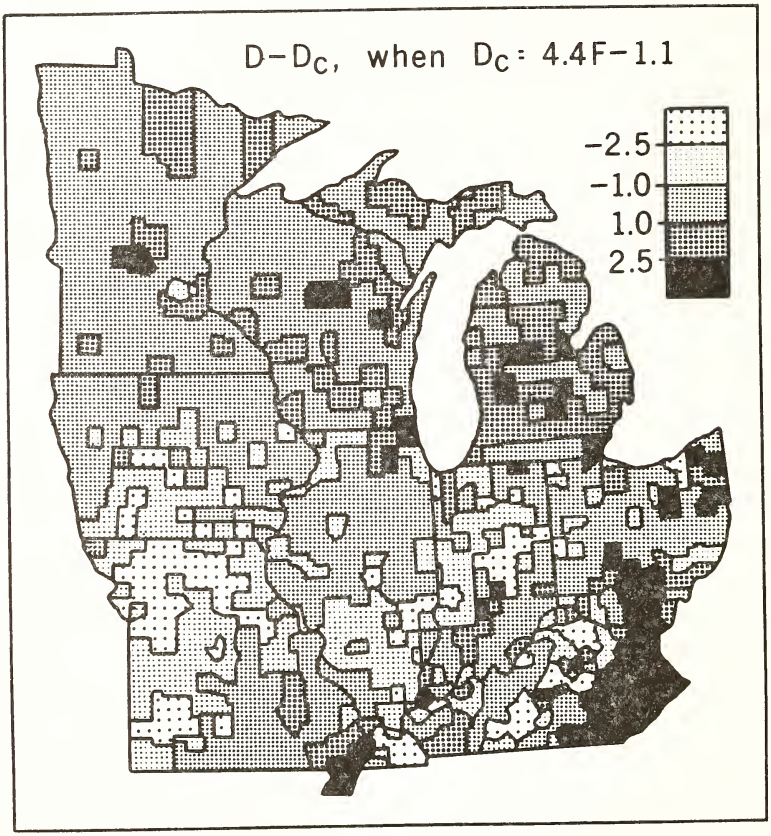

Fig. 5

A plus figure indicates that the actual density is higher than the computed density, while a minus figure indicates that the actual density is lower (Fig. 5). This formula computed the farm population density of 412 counties—almost half—to an accuracy of one person per square mile, and it computed the density of more than 80 percent of the counties to within 2.5 persons per square mile—a range of plus or minus one standard error of estimate. In other words, when we can explain variations in farm size,

we can explain a very considerable proportion of variations in farm population density in this area in 1950 (7).

The great majority of the variations that cannot be explained by the use of this formula can be explained by variations in farm family size. Unfortunately, we have no direct measure of farm family size by counties in 1950, and there are serious objections to any indirect measure that might be used. All in all, however, the median number of farm persons per occupied farm dwelling unit seems to be the least objectionable (Fig. 6).

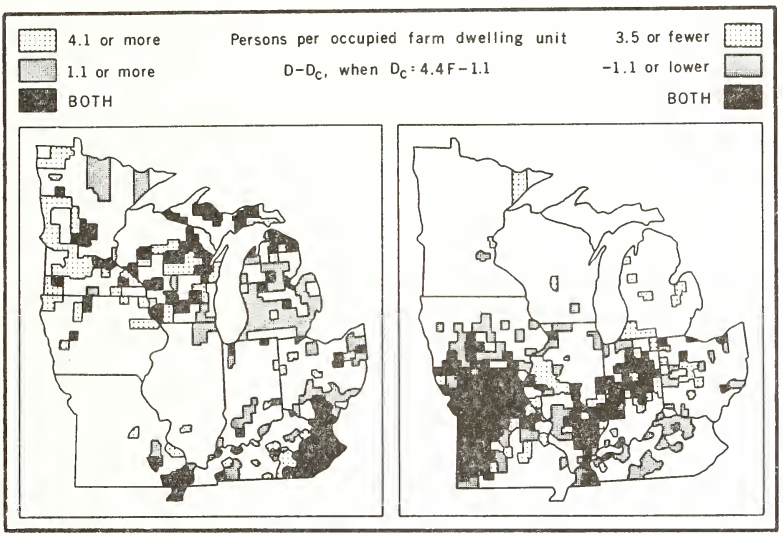

Fig. 6

Fifty-four percent of the counties whose actual farm population density was 1.1 or more persons more than the computed density also had 4.1 or more persons per occupied farm dwelling unit, whereas 59 percent of the counties whose actual farm population density was 1.1 or more persons less than the computed density also had 3.5 or fewer persons per occupied farm dwelling unit.

More significant, perhaps, is the fact that three quarters of the 160 counties which fell outside plus or minus one standard error of estimate—as computed by the regression formula—can be explained in terms of farm family size, leaving only 40 of the 856 counties whose farm population density cannot be explained in terms of variations in farm size or in the size of the farm family.

In summary, variations in population density in these nine Middle Western States apparently result from the superimposition of two different distributions. One is point-oriented, while the other has considerable regional uniformity. The latter is essentially the distribution of the farm population; its areal variations are primarily the product of variations in farm size and in the size of farm families. Superimposed upon the regional uniformity of the farm population distribution is the distribution of the rural nonfarm and urban population, which has been likened to the distribution of scattered conical tents; the density and extent of this popula-

tion around each city are crudely proportional to the size of the city's population, just as the diameter of each tent is proportional to the height of its central pole. More precise description and explanation of the distribution of the point-oriented population may be based on better formulation of principles relating to the size and distribution of places in the urban hierarchy.

This scheme of population distribution would appear to have validity for nine Middle Western States as of 1950. But how valid is it in time? And in other parts of the nation? And of the world? If it does prove fairly constant in time, how constant has been the size of farms? And the size of farm families? And if it proves fairly constant in space, is farm family size or farm size the most important factor influencing spatial variations in farm population density? What factors influence the size and location of cities?

These quite obviously are questions requiring further research, but if they can be answered, they will help us to describe, understand, and explain the distribution of population in a more precise and objective fashion. And the distribution of population is one of the most fundamental facts of human geography.

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