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RURAL POPULATION DENSITY IN THE SOUTHERN APPALACHIANS

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INTRODUCTION

Density of population in its relation to the possibilities of existing natural resources and economic opportunities is one of the main elements in the economic and social structure of a region.

Many of our social and economic institutions are directly or indirectly an outgrowth of, or at least strongly influenced by, population density. Certain aspects of land tenure and land use may be traced in part to population density; for example, types of land ownership, intent of land ownership, size of holdings, land values, intensity of land use, and type of farming. Population density will be reflected in the form and functions of the local government, in the need for public services, public utilities, religious and educational institutions, recreational opportunities, transportation and communication facilities, and in the kind and quantity of commodities needed. These are some of the relationships that population density bears to other factors. They are found in urban concentrations as well as in scattered rural settlements.

In a regional study of economic and social conditions, the graphic delineation of areas of relative population density within the region is of particular significance in that it will contribute materially to an understanding of existing problems and their extent in the region, and at the same time will furnish an illustration of the complexities in the relationship of population aggregation to the natural environment. Likewise, in the formulation of policies concerning the use of natural resources, and in the planning of remedial measures to attack problems of a social or economic nature, variation in the distribution of population density within the region must be taken into account in order to make these proposals practicable. In fact, the acuteness of certain problems may be closely associated with population density.

Gray, Clayton, and also Manny (*8, pp. 5, 120–136*)[1] refer to population density in the Southern Appalachians, and population distribution is indicated by means of dot maps. The material available when that study was made was inadequate for more complete discussion of population density, as it is related to the natural environment. A fuller discussion requires the determination of the ratio of density to the area of actual occurrence. Such density areas have been delimited on the pocket map compiled by the author and accompanying this publication; and the observations made during the study of density distribution, incidental to the construction of the map, form the basis of this text.

POPULATION DENSITY

GENERAL OBSERVATIONS

The Southern Appalachians as a region comprise mountains, plateaus, and valleys that have only one feature in common—an elevation higher than the surrounding country. Aside from this, character of relief, climate, distribution of the natural resources in the form of land suitable for crops, grazing and forest, extractable minerals, and water-power sites is most diverse. Natural advantages and disadvantages for human occupancy are, necessarily, closely associated with the distribution and use of natural resources, and are reflected in the distributional patterns of population density.

Of the total population of 6,641,293 in 1930 for the counties of the Southern Appalachians represented on the accompanying map, about one-fourth, or 1,682,896 persons, lived in incorporated communities of more than 2,500 inhabitants, and the rest in the rural villages and in the open country. Thus about three-fourths of the total population is rural and is more or less directly dependent upon the products of agriculture, mine, and forest.

It is this rural portion of the population that is the main object of consideration. Country people are closely connected with the natural environment and are more conscious of their dependence upon the natural resources of the landscape in which they happen to live than are city dwellers. It may be expected that they show a considerable degree of discrimination in the selection and attachment to places of settlement, paying due regard to the natural advantages

[1] Italic numbers in parentheses refer to Literature Cited, p. 18.

and disadvantages of the locality, especially to the suitability of the land for crop production where farming is concerned.

Climate and character of soil are, in many regions, the dominant physical factors determining the possibilities and limitations of agricultural land use. They are important in the Southern Appalachians. The distribution of some of the main crops is dependent on these conditions, which leave, in places, an imprint on population density. However, being a mountainous region located in a humid-temperate climate, the main influence on the distribution of settlement may be presumed to come from land-relief conditions. In rugged regions, as Huntington and his coworkers (*5*, *p. 120*) say: "The scarcity of level land, the scattered location of the fields, and the small yield per acre usually cause the agricultural population to be sparse * * *," or again, as Pearson (*6*, *p. 17*) puts it: "Naturally man will tend to congregate more closely where land is most fertile because there he can more easily produce the food he needs."

A study of the population-density map of the Southern Appalachians reveals that much of the distributional pattern of population conforms to such broad generalizations. But it is equally apparent that the nonconforming areas are numerous, and that in this region natural conditions by themselves are not and cannot be the only factors to which degree of population density is consistently attributable.

All the spaces unoccupied by resident population can be identified as extremely rough and mountainous country. Most, but not all, of the sparsely settled land with less than 10 inhabitants per square mile lies in areas of very broken land relief. As to the other extreme, the densest rural population, with over 100 inhabitants per square mile, is found almost exclusively in the valleys; but the locations of few if any of these dense-population areas are entirely attributable to a particularly favorable lay of the land combined with exceptional fertility of the soil for agricultural use. In the Allegheny and Cumberland Plateaus, the narrow, densely populated valleys are primarily coal-mining centers, while for the rest of the area, they represent the industrial, suburban, or village type of settlement.

For the intermediate density classes often no such close, direct relationship can be detected between population density and the advantages and disadvantages of the natural environment. Degree of roughness of surface relief or soil fertility is by no means consistently represented by corresponding population-density classes. Economic and social factors inject themselves into the situation and complicate the reciprocal relationship between man and nature. The historical background of settlement is another factor that has influenced population density in some places more than in others. Moreover, a traditional attitude of the people in their preference for environmental features undoubtedly accounts for and explains, to some extent, the location of settlement in comparatively poor situations. Nonconformities of population density as related to the natural advantages and disadvantages of the landscape are the result.

Before the advent of white settlement, nearly the entire Southern Appalachian region was forest-covered. The early settlers developed agriculture in the valleys first; commercial exploitation of the forest resources followed much later. The extensive lumbering operations, which started about 1880 and attained a peak in 1909, also gave

impetus to new settlements in the mountains. Communities dependent upon the products of the forests were established in many places. But with the depletion of the original timber wealth, the lumber industry declined as rapidly as it rose, leaving in its wake unemployed labor and some partly or wholly stranded communities.

The rise and decline of the lumber industry is not only an outstanding event in the economic history of the Southern Appalachians, but is also a factor that played its part in the distribution of population, which in many localities is still in evidence as expressed in the present population density. Forest and woodland even now comprises nearly two-thirds of the total land area with a high potential growth capacity. But with its depleted timber stand, it does not now offer the opportunities for the utilization of the available supply of labor, and consequently does not contribute its due share to the improvement in the standard of living of the population, as it might in the future with proper management. The woodsmen released by the lumber industry have had to shift to other occupations. Not infrequently they have taken up farming on the steep hillsides to wrest a precarious living from the land through intensive agricultural use.

Intensity of land use is closely connected with population density in that the extent of land utilized by individual farmers and settlers will tend to affect the number of people that can reside in an area and obtain a living from the prevailing form of land use. Broadly speaking, however, intensive agricultural land use is conditioned, not so much by the quality of the land itself as by the available amount of water and heat for plant growth. Being ample nearly everywhere for some type of intensive land use, the last two factors scarcely enter the picture as absolute limiting factors in the Southern Appalachians.

Although the climate in no part of the Southern Appalachians is so extreme as to prevent intensive land use, the existing wide range in climatic conditions makes its influence on rural settlement by no means uniform. The warmer climate in the South has promoted, in places where cotton yields well, a close occupancy of the land. The value of cotton per acre as a cash crop is relatively high. But cotton requires a high input in fertilizer and an even higher input in man labor per acre, which restricts the acreage a farmer can cultivate and harvest. As a result, areas of land with climate, soil, and surface well adapted to cotton are conducive to intensive land use, and have attracted and hold a denser population than would have been the case if the farmers had to depend on other field crops.

Land is sometimes used intensively for crop production where natural inducements or comparative economic advantages do not exist. In parts of the more-or-less secluded hill and mountain recesses in the Southern Appalachians, untouched by the arteries of travel and communication, a relatively dense population has backed up on the land in unfavorable natural surroundings. Because the people are dependent primarily on agriculture for a living, intensive land use is resorted to on land that is poorly adapted to arable farming. Cultivation of the steep hillsides provides bare subsistence for many of the inhabitants, often at a declining rate of return owing to the reduction in yield that accompanies the depletion of the soil

through erosion. Accustomed to a comparatively low standard of living, with little or no means or opportunity for education and training, many of the youth of these areas are handicapped. They face three possible but unfavorable alternatives: Clearing of more land on the mountainsides, increasing the surplus of unskilled labor, or moving on to settle as tenants on other poor land.[2] Migration to better lands of higher price is deterred by the difficulties of accumulating capital. Thus, maladjustment in land use is not only perpetuated but is likely to be aggravated.

There are also factors that operate in the opposite direction. One of these, modern technical development, has contributed to the restriction of population density on land well suited to general farming. Obviously, one of the qualifications for such land is sufficient smoothness of surface relief to permit the employment of modern farm machinery and implements. The use of farm machinery increases the efficiency of man labor tremendously, and enables the operator to cultivate and utilize effectively a much larger acreage than could be utilized without it. As a result, the size of the family farm can be correspondingly larger where mechanical production methods are possible. Such farms represent a considerable capital investment, and with their equipment in the form of buildings, machinery, and implements adjusted to the size of the farm, are encumbered with a commitment that will tend to keep them intact as operating units.

The size of farms necessarily affects the number of farms in a given area, and in turn, population density. Moreover, the land requirements per farm are determined, to a large extent, by the type of farming practiced in an area. A type of farming in which a livestock combination requiring large permanent pasture is characteristic, is, on account of the larger size of the farms, more restrictive in its effect on population density than are those types of farming in which livestock with large pasture requirements is not the dominant feature in the farm economy. Under humid-temperate conditions all the major land uses are possible, and the type of farming may or may not be properly adjusted to the most economical use of the land. All of these combinations are found in the Southern Appalachians and help to explain the occurrence in some of the subregions, of population densities seemingly out of line with the capabilities of the natural environment. However, not all the nonconformities can be readily explained by the available information. They require further field investigation.

Rural population distribution by degree of density usually has developed in the Southern Appalachians distinctive density areas which in outline fit, more or less, the natural background of the landscape. This may be said of areas in which degree of population density is associated with a balanced relationship between the quality of the land and the intensity of its use, as well as of areas where this is not the case. The geographic divisions and subdivisions used for the purpose of orientation and identification of areas in the following short discussion, are the same as those used hitherto (*8, p. 11*).

[2] BAKER, O. E. THE OUTLOOK FOR RURAL YOUTH. Address at Institute of Rural Economics, Extension Service, New Jersey State College of Agriculture, New Brunswick, N. J. 1936. [Mimeographed.]

These divisions, the result of a study of the natural land use areas of the United States (fig. 1), are:

Central Division or Appalachian Valleys and Ridges:
- Central Appalachian Valleys.
- Central Appalachian Ridges.
- Appalachian Valleys of Southwest Virginia.
- Appalachian Valleys of East Tennessee.
- Southern Appalachian Valleys.

Eastern Division:
- Blue Ridge.

Western Division:
- Allegheny Plateau.
- Northeastern Cumberland Plateau.
- Northwestern Cumberland Plateau.
- Southern Cumberland Plateau.

Appalachian Fringe:
- Northern Piedmont.
- Central Piedmont Plateau.
- Southern Piedmont Plateau.
- Appalachian Border of the Coastal Plain.
- Southern Highland Rim and Tennessee Valley.
- Highland Rim.
- Upper Ohio Hills.

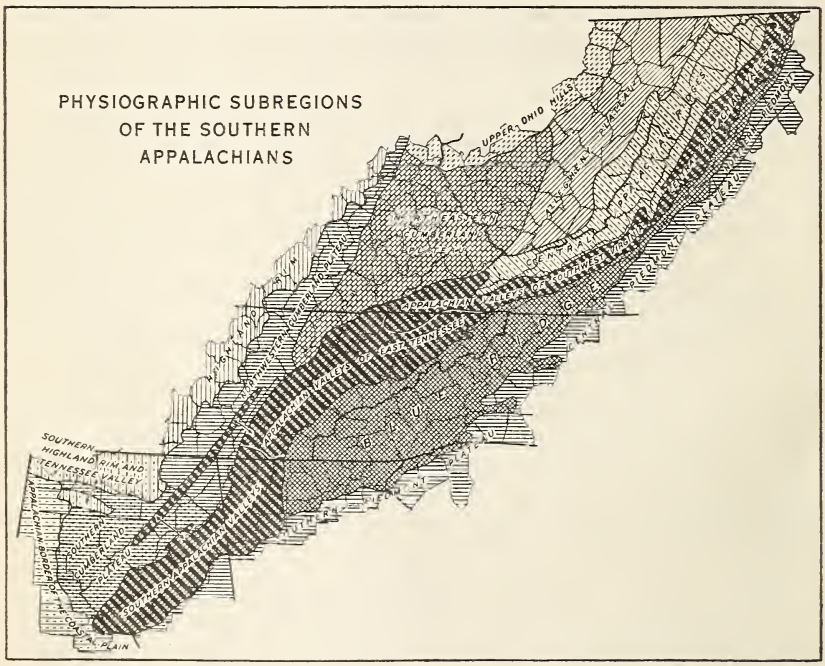

FIGURE 1.—The subregions are determined primarily on the basis of distinct areal associations in the character of land relief, soil, and climate. Localization of these characteristics in areal associations facilitates the comparative study of human reaction to the natural environment and admits reference to areas having a fairly uniform combination in physical conditions. (Reproduced from Natural Land-Use Areas, a map prepared by C. P. Barnes and F. J. Marschner, Bureau of Agricultural Economics, and published by the U. S. Department of Agriculture.)

POPULATION DENSITY IN THE CENTRAL DIVISION OR APPALACHIAN VALLEYS AND RIDGES

Of the main divisions in the Southern Appalachians, the Appalachian Valleys and Ridges exhibit more consistently than the others the influence of the geographic setting on the use of the land and the distribution of population. Distinctions in these respects between valleys and ridges are evident. The smooth and fertile portions of the valley floors are used largely for arable farming, while the narrow longitudinal ridges are left usually in woods and forest. Within the valleys, character of soil and location of roads and railroads, in addition to location of cities and towns, have had a great deal to do with producing the present density distribution of rural settlement.

Urbanization of the population has progressed further in the Appalachian Valleys than in other subregions. Cities and towns are scattered all along the valleys, many in points of natural vantage. The larger cities usually form the junction point of communication in the center of the broad valleys. Practically every gap in the Blue Ridge has its portal town. Of the three metropolitan cities, Chattanooga, at the narrows where the Tennessee River passes through the Cumberland Plateau, is the gate city to the Eastern Tennessee Valley. Knoxville occupies its focal point. Birmingham, located at the dividing line between the Southern Cumberland Plateau and the Southern Appalachian Valleys, owes its industrial development to the iron and coal mines in the vicinity.

There are other areas along the contact line of the Appalachian Valleys and Ridges with the Cumberland Plateau in which the population density is affected by the coal-mining operations on the Plateau side. On the whole, the Appalachian Valleys and Ridges furnish a striking example to illustrate how settlement may react to geologic structure and land forms. This is in agreement with what may be expected but there are some valley areas that, compared with other sections in the same division, are strikingly dissimilar in population density.

The most notable exception of this kind is found in that portion of the Central Appalachian Valleys subregion known as the Shenandoah Valley, with approximately 40 people to the square mile in the northern part. The Shenandoah Valley is one of the best general-farming sections of considerable size in the whole region. The valley contains a large extent of fertile soil developed from limestone. Some of the land is rocky and rough, but much is rolling and smooth enough to allow the use of farm machinery. The climate is favorable for all the field crops and fruits that are grown in this latitude. From the standpoint of natural advantages, this subregion offers as much or more than any other in the division or even than the region as a whole. In terms of natural advantages in relation to the number of people that may be supported through more intensive land use, population density is low; it is lower than in many other valleys in the Appalachian Valleys and Ridges division.

The explanation for this condition cannot be found, therefore, in the paucity of land resources. It is one of those nonconformities which results from checking the natural tendency of people to congregate in places that possess natural advantages. The checking power is largely economic. Farming in this part of the region re-

quires a high capital investment and can be carried on with a comparatively low input of man labor (*8*). Value of land and buildings per farm is high; the extent of cropland per farm is high; the farm income is comparatively high, with a corresponding standard of living.

The northern part of the adjoining subregion, the Central Appalachian Ridges, is similarly affected. This subregion is a succession of ridges and valleys. Most of the valleys are narrow. The agricultural potentialities, therefore, are not nearly so great as in the Shenandoah Valley. But among these valleys there is a noticeable distinction in the population density. The southern valleys in this subregion are more densely settled than the northern. The explanation is again found in the prevailing land use practices. Animal husbandry is much more prevalent in the northern districts, with the result that the average size of farms is the largest for the entire region and thus, in turn, holds down population density.

POPULATION DENSITY IN THE EASTERN DIVISION

In the Eastern Division, which comprises the Blue Ridge, the rural population, like that in the Appalachian Valleys and Ridges, is primarily dependent on the surface use of the land. Mining is relatively unimportant, and only in exceptional cases, as in the vicinity of Ducktown, near the junction of the State boundaries of North Carolina, Tennessee, and Georgia, has it produced outstanding population concentrations. The northern part of the Blue Ridge is too rough and mountainous to permit more than occasional and scattered settlement, but in the southern part more than half a million people make their homes. Here also farming potentialities are restricted severely by high mountain ranges that are rough and rocky. About 2,300 of the 15,000 square miles comprising this part of the Blue Ridge are left unoccupied by resident population.

The population distribution shows not only strong contrasts but also nonconformities as related to the possibilities of the physical environment. The Blue Ridge Plateau and the basins and valleys farther south accommodate a good share of the inhabitants. The influx of people into the Asheville Basin is particularly strong and has accelerated the process of urbanization. Buncombe County, in which Asheville is located, doubled its population in the 20 years from 1910 to 1930. Some of the rural civil townships in this county doubled, or nearly doubled, their populations from 1920 to 1930. The great increase (nearly 45 percent) in the number of farms reported from the 1930–35 period seemingly indicates that this strong upward trend still prevails, although a large part of the increase may be accounted for by the occupational shift of resident laborers to farming.[3] The peculiar scenic attractions of the landscape and the amenities of the climate are natural advantages, which, through the development of this part of the Blue Ridge as a great recreational center, have been turned into economic assets, and have yearly attracted an increasing number of visitors as well as many permanent residents.

[3] DODSON, L. S. LIVING CONDITIONS AND POPULATION MIGRATION IN FOUR APPALACHIAN COUNTIES. U. S. Farm Security Admin. and Bur. Agr. Econ. Social Research Rept. 3, 152 pp. 1937. [Multigraphed.]

The Blue Ridge Plateau and mountains between Roanoke and Asheville are, over much of the area, as densely populated as the valleys. Here too, the population is primarily dependent on the surface use of the land, demonstrating the close connection between population density and intensity of land use. On the Blue Ridge Plateau, with a large part of the land smooth enough for the use of machinery and wheeled implements, type-of-farming areas coincide very nearly with population-density areas. In Floyd County Va., and Alleghany County, N. C., where general farming predominates, the population density is notably lower than in the other counties of the plateau such as Carroll and Grayson Counties in Virginia, and Ashe County and the eastern part of Watauga County in North Carolina, where the self-sufficing type of farming predominates. Intensive land use in the mountains in this part of the Blue Ridge is necessary also to provide the main support of a relatively dense population. In Ashe, Johnson, Avery, Mitchell, and Yancey Counties, and the western part of Watauga County, the population density on much of the land not too steep and rocky for the primitive methods of cropping used in the mountains is greater than in the northern Shenandoah Valley.

POPULATION DENSITY IN THE WESTERN DIVISION

In the western division of the Southern Appalachian region, which comprises the Cumberland and Allegheny Plateaus, the physical backgrounds affecting population aggregation differ in many respects from those found in the Appalachian Valleys and Ridges or in the Blue Ridge division. Land relief alone provides marked contrasts in form within the subregions. Moreover, economic opportunities over much of the area are not confined to the capabilities of the surface use of the land. Coal underlies the entire division, and wherever collieries have been opened, they have put their imprint on population density.

Population density in the Allegheny Plateau shows the influence of both mining and mountainous relief very clearly. The high and deeply dissected eastern part of the Allegheny Plateau has only a sparse and scattered population, while the southern and western parts, which are lower, warmer, less severe in relief, and more accessible, have a higher density. Coal mining, especially along the Monongahela River, is primarily responsible for the population concentration in that part of the subregion. Farming in the southern, and more so in the western, portion is rather irregularly distributed. It is not solely confined to the smoother land, but is carried on in many less favorable or even in unsuitable places, as described by Peck, Frank, and Eke (7). A spotty distribution is the result.

The population density of the Northeastern Cumberland Plateau may be considered as another nonconformity as far as farm population is concerned. This entire subregion is fairly uniformly dissected into narrow ridges and valleys, and the only level land is found in the narrow creek bottoms. Agricultural land use is thus particularly handicapped in that most of the cultivated crops must be grown on hillsides too steep for the use of wheeled implements. Acreage of cropland per farm is therefore small, being less than 10 acres over the greater part of this subregion, much of it on soils of rather low fertility. Natural disadvantages, with reference to farm-

ing, are greater here than in any other of the subregions. But the country population is, for the most part, as dense as the population in many places in the Appalachian Valleys. The self-sufficing type of farming is characteristic of this subregion, and coal-mining operations have produced the great concentration of people in the valleys.

In the form of land relief and population density, the Northwestern Cumberland Plateau provides a strong contrast to the Northeastern Cumberland Plateau. The surface of the main portion is still a true plateau, chiefly rolling with only the northern and southern ends deeply cut by rivers and creeks. Land relief does not interfere to any appreciable extent with the agricultural use of the land over a large and compact area. Almost any kind of farm machinery or implement can be used in cultivation. If land relief is considered as the indication of land-use capabilities in this climate, this subregion should be agriculturally well developed and settled. But, actually, only about one-fourth of the land is in farms. The average size of farm is comparatively small with a small average acreage of cropland per farm, and the population is sparse and scattered. To accentuate the apparently discordant relation between land relief on the one hand and agricultural land use and settlement on the other, the number of farms decreased notably during the last decade.

There is no ready explanation for this situation. The soils are sometimes called shallow and rocky but no modern soil surveys are available to confirm this. The information furnished by the old Pikeville-area soil survey does not indicate that shallow and rocky soils predominate over the plateau. There are spots of shallow and rocky soil on the knolls, along the draws, and the edge of the plateau rim, and others are mentioned as being too small to be shown on the soils map. Soil fertility is low, but the indications are that it can be increased considerably with proper soil management. Isolation is a natural drawback. Bluffs about 1,000 feet high separate the plateau from the Highland Rim on the west and the valleys on the east, making it difficult of access. Roads are now entering it and with the construction of additional roads the plateau can be made more accessible.

These factors undoubtedly help detract from the desirability of the land for agricultural use. Apparently the yield and value per acre of the common field crops is not high enough on these soils to encourage general farming, and crops that can be grown by intensive land use with a heavy input of fertilizer and labor—like fruits and vegetables—have no readily accessible markets.

Comparison of this subregion with the completely dissected northeastern part of the Cumberland Plateau suggests that the greater isolation of the former constitutes the major natural disadvantage which it has in comparison with the latter, and that this disadvantage is more than offset by the greater man-labor efficiency with which the land in the northwestern portion can be cultivated. Other factors may be involved, as, for instance, the reported holding of land in large tracts for other than agricultural purposes. Information is inadequate on many points, and much more investigational work in the field must be done to ascertain the capabilities of agricultural land use and the possibilities of closer settlement. Until that is done, this subregion will appear as one of the outstanding

examples of nonconformity between population density and surface configuration in the region.

The Southern Cumberland Plateau exhibits characteristics of land relief similar to the Northwestern Cumberland Plateau with a notable difference in elevation. The absolute elevation above sea level of the Southern Cumberland Plateau is considerably lower than that of the Northwestern Plateau, as is the relative elevation above the adjacent valleys. Most of the bluffs delimiting the plateau are not more than 400 to 500 feet high; in some places they are even less, and therefore are much less effective barriers than in the case of the Northwestern Cumberland Plateau. Aside from this, the physiographic character of the two plateaus is much alike. The greater part of the Southern Cumberland Plateau is still preserved as rolling tablelands; only the western part is badly dissected, leaving narrow summit flats along the divides between the streams.

The similarity is not shared when population density is considered. Sand Mountain and Lookout Mountain, the names under which this part of the Cumberland Plateau is locally known, are heavily populated in comparison with the Northwestern Cumberland Plateau. The change from the sparsely to the more densely settled portion of the plateau takes place in the northern part of Sand and Lookout Mountains. Here, too, most of the inhabitants are dependent on farming, but a change in climate has produced a change in the natural environment that is primarily responsible for the short transition from the lower to the higher population densities. The warmer climate permits growing of cotton. As cotton farms are limited to a small acreage of cultivated land per farm, this increases proportionally the possible number of farms and the number of people living on the land in a given area.

A combination of natural factors—sandy loam soil, smooth rolling surface, warm and sufficiently long growing season—makes the tablelands more favorable than the valleys for cotton growing, and has brought about an exceptional arrangement in population distribution. The result is an inversion of the usual order of denser population in the valleys than on the upper level of the mountains. Here cases are found in which the valleys are less densely populated than the mountains, in spite of the fact that the valley soils would rank higher in fertility, for most crops, than the plateau soils. But the plateau soils have their compensating features. As they are lighter in texture, they warm earlier in the spring and are easier to cultivate. Examples of this inverse population-density arrangement may be found in the Big Spring Creek Valley, which connects the Tennessee River with the Black Warrior River, and in the Big Wills Creek Valley, which separates Lookout Mountain from Sand Mountain in Alabama.

POPULATION DENSITY IN THE SOUTHERN APPALACHIAN FRINGE

In the fringe around the Southern Appalachians, shown on the pocket map, nonconformities as related to natural environment are no less in evidence than in the Appalachians proper. Most of these fractional areas in the bordering subregions are too incomplete to admit valid comparisons among them. But some of them are out-

standing. The most conspicuous areas are found in the Piedmont and in the Highland Rim.

For the relatively low population density in the Northern Piedmont on the Virginia side, prevailing natural conditions do not furnish a plausible explanation. This subregion may not be equal to the Shenandoah Valley in agricultural capability, although the two have much in common. Most of the land is smooth enough for the use of farming machinery, and the soils are fairly productive. Natural factors do not prevent closer settlement. Apparently, type-of-farming and land-use practices are important considerations. Breeding of livestock, in which horses are well represented, is one of the main features in this part of the country. The farms are large, and farm real-estate values are high per farm and per acre.

A tendency in the opposite direction may be observed in the Southern Piedmont Plateau in North Carolina and South Carolina. Cotton farming in conjunction with industrial development accounts in large measure for the greater population aggregation in this section.

On the western margin of the Southern Appalachians, a portion of the Highland Rim represents another case in which the postulate that the greater suitability of level land for arable farming, other things being equal, tends to enhance its desirability for agricultural use, and with it favors intensification of population, is not borne out by actual conditions. Although the land, if judged exclusively by its smooth and slightly rolling surface, is well suited to the production of cultivated crops, it is only partly occupied and developed. Moreover, the type of farming that is carried on in this area is mostly of the self-sufficing type.

Unfortunately, the information on soils is incomplete. The soil surveys of Coffee, Overton, and Putnam Counties, Tenn., include part of the Highland Rim. They are all of the early kind of survey. The predominant soil type of the Highland Rim appears in all three surveys to be Clarksville silt loam. The soil is described as a silt loam with silty clay subsoil developed from siliceous limestone and chert. Chert fragments are present in the upper and lower horizons, although usually in negligible quantities. On account of the heavier texture, the soil is not so easy to work as the sandy types, its humus content is low, and natural fertility is only fair.

As described, there is no doubt that the soil has its deficiencies, although it seemingly is fairly well adapted to arable farming if properly managed. In fact, in the northern Highland Rim counties, Overton and Putnam, this soil is considered one of the best. Much of it is used for crop production, and rural population on the Highland Rim portion is the densest in these counties.

The soil conditions so far as known, therefore, do not offer a plausible explanation for the almost reverse condition prevailing on the "Plateau of the Barrens," as the area is locally known. This area, of which Coffee County may be considered representative, is more compact and creeks have not cut in so far nor so deeply as in the northern counties. On that account drainage may be slower, with a consequent increase in the difficulties of soil management. From the information available, it is difficult to explain why this portion of the Highland Rim has been avoided by settlers, and why the rough and rugged breaks that separate the Highland Rim from

the Nashville Basin are considered more attractive and advantageous as sites for settlement. The breaks are more densely settled than some adjacent parts of the Highland Rim Plateau.

INTENSIVE SETTLEMENT AT THE BASE OF THE MOUNTAINS

So far the discussion of population density in the Southern Appalachians has revolved primarily around nonconformities in relation to the natural environment, as found in the different divisions and subregions. Another distinctive distribution feature of settlement, which is not confined to any particular subregion or division, must be mentioned. This is the occurrence of denser population at the foot of mountains, a tendency which is not universal, but may be observed in many places in the Appalachian Valleys, in the Piedmont, and in the Highland Rim.

A number of actual advantages are inherent in such a location. Water, for example, is usually abundant and within easy reach. On account of the higher elevation, the land is usually well drained and affords a view over the land receding from the mountains. Air drainage is better than on the lower levels, with a consequent decrease in the hazard of unseasonable frosts. The location of roads frequently follows the trend of the mountains. Roads, when approaching mountains, are often deflected to run along the mountain base, thus encouraging settlement along their route. In some cases, no doubt, peculiar local advantages have been an influence. This tendency is one of the peculiarities that has contributed to the unique distributional pattern of population found in the Southern Appalachians.

THE CONSTRUCTION OF THE COLOR MAP

Population density and distribution are usually shown on maps by means of dots, each of which represents a definite number of people, or by progressively intensified shading of political divisions corresponding to a graduated scale of average groups. The first is referred to as the absolute and the second as the relative method of presenting quantitative distribution. Both methods have their advantages and disadvantages when used to illustrate population distribution and density. The advantages are primarily technical. Both types of map are easy to prepare and equally easy to reproduce. Moreover, the dot method may also be employed to combine two features on one map, showing population by means of dots and a second feature through areal color distinctions, the method used, for example, in the report of the Land Planning Committee to the National Resources Board (*9, p. 144*). On small-scale maps, which are primarily used to illustrate general conditions, these methods serve the purpose fairly well, and are instructive to that extent. They are inadequate, however, when the maps are intended to serve as a base for an analytical or comparative study of rural-population density distribution within an area.

Experiments, such as that conducted by O'Dell (*3, pp. 150–153*) at Birkbeck College have demonstrated that relative population density cannot be read from dot maps. Dots that represent hundreds or thousands of people each cannot be properly correlated with the physical background of the area, even though they are carefully placed to

coincide with the gravitational center of the number they represent. Areas having natural distinctiveness cannot be appraised correctly as to their relative population density, and therefore a comparison for closer study is precluded.

Average densities of political divisions are similarly affected. By comparing average densities of States, great differences in adaptability for settlement are suggested by the figures, but the figures obviously are not even representative of sections within the States. Using counties increases the meaning of averages in reflecting conditions in different parts of the States and the country as a whole, but provides only averages often derived from very dissimilar distribution areas. The use of minor civil divisions advances the process a step further, but in most cases still falls short of showing population density in the place of actual occurrence.

In some parts of the country where the physical character of the land changes very gradually, and the minor civil divisions are fairly uniform in shape and size, rural-population averages by minor civil divisions may not change markedly over several townships, and can be considered as representative of actual conditions. In hilly and mountainous country, or where soil character changes rapidly, or where areas of deficient drainage are interspersed irregularly, or where the cultivation of the land depends on irrigation, the over-all averages per square mile of even minor civil divisions are likely to disguise more than to reveal the true situation of the rural-population density distribution in the areas. Both methods, the dot method and the shading of political divisions, fail in this respect. Neither permits the reading of density grades in place.

The method employed in working out the pocket map is calculated to overcome these difficulties. Rural-population density, as shown on the map, is related to the delimited areas which take into account changes in the natural environment and changes in the population density itself, as far as they can be discerned from the evidence furnished by the source material and can be expressed within the limitations imposed by the scale of the map. Russian scientists have named this the dasymetric (density-measuring) method.

Minor civil divisions are the smallest divisions for which population statistics have been published by the census. They furnish the principal statistical data on which this map is based, although additional local figures were consulted. On the basis of minor civil divisions, the entire Southern Appalachian region, as shown on the map, was broken down into 2,435 tracts having an average size of about 45 square miles. The average size of these divisions by States for the included counties varies, however, from 21 square miles for Maryland to 94 for the Virginia counties. Nevertheless, the minor civil divisions provided relatively small units within which the density distribution had to be further adjusted in order to fit local conditions.

No published statistics exist on the area of minor civil divisions; these were obtained from measurements on maps. Available topographic-survey and soil-survey maps provided the bulk of the material for the computation of the areas. For most States, the location of minor civil-division boundaries was plotted on these maps from material furnished by the United States Bureau of the Census.

County boundaries were also checked with surveys made by the Forest Service, local surveys, and State legislative enactments pertaining to county boundaries. The cartometric operations were controlled by the independently computed areas of quadrilaterals of 5′ extent in latitude and longitude.[4]

Errors of measurement requiring adjustment were held to 0.2 percent of the area of quadrilaterals 10′ square on the 1:125,000 scale maps and the area of quadrilaterals of 5′ square on the 1:62,500 scale maps. It is evident that, with the use of this method, the degree of accuracy of the resulting areal figures depends primarily on the exactness of the map material on which the measurements are taken.

The measurements yielded not only areas of minor civil divisions, but also new areal figures for the counties as a whole, which in some cases vary considerably from the old ones in current use. For counties that are entirely covered by recent topographic surveys these figures may be considered as final; for the rest, they must be revised with the appearance of new and more precise survey material. But in all cases they represent the closest approach to the actual area that could be obtained from the available map material. The function of the map is, therefore, not confined to furnishing the evidence of population distribution but is also the basis of the areal figures.

The allocation of population density to place of occurrence requires some consideration of what rural-population density represents on the map. With the adjustments of the average densities of minor civil divisions to distribution areas, a change in relationship takes place; reference to political divisions ceases and is superseded by actual density areas. In this form, population-density areas denote only an approximation to actual conditions; absolute correctness cannot be secured by hard-and-fast rules. Even though the location of every dwelling were plotted on the map and the number of people living in each dwelling were known, there still would remain the important question of how much land these people inhabit, which would not change the population density but only population—land occupancy.

In drawing the line of demarcation between settled and unsettled areas, the assumption is that rural-population density applies to the land area effectively used by the people, the area within which they ordinarily move and work. In many cases no distinct line can be found that would unequivocally define an area so described. It is left to the judgment of the compiler to locate and draw the bounding line. The same is true in locating the line separating areas having different degrees of population density.

The procedure followed is that of outlining density areas as suggested by the evidence furnished on survey maps. Location of cultural features, particularly settlements, with reference to changes in the character of natural features often indicates the existing local relationship between natural environment and population distribu-

[4] MARSCHNER, F. J. THE NEED OF REVISION OF AREAL FIGURES OF THE UNITED STATES BY COUNTIES WITH TABLES OF THE AREAS OF QUADRILATERALS OF THE EARTH'S SURFACE OF FIVE MINUTES EXTENT IN LATITUDE AND LONGITUDE. U. S. Dept. Agr. 1929. [Mimeographed.]

tion. The bounding lines of these density areas are, from their nature, not isopleth as are relief contours, isohyets, and isobars. The spread of population density does not always go through a gradual transition from one degree of density to the next higher or lower. Not infrequently, high-population density areas abut low-population density areas without intermediate transition. Places with sharp distinctions of this kind may be found between coves or valleys and the mountains; between mining camps and the surrounding country; and, in the arid regions of the West, between irrigation districts and the deserts. The methods of delimitation necessarily follow different principles as Eckert (*1, p. 192; 2, p. 136*) has pointed out.

Isopleths are lines of interpolation between actual measures or ratios spotted on the map in their proper geographic position, while bounding lines of population-density areas are lines of demarcation which require, for their construction, the apprehension of the landscape as a whole including its physical background and cultural development. The bounding lines may follow the foot of mountains or the rim of plateaus and yet not be contours. To illustrate their nature with an example, the boundaries may be compared with lines delimiting areas having a definite range in the gradient of slope—say 0 to 2 percent, 2 to 5 percent, 5 to 10 percent—as they are mapped on erosion surveys.

Gradient of slope does not always change gradually; often the change is marked or even abrupt. Wherever that is the case, areas falling in one of these classes will be abutted by areas one or more steps apart in the scale of classified steepness. It will be noted that lines bounding areas having a certain range in slope gradient and lines bounding areas of population density have a great deal in common. In fact they may coincide in many places, and yet belong to two different categories. One delimits areas characterized by a single factor, the other delimits areas of ratio distribution which must be found by taking into account a number of factors. Demarcation of the first is founded on measurements, while delimitation of the second is a process of geographic induction.

The delimitation of areas and the identification of their population density are not two independent operations; one must be done with the other in mind. In the Southern Appalachians, the lowest densities are, as a rule, the easiest to identify. In many cases they can be read directly from the survey maps. Areas without resident population are those found on recent surveys to be unsettled mountain land, or areas in which almost all the land is in public ownership, mostly national forests. The population density from 0 to 10 per square mile is almost as easy to outline. Rough, mountainous lands with an occasional dwelling are included in this class. Outlining the low-density areas as the first step in the process simultaneously confines the distribution of the remaining population. The assignment of density grade to the more populous areas is controlled by the number of people reported by the census for the minor civil divisions, and the interpretation of the evidence contained on survey maps. Obviously, in areas for which recent survey maps are available, the identification of the density range can be made with a greater assurance of correctness than where they are not available. In general, rural dwellings in the Southern Appalachians house one family. A

fairly close estimate of how populous an area is may be obtained by multiplying the number of houses by the average number of people per family. In areas for which only older surveys are available, the assignment of population density is usually a matter of rationalized apportionment in agreement with the census and information that can be gleaned from the maps.

Areal estimates of fractions of minor civil divisions were made either by inspection or, if the areas were too large and irregular in outline, with the planimeter or a grid template. These, and the slide rule, were the main instruments used in computing densities.

The method is essentially the same as the one applied by Wright (*10*) in his example of population distribution on the Cape Cod Peninsula, but the density distinctions on the Southern Appalachian map are different. Urban and rural populations are kept apart and represented distinctly as such. Rural-population-density distribution, as the primary object of consideration, has received particular attention in this study, while urban population is indicated by simply filling in the town symbols on the base map. Density distinctions have been decided upon with the thought of bringing out variations in density ranges which are of particular significance in connection with problems in land-use adjustment in the Southern Appalachians. This applies, in the main, to densities below 50 people to the square mile. The density scale, therefore, is one that fits this particular region, but might not express equally well the conditions in other parts of the country. In fact the first step, 0 to 10 people per square mile, would have little meaning for most of the western half of the United States.

The population-density map has been prepared and worked out on a scale of 1 : 1,000,000, but areal measures and estimates were taken on the survey maps. The unequal value of the survey maps has necessarily affected somewhat the uniform reliability in outline of the population-density areas. This appears to be of little moment, however. Because of the small scale of the published map, 1 : 1,250,000, a certain degree of generalization was inevitable throughout to preserve clarity of expression. The main purpose of this map is to register, within the capacity of the scale, the rural-population density in place, and with it throw new light on the complexities of the population question in relation to land use in the Southern Appalachians.

SUMMARY

Distribution of population density in the Southern Appalachians is, in its extreme occurrences of concentration and sparsity, largely controlled by and related to the physiographic character of the region and the location of its mineral resources. For the intermediate densities, in areas in which the population is primarily dependent on land use, especially farming, a similar simple and direct relationship is much less in evidence.

There are areas which may be considered as conforming to the premises that the greater adaptability of the land to farming is responsible for the denser population, or conversely, that because the land is poorly adapted to farming the population is sparse. But the exceptions are too many to establish such a relationship as the pre-

vailing rule. Economic factors and technical development frequently exert a stronger influence on intensity of land use and on population density, than does the quality of the land itself. Basic sources of information are as yet too incomplete and meager to permit more than a tentative inference as to reasons why certain areas are populated as they are. Moreover, population density is in a state of constant flux. Migration is stronger and birth rates are higher in some sections than in others.

No attempt has been made to unravel and interpret the many complexities resulting from the interplay of natural, economic, and social factors that affect density of rural population in the Southern Appalachians. One feature is apparent, however—the frequently observable tendency of the rural population to congregate more closely in areas poorly adapted to arable farming than in areas of better land.

LITERATURE CITED

(1) Eckert, Max.
1925. die kartenwissenschaft . . . Bd. 2. Berlin.
(2) Eckert-Greifendorff, Max.
1936. kartenkunde. 147 pp., illus. Berlin.
(3) Fawcett, C. B.
1935. population maps: a discussion at a meeting of the royal geographic society . . . Geog. Jour. [London] 35: [142]–159, illus.
(4) Goodrich, Carter and others.
1936. migration and economic opportunity. 763 pp., illus. Philadelphia.
(5) Huntington, Ellsworth; Williams, Frank E.; and Van Valkenburg, Samuel.
1933. economic and social geography. 630 pp., illus. New York and London.
(6) Pearson, S. Vere.
1935. the growth and distribution of population. 448 pp., illus. London.
(7) Peck, Millard; Frank, Bernard; and Eke, Paul A.
1932. economic utilization of marginal lands in nicholas and webster counties, west virginia. U. S. Dept. Agr. Tech. Bull. 303, 64 pp., illus.
(8) United States Bureau of Agricultural Economics, Bureau of Home Economics, and Forest Service.
1935. economic and social problems and conditions of the southern appalachians. U. S. Dept. Agr. Misc. Pub. 205, 184 pp., illus.
(9) [United States] National Resources Board.
1934. a report on national planning and public works in relation to natural resources and including land use and water resources with findings and recommendations. II. report of the land planning committee. pp. 89–251, illus.
(10) Wright, John K.
1936. a method of mapping density of population with cape cod as an example. Geog. Rev. 26: 103–110. illus.

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POPULATION DENSITY
BASED ON 1930 CENSUS
THE SOUTHERN APPALACHIANS

Scale 1:1,250,000

10 0 10 20 30 40 50 60 70 80 90 100 Mi.

URBAN POPULATION

- KNOXVILLE *Cities with a population of more than 100 000*
- Roanoke " " " " " 50 000 to 100 000
- Greenville " " " " " 25 000 " 50 000
- Bluefield " " " " " 10 000 " 25 000
- Williamson " " " " " 5 000 " 10 000
- Logan " " " " " 2 500 " 5 000
- Hindman " " " " " less than 2 500

Conic equal-area projection

RURAL POPULATION
Density per square mile

- A *Without resident population*
- B *Under 10*
- C *10 to 20*
- D *20 to 30*
- E *30 to 40*
- F *40 to 50*
- G *50 to 75*
- H *75 to 100*
- I *100 to 150*
- J *150 to 200*
- K *200 and over*

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