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RURAL DEPOPULATION IN KANSAS: A CONCEPTUAL INQUIRY  
INTO THE NATURE OF CHANGING RURAL SETTLEMENT  
PATTERNS, ON THE AMERICAN PLAINS

by

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## CHAPTER I

### INTRODUCTION

Geographers of different periods, nationalities, and methodological inclinations have seen settlement patterns<sup>1</sup> as one of the prime visual expressions of human organization of space.<sup>2</sup> Because the density and pattern of settlement are at least in part the result of the interaction of the type of human exploitation of the land, the level of technological achievement, and the predominant pattern of social contact, they give a possible indication as to the nature of the inter-relationship of these factors. Bowman noted the need for a science of settlement in 1931. He observed that "settlement habitually advances and retreats on the outer fringe of land occupation." And he went on to suggest that "a science of settlement is not desirable merely to provide means by which to attract men to new lands. The ultimate withdrawal of the borders of settlement in the least favorable situations is

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In general settlement pattern is defined here as where people live in relation to where other people live. Later on in this paper the notion of pattern will be given a more rigorous definition as an aid in analysis. See Marion Clawson, "Factors and Forces Affecting the Optimum Future Rural Settlement Pattern in the United States," Economic Geography, 42, No. 4 (October, 1966), p. 284.

2

A partial list of geographers whose studies have involved the analysis of settlement patterns would include: Richthofen, Meitzen, Schlüter, Vidal de la Blache, Demangeon, Lefèvre, Bowman, Hall, Kohn, Stone, Duncan, King, and Hudson.

also one of its objects."<sup>3</sup>

On the American plains human settlement has remained relatively sparse, with the cultural landscape since an early stage of European occupancy ordered in a hierarchy of farmsteads, hamlets, villages and towns. While these different levels of settlement clustering have been arranged in variable combinations, the typical pattern at any given time has been some function of the position of an area within the broader layering of the American population and local conditions.<sup>4</sup> The apparently systematic nature of this changing structure strongly suggests the prominence of spatial interaction as an historic organizational principle. Market oriented economic activity and the consequent areal specialization of human pursuits have played a significant role in forging settlement patterns.<sup>5</sup> Exploitation of the relative advantages of one place over another in terms of such factors

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<sup>3</sup> Isaiah Bowman, The Pioneer Fringe (New York: American Geographical Society, 1931), p. vi.

<sup>4</sup> See Leslie J. King, "A Quantitative Expression of the Pattern of Urban Settlements in Selected Areas of the United States," Tijdschrift voor Economische en Sociale Geographie, 53 (1962), pp. 1-7; Wilbur Zelinsky, "Changes in the Geographic Patterns of Rural Population in the United States 1790-1960," Geographic Review, 52, No. 4 (October, 1962), pp. 492-524; and John Hudson, "A Location Theory for Rural Settlement," Annals of the Association of American Geographers, 59, No. 2 (June, 1969), pp. 365-381.

<sup>5</sup> Douglass North offers the classical argument of this point in "Location Theory and Regional Growth," Journal of Political Economy, 63, No. 3 (June, 1955), especially pp. 246-247.



as perceived resource endowment and minimizing the friction of distance seems to be related to the geographic distribution<sup>6</sup> of population at all scales of generalization.

Continuing changes in this functional pattern of settlement are probably in part the consequence of more widely defined social evolution. Many of the problem issues faced by American society today were brought about by recent spatial adaptation to other needs. The major reshuffling of people from countryside to city, which has been a dominant characteristic of the American scene now for several decades, is a notable example of this phenomenon. The enlargement of farming units to take advantage of the scale economies of mechanization and the consequent exodus of displaced people to urban areas in search of jobs have seemed often to lower rural population levels below the threshold required to support many needed services. The identification of any regularities as might exist in the settlement process and the related spatial ramifications for meeting human needs characteristic of these patterns would be useful to both the scholar and the public decision maker. The objective of this study is to investigate the spatial reorganization of settlement caused by depopulation, and to analyze the effect of this

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<sup>6</sup>  
 Von Thünen, Christaller and Weber all advance early statements of this position in explaining location of human activities across the landscape.

reorganization on the services available to the remaining population.

#### A. BACKGROUND FOR THE STUDY

Migration of the rural population to the urban areas of the country has been a subject of both interest and concern to scholars and political leaders alike for the last several decades. Preliminary analysis of the 1970 U.S. Census of Population has served to prompt a more urgent desire to comprehend this phenomenon.<sup>7</sup> Urban in-migration is quickly draining sections of the North American continent of most of the descendants of those settlers who only a few score years ago went rushing out to the land.

In the past three decades, a startling social and economic change has occurred over the United States landscape. The change stems from the revolutionary shift from a mixed rural-urban environment to a basically urban environment. By this it is not implied that farming has disappeared. What is emphasized is that farmers, essentially, have disappeared.<sup>8</sup>

With these tremendous changes in the technological and economic structures of the country, already in 1960 70 per cent of the nation's population lived in urban areas and 60 per cent of

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<sup>7</sup> See "Thousands Continue to Abandon the Towns of America's Lonely Plains," The New York Times, Sunday, February 14, 1971, pp. 1 and 68.

<sup>8</sup> Saul B. Cohen, "The United States and its Geopolitical Setting," Problems and Trends in American Geography, Saul B. Cohen, Ed., (New York: Basic Books, 1967), p. 152.

it lived along the various coastlines.<sup>9</sup> Thus much attention is being rightly focused upon the growing problems of social organization accentuated by this rapid urbanization.

The real effects of continued out-migration on the sending areas, the emptying acres of the farming regions, are less well understood.<sup>10</sup> In the state of Kansas, for example, during the period 1950-1970 there was a marked absolute loss not only in the farm population but also in the rural non-farm population. On-the-farm population accounted for only 11 per cent of the state's total population by 1970.<sup>11</sup> As ownership of the productive land tends to be concentrated more highly, the operation of farms is becoming more mechanized and presumably more efficient. (It is estimated that today the typical American farmer manages to feed about thirty urbanites.<sup>12</sup>) Sidewalk and suitcase farming is increasingly popular in

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<sup>9</sup>  
Ibid., p. 153.

<sup>10</sup>  
See David Lowenthal and L. Comitas, "Emigration and Depopulation: Some Neglected Aspects of Population Geography," Geographical Review, 52, No. 2 (April, 1962), pp. 195-210.

<sup>11</sup>  
Bureau of the Census, U.S. Department of Commerce, U.S. Census of Population, 1970, PC(1)-C18 Kans., General Social and Economic Characteristics.

<sup>12</sup>  
John Fraser Hart, "The Changing American Countryside," Problems and Trends in American Geography, Saul B. Cohen, Ed., (New York: Basic Books, 1967), p. 66.

13  
 numerous areas, and many large operations are in fact run  
 14  
 by far-off corporate boards.

But given the present state of agricultural technology, transportation technique, and social demands, what has been the effect of these shifting patterns of settlement and population densities upon the spatial organization of the different sending areas? How is the remaining population grouped, and what is the level of social and retail services now available to it? Hudson has suggested that the several stages of advance during the settlement process are characterized by particular patterns of settlements.<sup>15</sup> It would seem reasonable that the stages of depopulation are accompanied by their own patterns. Lowenthal and Comitas explain that

as depopulation goes on, the per capita cost of services rises, the burden of maintaining schools, roads, and other community functions falls more and more on outsiders. Ultimately the community ceases to be socially viable and may, like England's deserted villages and Nevada's ghost mining camps, vanish entirely.<sup>16</sup>

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13  
Ibid., pp. 70-71; Walter M. Kollmorgen and George F. Jenks, "Sidewalk Farming in Toole County, Montana and Trail County, North Dakota," Annals of the Association of American Geographers, 48, No. 3 (September, 1958), pp. 209-231; and by the same authors, "Suitcase Farming in Sully County, South Dakota," Annals, 48, No. 1 (March, 1958), pp. 27-40.

14  
 Hart, Problems, pp. 68-69; and Kollmorgen, Problems, p. 90.

15  
 See John C. Hudson, "A Location Theory for Rural Settlement," Annals of the Association of American Geographers, 59, No. 2 (June, 1969), pp. 365-381.

16  
 Lowenthal and Comitas, "Depopulation," pp. 195-210.

Emigration then is normally thought to be inseparably related to decline.<sup>17</sup>

An important question is: At what point does continued depopulation lead to the decline of an area's service base? Although Clawson points out that settlement pattern will always lag behind optimum pattern, he also states that change will always be under way.<sup>18</sup> Thus the residual population of an area experiencing depopulation and technological change should tend to re-group in more functional patterns, and in so doing alter the type of service base it can support. The cumulative friction of distance as well as population density and absolute population size should play an important part in creating economies of scale. It is possible that a more closely knit pattern of settlement could to some extent make up for the loss of sheer numbers of people.

#### B. STATEMENT OF THE PROBLEM

The purpose of this study is to observe the changing patterns of rural settlement in several representative areas of Kansas, relating these changes to the depopulation process and attempting to analyze the effects of these changes on a

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<sup>17</sup> Ibid., p. 197.

<sup>18</sup> Clawson, "Optimum Future Rural Settlement Pattern," pp. 283-294.

selected set of basic services available to the residual population. There are three major elements in this problem. First, an endeavor is made to elaborate on the theoretical geographic explanation of the quintessential association between the form and process of human element. Here the analytic emphasis is placed upon morphology rather than process. Several assumptions are made concerning the modus operandi of the depopulation stage of settlement, these being compared conceptually with those used by Hudson in his Iowa study. It is thought that a better understanding of the pattern taken by rural settlement after prolonged depopulation will shed light upon the basic dynamics of the process.

The second part of the problem pertains to the level of services available to the remaining residents of the study areas. The location of tertiary activities has been most successfully explained theoretically as a function of market area population size thresholds. But it is apparent that occupancy of an area is dependent upon the availability of a socially defined minimum level of societal and retail services. A major component of this study is the examination of the possibly causative nature of variations in the level of services available to a rural population as a result of differences in the settlement pattern. It seems reasonable to hypothesize that the service base of an area will change not only as a consequence of absolute population size and population density, but also as a product of divergent settlement forms. As

argued above, more clustered patterns of settlement should decrease the friction of distance involved in the delivery of services to the areal market. This idea is compatible with empirically based notions of the distance decay characteristics of industrial location. Transportation economies should, by lowering price, increase a population's marginal propensity to consume, and thus contract the required spatial limits of an activity's feasible margins of profitability. (Or as is hypothesized in this instance, effective levels of demand within a market area undergoing increased settlement clustering could rise sufficiently to compensate, up to a point, for the loss of consumers.) Under these circumstances revenue could remain high enough to ensure continued operation through the balancing of population loss by increased per capita consumption. Lösch argued for the special importance of the effects of pricing policies on an activity's market area, and he also made note of the importance of local differences in accessibility in explaining economic location.<sup>19</sup>

The problem-ridden nature of the rural transition which originally suggested this topic for consideration, as well as the obviously direct comments upon critical elements of the

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Paraphrased in David M. Smith, Industrial Location: An Economic Geographical Analysis (New York: John Wiley and Sons, Inc., 1971), p. 134.

contemporary national situation which the results of studies such as this could make possible, logically suggests the third facet of this investigation. What are the implications of changing rural settlement patterns for regional growth and development policy? Theoretically generated empirical input is badly needed in the formulation of realistic goals and objectives for such policies. If government programs are to be successfully implemented, they must be based upon policies which reflect an understanding of the functional relationships of the phenomenon being manipulated.

In summary, then, the problem investigated in this paper is posed as follows, (1) What are the effects of depopulation upon rural settlement patterns, (2) What is the apparent relationship between settlement patterns and service levels, and (3) What are the ramifications of these inter-relationships for regional development policies?

### C. METHODS OF ANALYSIS

In order to analyze rigorously the nature of changes in rural settlement patterns as a result of depopulation and to relate these changes to the level of services availability to the rural population, two hypotheses are tested. These are:

- (1) With depopulation, the pattern of rural dwellings in an area will become more clustered over time.
- (2) Areas displaying a tendency toward settlement



clustering will experience a relatively higher level of services than similar areas with less agglomerated settlement patterns.

Policy recommendations based upon the finding of these investigations are of course more subjective.

To test these hypotheses six rural counties in the state of Kansas were chosen for examination. The criteria used in selection are discussed in Chapter III. The location of individual dwelling units on the rural landscape was determined for two points in time, separated by an interval of approximately twenty years, from the Highway Commission of Kansas. The pattern of settlement on both dates in each of the subject counties was measured by the nearest-neighbor method of point pattern analysis, as used by King in 1962.<sup>20</sup> The significance of differences in the computed R statistical index for the same county on the two dates is tested by a one-way analysis of variance.

The association of variations in service levels with changes in settlement pattern is assessed by comparing the employment per thousand people in several selected service occupations in counties in 1950 and 1970, with the computed nearest-neighbor indices. The comparative rates of change

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Leslie J. King, "A Quantitative Expression of the Pattern of Urban Settlements in Selected Areas of the United States," Tijdschrift voor Economische en Sociale Geographie, 53, No. 1 (January, 1962), pp. 1-8.

in these two measures during the study period is also analyzed. The Kendall rank correlation,  $\tau$  (tau), is used to measure correlation between these variables.

At the outset it was hoped that a more spatially sensitive measure of accessibility to services could be employed. Consideration was given to the calculation of cumulative travel distance measures rather than to the arbitrarily delimited areal availability counts, but time limitations and the difficulty in obtaining anything but nominal scale location data precluded the utilization of this more geographic technique. Recent work done by the author for the Highway Commission of Kansas has shown that the enumeration of employment by industrial classification available in the 1970 Census of Population gives a fairly accurate picture of categorical employment in Kansas counties.<sup>21</sup> Through the selection of the areas to be studied an attempt was made to limit the probability of inter-county travel on the part of the population served.

The policy implications of this analysis are woven into the framework of ideas presented in recent scholarly discussion and current practices related to policies for regional development. Although the present study deals

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Highway Commission of Kansas, Hutchinson Growth Center Area Planning Study, Economic Growth Center Highway Demonstration Program. Unpublished rough draft, p. 32.

exclusively with the United States, these considerations might also be relevant to other areas which substantially share America's settlement history and stage of urban-industrial development.

#### D. JUSTIFICATION

Justification for both the subject matter and analytic techniques used in this study can be made on scholarly and pragmatic grounds. The long geographic tradition of concern for the study of human settlement and the location of economic activities was cited above in introducing the problem. A substantial body of literature exists upon which to build. The increasingly theoretical nature of this work encourages further efforts to add to our conceptual understanding of these phenomena.

Rigorous analytic methods have proven themselves useful in the investigation of geographic problems. The nearest-neighbor method of point pattern analysis used here has become a standard tool for geographers interested in the distribution of punctiform objects over space. Hudson surmises that the reason for the early popularity of the study of settlement among European geographers was the ease with which a distribution of dwellings could be conceptualized as a pattern of points on a map.<sup>22</sup> King relates that while the problem of

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Hudson, "Rural Settlement," p. 365.

deriving a mathematical expression of the pattern of settlement received much attention from these early researchers, the near-neighbor method, based on contemporary statistical theory, offers a more meaningful and precise description of the distribution of points within an area.<sup>23</sup> The other statistical procedures used in this thesis are simple measures employed to lend credence and a higher degree of reliability to the conclusions drawn from the analysis.

It would seem that settlement geography has been inspired from its beginnings by rather pragmatic concerns. This has been especially true in newer areas of human occupation, where settlement processes and the frontier have but recently played an important role in a nation's public life and governmental policy decisions. The quotation from Bowman cited in footnote number 3 strongly suggests the practical motivations which encouraged that work, and even a cursory inspection of other important publications in the field reinforces one's perception of this emphasis. It is very appropriate, and consistent with a distinguished geographic tradition, that this study should not only attempt to add to our theoretical understanding of the settlement process, but also inquire into the ramifications of such considerations for public policy. Decision-makers, who are indeed now contemplating further tampering with the urbanization process, need the

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<sup>23</sup>

King, "The Pattern of Urban Settlement," pp. 1-2.

largest base of knowledge possible upon which to formulate their future policies and programs.<sup>116</sup>

The remainder of this paper is organized into five chapters. The next chapter briefly reviews the development of geographic research on settlement, with an eye to gleaning the major conceptual positions which have evolved. Chapter III deals with settlement patterns, measuring and relating them to rural depopulation. Chapter IV tries to measure the effects of changes in settlement on rural service availability. Chapter V outlines the apparent implications of these investigations for governmental policy decisions. And finally, a summary and conclusion are offered in the last chapter.

## CHAPTER II

### REVIEW OF THE GEOGRAPHIC LITERATURE ON SETTLEMENT

It is not within the scope of this paper to outline in any detail the development of settlement geography. But a brief examination of the more salient points of its evolution will be helpful in bringing contemporary work into perspective. Later on, the consideration of some of the notions reviewed in this chapter will prove useful to the development of the conceptual arguments posed in this study.

#### A. AN OVERVIEW

The form taken by human settlement is one of the fundamental aspects of man's relationship to the land and his organization of space. It is inseparably tied to culturally defined patterns of land use, and thus is affected by the evolution of economic activity.<sup>1</sup> The importance of these interrelationships, and the central significance of settlement to geographic study, is emphasized by Murphy when he identifies "the distribution and relationships of mankind over the earth and the spatial aspects of human settlement and use of the

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A. Perpillou paraphrases Demangeon's view to this effect in "Problèmes de l'Habitat Rural," La Géographie Française au milieu du XX<sup>e</sup> Siècle (Paris: J.B. Baillere et Fils, 1957), pp. 133-41, especially pp. 135 and 138.

earth" as one of the distinct areas explored by geography.

A brief review of definitions of the term 'settlement', in the nominative sense, will suffice to show that three main components can be identified which lend it meaning. First, it denotes a more or less permanent abode for man. This sedentary feature suggests the second characteristic, the existence of a relatively substantial dwelling unit. These two attributes, given the nature of man, logically suggest a third, multiplicity. A settlement then might be defined as a group of reasonably permanent human dwellings.<sup>3</sup> As a corollary to this, the act of settlement would be a trait of agricultural and post-agricultural societies. The form or pattern taken by settlement must surely be seen as one of the fundamental material attributes of the society; a variable product of economic pursuits, social organization and ability to overcome the friction of distance. In general form then, the study of settlement would consist of an investigation of morphology, process and causation.

European geographers developed an early interest in the pattern of settlement, emphasis here being centered on a categorization of settlement and housing types and their

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Rhoads Murphey, An Introduction to Geography, 3rd edition (Chicago: Rand McNally and Co., 1971), p. 5.

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See for instance F.J. Monkhouse, A Dictionary of Geography (Chicago: Aldine Publishing Co., 1965), p. 278.

relationship to rural land use. This orientation has been carried over to America in the work of such scholars as Kniffen and Stone.<sup>4</sup> In recent years there has also been an interest in the processes behind this variegation of the cultural landscape. Swedish and American work is notable in the area.<sup>5</sup> This kind of research has shown the need for a more explicit theoretical explanation of the causative relationships involved in the settlement process. Hudson has made a substantive start in this direction with his proposed location theory for rural settlement.<sup>6</sup> In this chapter an attempt is made to summarize the conceptual framework developed in this literature.

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Kirk H. Stone, "The Development of a Focus for the Geography of Settlement," Economic Geography, 41, (1965), pp. 346-55; Clyde F. Kohn et al., "Settlement Geography," in American Geography: Inventory and Prospect, P.E. James and C.F. Jones, eds. (Syracuse, N.Y.: Syracuse University Press, 1954), pp. 121-41.

5

For example, E. Bylund, "Theoretical Considerations Regarding the Distribution of Settlement in Inner Northern Sweden," Geografiska Annaler, 42, No. 4 (1960), pp. 225-31; D. Hannerberg et al., eds., Migration in Sweden, A Symposium, Lund Studies in Geography, Series B, Human Geography, No. 13 (Lund, 1957); R.L. Morrill, "The Development and Spatial Distribution of Towns in Sweden: An Historical-predictive Approach," Annals of the Association of American Geographers, 53 (1963), pp. 1-14; T. Hågerstrand, "The Propagation of Innovation Waves," Lund Studies in Geography, Ser. B, Human Geography, 4 (1952), pp. 3-19; and Isaiah Bowman, The Pioneer Fringe, American Geographical Society Special Publication No. 13 (New York: American Geographical Society, 1931).

6

Hudson, "A Location Theory for Rural Settlement," pp. 365-81.



## B. THE TRADITIONAL EUROPEAN INTEREST

Although an interest in human settlement can be found in geographical work dating back to the Roman era, the systematic study of settlement as a landscape feature began with the work of von Richthofen and Meitzen in late nineteenth century Germany. The emphasis here was on the form of settlement, especially rural villages. In a monumental work of four volumes Meitzen set about classifying German villages as to their form.<sup>7</sup> Here we find the first approximation of a functional categorization of rural settlement form, the identification of clustered (compact) villages and dispersed (isolated) farm dwellings. In the European experience the latter category was dominated by hamlets, small clusters of grouped farming units. This fact seems significant to the development of a conceptual frame for dealing with dispersed settlement patterns. Hartshorne has pointed out that a preoccupation with tangible features of the landscape can lead to a concentration on the form of such features.<sup>8</sup> This was indeed the case with early settlement geographers. Although they theorized about process, their main interest seems to have

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<sup>7</sup> A. Meitzen, Siedelung und Agrarwesen der Westgermanen und Ostgermanen (Berlin, 1895).

<sup>8</sup> Richard Hartshorne, The Nature of Geography (Lancaster, Penn.: Association of American Geographers, 1939), pp. 189-236, especially pp. 229-35.

centered upon the taxonomy of village morphology, and at an even smaller scale, the development of housing types.

Schlüter, often thought to be the 'father' of settlement geography, broadened the working definition of the field. To the study of location, size, growth, and man-land relationships of settlements he added internal and external form, areal arrangement, and socio-economic influences. He brought attention to the ideas of process and areal arrangement, and insisted that interest should be paid to settlement and not to the settler. Another innovation was the consideration of urban units as well. Christaller was to use these last three elements during the 1930's to formulate his theory of central places.

The French followed close upon the heels of the Germans in their development of settlement studies. Demangeon, a student of Vidal de la Blache, furthered the development of classifications in his many regional studies. This was capped by his synthesis in "La Geographie de l'Habitat Rural", published as the best part of a volume of the Annales in 1927. He also led the formation of the I.G.U.'s Commission on Rural Settlement in 1925, which encouraged an international effort of the European type for some years.

Brunhes, another Frenchman, was the most celebrated proponent of the study of house types as the center point of the subfield. His work emphasized areal variations in man's adaptation to different regional environments. So it can be

seen that the French school basically collaborated with the research interests of their neighbors. Other Europeans, primarily the Belgians and the English, pursued variations on the same theme, with the English concentrating perhaps more steadfastly on land use.

Several main themes developed in the evolution of European settlement geography. Settlements types were quickly dichotomized as either grouped or dispersed. While a continuum between these extremes was acknowledged, investigation went forward basically in two main realms. The vast bulk of work dealt with the historical development of the various forms of the rural village, and most consideration of more dispersed patterns concentrated on the rise and fall in the agglomeration of hamlets. The identification and explanation of different forms of truly dispersed settlement seems to have suffered from a neglect grown out of the long, complex settlement histories of the countries within which study was centered.

Several mathematical formulations were attempted to ease generalized description of settlement patterns.<sup>9</sup> Demangeon's coefficient

$$K = \frac{E \times N}{T}$$

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<sup>9</sup> For a review of these formulations see J.M. Houston, A Social Geography of Europe (New York: Frederick A. Praeger, 1963), pp. 81-5.

(where K = the index, E = the population of the area except for the chief nucleated settlement, N = the number of other settlements except the dominant center, and T = the total population of the area) is actually inappropriate for use in areas with isolated settlement patterns. By definition it requires a degree of settlement agglomeration. Zierhoffer's equation

$$R = \frac{P \times s}{d} \times K$$

(where R = the index, P = the average area per dwelling, s = the number of house groups in the study area, d = the total number of inhabitants, and K = a constant coefficient) has the same failing. Debouverie's formula

$$R = \frac{X \times L}{H}$$

(where  $X = \frac{H}{L}$  and X is a regionalization factor, K = the index, H = the total number of dwellings, and L = the number of settlement units) again demands nucleation to an observable degree. All these efforts, and the numerous variations based upon them, reconfirm this concentration on the study of clustered and semi-clustered populations.

A good deal of interest was centered around the identification of the primal rural settlement type and its sequence of evolution. While evidence of both early aggregated and dispersed settlement was uncovered, the nucleated pattern was thought to be the more normal primitive form. Its con-

sequent change to a dispersed pattern was seen as a product of economic, social and technological change. But these factors were always conceptualized within the framework of agricultural evolution. The urbanization process does not seem to play a major role in most such thinking. Changes were thought to be cyclical, and no single condition such as over population was thought to yield necessarily a particular pattern--although both dispersion and clustering were seen as having specific attributes. Rather than process determining form, the causative social factors behind the process (function in scientific terminology) tend to vary its result.<sup>10</sup> Demangeon felt that the degree of dispersion of the rural settlement pattern was independent of the area's population density.<sup>11</sup> This point seems paramount, and will be drawn upon in the next chapter.

To summarize, Europeans developed an interest in the form of settlement at all scales, but especially within the context of the village landscape and the individual farm dwelling. This led to the categorization of village types and house types, and the general identification of a continuum of settlement patterns, with clustered and dispersed landscapes being the extreme examples. In truth, they dealt main-

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<sup>10</sup>  
A. Perpillou, "Problemes de l'Habitat Rural," especially pp. 136-8.

<sup>11</sup>  
Ibid., p. 136.

ly with different variations of the former category. Interest was shown in the identification of the most probable sequence of settlement pattern development from some primordial type, and this process was seen as a cyclical phenomenon--the social factors of the moment providing the formative force, rather than the process itself.<sup>12</sup> Thus a process like rural depopulation would be connected with no particular settlement pattern, but rather, the pattern would be determined by the function which it served, such as agricultural adaptation, civil unrest or technological innovation. A theoretical chain of causation would have helped in such explanations, but existent frameworks were seen in terms of the demands of the rural agricultural system, and the urbanization process was not seen as an important factor in itself. Even given these notions of flexibility, agglomerated settlement patterns were thought to be the more ancient form, and both clustered and dispersed patterns were assigned basic attributes.

. . . compact settlement is always due to some constraint: physical constraint when man is ill-equipped to deal with his environment and must needs form a group for maintaining . . . appliances for the common use; and agrarian constraint when the system of rotation (etc.) demands a set course in the use of the soil. There is also sometimes social constraint imposed by the land-owner, or by rigid social structure . . .

Dispersion on the other hand is a form of freedom. It may develop when man has mastered nature, and technical development has made possible the extraordinary scattering of human dwellings. Freedom has also come from the progressive mastery of an economic system

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Ibid., pp. 136-7.

which taxes the productions rather than the instruments of production . . .<sup>13</sup>

From these generalizations, the new world rural settlement patterns in such places as Kansas are thought to be explained by the freedom provided by the technological ability and market economies and the constraint of the survey system and social needs based on man's gregarious nature. Perpillou sees the dispersed pattern of large farms as the natural habitat of scientific agriculture, but feels inevitable the development of sidewalk farming and the predominance of small towns to serve man's social needs.<sup>14</sup> This scholar's observation of nebulization within dispersed patterns perhaps points to a sequential tendency in this direction.<sup>15</sup>

In a closing thought, the almost 'closed rural system' nature of European explanations must be kept in mind, and the lack of much work with variations found within primarily dispersed populations is significant. The European idiom, speaking of villages and isolated hamlet-type units as clustered and dispersed, should not be confused with the terminology applied in the context of American point pattern analysis.

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<sup>13</sup> Aimé Vincent Perpillou, Human Geography, Translated by E.D. Laborde. (New York: John Wiley & Sons, Inc., 1966), pp. 433-4.

<sup>14</sup> Ibid., pp. 432-3

<sup>15</sup> Ibid., pp. 410-11.

## C. THE AMERICAN CONTRIBUTION

American concern for the study of settlement is rather less developed than European. Or perhaps it should be said that American interest has developed along rather different lines. To be sure, there has been some work with the nature of housing type distributions and the form of rural villages. The work of Kniffen, Durand, Lee, Stone and Kiefer is worthy of mention in relation to the study of specific facilities, while Trewartha, Hall, Augelli and Kohn have all shown interest in morphology in the European sense.<sup>16</sup> Little of substance, it would seem, has been added to the body of knowledge accumulated by the Europeans as a result of this work. In his review of the development of settlement geography, Stone felt obliged to include only two rather meager paragraphs on the American contribution. He notes that interest in rural studies has been overshadowed by the vigorous growth in urban analysis.<sup>17</sup> Kohn's essay on American settlement geography in the 1954 inventory of the state of geography in the United States was built up around a mere handful of studies, several

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For a discussion of the development of traditional settlement geography in the United States see Kohn, "Settlement Geography," pp. 124-141. The latest contribution along these lines is offered by Wayne E. Kiefer, "An Agricultural Settlement Complex in Indiana," Annals of the Association of American Geographers, 62, No. 3 (September, 1972), pp. 497-506.

17

Stone, "A Focus for the Geography of Settlement," pp. 353-4.



of which dealt with other parts of the world.<sup>18</sup> In fact, Hartshorne felt justified in commenting that some American workers in this field displayed an absolute lack of comprehension as to how their work fit into the broader framework of cultural geography.<sup>19</sup> One of the most serious criticisms however that can be leveled against the American endeavor is that it took its focus uncritically from its European predecessors. Even though rural settlement in North America from western Pennsylvania to the Mississippi and beyond has been dominated by dispersed settlement forms, traditionally oriented American geography has busied itself with village morphology and less irrelevantly with buildings types.

The predominant strain in American work in past decades though has been centered around the process of settlement, especially as it relates to the peopling of frontier areas. Bowman's studies of frontier settlement, and the related publications by the American Geographic Society mark the high point of the interest.<sup>20</sup> The intent of this work was highly practical in nature, hoping to identify relationships which

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Kohn, "Settlement Geography," pp. 124-141.

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Hartshorne, Nature, pp. 230-1.

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Isaiah Bowman, The Pioneer Fringe (New York: American Geographical Society, 1931); W.L.G. Joerg, ed., Pioneer Settlement (New York: American Geographic Society, 1932); Isaiah Bowman, ed., Limits of Land Settlement (New York: Council on Foreign Relations, 1937).

would aid in the process of governmental settlement policy formulation. It is only fair to state that, like the European scholarship reviewed above, this emphasis in American work was obviously prompted by a natural ethnocentric bias. Kohn pointed out, in the article already cited, that this work probably took place after the settlement of virgin land had ceased to be an important policy issue.

A logical outgrowth of this interest in the settlement process was the development of the currently continuing interest in migration. Migration, as the vehicle of pioneer settlement as well as rural population redistribution, has produced interesting literature in both the United States and Sweden. Hägerstrand and Bylund in Sweden have been leading contributors in this movement, as has Morrill in the United States. Interestingly enough, Morrill has worked at length<sup>21</sup> with Swedish data. The most important distinctions of this research from the French and German considerations of process are: (1) its prime concentration on the process and relative location of settlement rather than the form, (2) the extensive use of mathematical techniques, and (3) an emphasis on theory building. The attempts to reproduce and explain the generalized migration process has led to the use of computerized

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Beside the references cited in footnote number 5, see H.L. Seyler, "Urban Geography: A Selective Bibliography for the Beginning Urban Studies Student," Unpublished reference, Kansas State University, Department of Geography, 1972, pp. 18, 19 and 21.

simulation models and other contemporary tools. While form is certainly a consideration in such studies, it definitely takes a backseat to the generation process. The movement of human beings has been a more important topic for study than the pattern of their dwellings. This work has been pursued within the frame of central place theory and the assumptions associated with Lösschian settlement landscapes. Its process emphasis is strongly evidenced by the adoption of its techniques for use in urban mobility situations. Morill and Rose have applied this methodology to the study of urban ghetto spread and intra-urban mobility. Movement and location have been the keynotes.

One must take a few steps back perhaps to tie this theoretical consideration of the migration process directly to the study of settlement patterns. But the link has been made recently in the theoretical work by Hudson dealing with changes in dispersed settlement patterns in Iowa. Hudson's conceptualization of the stages of the settlement process is explicitly built around a synthesis of central place theory, diffusion theory, ecological distribution theory, and a fourth category of generalizations encompassing aspects of all these three, morphological laws.<sup>22</sup>

## D. THE CURRENT EMPHASIS

Hudson's theory of rural settlement has set the tone<sup>23</sup> for contemporary American and some foreign work. Based on a three-step conceptualization of the pioneer settlement process, it hypothesizes and empirically tests a generalized model of the settlement process for areas similar to the American Midwest. The basis for this conceptualization, drawn from both geography and biology, is a tri-stage settlement process, dividing settling into phases of colonization, spread and competition. A continuum of dispersed settlement patterns is hypothesized, the characteristic form for each step of the process defined in terms of contemporary point pattern analysis. Hudson tests this model against a sample made up of segments of six counties in the state of Iowa. Attempting to fit settlement patterns observed on topographic sheets and general highway maps to several mathematical surfaces, he found some tendency toward agreement with two of his formal hypotheses. The form of the dispersed settlement pattern was defined by the use of computerized quadrat sampling techniques, and the goodness of fit was tested statistically by the Kolmogorov-Smirnov test. The variance-mean ratio was computed

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David Grossman, "Do We Have a Theory for Settlement Geography? The Case of Iboland," The Professional Geographer, 23, No. 3 (July, 1971), pp. 197-203.

and a t-test of its significance was carried out.

More specifically, Hudson hypothesized that while passing through a process of colonization, spread and competition, the dispersed settlement pattern would progress from randomness to clusteredness to regularity.<sup>24</sup> He manages to represent this transformation as an ever increasing tendency toward regularity. Operationally, Hudson enumerated settlement distributions in several selected areas by the use of quadrat frequency counts. Because these densities have a definite arithmetic mean and variance from the mean, he was able to use the variance-mean ratio as a measure of pattern. If the mean was greater than the variance ( $\bar{X} > V = < 1$ ) the distribution is called regular. In cases where the variance was larger than the mean ( $\bar{X} < V = > 1$ ) the pattern was labeled clustered. Where the mean and variance are equal ( $\bar{X} = V = 1$ ) the distribution is thought to be uniform. Since the variance-mean ratio has a known sampling distribution, the statistical significance of any departure from unity may be tested. In a further test of his conceptualization of the settlement process he fit three different probability distributions to his data sets: (1) the regular Poisson distribution to cases where the distribution ratio yielded regular or random results ( $R \leq 1$ ), (2) the negative binomial

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The precise definition of these terms is explained in the section on methodology in Chapter III.

distribution for units with clustered tendencies ( $R>1$ ), and (3) the Poisson distribution to all areal units.

Hudson tested three formal hypotheses against his empirical data. Hypothesis number 1 stated that during competition, with its concomitant short term effect of lowering settlement density (farm abandonment), the settlement pattern would become more regular. Hypothesis number 2 proposed that increased clustering would be a sign of increased density. Hypothesis number 3 stated that with long term competition, areas once supporting denser farming populations would undergo farm abandonment, increase in farm size, and increasing regularity in settlement distribution (if most of the land stayed under cultivation.) In the eleven cases where hypothesis 1 could reasonably be tested, it was accepted ten times. There were not enough increases in density to make inferences for hypothesis 2. Hypothesis 3 was accepted because, in most instances, more units were found to display regularity over time.

Hudson concludes that:

As density increases (in an area) through a continued diffusion of settlements, competition for space becomes increasingly important. The pattern changes from clustered to a highly regular arrangement as weak individuals are forced out and the average size of holdings increase.<sup>25</sup>

It should be noted that Hudson's conclusions have been crit-

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<sup>25</sup>

Hudson, "A Location Theory for Rural Settlement," p. 380.

icized by Grossman because they do not seem universally true. Grossman points out that: (1) the degree of philosophical individualism presented in the Iowa farm population is not common on a worldwide scale among rural societies, and (2) that the residents of Iowa represent an atypically complex and diverse mixture of cultural heritages.<sup>26</sup> While these comments could be questioned on conceptual grounds, Perpillou states for instance that increasing individualism is a typical characteristic of rural societies at certain thresholds during their development.<sup>27</sup> Their greatest weakness is failure to take note of Hudson's specifically stated qualifications. Hudson writes in his conclusion, "It should not be inferred that the theory of settlement location described here states that all distributions will pass through these pattern changes in precisely the same way and in the same length of time."<sup>28</sup> He constantly restates that his generalizations are only meant for areas such as Iowa.

This is not to say that Hudson's arguments are entirely clear or acceptable. It is of importance to note that, as did his European predecessors, he seems to treat rural settlement in a closed agricultural system manner. Perhaps this is

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<sup>26</sup>

Grossman, "Have We a Theory?", p. 197.

<sup>27</sup>

Perpillou, Human Geography, pp. 425-6.

<sup>28</sup>

Hudson, "A Location Theory for Rural Settlement," p. 380.

valid in as much as he is dealing with a situation in which competition, farm abandonment and loss of population are seen as a process increasing farm efficiency. But on the other hand, it might be useful to consider rural depopulation, especially during the decade of the 1950's, as a part of the larger urbanization process in which people are actively leaving the land for the city.<sup>29</sup> This is indeed a wider view of such depopulation trends, one which makes rural counties small open system segments of a larger phenomenon. Although the logic of some of Hudson's arguments is at times opaque to this student, it is not the object of this paper to re-test his hypotheses as such. Rather, in the next chapter, an attempt is made to add a distinct depopulation stage to Hudson's theoretical series. While competition may be the vehicle of farm expansion and the initial mechanism behind population loss, it will be argued that settlement pattern is not necessarily determined by the broad process of competition, and that other variables such as the social needs of man which the process serves (the function) come into play also. This seems in keeping, at least, with the traditional European view of settlement form, and the general methodology of science which views form, function, and process as inseparable



in a successful explanatory model.<sup>30</sup> If variant hypotheses and empirical results are produced by this approach, they should be interpreted as complimentary rather than conflicting. The study areas, methods of analysis, and (presumably) stages of the settlement process are different although study periods do overlap somewhat. The emphasis here is on the analysis of pattern, speculations as to process being through the analysis of observed changes in settlement form and the function of that form.

#### E. A CONCEPTUAL MODEL FOR RURAL SETTLEMENT PATTERNS IN KANSAS

Several 'stage' theories of changing population patterns have been offered in the literature. Both Zelinsky and Gibbs have considered changes in rural settlement patterns on a broad scale, explaining distribution at different levels as a function of changing technology, the prevalent economic system, and the urbanization process. Zelinsky visualized five stages, or 'life cycles', in the evolution of population

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The implications for geographic methodology of the three aspects of phenomena is discussed with insight in Jack Eichenbaum and Stephen Gale, "Form, Function, and Process: A Methodological Inquiry," Economic Geography, 47, No. 4 (October, 1971), pp. 525-44.

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patterns in counties in the United States. These stages are: (1) a period of pioneer settlement, (2) a period of substantial natural increase (sometimes along with continuing immigration as the possibilities of the farm oriented rural economy are developed), (3) a period of equilibrium before the onset of dwindling numbers begins, (4) a period of initial urbanization and economic growth, and (5) a period of expanding urbanization and strong, continuing rural-urban migration (an emptying of rural space).

Zelinsky tested this model with some measure of success on a county basis on all American counties from 1790 through 1960. He dealt basically with gross descriptive measures of county population concentration and rural-urban population ratios. The decline of rural areas during the final period is seen primarily as the product of urbanization, with its concomitant age selective migration and urban economic growth. Zelinsky's effort does not really deal with the changes in rural settlement pattern at a scale that would be helpful to this study, but he does emphasize the importance of the urbanization process.

Gibbs begins his model in what would be stage number four of Zelinsky's framework. His interest is focused upon the evaluation of population concentration, and he hypothesizes

a five step process centered around urbanization.<sup>32</sup> The sequence is as follows: (1) initial urbanization (rural population growth equals or exceeds urban increases); (2) urban growth comes to exceed rural population growth; (3) rural population undergoes an absolute decline; (4) the population of small cities suffers an absolute decline; and (5) areal variations of population concentration decrease, with a tendency toward more even spatial distribution of population. Stages two, three and four represent a tripartite splitting of Zelinsky's fifth stage, and Gibbs' stage five goes a step beyond Zelinsky, based on the notion of decentralization.

It must be noted that Gibbs and Zelinsky worked at two different levels of areal aggregation, the former using concentration by county to measure intra-state changes, and the latter measuring intra-county evolution. But Gibbs appends a final stage to Zelinsky's continuum, the urban spread stage, which changes the theoretical outcome of the process. As far as the present study is concerned the most important contributions made by these two formulations is the insistence that changes in rural population patterns in the United States during the last several decades can be conceptualized as part and parcel of the urbanization process.

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Jack P. Gibbs, "The Evolution of Population Concentration," Economic Geography, 39, No. 2 (1963), pp. 119-30

**THIS BOOK  
CONTAINS  
NUMEROUS PAGES  
WITH MULTIPLE  
PENCIL AND/OR  
PEN MARKS  
THROUGHOUT THE  
TEXT.**

**THIS IS THE BEST  
IMAGE AVAILABLE.**

Hudson's model, reviewed above, deals with changes in the dispersed pattern of rural settlement. Working with the location of individual housing units at the sub-county scale, Hudson hypothesized a three-stage process involving: (1) colonization, (2) spread, and (3) competition. These steps agree substantially with Zelinsky's first three stages, although the two scholars were working with different levels of generalization. Hudson conceptualized his model in terms of a basically closed rural system. His framework stops at the beginning of Zelinsky's fourth step, thus not taking city formation into account as an important independent variable affecting rural settlement form. Hudson's end product, like that of Gibbs at a different level of population agglomeration, is the relatively homogeneous spatial distribution beloved of geographers. It would seem, perhaps, that stopping as he did with a rural settlement equilibrium, Hudson missed the most apparent fact of the American cultural landscape in the mid-twentieth century, urbanization. Rural America does not operate within a vacuum. It is tied to the broader geography of the United States by innumerable spatial interdependencies born of commercial agriculture, technological change, and, most important, an urban dominated socio-economic process.

Writing of dispersed new world rural settlement patterns, Perpillou said, ". . . wherever dispersion becomes excessive, social needs, using any existing assets, tend to

create artificial groupings, which try to satisfy the material and moral needs of the people." He went on to note:

In Kansas the small density of population on a vast area results in an extraordinary scattering. Within the framework of the impersonal 'townships' are scattered the swarm of 'homesteads'. A township may have only one of its concessions occupied. In such a case, the remaining land cannot be used by that one settler, even as a passageway or as a pasture. A strange regrouping of farmers is therefore in progress round schools and railway stations, which are becoming attraction centers with urban characteristics. In these, the farmers lead the life of townsmen and enjoy all urban comforts. Cultivation is by means of a satellite farm, built a few dozen miles away in the middle of the cultivated land, but this is occupied only seasonally at times of work and harvest. No longer is the place of settlement seen in its agricultural role, its rural function has disappeared, there is no longer even a market. This change in living conditions is produced wherever machinery enables the farmer to be transferred easily to and from his land, thus enabling him to live some distance from his fields. This is only possible when no cattle bind him to the soil.<sup>33</sup>

Referring back to another one of Perpillou's observations, mentioned at the end of Section B, not only should one expect urban agglomeration in dispersed settlement areas, but there seems also to be a frequent tendency toward nucleation within the scattered dwelling pattern itself. This tendency as well might best be accounted for by the need for more intensified social intercourse, accentuated by a social milieu increasingly built around urban ideals. Both man's need for social interaction and broader urbanization trends seem to lead to the expectation that the settlement process

will climax in a relatively agglomerated form.

A more inclusive model of the changing rural settlement patterns in areas with the same spatio-temporal frame as Kansas might be composed of four stages. First, an era of pioneer settlement (colonization), marked by a clustered pattern of sparse, dispersed settlement. Second, a period of spread, characterized by a general filling in of the rural landscape. This would be caused by both natural increase and continued in-migration. Third, an interval of competition brought about by economic rivalry and an enlargement of farm size to meet the economic demands of commercial agriculture. This period would, by definition, show the beginnings of out-migration and population decline. And fourth, a period of population decline, brought about by the age selectivity of the emigration movement started in stage three and greatly intensified by the ever increasing urban transformation of the nation's economy and society. This last stage would display a tendency toward re-clustering of dispersed rural settlements, as men regroup for convenience and companionship. It would show an even greater trend of the remaining farmers to search out a semblance of urban amenities in smaller urban-like centers.

The first three stages of this construct are drawn from Hudson's Iowa model. This has shown that indeed there seems to be a movement from clustered settlement forms to rather regular ones, as the landscape is divided into econom-

ically sized, evenly spaced farms. But the fourth stage proposed above seems necessary to describe the current situation on the American plains. It would seem that rural depopulation has gone beyond the point demanded by agricultural scale economies. The filling cities testify that ruralites are still drawn by the lure of the metropolis. It is also evident from census results that an increasing number of farmers are drawn into city style life, practicing what Kollmorgen has called 'sidewalk farming'. This tendency is spurred on not only by the need for more fraternization than is allowed by the emptying quarter sections of the actual farming area, but also by the loss of any work advantage to be gained from living in the middle of prohibitively large, areally scattered agricultural holdings. It is the purpose of the next chapter to test the proposition that continued out-migration, serving as a vehicle for national urbanization, has brought about increased clustering within a dispersed rural settlement pattern.

Hudson's tests of the first three stages of the model are accepted as indicative of probable settlement form during those periods. Here the empirical investigation will be confined to the last depopulation stage. The hypothesis is tested that at the county level in Kansas rural settlement patterns have become progressively more clustered over the period 1950-1970.

This study period was chosen on conceptual grounds because it was felt that the social factors affecting rural out-migration have been relatively stable since World War II,



and also because a twenty year span should be long enough to allow meaningful changes in form, if depopulation is prompting adjustments in rural settlement structure. Operationally, this particular time period allows comparisons to be drawn between measures taken here and data available in the decennial census of population.

## CHAPTER III

### RURAL DEPOPULATION AND CHANGING SETTLEMENT PATTERNS

In Kansas, as in the United States at large, urbanization is changing the patterns of human spatial organization. For several decades now rural counties have been steadily losing population, and an arc of urban counties, stretching from Wyandotte in the northeast to Sedgwick in the south central portion of the state, have come to dominate the state's socio-economic structure.<sup>1</sup> Only 29 of 105 counties experienced population growth during the decade 1960 - 1970, and only 35<sup>2</sup> had grown between 1950 and 1960. In 1870 rural dwellers made up 86 per cent of the state's population, while by 1970 they only composed 35 per cent of the total. Migration has played a major role in this change. Only 13 counties experienced a net in-migration during the last decade, and but 10 counties increased their populations through migration between 1950

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For the sake of comparability with U.S. Bureau of the Census data, rural counties are defined in this study as those counties which have never contained a place of 2,500 inhabitants or more, and which are not contiguous to a Standard Metropolitan Statistical Area.

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Data source: Institute for Social and Environmental Studies, Kansas Statistical Abstract, 1971 (Lawrence, Ks.: The University of Kansas, 1972), pp. 13-14.

and 1960.<sup>3</sup> In fact, 69 per cent of the state's counties have lost population by emigration for the last three decades consecutively.<sup>4</sup>

If one considers only rural counties, the changes are even more striking. Ninety per cent of the 41 rural counties in Kansas lost population between 1959 and 1970, the average rate of loss for this 20 year period being 17 per cent. In comparison with the statewide 69 per cent figure for counties suffering net out-migration over the last 30 years, 83 per cent of the rural counties experienced net emigration during this period. Between 1950 and 1970, 93 per cent registered out-movement.<sup>6</sup> Such sweeping changes in the regional population structure of the state must have had significant effects upon the patterns of settlement on a county scale as well. It seems reasonable that changes of such magnitude have brought change

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<sup>3</sup>  
Ibid., pp. 9-10.

<sup>4</sup>  
Cornelia Flora et al., "Migration in Kansas," Contribution No. 31, Sociology and Anthropology, Population Research Laboratory, Dept. of Sociology and Anthropology. (Manhattan, Ks.: Agricultural Experiment Station, Kansas State University, April 1971), Figure IV.

<sup>5</sup>  
Data source: Kansas Statistical Abstract, 1971. This mean seems relatively representative of the data array. The calculated standard deviation is 12.6 with 76 per cent of all examples falling between  $\pm 1$  s.

<sup>6</sup>  
Data source: Flora et al., "Migration in Kansas," Figure IV.

in spatial relationships across the cultural landscape.

In this chapter the conceptual model of changes in the rural settlement pattern is tested on empirical data from six counties in the state by use of the nearest-neighbor method of point pattern analysis. Before discussion of the results of the analysis, some attention must be given to the analytical technique employed and the study area selected.

#### A. METHODOLOGY

A rigorous method of measurement is needed to determine accurately changes in settlement patterns over time, especially if they remain within the same generic classification. If one assumes that the pattern of points described on a map by rural houses is an adequate representation of settlement form, then two statistical methods of point pattern analysis are available, quadrat method (cell count analysis) and near-neighbor analysis. Both of these methods are based upon measurement of the arrangement and dispersion of points in a given area,<sup>7</sup> and both measures are thus markedly affected by the size of the selected study area. Hudson pointed out the

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<sup>7</sup> Arrangement refers to the relationship of points in a display relative to each other, and dispersion is a summary measure of their relative situation within the areal extent of the study region. Together these attributes make up "pattern" as the term will be defined operationally for the remainder of this paper. See Michael F. Dacey, "Description of Point Patterns", Unpublished working paper prepared for the University of Iowa, May 1965, especially pp. 5-6.

size problem in relation to these two methods, but he inferred<sup>8</sup> that it was equally grave in either case. This is probably true in reference to choice of study area size in relation to the entire cultural landscape. Here we are dealing with the normal problem of sample size in statistical research. But the effects of quadrat size, which Hudson argued vis-a-vis near-neighbor technique problems, seem more properly listed as a second complication, exclusive to quadrat methods. Since this technique relies on the counting of points within cells of an arbitrarily assigned grid, the chance of sampling error is introduced twice, once when choosing the size of the study area and once again when subdividing it into any given sized quadrats. Near-neighbor analysis only offers the prejudice of the first error since no further areal subdivision of the region is required. For this reason, although the mechanical requirements of the nearest-neighbor technique make it considerably more time consuming in execution than cell count analysis, the second technique was chosen for use in this study.

Two further mechanical objections might be raised about the use of this procedure to test step four of the proposed settlement change model. The first of these is what is termed the "boundary problem" in near-neighbor analysis. The handling of this problem is explained below as the method is outlined step by step. The second issue is the relation of

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Hudson, "A Theory for Rural Settlement," p. 377.

the size of a study area to the degree of uniformity to be expected within it, when the sample is taken from an admittedly non-homogenous universe. Simply, the larger the scale the higher the probability of finding a clustered pattern, and the smaller the scale the greater the chance of finding a more uniform pattern. There may well be a lack of comparability between this study and Hudson's because of differences in scale, this study working with county units and Hudson's dealing with sub-county units. Be this as it may, it could be argued that the relative size used here biases the result in favor of the hypothesized pattern no more than Hudson's relatively smaller area samples did it in the hoped for direction of uniformity. Sample size is a vexing problem. It is obviously related to the level of generalization problem found in conceptual arguments, and the result of investigation based on statistical observation must always be qualified by the same types of reservations and care used in evaluating other generalizations based on observations at different levels of abstraction.

Mechanics of Near-neighbor Analysis. It is not the purpose of this section to justify the rationale of the near-neighbor technique, or to prove its validity for geographic research. Both of these points have already been substantuated in academic literature. Clark and Evans, in the classical exposition of the near-neighbor index, explained in its entirety

the technique and characteristics of the measure.<sup>9</sup> The mathematical logic, as well as the appropriate statistical tests of significance and variance among samples, are demonstrated at length in their paper.

The applicability of the nearest-neighbor method to geographical research has been shown by King.<sup>10</sup> King concluded:

The decision up to this point has been focused upon the validity of the near-neighbor statistic as a descriptive statistic of the manner in which urban settlements are distributed over portions of the earth's surface. Considerable emphasis has been given to the interpretation of the various obtained values of R, and it is evident that the statistic is sufficiently sensitive in character to point up the differences which do exist between various distribution patterns. . . . The nearest neighbor statistic provides a logically acceptable and precise expression of the character of a distribution pattern of settlement.<sup>11</sup>  
(emphasis added)

A brief explanation of the technique will be useful to the understanding of the results obtained in the analysis to be presented later in this chapter. The nearest-neighbor method of point pattern analysis, as opposed to the settle-

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<sup>9</sup> Philip J. Clark and Francis C. Evans, "Distance to Nearest Neighbor as a Measure of Spatial Relationships in Populations," Ecology, 35, No. 4 (October, 1954), pp. 445-53.

<sup>10</sup> Leslie J. King, "A Quantitative Expression of the Pattern of Urban Settlement in Selected Areas of the United States," Tijdschrift voor Economische en Sociale Geographie, 53, No. 1 (January, 1962), pp. 1-8.

<sup>11</sup> Ibid., p. 7.

ment pattern measures discussed in Chapter II, is based on contemporary statistical theory. The results of the analysis, an index,  $R$ , vary from 0 to 2.15. This ratio is a comparison of the average straight line distance between any point in an array and its nearest neighbor, and the theoretical mean distance for such a sample, when all points are distributed randomly. Symbolically  $R = \frac{\bar{r}_A}{\bar{r}_E}$ .<sup>12</sup> In any test distribution of points the average distance to a point's nearest neighbor is  $R$  times as great as would be expected in a randomly distributed sample of the same density. Thus the range of  $R$  may be treated as a finite continuum, with  $R = 0$  representing a completely clustered pattern (all points in one place), and  $R = 2.15$  expressive of a uniform Christaller-like hexagonal arrangement. Because the sampling distribution of  $R$  is reasonably accurately described by the normal curve, the significance of departure of  $\bar{r}_A$  from  $\bar{r}_E$  can be tested by a standard  $Z$  test

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where

$R$  = the index

$\bar{r}_A = \frac{\sum r}{N}$  = the mean of the series of distances to nearest-neighbor

$\bar{r}_E = \frac{1}{2\sqrt{\rho}}$  = the mean distance to nearest neighbor expected in an infinitely large random distribution of density  $\rho$

$\rho$  = the density of the observed distribution expressed as the number of individuals per unit of area

$N$  = the number of measurements of distance taken in the observed population.



where:

$$Z = \frac{\bar{r}_A - \bar{r}_E}{\bar{r}_E}$$

and  $\bar{r}_E = \frac{0.26136}{N} \cdot 13$ . Of equal importance is the fact that differences between values of R for any given populations can be tested for significance by an analysis of variance.

Clark and Evans used the variance ratio, F, for this purpose.

This test statistic is calculated by the formula:

$$F = \frac{(c - b) (N_1 + N_2 - P)}{(a - c) (P - 1)}$$

where

$$\begin{aligned} a &= e_1 \Sigma_1^2 + e_2 r_2^2 \\ b &= \frac{(\sqrt{e_1 \Sigma r_1} + \sqrt{e_2 \Sigma r_2})^2}{N_1 + N_2} \\ c &= \frac{e_1 (\Sigma r_1)^2}{N_1} + \frac{e_2 (\Sigma r_2)^2}{N_2} \end{aligned}$$

Two other mechanical details to keep in mind are the boundary problem, alluded to earlier, and the need for comparative metrics when expressing the areal extent of the study sample and the nearest-neighbor distances (r). The data source used in this study, highway commission general highway maps, arbitrarily divides the total possible universe of points into county areas. It is easily understandable that a given point may be cut off from its actual nearest neighbor which, being in another county, is not shown on the map. In an attempt to

minimize the error introduced by this possibility, in this project, all points lying nearer to a map boundary than to another point are thrown out. It is felt that this adds more in the way of accuracy than it takes away. Measurement of nearest-neighbor distances are taken in hundredths of inches and area is calculated in square inches from the map scale (1:126,720) and available square mileage data. No significant change took place in the size of the study areas over the twenty year period, even though in several counties artificial reservoirs were constructed by the beaver-like Corps of Army Engineers.

By way of a last remark concerning the characteristics of near-neighbor analysis, it is appropriate to quote King again, concerning the consequences of logically considering the R statistic as a continuous variable over its two point range: "Accepting this to be the case, then a number of powerful sophisticated statistical techniques . . . can be brought to bear on the more fundamental and important (geographical) problem of providing an explanation of the variation in the magnitude of the obtained values of R".<sup>14</sup> The size of the sample used in this study limits the measures which can be used, but interesting results are obtained by use of the Kendall ranking correlation, tau ( $\tau$ ). Several tendencies are

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King, "Pattern of Urban Settlements," p. 8

identified which shed light on the variables related to changes in settlement patterns during recent rural depopulation. These tendencies, along with the outcome of the near neighbor analysis, suggest support for the tentative acceptance of a modified form of the rural settlement model posed earlier in this Kansas example.

Selection of the Study Area. Three criteria were used in selecting counties to be studied for this empirical test of the settlement change model. The first constraint, derived from the definition of "rural" applied here, specifies that counties should contain no town with a population which has ever exceeded 2,500, and these counties should not be adjacent to a large urban center. This criterion is taken from Census Bureau definitions of "rural", and is adopted basically<sup>15</sup> for the sake of comparability with published data source. The second requirement is a function of the data source chosen for use and the need for temporally comparable information in testing the second hypothesis, dealing with the availability of a selected service base. The only regularly updated maps available, showing cultural landscape features for the state by counties are the general county highway map series, produced by the State Highway Commission. These maps have been revised at varying intervals, and are currently

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For the rationale behind this decision see Zelinsky "Rural Population in the United States," pp. 492-524.

redone approximately every five years. The location of all cultural features outside of cities and towns, including all buildings, roads, bridges and the like, are represented on the maps. The revisions are based upon actual field inspections, and all buildings are classified as to use and occupancy status. Field checks of the location and tenancy status of selected rural housing units were made to ascertain the accuracy of these maps as a data source, and in the examples inspected the maps have proven to be commendably precise. The work involved in producing these documents obviously limits the number which can be completed during any year, so the date of the latest revision available for a given county is determined by its place in a rather flexible updating cycle.<sup>16</sup> The last necessary condition, posed by the conceptual requirement that counties be in a depopulation stage of settlement, is that study area counties must have lost population in absolute terms during the twenty years between 1950 and 1970.

Operationally then, counties were selected which (1) have never contained an urban place, (2) are not located in propinquity to a major urban area, (3) have a revision of the general county highway map available reasonably near the two decennial census dates 1950 and 1970 and (4) have lost popula-

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I would like to express my special thanks to Mr. Glen Sutton, Head of the Department of Planning and Development, and Mr. Wendell McColl, Head of the Drafting Section, of the State Highway Commission.

tion during at least the last two census periods. Forty-one of the state's 105 counties were found to meet the operational definition of rural, but an inventory of the availability of maps for these counties yielded only 6 counties with maps revised during 1969 or 1970. All of these 6 counties also had maps available within a margin of four years of 1950 (see Table 3-1 and Map 3-1).<sup>17</sup> As well, they have all lost population for an extended period, having with two exceptions experienced net population decline for at least 60 years (see Table 3-2). The two far western counties, Gove and Logan, were the last to be settled, and they have suffered continual population losses for 40 and 20 years respectively. Table 3-3 suggests that during the study period, age selective out-migration, evident during both census periods but heavier between 1950 and 1960, has been responsible for an actual decrease in population for the most recent census interval in half of the subject counties. The study area was thus limited to six counties: Coffey, Ellsworth, Gove, Linn, Logan and Wabaunsee.

Fortuitously, these counties offer reasonable representation of the state's several major regions, as well as a typical range of rural population densities (see Table 3-4).

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Consideration of counties with recent revisions in 1968 and 1967 added nothing to the temporal comparability of the data sources. Ironically these counties were all represented for the earlier date by maps dated between 1954 and 1957.

TABLE 3-1 MAP AVAILABILITY FOR SELECTED RURAL COUNTIES

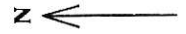
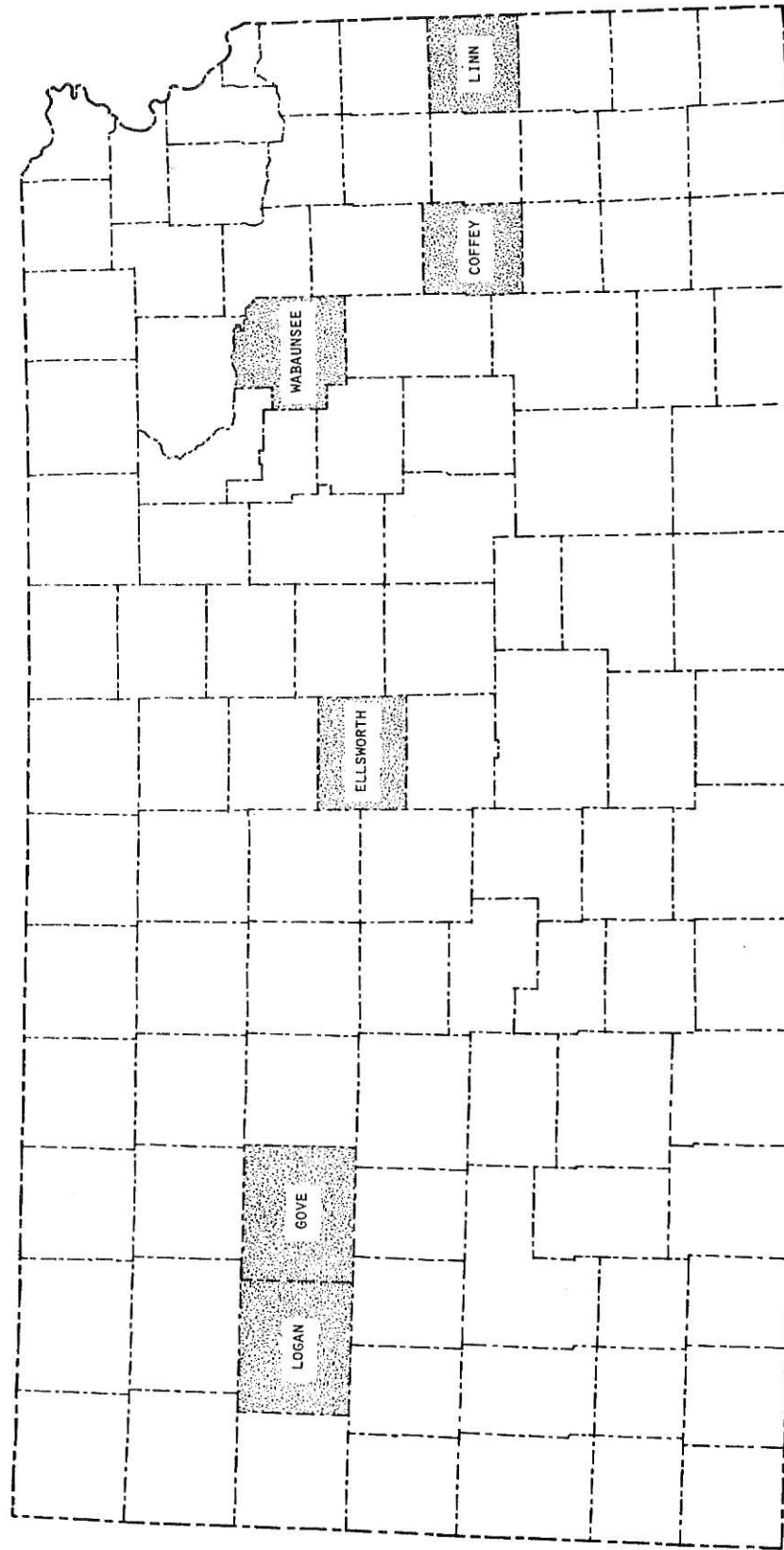
County	Beginning Date	Ending Date	Time Interval in Years
Coffey	1947	1969	22
Ellsworth	1953	1970	17
Gove	1954	1969	15
Linn	1954	1969	15
Logan	1954	1970	16
Wabaunsee	1953	1969	16

Data Source: Publishing date printed on each respective map

**THIS BOOK  
CONTAINS  
NUMEROUS PAGES  
WITH DIAGRAMS  
THAT ARE CROOKED  
COMPARED TO THE  
REST OF THE  
INFORMATION ON  
THE PAGE.**

**THIS IS AS  
RECEIVED FROM  
CUSTOMER.**

STUDY AREA COUNTIES



STUDY AREA COUNTIES



MAP 3-1



TABLE 3-2 POPULATION HISTORY BY COUNTY 1880-1970

County	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970
Coffey	11,438	15,856	16,643	15,205	14,254	13,653	12,278	10,408	8,403	7,397
Ellsworth	8,494	9,272	9,626	10,444	10,379	10,132	9,855	8,465	7,677	6,146
Gove	1,196	2,994	2,441	6,044	4,748	5,643	4,793	4,447	4,107	3,940
Linn	15,298	17,215	16,689	14,735	13,815	13,534	11,969	10,053	8,274	7,770
Logan	--*	3,384	1,962	4,240	3,223	4,145	3,688	4,206	4,036	3,814
Wabaunsee	8,756	11,720	12,813	12,721	11,424	10,830	9,219	7,212	6,648	6,397
Totals	45,182	60,441	60,174	63,389	57,843	57,937	51,802	44,791	39,145	35,464

\* Logan County created 1881 and organized 1887

Data Source: Kansas Statistical Abstract, 1971

TABLE 3-3 COMPONENTS OF CHANGE IN  
POPULATION BY COUNTY 1950-1960, 1960-1970

County	1950-1960		1960-1970	
	Net Change	Natural Increase	Net Migration	Net Natural Increase Migration
Coffey	-2,005	282	-2,287	-214
Ellsworth	-788	642	-1,430	-43
Gove	-340	904	-1,244	533
Linn	-1,779	269	-2,048	-336
Logan	-170	805	-975	410
Wabaunsee	-564	471	-1,035	30
Totals	-5,646	3373	-9,019	380
				-4,061

Source: Kansas Statistical Abstract, 1971

TABLE 3-4 POPULATION DENSITY BY COUNTY 1950, 1960, 1970

County	Land Area (Sq. Mi.)	1950	1960	1970	Percent Change	
					1950-1960	1960-1970 1950-1970
Coffey	656	15.9	12.8	11.2	-19.5	-12.5 -29.6
Ellsworth	718	11.8	10.7	8.6	-9.3	-19.6 -27.1
Gove	1,070	4.2	3.8	3.7	-9.5	-2.6 -11.9
Linn	605	16.6	13.7	12.8	-17.5	-6.6 -22.9
Logan	1,073	3.9	3.8	3.6	-2.6	-5.3 -7.7
Wabaunsee	791	9.1	8.4	8.1	-7.7	-3.6 -11.0
Totals	4,913	9.1	8.0	7.2	-12.1	-10.0 -20.9

Data Source: Kansas Statistical Abstract, 1971

The fact that the settlement process began at different periods, increasingly more recently moving from east to west, lends more weight to the fact that any present similarity in settlement patterns among these diverse areas may well represent the influence of factors exogenous to the process of agricultural evolution such as urbanization and readjustment of settlement patterns within the bounds of the culturally prescribed social interaction space. For the sake of simplicity, although the map-derived data utilized here represent several different years and varying time periods (refer back to Table 3-1), for the remainder of this study the earlier of the two dates is referred to as '1950' and the later as '1970'. Similarly, the study period is referred to as a twenty year interval.

Maps were obtained for the beginning and ending dates of the study period for the six counties selected. The most recent editions were available for purchase in printed form, while the earlier maps were obtained by making contact-scale photo-copies of documents from the State Highway Commission's historical files. The settlement patterns evidenced by the occupied dwelling units in these twelve samples were analyzed and described by the near-neighbor technique, a process requiring an estimated 25,000 measurements. The resulting settlement pattern indices were tested for both statistical significance and significant change over the study period. In an effort to understand the dynamics of the process involved, the R statistics were correlated with population densities at

both dates and the rate of change in population density.<sup>18</sup> The results of these analyses, and their implications for the settlement pattern model constructed here, are discussed in the next section.

## B. RESULTS OF THE ANALYSIS

A four-step conceptual model of settlement pattern change has been postulated involving: (1) a colonization stage, (2) a settlement spread stage, (3) an agricultural competition stage, and (4) a depopulation (external urbanization) stage. A typical settlement pattern is attributed to each stage which can be described graphically as a progression from clusteredness to regularity and back to clusteredness (see Figure 3-1). Hudson's tests of the first three steps of the model are accepted as describing the rural settlement process as it relates to settlement form. The hypothesis that stage 4 (depopulation) will be related to a clustered settlement pattern is tested empirically on a sample of six Kansas counties. Hudson visualizes the process of agricultural evolution as the energizing mechanism responsible for the expected patterns of settlement during stages 1, 2 and 3 of the model.

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A ranking correlation between absolute population per county and population density per county yielded a correlation coefficient ( $r$ ) of .87, significant at the .01 level, for both 1950 and 1970. Thus, it was decided that the density measure, a standardized metric, sufficiently describes both parameters (even though both variables, county size and population count, fluctuate between counties).

## SETTLEMENT PATTERN CHANGES PREDICTED BY THE MODEL

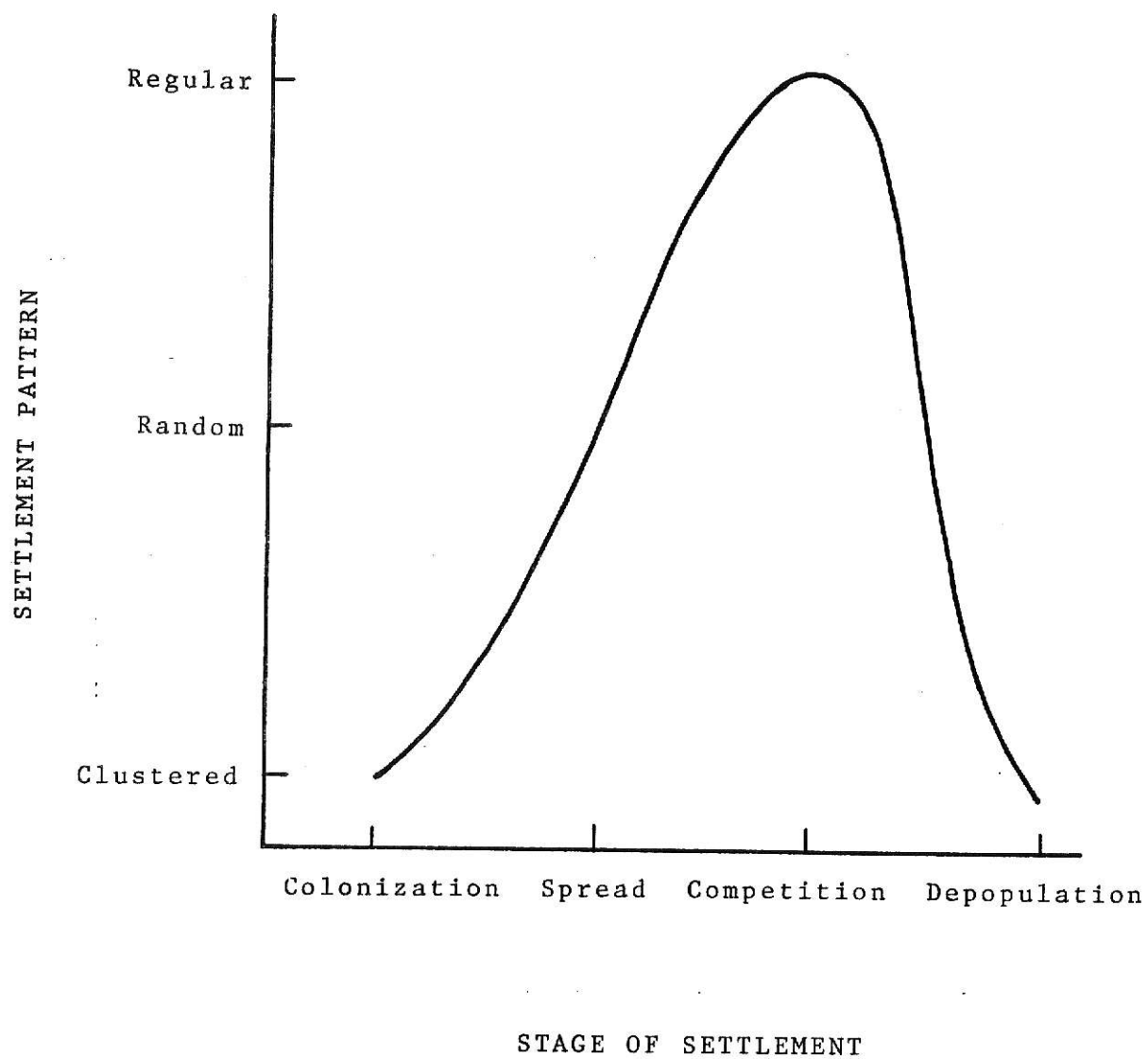


Figure 3-1

From notions developed historically in the geographic settlement literature, it is argued here that the pattern most likely to develop during stage 4 is a function of external urbanization and locational readjustments brought about to facilitate social intercourse. The chain of causation implicit in this idea would seem in keeping with the general paradigm of scientific explanation, which conceptualizes form to be a result of not only the processes involved, but also the function served by that form and process.

The Nearest-Neighbor Analysis. To test the hypothesis that rural counties experiencing prolonged population loss will display a settlement pattern tending over time toward clustering, the nearest-neighbor technique of point pattern analysis was applied to the two sets of county maps for 1950 and 1970. Because of the relatively large size of the sample of points in each county, the .05 level of significance was chosen for rejection of the null hypothesis.<sup>19</sup> Table 3-5 shows selected statistics used in the calculation of R and the determination of the significance of deviations in R values from random. Row nine on the table gives the calculated values of R, and row twelve indicates whether it is probable that such a value could have occurred by chance at  $\alpha = .05$ . All

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$H_0$  states that there is no significant difference between the sample observed distribution and a random distribution.  $H_1$ , the test hypothesis, being that the sample distribution deviates significantly from randomness in the direction of clustering.

TABLE 3-5 NEAREST NEIGHBOR STATISTIC CALCULATION

Statistic	Coffey		Ellsworth		Gove		Linn		Logan		Wabunsee	
	1950	1970	1950	1970	1950	1970	1950	1970	1950	1970	1950	1970
Size of Area (Sq. inches)	164.00	164.00	179.50	179.50	267.50	267.50	151.25	151.25	268.25	268.25	197.75	197.75
N	1712	1163	998	721	589	532	1783	1397	305	248	1220	1072
$\sqrt{e}$	10.44	7.09	5.56	4.02	2.20	1.99	11.79	9.24	1.14	.92	6.17	5.42
$\Sigma r$	3.23	2.66	2.36	2.00	1.48	1.41	3.43	3.04	1.07	.96	2.48	2.33
$\Sigma r^2$	248.58	187.98	203.60	153.30	166.50	142.00	250.18	212.34	112.81	95.75	193.20	179.44
$\bar{r}_A$	44.31	40.89	53.99	46.81	63.52	61.56	41.20	41.11	59.23	64.97	39.86	51.66
$\bar{r}_E$	.1452	.1616	.2040	.2126	.2827	.2669	.1403	.1520	.3699	.3861	.1584	.1674
R	.1548	.1878	.2121	.2495	.3369	.3546	.1456	.1645	.4689	.5200	.2013	.2147
$\bar{r}_E$	.9380	.8605	.9618	.8521	.8391	.7527	.9636	.9240	.7889	.7425	.7869	.7797
C	.0020	.0029	.0035	.0049	.0073	.0080	.0018	.0023	.0140	.0173	.0030	.0034
Significant at .05 (C = 1.96)	-4.91	-9.10	-2.31	-7.60	-7.47	-10.91	-2.94	-5.43	-7.05	-7.76	-14.24	-13.80
	Yes*	Yes*	Yes	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*

Source: Calculated by author

\* Significant at .01 level



R calculations are found to vary significantly from a random distribution where the test value of  $C = 1.96$ .<sup>20</sup> Table 3-6 equates a verbal description, following the terminology used<sup>21</sup> by King, with each of the near-neighbor values. In a test of the formal hypothesis, that settlement becomes more aggregated over time with depopulation, the R's for each county in 1950 are compared with the corresponding R's for 1970, by the F-test of variance. The results of this analysis are shown in Table 3-7. By collating the information in Tables 3-6 and 3-7 it can be seen that all counties experienced additional aggregation during the study period (therefore following the hypothesis), and that in two-thirds of the cases the change toward increased clustering is statistically significant when  $\alpha = .05$ .

Implications of the Nearest-Neighbor Analysis for the Proposed Model of Settlement Pattern Change. What do the implications of the test case used here mean for the proposed conceptual model of settlement pattern change? Based on notions developed in the geographic settlement literature, the model specifies that, as population first fills and then abandons an area, the dispersed settlement pattern will become increasingly more uniform with time through the competition stage of

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When  $C = 2.56$  ( $\alpha = .01$ ), all values of R are still significantly different from random, except Ellsworth county in 1950.

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King, "Pattern of Urban Settlement."

TABLE 3-6 VALUES OF R AND VERBAL DESCRIPTION

County	R Value 1950	Description <sup>1</sup>	R Value 1970	Description <sup>1</sup>
Coffey	.94	Random	.86	Approaching aggregation
Ellsworth	.96	Random	.85	Approaching aggregation
Gove	.84	Approaching aggregation	.75	Aggregated
Linn	.96	Random	.92	Random
Logan	.79	Approaching aggregation	.74	Aggregated
Wabaunsee	.79	Approaching aggregation	.78	Approaching aggregation

Source: Caluclated by author

<sup>1</sup> Terminology taken from King, "Pattern of Urban Settlement"

TABLE 3-7 F TEST OF VARIANCE<sup>1</sup>

County	Calculated Value of F	Significant <sup>2</sup> at .05 level
Coffey	18.82	Yes
Ellsworth	17.26	Yes
Gove	6.99	Yes
Linn	6.63	Yes
Logan	.96	No
Wabaunsee	.13	No

Source: Calculated by author

<sup>1</sup>  
H<sub>0</sub> = There is no difference between R statistics for the same county for 1950 and 1970.

H<sub>1</sub> = There is a significant tendency toward clusteredness within counties over time.

<sup>2</sup>  
Hubert M. Blalock, Social Statistics (New York: McGraw-Hill, 1960), Table J, 453.

development (stage 3), but with the continuation of an increasing rate of population loss the settlement pattern will display a tendency toward clustering. The energizing mechanism through stage 3 is seen as agricultural competition, while patterns typical of stage 4 are thought to be a function of external urbanization and readjustment for the facilitation of social interaction. The model calls for a degree of uniformity at the on-set of urbanization and increasing clusteredness thereafter.

It would seem that the first hypothesis being tested in this paper, dealing with changes in settlement pattern, can be tentatively accepted. Indeed, all the rural counties tested displayed increasing aggregation in their settlement morphology, four of them significantly so. But the adequacy of the settlement model as presently stated is more questionable. All of the counties were found to be slightly more clustered than random, statistically speaking, in the earlier period. King's terminology would label them verbally either random or approaching aggregation. While the terminal date scores are all internally more aggregated than the 1950 statistics, these R values range descriptively from random to aggregated. Either the model ill-fits the empirical data in this instance, or a more precise depopulation sequence and specification of stage might be necessary. Since no attempt has been made in this instance to measure settlement patterns during the active settlement stages of the model, any speculation as to divergence from Hudson's Iowa findings would be only guess work. A more

constructive path might be the recognition: (1) that depopulation in all but one county in this study has occurred for between 40 and 60 years, and (2) that there is most probably a step-wise movement pattern from the competition stage through the depopulation stage. It might be useful then to divide stage 4 into two parts, the new fourth stage called perhaps 'selective loss' and a fifth stage labeled 'regrouping'. Stage 4 would then be characterized by settlement patterns changing from relative regularity toward randomness once again, and stage 5 would see this random pattern transform itself into a more clustered form. An operational definition of each of these steps, in terms of population density, would increase the accuracy of the model as well. If stage could be specified independently from settlement pattern, a more rigorous test of the causative factors influencing pattern could be carried out.

In an attempt to analyze the function served by the settlement patterns observed in this study, several factors, the influence of which are implicitly assumed in the hypothesized energizing mechanisms for the final stage of the settlement model, have been compared with changes in settlement pattern by use of Kendall's rank correlation (see Table 3-8). Hudson visualized changing settlement patterns to be a function of agricultural evolution, implying that at each stage of development, settlement form can be directly deduced from the density of the dispersed rural population. (This would at

TABLE 3-8 KENDALL RANK CORRELATION COEFFICIENT ( $\tau$ ) FOR SETTLEMENT DATA

Variables	$\tau$	1950 Signi- ficance <sup>1</sup>	De- cision <sup>2</sup>	$\tau$	1970 Signi- ficance <sup>1</sup>	De- cision <sup>2</sup>	$\tau$	1950-1970 Signi- ficance <sup>1</sup>	De- cision <sup>2</sup>
Near-Neighbor Statis- tic and Population Density	.60	.068	Accept $H_0$	1.00	.0014	Reject $H_0$			
%Change in Near- Neighbor and % Change in Population Density							.33	.235	Accept $H_0$
Absolute Population Count and Population Density	.87	.0083	Reject $H_0$	.87	.0083	Reject $H_0$			
Population Density 1950 and % Change in Population Den- sity 1950-1970							.60	.068	Accept $H_0$
% Change in Popula- tion Density and Near-Neighbor 1970				.60	.068	Accept $H_0$			

Source: Caluclated by author

<sup>1</sup> Critical level = .01 on single tailed test

<sup>2</sup>  $H_0$  = No relationship;  $H_1$  = Positive relationship

least be the outcome of any empirical application of his colonization-spread-competition sequence). His test hypotheses discussed earlier clearly point out this fact. If population loss then, through continuing agricultural competition, is responsible for observed patterns of settlement during the protracted period of population decline studied in this instance, it could be expected that a constant monotonic relationship would be found between population density and the settlement pattern observed. Hudson expected that during the competition stage depopulation would be accompanied by increasing regularity. Although care must be taken in generalizing from a sample of only six cases, it can be seen that in 1950 there was not a significant relationship between density and form; nor is there a significant relationship between the rate of change in settlement pattern and population density, over the twenty year study period.<sup>22</sup> (The significant relationship discovered, because of the order of scaling, would show a tendency toward regularity of pattern. The higher the loss of population, the greater the degree of clustering). Again, unfortunately, nothing can be said about circumstances in these counties during early stages of settlement. It would be difficult, in this instance, to ascribe changes in settlement pattern to be the result of a population

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<sup>22</sup>Because of the small size of the sample ( $N = 6$ ), the level of significance is specified as  $\alpha = .01$ .

loss process caused by agricultural competition. Hudson's proofs call for increasing settlement regularity with population loss. This does not seem to be the observed tendency here.

Based on the concepts developed by Demangeon, Perpillon, Houston and others, reviewed in Chapter II, it was argued above that the function served by a given form must be considered along with the process involved. Rather than conceiving settlement pattern during depopulation as a result of agricultural competition (both as process and function) in a basically closed system, it was suggested that present rural population losses are the result of a broader societal urbanization process, and that an ever more clustered settlement structure should result from attempts by the residual dispersed population to facilitate social interaction.

It has been shown that patterns of settlement have become increasingly clustered over a period of rapid population loss. Out-migration has played an important role in this process. Table 3-8 shows that there was an insignificant relationship between low population density and settlement clustering. But this trend was not to be trusted at either the  $\alpha = .01$  or  $\alpha = .05$  levels of significance. An inspection of the 1970 correlation between low density and clusteredness reveals a rather more adequate picture. In that year, a perfect direct relationship existed between low density and clustering, and this value is significant at the  $\alpha = .01$



level.

What can be inferred from this trend of ambiguous relationships and relatively random settlement patterns transforming to internally more aggregated patterns with apparently strong ties between pattern and population density? Because of small size of the sample examined and the ambiguity of relationships involved during the depopulation process, it would be improper to make too much of the results of this analysis. Certainly no direct measure has been made of causation, and intra-period variances are as large as inter-period variances. But perhaps several observations which shed some light on the matter seem justifiable. First, the confused interrelationship displayed between population density and settlement pattern at the beginning of the study period may be suggestive of just such a transition in the function served by the pattern of settlement as envisioned in this paper. If conflicting processes were at work, serving different ends, a random pattern of settlement with unclear relationships between the variables involved would be a likely result. Secondly, all observed trends (no matter how weak or uncertain) reveal a correlation of low population density with settlement clustering, suggesting that there may have been a reversal in the direction of interrelationships from that observed by Hudson. And finally, while the clustering of population would serve no apparent spatial function for the economic aspects of contemporary agricultural evolution, it would definitely facilitate social contacts among the remaining rural families

and could perhaps raise the likelihood of the adequate availability of amenities to improve their lifestyle. With the double weight of both social and economic benefit behind it, a natural re-alignment of causative linkages would seem quite likely. The next chapter looks into the matter of the availability of goods and services and its relationship to settlement pattern. It should not only add another dimension to this study, but possibly lend more credence to the last observation offered above.

## CHAPTER IV

### SETTLEMENT PATTERN CHANGES AND THE AVAILABILITY OF SERVICES

In Chapter III it was shown that in the counties studied there has been a trend toward more clustered patterns of rural settlement coincident with continued depopulation. The question examined in this chapter is whether this increased aggregation of dwellings within an area is associated with any measurable change in the availability of services to the rural population. It can be argued that even though population loss lowers the demand for services within an areal market, a counter-balancing effect may be introduced by the lower total transportation costs realized by a closer packing of the remaining consumers within the region. This position rests upon the recognized importance of demand in explaining the location of service and retailing activities, the frequently strong relationship between price and the level of demand, and the major role played by transport costs in determining the delivered price of standardized consumer items. In order to analyze the plausibility of this suggested chain of causation the following formal hypothesis was tested: Areas displaying a tendency toward settlement clustering will experience a relatively higher level of services than similar areas with less agglomerated settlement patterns.

## A. THEORETICAL ORIENTATION

Historically, two opposing bodies of theory have been developed in an attempt to explain the location of economic activities. One, commonly referred to as 'least-cost' theory, posits that the prime factor in determining the location of industry is the areally differential cost of assembling the several factors of production. This approach has been thoroughly developed in the economics literature and has proven most useful in predicting the actions of the individual firm engaged in primary or secondary activities. The other viewpoint, founded on the spatial variation of consumer demand across the cultural landscape, is often called the "demand model" of economic location. Pursued steadfastly by geographers, following the conceptualization of Christaller and Lösch, this method of viewing economic location typically concentrates on the explanation of the generalized economic landscape. High points and valleys in the economic topography are related to the variable cost of delivering goods and services to the consumer, with peaks in the activity surface closely associated with the location of the market. For the early stages of industrial evolution, at least, this approach accounts most successfully for the occurrence of tertiary activities such as servicing and retailing, enterprises involving a high labor input. Both of these systems, especially if the least-cost model is viewed in its most general form, depend heavily on variations in transportation costs to explain the situation

of productive activities. As in most cases, both of these theoretical orientations rest upon a measure of empirical validity. They both have proved useful in organizing research by location scientists, and thus the failure to date, despite the efforts of Isard, Greenhut and Smith to integrate successfully these two basic notions into a comprehensive theory of location, is particularly unfortunate. Be this as it may, economic geographers have used the demand theory model to some advantage in expanding their comprehension of the organizing principles behind the economic landscape, and through this medium, they have made notable strides in explaining the broader system of human settlements.

McCarty and Lindberg point out that the demand orientation hypothesis, as indicated above, has proven more successful in explaining the location and distribution of some activities than others.<sup>1</sup> It has been most efficient in dealing with activities containing a large service component - those which typically are relatively more specialized and perishable in the sense that they must be produced to a greater or lesser degree in the presence of the prospective consumer. Among the industries most readily grouped in this category are wholesale and retail trade, professional services, and transportation, communication, and public utilities.<sup>2</sup>

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<sup>1</sup>  
Harold H. McCarty and James B. Lindberg, A Preface to Economic Geography (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1966), especially chapters 6 and 7.

<sup>2</sup>  
Ibid., p. 110, Table 6-a.

An extensive amount of empirical evidence seems to confirm that the locational affinities between retailing and servicing activities and the areal distribution of the demand for them are particularly strong. Although mass production and advances in transport technology are allowing ever-increasing standardization and wider distribution of commodities (often in substitution for services), the attraction of the market is undeniable. If one incorporates the notions of internal economics of the firm (more fully developed in least-cost theory) as distortion factors in this production-demand association, a reasonable description of the energizing mechanisms responsible for the location of tertiary activities is provided.

Several Tenets of Geographical Location Theory. Because this study seeks to analyze the relationship between varying patterns of consumer arrangement and the intensity of service activities, and because these activities locate in the closest proximity to their market consistent with internal scale economies, it will be useful to dwell a little longer on the restraints posed by establishment size and the characteristics of the intensity of demand. The location of service-based activities seems to be a compromise between the firm's need for a minimum level of income to meet the fixed costs of production (including entrepreneurial profit taking) and the consumer's willingness to pay the cost of transport (in time-distance or pecuniary terms) involved in delivering the

service to him.<sup>3</sup> These two notions have come to be identified under the rubrics "threshold size" and "range of a good", respectively.

The longest standing theory in the field of human geography, central place theory<sup>4</sup>, is an elaboration of Christaller's efforts to synthesize these two elements in his classic work, Central Places in Southern Germany<sup>5</sup>. "One of Christaller's fundamental assumptions was that some power limit of numbers of consumers was required before a given type of function could come into existence"<sup>6</sup>. This point is of central importance to the present discussion. Christaller's network of central places was produced by the location of activities within market areas of sufficient size to meet the minimum threshold of demand, while staying within the range which

<sup>3</sup> Whether the customer comes to the service, as in the case of most retailing, medical services, or educational services, or whether the service is delivered to the customer, as with public utilities and communication services is dependent upon (1) the purpose of the service (e.g. to electrify the person's home), and (2) the amount of equipment necessary to provide the service (e.g. the hardware involved in education facilities). In either case the principles involved are the same.

<sup>4</sup> William Bunge, Theoretical Geography (Lund, Sweden: Dept. of Geography, The Royal University of Lund, 1962), p. 122.

<sup>5</sup> Walter Christaller, Die Zentralen Orte in Süddeutschland (Jena: G. Fischer, 1935).

<sup>6</sup> Bunge, Theoretical Geography, p. 145.

customers would be willing to travel to obtain the particular good or service. The range of different commodities has been found to vary directly with their purchase price and inversely with their frequency of use.<sup>7</sup> Agglomeration economies and fractionalization of consumer transport cost have tended to bring about aggregation of services at these centralized points. In relatively densely populated areas the locational demands of threshold size and range of goods overlap rather widely, facilitating the solution of location problems and encouraging growth of the center. In sparsely populated regions there is much less flexibility, and thus the possible range of functions which can be supported is severely limited.<sup>8</sup> Because of this, the growth of small centers is limited. Berry has shown that while there is a direct relationship between the size of a central place and the size of its hinterland, an upward shift in tributary area size requirements takes place with lessening population density.<sup>9</sup> The number of functions available in a center varies directly with the size of the place (or, if you will, the size of its market area)<sup>10</sup>, with only functions

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<sup>7</sup>

McCarty and Lindberg, Preface, p. 120

<sup>8</sup>

Ibid., p. 120

<sup>9</sup>

B.J.L. Berry, "Cities as Systems within Systems of Cities," Papers and Proceedings of the Regional Science Association (December, 1963), Figure 1a.

<sup>10</sup>

H.A. Stafford, "The Functional Base of Small Towns," Economic Geography, 39 (1963), pp. 165-175.



requiring relatively small internal economies of operation locating in small towns because of the low available threshold population.<sup>11</sup> In relation to this fact Haggett notes that:

Isard has shown that the regular (i.e. equal-area) pattern of hexagons suggested by Christaller and Lösch are unlikely to occur in practice. Because of the high density of population at the central core postulated by Lösch, the size of the market area here is likely to be smaller, while away from the market it is likely to be larger.<sup>12</sup>

These facts suggest the existence of a hierarchy of central places.

Rather ironically, the low order, frequently used commodities available in smaller towns are just the ones for which the range of customer willingness to travel is the most limited.

. . . as one encounters decreasing population density the amount of area necessary to meet threshold size requirements may result in a travel need that is in excess of customer willingness. Several alternatives appear in such a situation. Sellers may engage in multiline operations, obtaining in this fashion a greater volume of business from a limited number of customers and also making it possible for consumers to serve several needs with one trip. Another alternative is for buyers to submit to higher prices per unit so that a large seller mark-up compensates for a smaller volume. The final alternative is for consumers to perform the services themselves.<sup>13</sup>

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<sup>11</sup> McCarty and Lindberg, Preface, p. 138, Figure 7-1.

<sup>12</sup> Peter Haggett, Locational Analysis in Human Geography (London: Edward Arnold, Ltd., 1965), p. 53.

<sup>13</sup> McCarty and Lindberg, Preface, pp. 120-1.

Bunge has emphasized the need to recognize rural consumers as major contributors in supporting the activities of small towns,<sup>14</sup> thus making the implications of these alternatives important to the present study. Chisholm generalized the problems of such sparsely populated areas to "collecting" services at the consumers' places of residence, and Haggett extended the argument to the provision of all delivered services to such areas, including "electricity supplies, water and sewerage, telephone and postal services and roads and transport services."<sup>15</sup> Obviously, rural depopulation in already sparsely settled areas would compound the problem even more. Before considering the implications of the threshold size-good range dilemma and decreasing population density for the six rural counties included in this study, it is necessary to outline in more detail the characteristics of the areal demand surface.

In central place theory (and the derivative body of demand-oriented location theory) a great deal of emphasis is placed on the nature of the spatial distribution of demand over a market area. Differences are also emphasized between regions with varying levels of population density. A basic tenet of economic theory is the law of downward slopping

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<sup>14</sup>Bunge, Theoretical Geography, p. 146.<sup>15</sup>Haggett, Locational Analysis. p. 100.

demand. As the price of goods or services rises, the quantity<sup>16</sup> purchased drops. The price of a given item, when spatial variables are being considered, is a function of the item's production costs and the price of transporting it to the consumer. Thus demand for a particular service may be represented as

$$q = f(p + t_i),$$

where  $q$  = demand,  $p$  = production costs, and  $t_i$  = the cost of transport to any  $i$ th point. Smith has pointed out that the assumption of "infinitely inelastic demand . . . is . . . poorly suited to the analysis of spatial economics as well as being patently unrealistic."<sup>17</sup> While the Löschian demand cone,<sup>18</sup> equating the demand curve as a function of distance, is useful, it must be modified in empirical application by consideration of (1) the variation of population density over space, and (2) the variable elasticity of demand with differing locations and population densities.<sup>19</sup> Lösch himself recognized

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<sup>16</sup>

Paul A. Samuelson, Economics: An Introductory Analysis (New York: McGraw-Hill Books Co., Inc., 1958), p. 445.

<sup>17</sup>

David M. Smith, Industrial Location: An Economic Geographical Analysis (New York: John Wiley & Sons, Inc., 1971), p. 238.

<sup>18</sup>

August Lösch, "The Nature of Economic Regions", Southern Economic Journal, 29 (August, 1963), p. 74.

<sup>19</sup>

Harry W. Richardson, Regional Economics (New York: Praeger Publishers, 1969), p. 72.

the influence of both these factors when he postulated that "the number of persons living at a certain distance from a factory increases in the same proportion as the distance" (decreases) and that "the elasticity of the individual demand in respect to transport costs . . . rises with distance . . ."<sup>20</sup> , but he did not incorporate these notions into his formal analysis. As a result of these last two considerations, Lösch reasoned that in the real world, "the regional demand (for a good or service) is smaller, and generally also more elastic, than local demand."<sup>21</sup> Smith would rework Lösch's formulation of total market demand to read

$$D = b \cdot 2 \pi \int_0^r f(p + t) t \cdot dt,$$

with  $b$  fluctuating over the market area as found in the real world<sup>22</sup> which recognizes that the density of population is higher in some parts of the market area and that sales will increase with density.<sup>23</sup>

Richardson succinctly summarizes the inter-relationships involved within the areal market by stating that for

<sup>20</sup> August Lösch, The Economics of Location. Translated from the second revised edition in German by William H. Woglom. (New York: John Wiley & Sons, Inc., 1967), p. 146; also Richardson, Regional Economics, p. 22.

<sup>21</sup> Ibid., pp. 142-3.

<sup>22</sup> Smith, Industrial Location, p. 241; and the original notation explanation in Lösch, Location, p. 107.

<sup>23</sup> Ibid., p. 242.

consumer goods industries the size of the population within a commodity's market area and transportation costs are two primary variables.<sup>24</sup>

But . . . the distribution of the population within the market area must also be taken into account. Therefore we must not only allow for the total population to which the firm has access but also estimate the influence of different population clusters within the market area by weighting them with distance, since nearer consumers will pay higher prices because of transport costs.<sup>25</sup>  
(emphasis added)

## B. CONCEPTUAL POSITION

Theoretically, the availability of goods and services in an areal market is dependent upon meeting the necessary "threshold" of the firm, given the existence of an adequate number of consumers within the "range" of the commodity produced. The two variables coming into play here are the distance decay function of demand caused by transport costs and the density of settlement within the area in question. Greater price-elasticity of demand is related to total transport cost, and (according to Smith and Richardson, although not Lösch) the density of population. Population density is normally visualized as dropping off with distance away from a central place, but whatever the pattern, the distribution of settlement clusters within the market area is of notable

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<sup>24</sup>

Richardson, Regional Economics, p. 72.

<sup>25</sup>

Ibid., p. 73.

importance in determining transport cost. Small places, especially with sparsely settled market areas, are only capable of maintaining a severely limited range of economic activities, and these activities are of the type which typically have a relatively short range--while the sparsely settled market area displays particularly price-elastic demand. With such a delicately balanced situation, rural depopulation could easily drop demand below the necessary threshold level, theoretically denying the good or service to the remaining population.

Three situations have been identified in which the complete loss of service availability may be avoided: (1) multiline operation by retailers, dividing consumer transport expenditure among the satisfaction of several needs; (2) higher prices, satisfying the seller's threshold sales limitations with fewer consumers. But perhaps there is a fourth alternative not suggested in the literature. Following the same logic as McCarty and Lindberg's first suggestion, if, during depopulation, settlement patterns were to shift toward more aggregated forms (as has been shown to be the case in the present study area), the travel cost to fortuitously located establishments--or from centrally located distributing points-- would be lowered. Lower cost could result in an upward shift of the flexible demand curve, causing a higher marginal propensity to consume, and thus theoretically allowing a firm to maintain its minimum threshold of profit-

ability with fewer, more closely spaced customers.<sup>26</sup> This, of course, in an extreme form is one of the energizing mechanisms of economies of urbanization. McCarty and Lindberg have themselves noted that greater transport cost is induced by a more scattered population.<sup>27</sup> An attempt to test the validity of this idea on the present six county study area is offered in the remaining pages of this chapter.

### C. METHODOLOGY

To test the hypothesis that increased settlement clustering is associated with a comparatively higher level of service availability, the nearest-neighbor statistics discussed in Chapter III are used again as an operational measure of pattern. For lack of a convenient measure of spatial accessibility, as mentioned in Chapter I,<sup>28</sup> categorical employment per thousand people is used as a surrogate for availability.<sup>29</sup> Both these measures dilute the analysis, perhaps

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<sup>26</sup> Reasonably, if  $q = f(p + t_i)$  and  $t_i > t'_i$ , then  $q' > q$ . Therefore in terms of an areal market, using Lösch's notation,  $D' > D$  when  $dt' > dt$ .

<sup>27</sup> McCarty and Lindberg, Preface, p. 118.

<sup>28</sup> Chapter I, p. 12.

<sup>29</sup> Employment is commonly used to measure the areal intensity of economic activity by industrial sector. See Walter Isard, Methods of Regional Analysis (Cambridge, Mass: M.I.T. Press, 1960), p. 154; McCarty and Lindberg, Preface, p. 34, and p. 110; and F. Stuart Chapin, Jr. Urban Land Use Planning (Urbana, Ill.: University of Illinois Press, 1970), p. 144.

but they may be able to show a crude tendency toward association. The points in favor of their usage are: (1) accessibility measures are typically available only as nominal scale measures (equating all establishments as equally important), (2) cumulative travel measures calculated from the large samples used in this study would have been truly prohibitively time consuming, (3) categorical employment seems fairly representative of county-wide economic activity in Kansas, and (4) in most cases, the counties chosen for use in this study should experience minimal inter-county movement.

Kendall's rank correlation ( $\tau$ ) is used to measure the association between (1) R statistics and per thousand employment in selected industries, and (2) population density and employment in the same industries in 1950 and 1970. The same technique is used on percentage rate of change for both association sets from 1950 and 1970. It was planned to use Kendall's partial ranking correlation ( $\tau_{xy.z}$ ) between settlement pattern and categorical employment, while controlling for the effects of population density. For reasons explained in the next section this was not done. All associations were tested for statistical significance at the 99 per cent significance level ( $\alpha = .01$ ) because of the small size of the sample ( $N = 6$ ).

The service base chosen for examination was selected by use of three criteria: (1) importance of the service to the population served, (2) location characteristics of the



industry in question<sup>30</sup>, and (3) availability of employment figures in the U.S. Census of Population. Although the level of disaggregation of industrial categories is thus limited by Census Bureau classifications, use of census data allows comparability with population data and comparability from the beginning of the study period to the ending date. The gross industrial sectors analyzed are : (1) communications, (2) utilities and sanitary service, (3) health, and (4) retail trade. Three other categories were considered for inclusion in the analysis (education, public administration, and entertainment and recreation) but they were deleted from the final analysis for a variety of reasons. Education in rural areas has undergone a tremendous change in the last several years because of government policy favoring school consolidation. As in all cases of planned social change, artificial manipulation of variables originating from factors exogenous to the normal interrelationships of social causation, makes<sup>31</sup> meaningful analysis all but impossible. Changes in educational employment over the twenty year period 1950-1970 cannot reasonably be expected to bear a predictable relationship to changing settlement patterns. Public administration is another cate-

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See McCarty and Lindberg, Preface, Chapters 6 and 7.

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Hudson discusses this problem in relation to settlement pattern analysis in "A Location Theory for Rural Settlement", p. 381.

gory which is only tangentially affected by changes in the rural cultural landscape. This is true basically for three reasons: (1) service levels are to a large extent independent of local support ability, (2) fantastic recent growth in the number of services offered is primarily a function of the increasing needs of an urban society, and (3) especially in rural counties, there is little possible flexibility in the location of public administration in response to changing needs the seat of such services having been legally determined decades ago. Finally, in regard to entertainment and recreation, the employment measure is especially inadequate, although it is the only comparable measure available. Recreation is a field which has undergone extreme technological change in recent years, as wholesale substitution of goods for services has been made.<sup>32</sup> A perfect, and perhaps paramount, example of this is the rise of television. Entertainment is provided for residents of dispersed areas from far-off centralized locations via the airways, and the few workers involved locally with the provision of the service are not classified by available data sources as being involved in entertainment. This "standardization" trend and the notable increase in the optimum firm size of entertainment establishments are identified as characteristics causing technology-related central-

ization of services in sparsely populated areas.<sup>33</sup> Another factor related to abnormally depressed recreational employment in the study area used in this paper is the region's relative lack of vacation resources.<sup>34</sup>

#### D. RESULTS OF THE ANALYSIS

Table 4-1 shows per thousand employment in 1950 and 1970 for the selected service industries analyzed. Beside the individual counties and the study area totals, information is recorded for the entire state, the total urbanized area within the state, and the total rural portion of the state. For the entire study area per thousand employment in communication fell by 10 per cent. Per thousand employment in utilities and sanitary services and retail trade rose during the study period by approximately 60 per cent, and the availability of health services jumped over five times. It is interesting to note that in all cases the change in the rural study area is in the same direction as that experienced by the entire rural portion of the state. For communications, utilities and retail trade, the study area changes seem very representative of state-wide rural tendencies. In the area of health area change is twice as great as that of rural Kansas as a whole.

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<sup>33</sup>  
Ibid., pp. 125-7.

<sup>34</sup>  
Ibid., pp. 127-8.

TABLE 4-1 SELECTED SERVICE EMPLOYMENT<sup>1</sup>

Area	Communications			Utilities & Sanitary Services			Health			Retail Trade		
	1950	1970	% Change	1950	1970	% Change	1950	1970	% Change	1950	1970	% Change
Coffey	3.4	2.2	-35.6	3.6	9.6	+170.0	2.594	20.8	+702.5	44.4	73.3	+65.1
Ellsworth	3.9	3.4	-12.4	5.9	7.0	+18.5	8.7	33.7	+285.3	45.6	63.8	+39.9
Gove	2.7	1.5	-43.6	2.9	5.1	+73.6	3.8	26.1	+583.9	36.9	75.1	+103.7
Linn	3.8	5.4	+43.0	2.3	1.7	-26.9	2.586	21.4	+726.1	41.7	53.2	+27.5
Logan	3.6	7.9	+122.0	2.1	2.9	+34.8	2.8	17.3	+506.2	60.2	103.0	+71.3
Wabaunsee	3.5	-	-100.0	1.1	3.3	+195.9	2.0	28.0	+1245.4	35.8	61.8	+72.6
Total Study Area	3.5	3.1	-10.5	3.1	5.0	+61.5	3.8	24.7	+546.3	43.4	68.5	+58.1
Kansas	4.5	4.9	+7.6	6.0	6.7	+10.7	11.1	25.2	+126.5	58.7	65.9	+12.3
State Urban	5.8	6.0	+2.9	7.8	7.0	-10.4	16.3	28.1	+72.2	78.4	72.3	-7.9
State Rural	3.0	2.6	-13.1	4.2	6.2	+48.1	5.4	19.8	+260.5	37.2	53.9	+44.9

Data Source: U.S. Census of Population, 1950 and 1970

<sup>1</sup> Employment per thousand people

Differences between the study area (and all of the state's rural areas) and the urban areas of Kansas are notable. In all cases but communications, the gap between service availability in the study area and in the state's urban centers was substantially closed during the study period. In utilities and retail trade this change took place through study area gains and urban area losses. In the field of health study area growth greatly out-stripped urban growth. The ever-increasing gap in communications employment reveals another weakness in the use of the employment measure. Major centralization trends within the communication industry have caused greater concentration of communication workers over the last twenty years, but surely the availability of such services to rural residents has increased rather than declined. Here the change is due to advances in technology and the subsequent adjustment of the threshold level of the firm (requiring vastly larger service areas), rather than a change in service availability to rural areas. From these statistics it can be concluded, with some qualifications, that the level of amenities available to rural Kansans today is largely comparable to that enjoyed by their urban neighbors.

What then is the relationship of declining rural population density and changing rural settlement patterns to service availability? It must be concluded at the outset that advances in technology and in increased propensity to consume on the part of rural dwellers have evidently more than made

up for the problems caused by dwindling numbers. In an overall sense, at least, there would seem to be little relationship between population loss and service availability. But this fact can be analyzed more rigorously by checking to see if the density of population in individual counties and the rate of change in service availability in counties are associated with the level of population density in those same counties. For the six study area counties, Table 4-2 shows the results of a Kendall rank correlation between service availability and population density. If population density modifies the general tendency toward change displayed in the total study area figures, there should be a significant correlation between these two variables. A quick glance at the tau values and probabilities given on the table suffices to show that perhaps surprisingly, there is no association between any of the services and population density at either of the standard confidence levels. (Although there is a consistent insignificant negative correlation between service availability and population density.)

The next step is to investigate the association between settlement pattern and service availability. It should be remembered that the analysis presented in Chapter III showed no significant relationship between R scores and population density in 1950, but a perfect inverse relationship between the two in 1970 ( $\tau = -1.00$ ,  $P = .0014$ ). Table 4-3 gives the results of the tau test for pattern and service availability.

As can be seen from the table, the null hypothesis ( $H_0$  = no significant association between the variables) must be accepted in every case at  $\alpha = .01$ . As would be expected from the relationships between R and population density,  $\tau$  scores for 1970 are just the inverse of those given in Table 4-2. It might be noted that for health, change 1950-1970, there is a strong negative relationship ( $\tau = -.73$ ,  $P = .03$ ) which would be significant at  $\alpha = .05$ . As in the former set of correlations, only an insignificant tendency toward a negative relationship can be inferred from this analysis.

It was originally planned to use Kendall's partial rank correlation ( $\tau_{xy.z}$ ) to analyze the relationship between pattern and service availability, with the influence of population density held constant. The coefficients discussed above are in fact a by-product of preparing for this operation. But in light of the ambiguous relationships associated with service availability and both of the proposed independent variables, a partial correlation test would add nothing to the analysis--especially since there is no way to ascertain the confidence interval associated with  $\tau_{xy.z}$ .

Because of the results of the analyses conducted in this chapter, the second formal hypothesis posed in this study (that increased settlement clustering is responsible for higher levels of service availability) is not supported. In this particular instance there is no apparent relationship between settlement pattern and service availability, or for

TABLE 4-2 RANK CORRELATION BETWEEN POPULATION  
DENSITY AND SERVICE AVAILABILITY<sup>1</sup>

Service	$\tau$ 1950	Signi- ficance Level <sup>2</sup>	$\tau$ 1970	Signi- ficance Level <sup>2</sup>	$\tau$ Change 1950-1970	Signi- ficance Level <sup>2</sup>
Communica- tions	.20	.36	.07	.50	.07	.50
Utilities & Sanitary Services	.20	.36	.20	.36	-.07	.50
Health	-.20	.36	.20	.36	-.07	.50
Retail Trade	-.20	.36	-.60	.068	-.20	.36

Source: Calculated by author

<sup>1</sup>

Coefficients are values of Kendall's tau ( $\tau$ ).

<sup>2</sup>

$\alpha = .01$ . Taken from Sidney Siegel, Nonparametric Statistics (New York: McGraw-Hill Book Co. Inc., 1956), Table Q.



TABLE 4-3 RANK CORRELATION BETWEEN SETTLEMENT  
PATTERN AND SERVICE AVAILABILITY<sup>1</sup>

Service	$\tau$ 1950	Signi- ficance Level <sup>2</sup>	$\tau$ 1970	Signi- ficance Level <sup>2</sup>	$\tau$ Change 1950-1970	Signi- ficance Level <sup>2</sup>
Communica- tions	-.33	.24	-.07	.50	-.07	.50
Utilities & Sanitary Services	-.60	.07	-.20	.36	-.20	.36
Health	-.20	.36	-.20	.36	-.73	.03
Retail Trade	-.20	.36	.60	.07	-.07	.50

Source: Calculated by author

<sup>1</sup>

Coefficients are values of Kendall's tau ( $\tau$ ).

<sup>2</sup>

$\alpha = .01$ . Taken from Sidney Siegel, Nonparametric Statistics (New York: McGraw-Hill Book Co. Inc., 1956), Table Q.

that matter, between population density and service availability.

#### E. IMPLICATIONS OF THE ANALYSIS

What are the ramifications of the results of this analysis for the conceptualization presented earlier? If it were not for the fact that the analysis found no relationships between economic activity and population density, a well documented theoretical assumption, perhaps the notion of a tie between rural settlement form and service availability should be dismissed out of hand. But failure to find the former association as well as the latter would invite speculation as to the reasons for this lack of success.

Several factors could have figured in the rejection of the hypothesis. Most obviously, there may be no relationship in this instance between service availability and settlement pattern. This must be at least the overt conclusion to be drawn, as noted at the end of the last section. The strength of theoretical support for the hypothesis would prompt consideration of a number of other possibilities, however. The factors to be taken into account are related to the characteristics of the analysis, the qualities of the measures used, and the traits of the industries studied.

A first contributing factor is the size of the sample chosen for study. Unlike the nearest-neighbor analysis, which drew from a sample containing several thousand indi-

viduals, this sample was made up of an N of six individuals for each test. Because the Kendall rank correlation varies in significance as a direct function of Tau values and sample size, moderate correlations between small samples are always insignificant statistically. As indicated by the confidence intervals associated with the values given on Tables 4-2 and 4-3, the probability of random association in a sample of the size used here is very high. Unfortunately, this could not be avoided if measures of concentration were to be located for entire counties, as they were in this study, because of the time consuming nature of the calculations.<sup>35</sup> As suggested by the probability values obtained, in consideration of strongly supported theoretical contentions dealing with population density these six counties may in this respect be unrepresentative of rural counties in general.

The second consideration should be the dimensions measured by the surrogates employed for service availability and settlement clustering. Service availability measured by per thousand employment is poorly suited to analyze the perhaps subtle effect upon transportation cost introduced by rural settlement pattern changes. A better measure of

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While several sub-county samples could have been drawn from each map, there were no other counties with maps available within reasonable intervals of the census dates and the census data is only available for rural areas at the county level of aggregation.

availability and total market travel distance (thus delivery cost) would be cumulative distance from all rural consumers to all service outlets, with the latter weighted in some manner for each study date. This type of analysis, beside being unrealistically lengthy for a paper such as this, would be basically impossible without first hand survey information, because of the federal disclosure rule for all printed data.<sup>36</sup> In relation to the R statistic as a measure of concentration, cumulative distance to the first nearest-neighbor may not in fact indicate overall clustering, but rather pairing or the linear arrangement of points. To overcome these possibilities, measurements could also be made to the second, third and fourth nearest-neighbors, as suggested by Haggett,<sup>37</sup> or the R measure could be replaced by a technique such as use of the Lorenz curve on data for quadrat units.

Finally, the characteristics of the industries analyzed could themselves affect the outcome of the analysis. In general terms, the hierarchy of central place activities is thought to progress in a series of step functions, with each level on the magnitude curve having a given feasible range

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<sup>36</sup> All collected data made available to the public, that is.

<sup>37</sup> Haggett, Locational Analysis, pp. 232-3.

of threshold sized represented by horizontal segments along the curve.<sup>38</sup> It is possible that any effect upon demand, introduced by difference in population density, could be of such a magnitude (over time and between similar counties on one date) that all observations would remain within one threshold size range. This same argument would also hold true for shifts in the demand curve caused by the reduction of transport costs as a result of settlement clustering.

In more specific terms McCarty and Lindberg have pointed out that today there is a strong tendency in rural areas toward centralization of services, arising out of increases in the most efficient size of establishments.<sup>39</sup> This upshift in threshold size, caused most notably by changes in technology, adds impetus to the prevailing trend--the larger the threshold the less locational association with demand and the more the emphasis on centrality. Depopulation, causing a more sparsely settled market area, also results in larger areal demands to meet minimum sales constraints, thus extending the necessary radius of operations of the individual firm and encouraging movement to larger,

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See Bunge, Theoretical Geography, p. 140 and 146-7; B.J.L. Berry and William L. Garrison, "The Functional Bases of the Central-Place Hierarchy", Economic Geography, 34 (April, 1958), pp. 145-54; Chas. T. Stewart, Jr. "The Size and Spacing of Cities", The Geographical Review, 48 (1958), pp. 237-38.

39

McCarty and Lindberg, Preface, p. 118.

centrally located centers.<sup>40</sup> Any upward change in areal threshold size requirements affects the scale at which the generalized locational association between service industries and population holds true.<sup>41</sup> This being the case, purely local (intra-county?) changes within the demand structure of a marketing region, brought on by changes in population density or settlement patterns, would be lost in the bigger picture and would show no predictable association with service availability.

In light of the considerations discussed in these last several pages, it would be useful to retest the hypothesis used in this chapter before the relationships it contains are rejected in general form.

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<sup>40</sup>  
Ibid., p. 141.

<sup>41</sup>  
Ibid., p. 129.

## CHAPTER V

### CHANGING SETTLEMENT PATTERNS AND REGIONAL DEVELOPMENT POLICY

In the last two chapters it has been found that with depopulation dispersed rural settlement patterns tend to become more aggregated, and that although there is a good deal of theoretical evidence to suggest that service levels should increase with settlement clustering, no such trend has been identified. What are the implications of these findings for regional development policy? This question is especially important now, with all of the attention which is being directed by both federal and state governments toward rural regional development policy.<sup>1</sup>

#### A. SALIENT FEATURES OF AN OPERATIONAL REGIONAL DEVELOPMENT EFFORT

A host of programs has sprung up in the last decade dealing with non-metropolitan regional development. Perhaps the most important of these are the Economic Development

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Examples of this interest are Public Law 92-419, the Rural Development Act of 1972; the imminent passage of a modified version of the "Jackson Bill", dealing with a national land use policy and state-wide land use planning; and the forthcoming expansion of the Ozarks Regional Commission, a Title V economic development effort, to encompass the entire state of Kansas.

Districts (E.D.D.) sponsored and funded by the federal Economic Development Administration, on the Appalachian model, under the control of the Department of Commerce. These are basically regional planning efforts, centered around economic development, which are being established under statutory authority with a strong input of local guidance in predominantly rural lagging areas of the country. The implementation mechanism in these programs is basically the input of federal monies into planned improvement programs to upgrade regional infrastructure and amenities, thus hopefully attracting additional private capital investment. This rationale is founded<sup>2</sup> on conventional regional growth strategies and puts a strong emphasis on the identification of regional growth centers<sup>3</sup> within which to concentrate investment.

The strategy of the Ozarks Regional Commission. The development strategy of the Ozarks Regional Commission (Title

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<sup>2</sup>  
A review of regional policy strategy is offered in Harry W. Richardson, Regional Economics (New York: Praeger Publishers, 1969), pp. 386-428; see also David G. McKee, Robt. D. Dean and Wm. H. Leaky, Regional Economics (New York: The Free Press, 1970); pp. 221-58; and John Friedman and Wm. Alonzo, Regional Development and Planning (Cambridge, Mass.: The M.I.T. Press, 1964), pp. 623-700.

<sup>3</sup>  
See Francois Perroux, "Note sur la Notion de 'pole de croissance'", Economie appliquée, 8, No. 2 (June, 1955), pp. 307-20; Albert O. Hirschman, "Interregional and International Transmission of Economic Growth", The Strategy of Economic Development (New Haven, Conn.: Yale University Press, 1958), pp. 183-201; and Niles M. Hansen, "Development Pole Theory in a Regional Context", Kyklos, 20, No. 3 (1967), pp. 709-725.



V) is especially appropriate for consideration at this point. In Kansas the Commission is in the process of expanding its activities from a nine county area in the Southeastern corner of the state to encompass all 105 counties. This, of course, means that the six counties studied in this thesis will become a part of its development region.

The goal of the Ozarks Commission's work is to close the income gap between the residents of its area and the rest of the nation<sup>4</sup>. They hope to accomplish this task through a four part strategy:

- (1) Develop employment opportunities to generate personal income through wages and salaries,
- (2) Develop resources to generate other forms of personal income,
- (3) Educate and train Ozarks people to increase their earning power, and
- (4) Enhance the general environment for economic development.<sup>5</sup>

It has been found that the priority for these objectives must be rated in a reverse order if the plan is to be successful.<sup>6</sup> This notion is based in elementary economic growth theory.

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<sup>4</sup> Ozarks Regional Commission, "Ozarks Regional Commission Annual Report, 1971". (The Commission: January, 1972), pp. vii and xv-xxiv.

<sup>5</sup> Ozarks Regional Commission, The Ozarks Regional Commission Action Plan (The Commission: January, 1971), p. 153.

<sup>6</sup> Noted in a lecture by Mr. Dale Baker, Kansas Liaison for the Commission, Manhattan, Kansas, 4 Octobre 1972.

If a region is to increase the per capita income of its residents without inadvertently slowing economic growth and thus causing additional out-migration, it must find a method to raise the marginal productivity of its labor supply. There are two feasible interacting methods to achieve this end. First the quality of the labor resource can be enhanced through the development of additional educational and training programs. And secondly, this more versatile labor force can then utilize the benefits of additional capital investment, bringing about an increase in production through the application of more efficient (technologically advanced) capital-intensive production methods.<sup>7</sup>

It would seem a straight forward process to provide the necessary educational programs and facilities through federal funding and then to watch as the region accrues the rewards of its improved labor force. Here the mobility of labor comes into play to complicate matters. As young people from rural areas receive more advanced educational training, the multiplier effect of increased labor productivity typically is not given an opportunity to improve the local job market. More highly skilled workers with a better possibility for higher wages in urban environments,

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<sup>7</sup> O.R.C., Action Plan, pp. 14-21; see also Development of a High Technology Industry Attraction Sub-System, Report to The Ozarks Regional Commission, Vol. 1, (Applied Decisions Systems, Inc.: June, 1972).

searching for the amenities of the "good life", promptly leave the region which has provided their training. This out-flow adds expensively to the already vicious circle of age selective emigration.

If higher income requires more and better jobs, and if their availability is dependent upon increased capital investment as a function of improving the marginal productivity of labor, how can these young, skilled people be encouraged to remain in the region? The answer seems to lie in providing more amenities for the area's residents. This not only improves their life styles, thus making them more satisfied with their surroundings, but also reduces the costs of doing business in the region (better utilities, retail services, health systems, etc.)<sup>8</sup>, further improving the area's industrial location advantages and its capital investment possibilities. This answer, in a simple form, equates the region's economic development with making it a more attractive and convenient place to live. While it could be argued that this chain of events is indeed a chicken and egg situation, there are exogenous funds available not only through the Department of Commerce, but also through the above mentioned Rural Development Act and the categorical grant programs<sup>9</sup> offered by several federal agencies and departments.

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<sup>8</sup>O.R.C., Action Plan, p. 108.

While more money is becoming available now than ever before for rural development purposes, the sum is definitely limited and must be invested usefully if it is to be effective. How can areally specific priorities for capital expenditures be fixed in such a fashion as to optimize the benefits received?

#### B. SETTLEMENT PATTERNS AND PROGRAM IMPLEMENTATION

Through the Ozarks Regional Commission and the Rural Development Act of 1972, the six counties studied in this paper will soon be eligible for outside financial assistance for improving the existent infra-structure and service base. Funds will not only be available for public roads, buildings, and utilities (such as water, sewer and solid waste disposal facilities), but also for loans to private businesses for the improvement of retail services and would-be home owners. These monies should be allocated in such a way as to take advantage of the functional relationships existent across the rural cultural landscape. If planned social change is to be effective it must deal with the socio-economic environment in terms of the systems through which its important inter-

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Most notable among these are the sewer and water programs conducted by H.U.D. through the Housing and Urban Development Act, solid waste disposal improvement funding through the Environmental Protection Agency, and the various grants provided by the Economic Development Administration. The new Rural Development Act covers all of these areas, plus the entire range of capital improvement programs and loans for private business and home building.

related variables operate.

The rural population studied in this paper has been found to be involved in a process of settlement pattern re-adjustment. As more and more people leave the countryside, the remaining population is grouping on the landscape in ever more clustered patterns. The theoretical implications of this evolution were discussed in Chapter IV. The costs incurred in making available a comprehensive base of services to this population should be less than would be the case if the people were scattered in a more dispersed fashion. It only seems logical to take advantage of this fact in planning the expenditure of the development funds now available. Obviously the concentration of investment over a relatively smaller area than might be anticipated from a superficial survey of population distribution by minor civil divisions holds the potential of providing a higher level of amenities to the areas affected. This intensified effort to improve the living space of the remaining rural residents might conceivably be successful enough to help stem the tide of continuing out-migration. If the Ozarks Commission' strategy is well founded, this could be the first step in attracting increased private investment into these areas and to start the slow process of re-building the economic base of rural America.

Before the optimism of this idea becomes too compelling, it would be worthwhile to outline in more detail the means available for implementing such a policy of controlled develop-

ment. The first step in taking advantage of the evolving aggregated settlement patterns would be to identify empirically the areas in which dwellings are situated. The nearest-neighbor technique used here to measure settlement pattern seems inappropriate for such a task, but perhaps a measure of concentration based on the old land survey townships would be useful. By overlaying a township grid on general highway maps it would be possible inexpensively to make quadrat frequency counts of the occupied houses in each county. These could be tallied for zonated regions surrounding the towns and villages of the county, following Lösch's theory that population density drops off away from central places. This process would be continued in increments of tiers of townships until most of the county's population was accounted for. If, in fact, the trends identified in this study can be generalized, a high percentage of the remaining population should be distributed over something less than the majority of the county's area.

When the more concentrated zones of dispersed population are located, a program of discontinuing unneeded services could be actively carried out in the depopulated areas of the respective counties. The state highway commission has been pursuing such a policy in Kansas successfully for several years, and thousands of miles of unneeded roads have been taken out of service. The savings involved for governmental units in the completion of a comprehensive program of this

nature would be significant. Although there would be varying degrees of public reaction against such initiatives, a hard look at the economic balance sheet should be sufficient to convince most planning board members and county commissioners of the merits of the program.

On the positive side, there are several tools available to guide the investment of public monies and the private development of land into desirable geographic areas. The eligibility requirements for most federal development programs specify that the petitioning local governmental units go through the motions of identifying goals and objectives for their particular community, and then that they must develop a comprehensive area-wide plan dealing with such functional areas as health, sanitary services, streets, open space, water treatment and so forth. An element of the general plan also projects desired land use at some future date. Within these several provisions are covered both matters related to public expenditures and the course of private development.

Through application for special rural development grants and the requisite planned expenditures of that money for the provision of necessary public services, local governments have a powerful technique for further reinforcement of the present trend toward rural settlement clustering. Another step that could be taken by rural counties and planning regions would be the adoption of a capital improvement procedure. Carrying out the objectives of the development plan, they

could program projects to be completed in logical sequence and within the financial limitations of the area's budget, thus making the most efficient use of the funds available to them. The power of the existence of utilities and other infrastructure items to guide the direction and intensity in which private development will take place should not be underestimated.

Two further steps for the control of settlement pattern development are zoning and subdivision regulation. Kansas law provides that all counties and incorporated cities within the state may zone the use of land on the basis of a comprehensive<sup>10</sup> plan. By adoption of a zoning ordinance specifying the districts under the governmental unit's jurisdiction in which different land uses, lot sizes, population densities, and building heights and volumes will be allowed, the development goals of a comprehensive plan can be pursued actively by all citizens within the area. The power to regulate the subdivision of land is also made available to these same units of local government.<sup>11</sup> With this right to approve subdivision plats the public can insure that the provisions of the zoning ordinance are carried out in all new land development opera-

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<sup>10</sup>  
Kansas Statutes Annotated, Section 12-707 et seq., and K.S.A. 19-2901 et seq.

<sup>11</sup>  
Ibid., Section 12-705 et seq., and K.S.A. 19-2918 et seq.



tions. And, as well, the necessary provision of all utilities, streets and sewers can be guaranteed before sale of the property to prospective residents.

With the implementation powers granted to local governments by state enabling legislation and with the increasing availability of funds from the government in Washington for the purpose of rural regional development, it would seem within the means of rural areas to profit from the possibilities offered by the present situation. Rural counties may now have the chance to increase the living standards of their citizens through a program of comprehensive service base development. Citizens can be encouraged to accentuate the current movement toward closer dispersed residential spacing through the carrot of infrastructure availability and the stick of land use regulation. In this fashion, commercial development can be directed toward the most convenient and economical locations, and industrial land can be upgraded in the most attractive situations. Without a doubt service costs will be easier to meet if the transportation component of service delivery can be reduced. If the Ozarks Commission's strategy proves successful, this could be the first step in improving the future economic prospects of rural Kansas.

## CHAPTER VI

### SUMMARY AND CONCLUSIONS

This thesis has treated three aspects of depopulation and settlement patterns in a group of six rural counties in the state of Kansas. First the changing form of dispersed settlement patterns over a twenty year period of population loss were measured by the use of the nearest-neighbor technique of point pattern analysis. An attempt was made to fit these observed patterns to a four-stage conceptual model. Next the indices of settlement pattern generated in this first section were correlated with the availability of a selected public and retail service base in order to ascertain whether or not settlement form seemed to exert a noticeable influence upon the availability of services to the residual population. Finally the implications of these two analyses for rural regional development policy were discussed in the context of programs actually soon to affect the study area. Emphasis here was upon the logical extension of information presented in this paper to the policy decisions required in meeting the explicit goals of an existing development effort, and upon the enumeration of those tools currently available for implementing these decisions.

## A. SUMMARY

After presenting some of the problems faced by depopulating rural areas in the context of the broader national urbanization process, this paper provides a synthesis of concepts developed historically in geographic settlement research. A conceptually oriented review such as this has been missing, at least in the English-language geographical literature, up to this point. From the notions crystalized in this review a four-stage model of the rural settlement process was constructed. Associated with these four stages (colonization, spread, competition and depopulation) were postulated four typical patterns of dispersed rural settlement. In descriptive terms the evolution would proceed from clustered forms in the first stage to regular forms in the second and third stage and back again to a more clustered pattern in the last stage. Special emphasis was placed on the fact that settlement pattern should not be analyzed only in terms of the general process involved. In order to predict the morphology associated with a given stage of the settlement model it was argued that consideration must also be given to the functions served by that form and process.

Six rural counties were chosen for study, basically upon the criteria of data availability and population dynamics. It was hypothesized that with continued population loss over the last two federal census periods these counties had

moved into stage four of the settlement model and would display increasingly aggregated dispersed settlement patterns over time. The notion of pattern was rigorously defined in terms of the nearest-neighbor method of point pattern analysis. This descriptive technique was employed on two sets of general county highway maps for the dates 1950 and 1970. It was found that in all cases intra-county settlement patterns had become increasingly more clustered over the study period (significant in each instance at  $\alpha = .01$ ). The formal hypothesis, that settlement patterns would become increasingly more aggregated with depopulation, was accepted. The magnitude of inter-county variation in each period, however, suggested that the fourth stage of the proposed settlement model might be more accurately represented as two separate depopulation phases, termed "selective loss" and "regrouping". It was also suggested that a metric differentiating one stage from the next, independent of pattern, would aid in the operationalization of the model.

The second argument developed was that in areas of continued population loss the residual population of counties with a greater degree of settlement clustering would enjoy higher levels of public and retail service availability. A brief review of central place theory and the demand model of industrial location gave support to the notion that a cumulative reduction of transport costs in such areas might partially balance the effects of dwindling numbers upon

total market area demand. The possibility of maintaining a minimum threshold of demand, necessary for the continued availability of a given service, might be enhanced by reduction of the delivered price of the item; thereby raising the remaining customers' marginal propensity to consume.

Employment per thousand people was used as a measure of the areal availability of four selected services. The R statistics produced in the near-neighbor analysis were utilized again as a measure of settlement pattern. The hypothesis that counties with more clustered settlement patterns would have better service availability was tested. An attempt was made to correlate these two variables by use of Kendall's partial ranking correlation ( $\tau_{xy.z}$ ), controlling for the effects of population density. Preliminary simple correlations between service levels and the two independent variables produced such ambiguous results on both counts that the procedure was abandoned. There was no significant association in this case between service availability and population density or settlement pattern, and so, the hypothesis was not supported. It must be observed however, that during the last twenty years the gap in service levels between rural and urban sections of Kansas has been greatly reduced.

The last segment of the paper, dealing with the implications of settlement patterns for regional development, related the results of these last two analyses to the development strategy of the Ozarks Regional Commission. It was recog-

nized that in a rather direct way the ability of an area to attract new investment, thus creating new jobs and raising the per capita income, is dependent upon the improvement of regional amenities and the other types of services examined in this study.

It was suggested that, with the aid of newly available federal assistance, efforts should be made upon the part of rural governmental units to accentuate the current trends in settlement evolution. The planned use of such tools as capital improvement programming and land use control could direct the course and intensity of future development into the most favorable locations. It was argued that this type of approach could make the most effective use of available monies, and that it holds the best chance for improving the rural environment for remaning residents.

## B. CONCLUSIONS

The primary point of interest in this thesis has been the analysis of changes in rural dispersed settlement patterns. It was hypothesized, in effect, that during the depopulation stage of rural settlement evolution there would be an inverse relationship between settlement clustering and population density. The acceptance of this proposition, based on strong empirical agreement with the proposed direction of interrelationship, places the findings of this paper in direct contradiction to the notion that rural settlement pat-

terns are basically, yet today, a product of continuing agricultural evolution, displaying a tendency toward an equilibrium of evenly spaced rural dwelling units. Generalization from a sample of only six counties must be of a very tentative nature, but these findings certainly suggest that it might be very useful, in extending geographic settlement theory, to consider seriously the function served by the urbanization process in the evolution of recent rural settlement patterns.

The expanded conceptual model of settlement evolution, the first three stages of which are based on Hudson's work in Iowa, has been meaningfully extended through reflection on the notions developed by traditional European settlement geographers. Added to this, the conceptualizations of Zelinsky and Gibbs lend additional weight to the ideas that contemporary rural settlement patterns are influenced by broader trends toward national urbanization and that the final result of rural settlement evolution may well be a dispersed settlement landscape marked by clustered settlement forms.

More work on the topic is certainly called for, and it could prove to be very rewarding in terms of the expansion of geographic theory. The results of this study, along with Hudson's conclusions based on a small sample of Iowa study areas, point tentatively toward a systematic development of rural settlement patterns. In order to substantiate the findings of this research much more empirical evidence is

required. Future studies should be based on much broader samples of the rural landscape, and an all out effort should be made to define operationally the several stages of the settlement process in terms unrelated to the pattern being measured.

The results of the spatial reorganization of rural areas for service availability seems much less clear. Although no relationship was found here between the dynamics of population and service levels, as might be expected from central place theory, it has been shown that service availability has improved significantly during this recent period of continued rural emigration. The variables which account for these facts are well known, but the spatial process through which they affect change has not been clearly identified. The areal availability of services has seemingly out-stripped the redistribution of income. And increasingly sparse rural population densities continue to challenge our technological ability economically to provide for the needs of the remaining residents. For evidence of this, one need look only to the continuing calls for help voiced by rural governments trying to maintain often hopelessly decaying infrastructure. Perhaps more direct measures of cumulative spatial flows within the areal market and better surrogates for the intensity of place-specific service activity will shed more light on the connection between reduced transport costs and service availability.



It will be interesting to see if the serious rural development efforts just beginning in the United States can offer additional insight into this problem. Although it would certainly seem preferable for prior academic work to have laid the foundations for such endeavors, there is undeniably a two-way flow of information in such situations. By careful observation of successes and failures in these regional development programs geographers and other social scientists will undoubtedly be able to contribute to their improvement.

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RURAL DEPOPULATION IN KANSAS: A CONCEPTUAL INQUIRY  
INTO THE NATURE OF CHANGING RURAL SETTLEMENT  
PATTERNS ON THE AMERICAN PLAINS

by

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The continued loss of population in rural America over the last several decades has become a problem of interest to scholars and public decision makers alike. This study investigates three aspects of rural depopulation in Kansas from a theoretical geographic perspective. First, changes in the pattern of dispersed rural settlement in six Kansas counties are measured in a rigorous fashion for the period 1950 through 1970. Next, changes in the availability of a selected service base are correlated to the indices of settlement pattern generated in part one. And last, the implications of these analyses for public regional development policy are considered.

A review of the geographic literature dealing with settlement is made, and from the concepts found there a simple four-stage model of settlement pattern evolution is constructed. The first three steps of the model were tested by Hudson in Iowa. In this study the fourth stage, meant to represent the recent prolonged period of rural depopulation, is examined by use of the nearest-neighbor technique of point pattern analysis. The hypothesis that dispersed rural settlement form becomes more clustered during population loss is accepted based on the results of this analysis.

Drawing from notions developed in central place theory and the demand theory of economic location, it is hypothesized that as settlement patterns become more aggregated



the cost of supplying the areal market will be lowered and, other things being equal, the availability of services will improve. Kendall's rank correlation is used to compare availability of services with both population density and settlement pattern in the six study area counties. No significant relationship is found to exist in this instance between service levels and either one of the independent variables.

The implications of these two analyses for regional development policy are woven into the ideas employed in contemporary academic literature and economic development programs. Special attention is given to the regional growth strategy used by the Ozarks Regional Commission. It is suggested that encouragement of further settlement clustering through the use of funds provided by several federal programs might enhance the possibility of growth in rural areas such as the ones studied here.